Table 3: Summary of Slope Stability Analyses Results

Cross Section	Loading Condition	Figure No.	Static Factor of Safety	Yield Acceleration[1]	S_{ur}/σ'_v
A-A′	After Construction Revetment – without Geogrid	12	1.08	–	
	After Construction of Revetment - with Geogrid[2,3,4]	13	1.38	–	
	5 Years After Construction – with Geogrid	15 & 18	1.52	0.053g	
	30 Years After Construction - with Geogrid	17	1.65	–	
	Post-Liquefaction Stability 5 Years After Construction – with Geogrid	19	1.24	–	0.14
B-B′	After Construction of Revetment – without Geogrid	21	0.91	–	
	After Construction of Revetment – with Revetment Geogrid[2,3,6]	22	1.37	–	
	5 Years Construction – with Geogrid	24 & 27	1.50	0.05g	
	30 Years After Construction – with Geogrid	26	1.62	–	
	Post-Liquefaction Stability 5 Years After Construction – with Geogrid	28	1.31	–	0.10
C-C′	After Construction of Revetment	30	1.26	–	
	After Construction of Revetment – with Improvement of Liquefiable Soil[6] and Geogrid[7]	31	1.38		
	5 Years After Construction – with Improvement of Liquefiable Soil and Geogrid	33 & 36	1.52	0.071g	
	30 Years After Construction – with Improvement of Liquefiable Soil and Geogrid	35	1.64	–	
	Post-Liquefaction Stability 5 Years After Construction – without Improvement of Liquefiable Soil and Geogrid	37	0.44	–	0.09
	Post-Liquefaction Stability 5 Years After Construction – with Improvement of Liquefiable Soil and Geogrid	38	1.25	–	0.09
D-D'	After Construction of Revetment	40	1.74	–	
	5 Years After Construction – with Ground Improvement of Liquefiable Soil	42 & 45	1.80	0.092g	
	30 Years After Placement of All Fill – with Geogrid– with Ground Improvement of Liquefiable Soil	44	1.86	–	
	Post-Liquefaction Stability 5 Years After Construction – without Ground Improvement of Liquefiable Soil	46	0.49	–	0.10
	Post-Liquefaction Stability – FLAC Analysis	47	FLAC Results are in Attachment F7		0.10

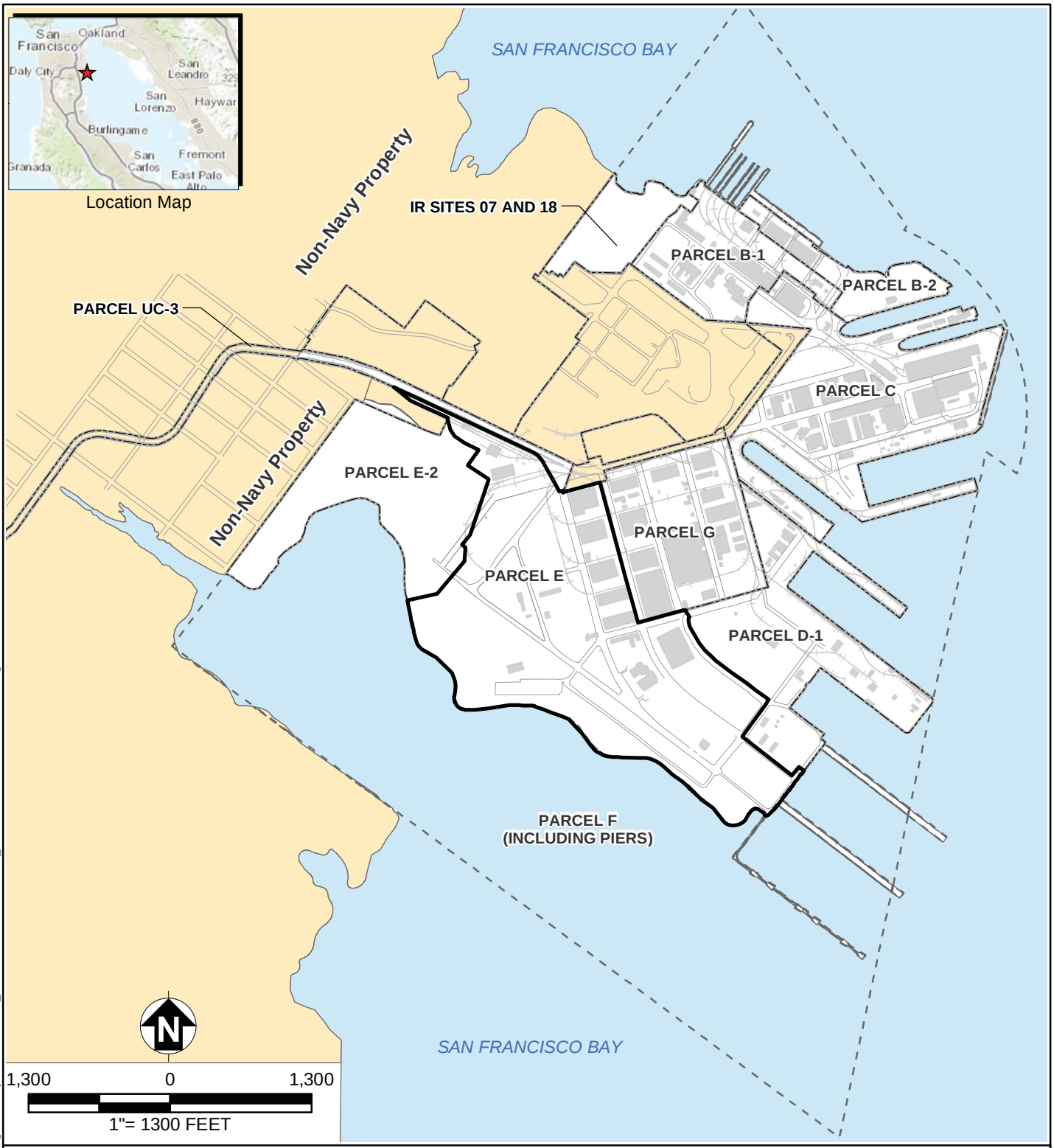
Notes:
[1] g = acceleration due to gravity
[2] The geogrid reinforcement consists of one layer of Tencate Miragrid 20XT with long-term design strength of 7,500 pounds/ft.
[3] To prevent slope instability during construction, the geogrid should be installed and anchored properly upslope of the revetment by placing backfill before placement of the revetment.
[4] Geogrid length = 105 feet
[5] Geogrid length = 110 feet
[6] Improvement from the proposed remediation which includes replacement of liquefiable soil and in-situ soil solidification/stabilization.
[7] Geogrid Length = 50 feet

Table 4: Summary of Estimated Seismic Displacements during the MCE

Cross Section	Yield Acceleration	Acceleration Time History	Figure No.	Permanent Displacement (feet)	
				(feet)	(inches)
A-A′	0.053g	Izmit	48	0.31	3.7
		PS10	49	0.64	7.7
		TCU051	50	0.58	7.0
		TCU076	51	0.66	7.9
B-B′	0.05g	Izmit	52	0.36	4.3
		PS10	53	0.41	4.9
		TCU051	54	0.41	4.9
		TCU076	55	0.40	4.8

Notes:
g = acceleration due to gravity

FIGURES



LEGEND

- Parcel E Boundary
- Other HPNS Parcel Boundary
- Parcel F Boundary
- Non-Navy Property
- Road
- Rail Line
- Building

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Hunters Point Naval Shipyard, San Francisco, California

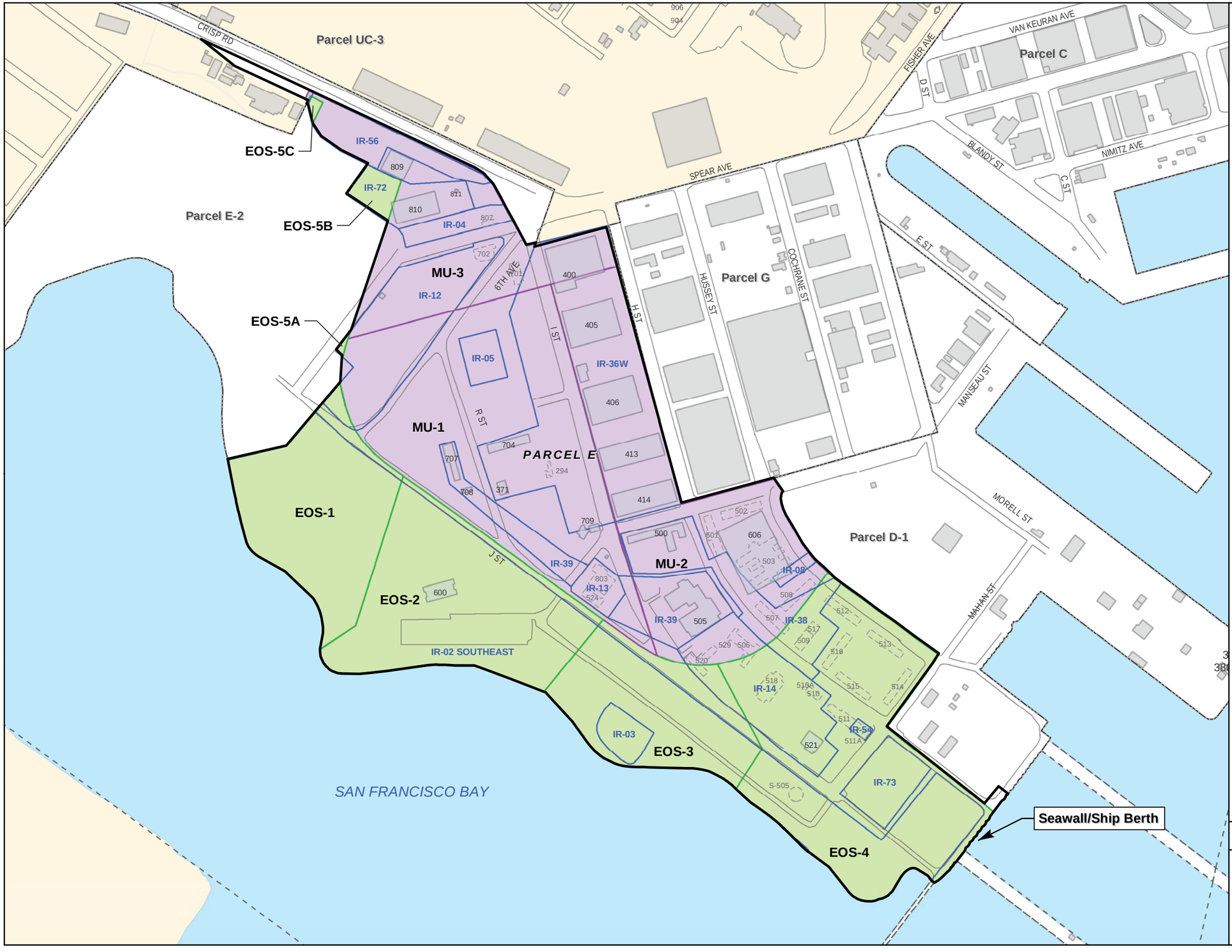
Department of the Navy, BRAC PMO West, San Diego, California

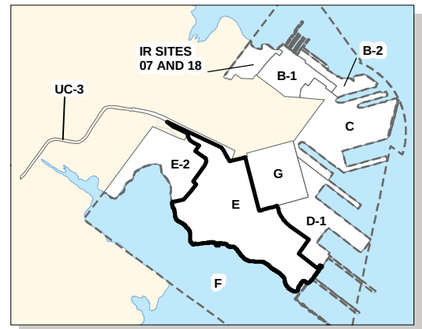
FIGURE 1

HPNS and Parcel E Location Map

Design Basis Report for Parcel E

11/30/2015 W:\2014\2014-091_ParcelE_RD_Investigation\Projects\Golders\01_HPNSandParcelELocation_v1.mxd ERRG-Martinez brodrigues





Legend

- Parcel E Boundary
- Other HPNS Parcel Boundaries
- Parcel F Boundary
- IR-03 IR Site Boundary
- Multi-Use District
- Open Space
- 400 Existing Building
- 502 Demolished Building
- Road
- Non-Navy Property

450 0 450

SCALE: 1"= 450 FEET
APPROXIMATE SCALE

Golder Associates

Hunters Point Naval Shipyard, San Francisco, California
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2

IR Sites at Parcel E

Design Basis Report for Parcel E

11/30/2015 W:\2014\2014-091_ParcelE_RD_Investigation\Projects\Golders\02_IRSitesParcelE_v1.mxd ERRG-Martinez brodrigues

LEGEND:

- PARCEL E BOUNDARY
- PARCEL BOUNDARY OTHER
- EXISTING TOPOGRAPHIC CONTOUR LINE
- GEOTECHNICAL DRILLED BORING
- CPT BORING
- SOIL BORING (TO BAY MUD SURFACE) FROM PREVIOUS IRP INVESTIGATION *
- SOIL BORING (THROUGH BAY MUD SURFACE) FROM PREVIOUS IRP INVESTIGATION *
- SOIL BORING (TO BAY MUD SURFACE) FROM PREVIOUS GEOTECHNICAL INVESTIGATION **
- SOIL BORING (THROUGH BAY MUD SURFACE) FROM PREVIOUS GEOTECHNICAL INVESTIGATION **
- CPT LOCATION FROM 2012 INVESTIGATION
- CPT LOCATION FROM 2013 INVESTIGATION
- PROPOSED PROTECTIVE LINER

NOTE:

1. BARAJAS & ASSOCIATES, INC., 2008

2. VARIOUS HISTORICAL BORINGS
   (NAVY, 1597a)
   (NAVY, 1957b)
   (NAVY, 1968)
   (NAVY, 1972)

CPT = CONE PENETROMETER TEST
IR = INSTALLATION RESTORATION
HPNS = HUNTERS POINT NAVAL SHIPYARD

0' 200'

SCALE: 1"= 200'

Golder Associates

CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	LOCATIONS OF CPTS, SOIL BORINGS, AND SLOPE STABILITY CROSS SECTIONS A-A' AND B-B'			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 05/26/17	CHECKED BY: DB 05/26/17	PROJECT NO. 2014-091	DWG NO. 3

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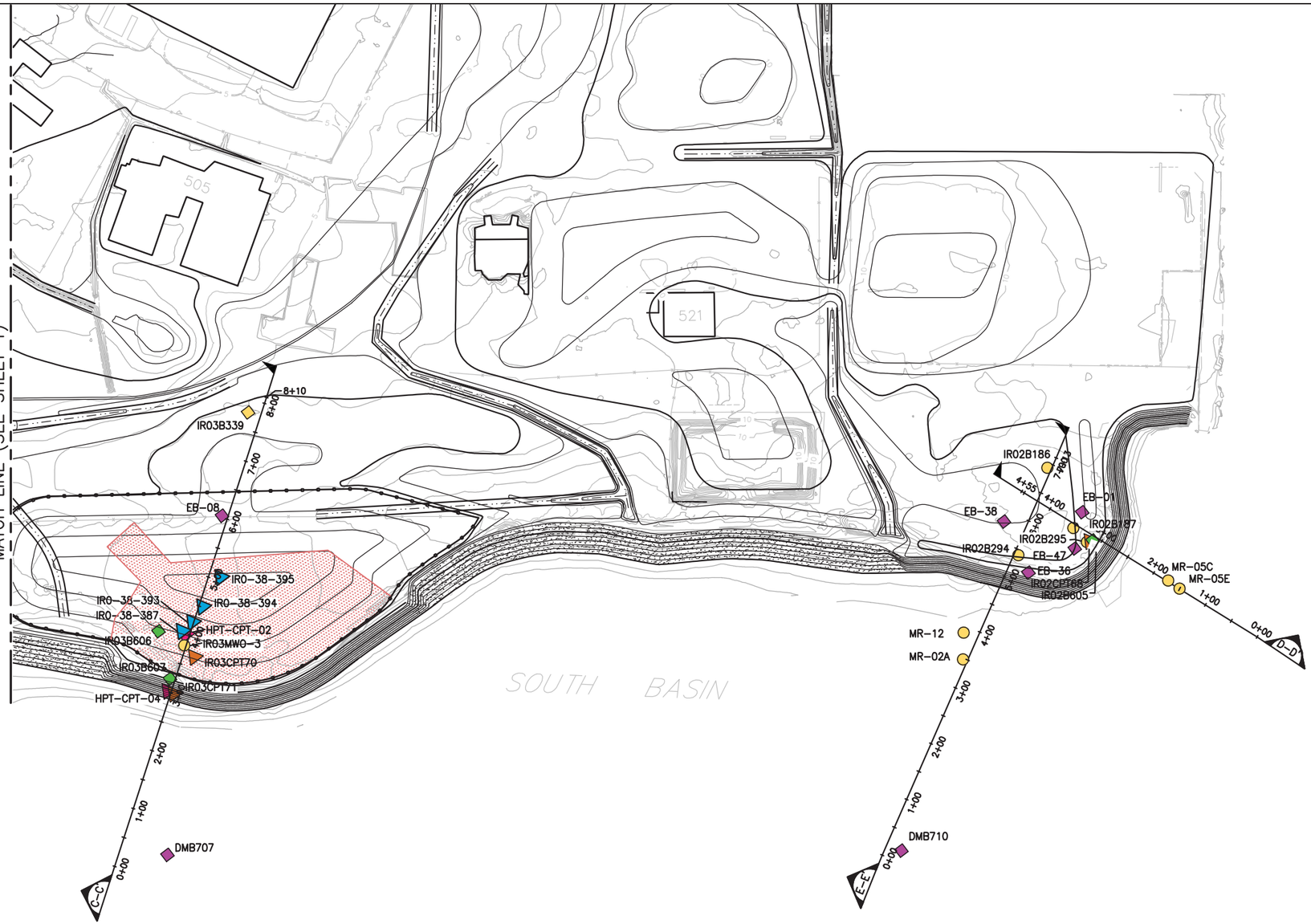

LEGEND:

- PARCEL E BOUNDARY
- PARCEL BOUNDARY OTHER
- SLURRY WALL
- EXISTING TOPOGRAPHIC CONTOUR LINE
- GEOTECHNICAL DRILLED BORING
- CPT BORING
- SOIL BORING (TO BAY MUD SURFACE) FROM PREVIOUS IRP INVESTIGATION *
- SOIL BORING (THROUGH BAY MUD SURFACE) FROM PREVIOUS IRP INVESTIGATION *
- SOIL BORING (TO BAY MUD SURFACE) FROM PREVIOUS GEOTECHNICAL INVESTIGATION **
- SOIL BORING (THROUGH BAY MUD SURFACE) FROM PREVIOUS GEOTECHNICAL INVESTIGATION **
- CPT LOCATION FROM 2012 INVESTIGATION
- CPT LOCATION FROM 2013 INVESTIGATION
- ISS TREATMENT AREA

NOTE:

1. BARAJAS & ASSOCIATES, INC., 2008

2. VARIOUS HISTORICAL BORINGS
   (NAVY, 1597a)
   (NAVY, 1957b)
   (NAVY, 1968)
   (NAVY, 1972)

CPT = CONE PENETROMETER TEST
IR = INSTALLATION RESTORATION
HPNS = HUNTERS POINT NAVAL SHIPYARD

N

0' 200'

SCALE: 1"= 200'

Golder Associates

CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	LOCATIONS OF CPTs, SOIL BORINGS, AND SLOPE CROSS SECTIONS C-C' AND D-D'			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 05/26/17	CHECKED BY: DB 05/26/17	PROJECT NO. 2014-091	DWG NO. 4

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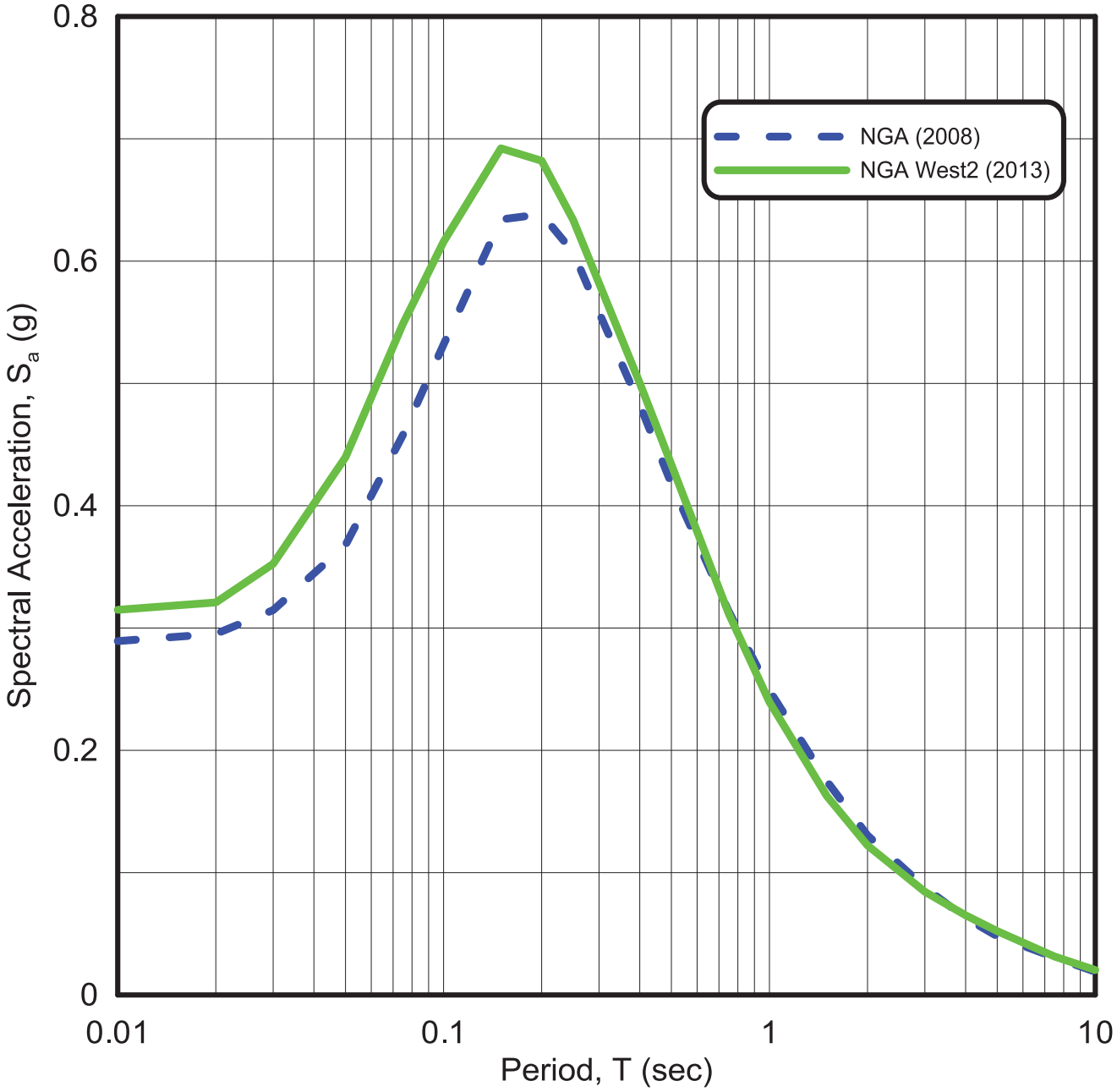
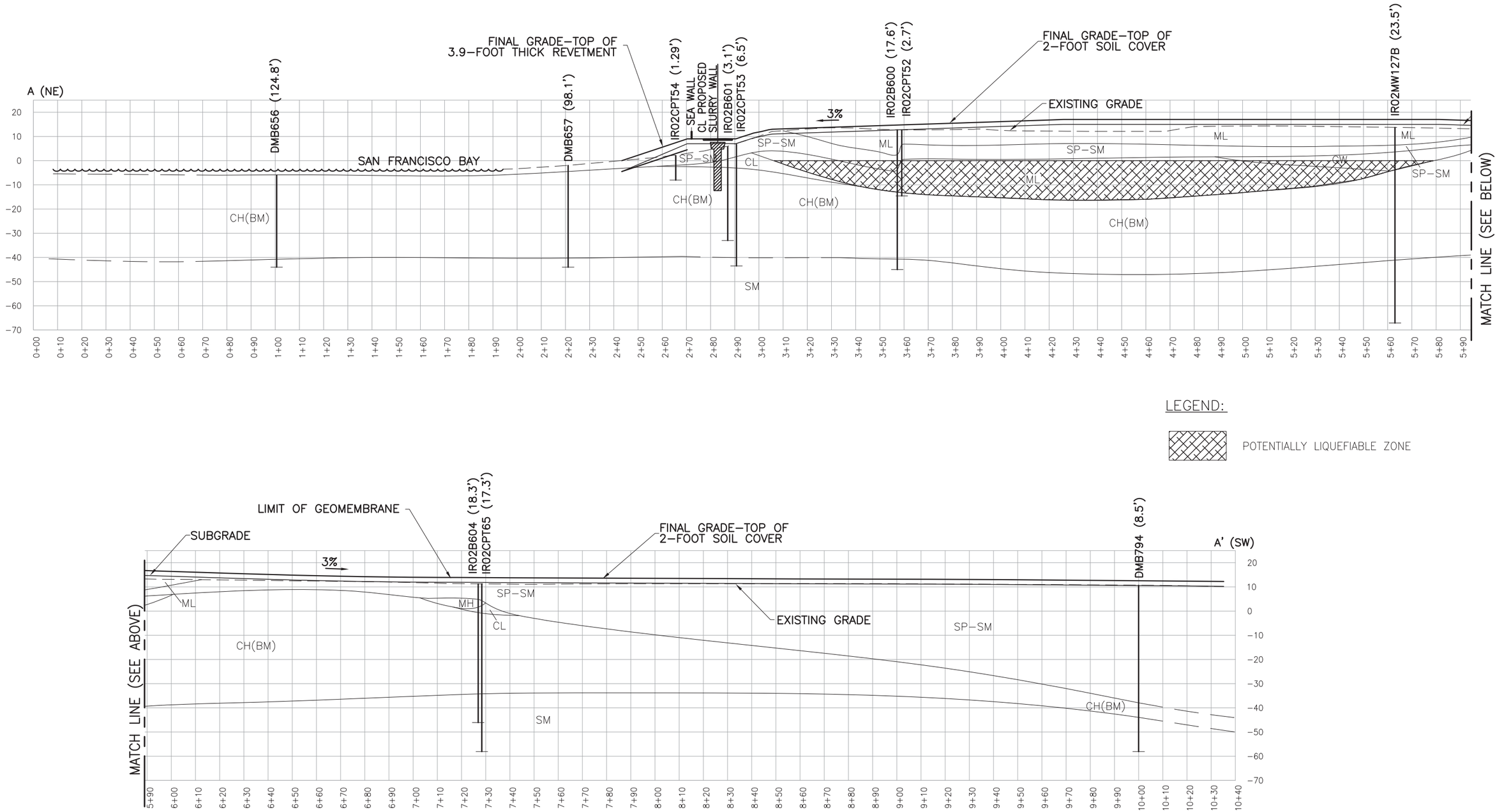


Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Comparison of Acceleration Spectra for MCE NGA (2008) Vs. NGA West-2 (2013)**	
Project No.: 1402317	Date: **November 2015**	Figure: **5**



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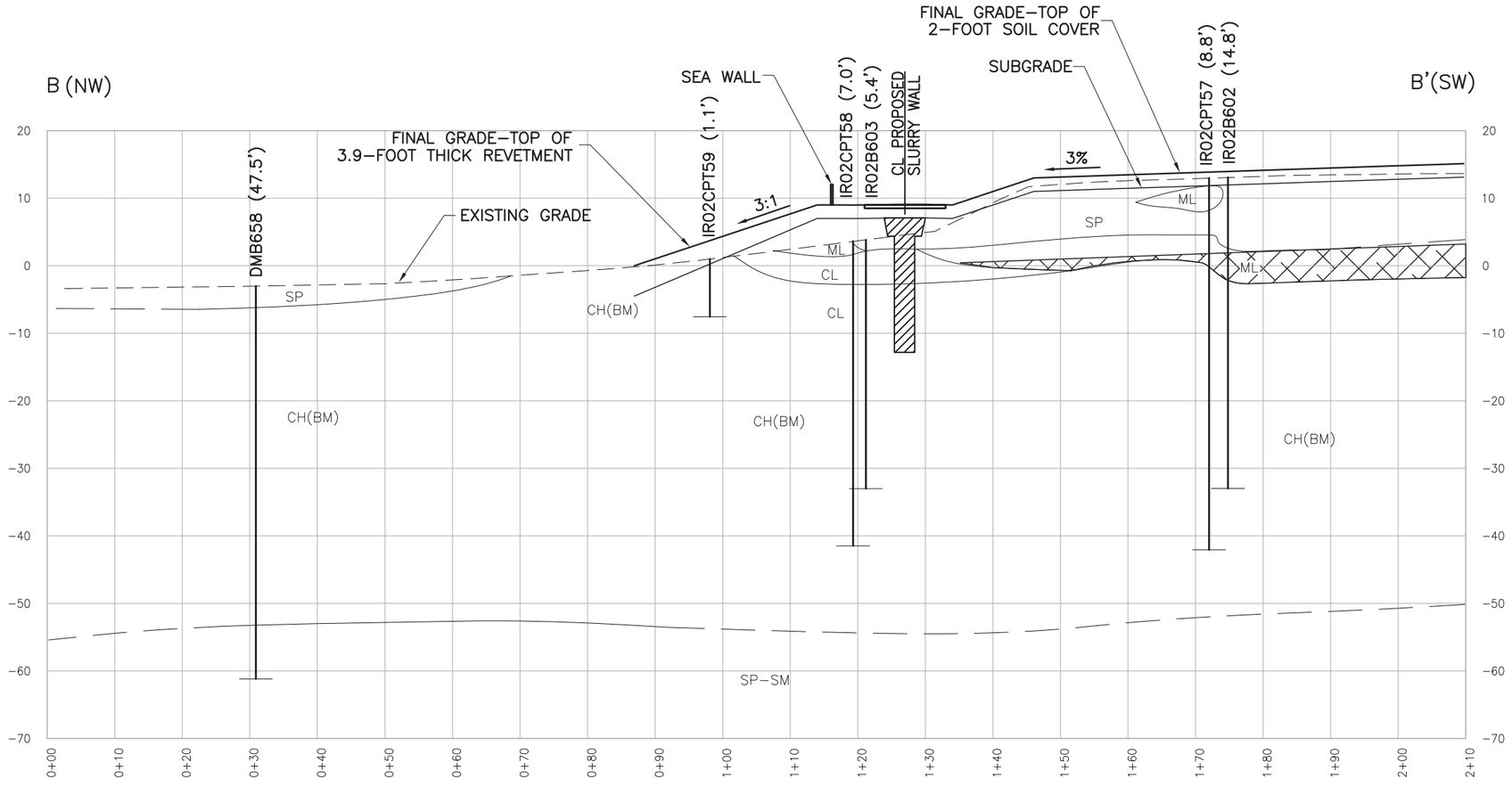
CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	SLOPE STABILITY CROSS SECTION A-A'			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 10/05/15	CHECKED BY: DB 10/05/15	PROJECT NO. 2014-091	DWG NO. 6



LEGEND:

POTENTIALLY LIQUEFIABLE ZONE

0' 20'

SCALE: 1"=20'

Golder Associates

CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	SLOPE STABILITY CROSS SECTION B-B'			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 10/05/15	CHECKED BY: DB 10/05/15	PROJECT NO. 2014–091	DWG NO. 7

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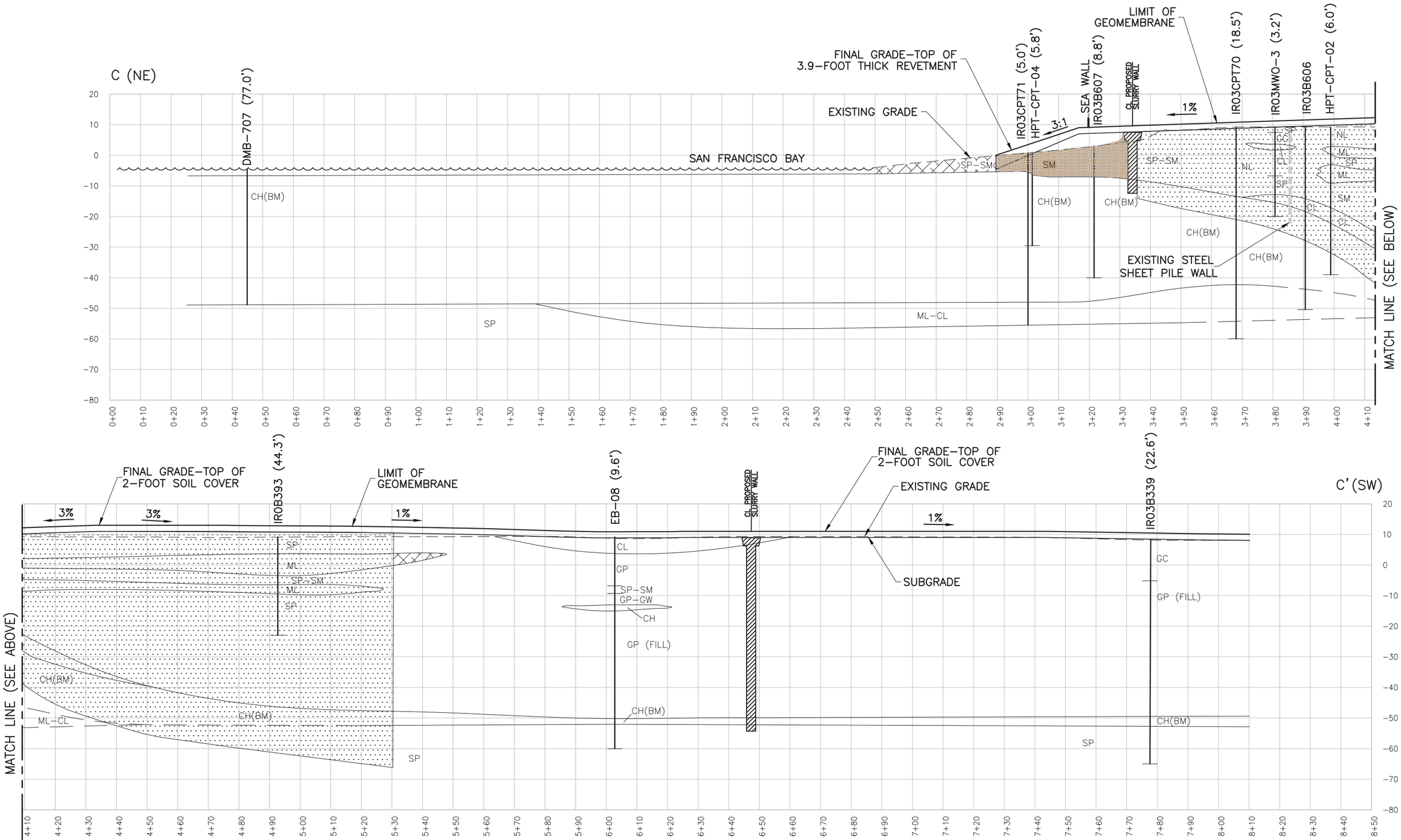

Golder Associates

CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	SLOPE STABILITY CROSS SECTION C-C' AFTER PROPOSED REMEDIATION ACTIVITIES			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 05/26/17	CHECKED BY: DB 05/26/17	PROJECT NO. 2014-091	DWG NO. 8

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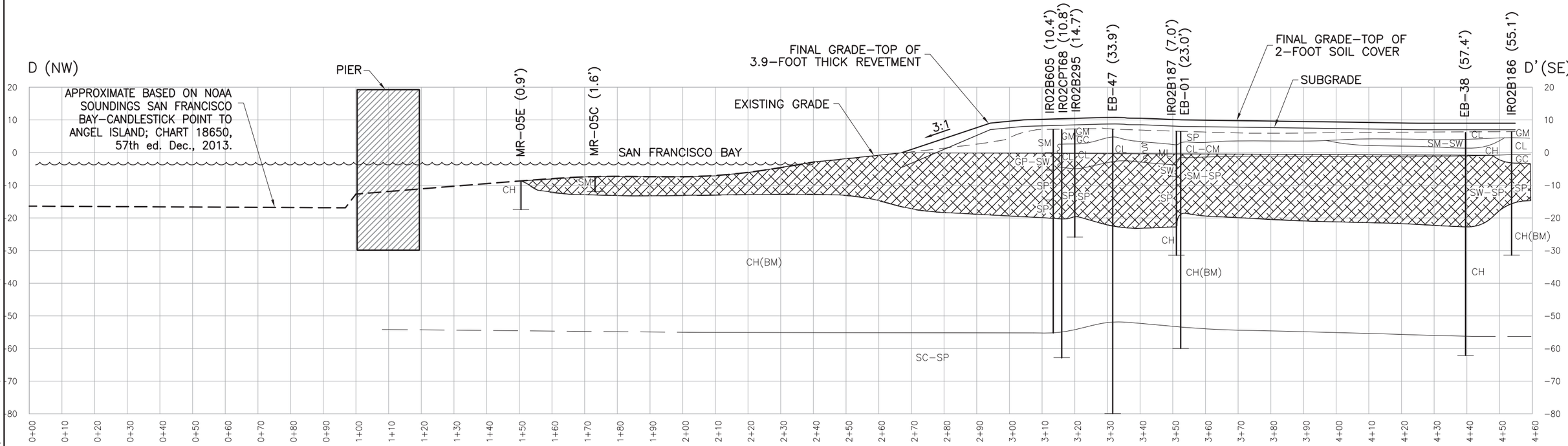

LEGEND:

POTENTIALLY LIQUEFIABLE ZONE

0' 30'

SCALE: 1"=30'

Golder Associates

CLIENT: DEPARTMENT OF THE NAVY BRAC PMO WEST	SLOPE STABILITY CROSS SECTION D-D'			
LOCATION: HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA	DRAWN BY: SC 10/05/15	CHECKED BY: DB 10/05/15	PROJECT NO. 2014–091	DWG NO. 9

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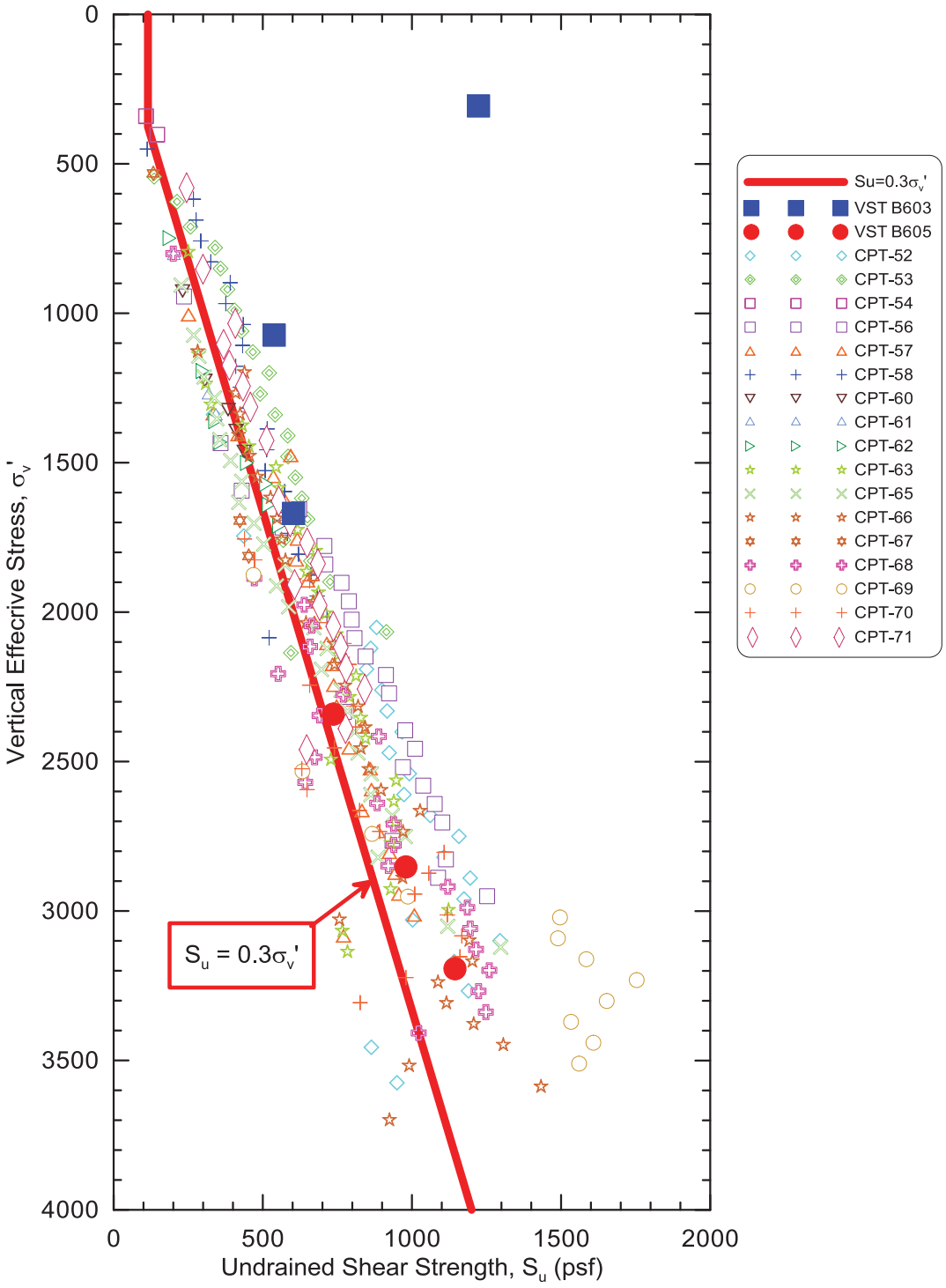
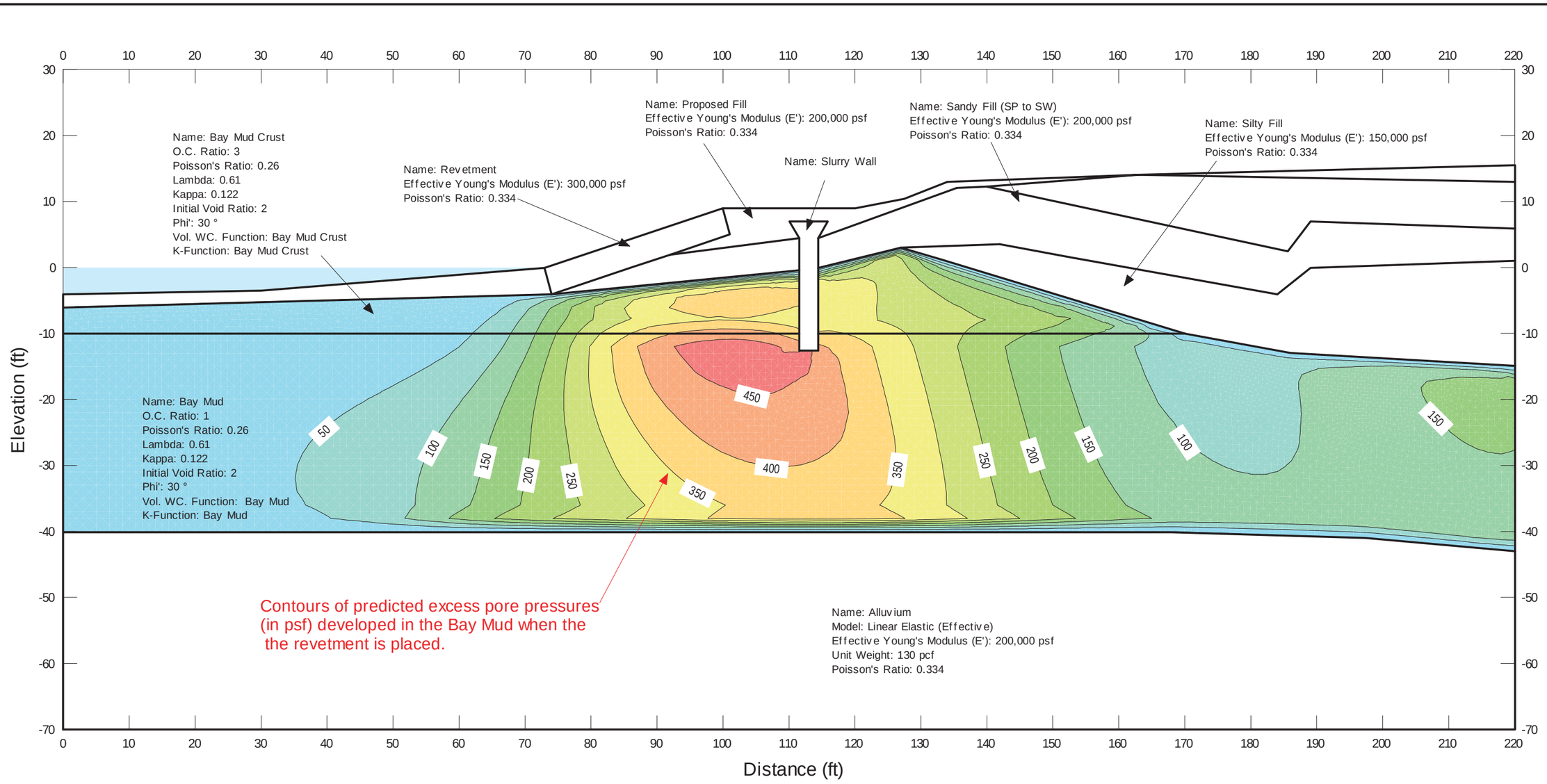


Hunters Point Naval Shipyard
Parcel E Remedial Design

Variation of Undrained Shear Strength of Bay Mud with Effective Vertical Stress Based on Cone Penetration and Field Vane Shear Tests

Project No.: 1402317 | Date: **November 2015** | Figure: **10**



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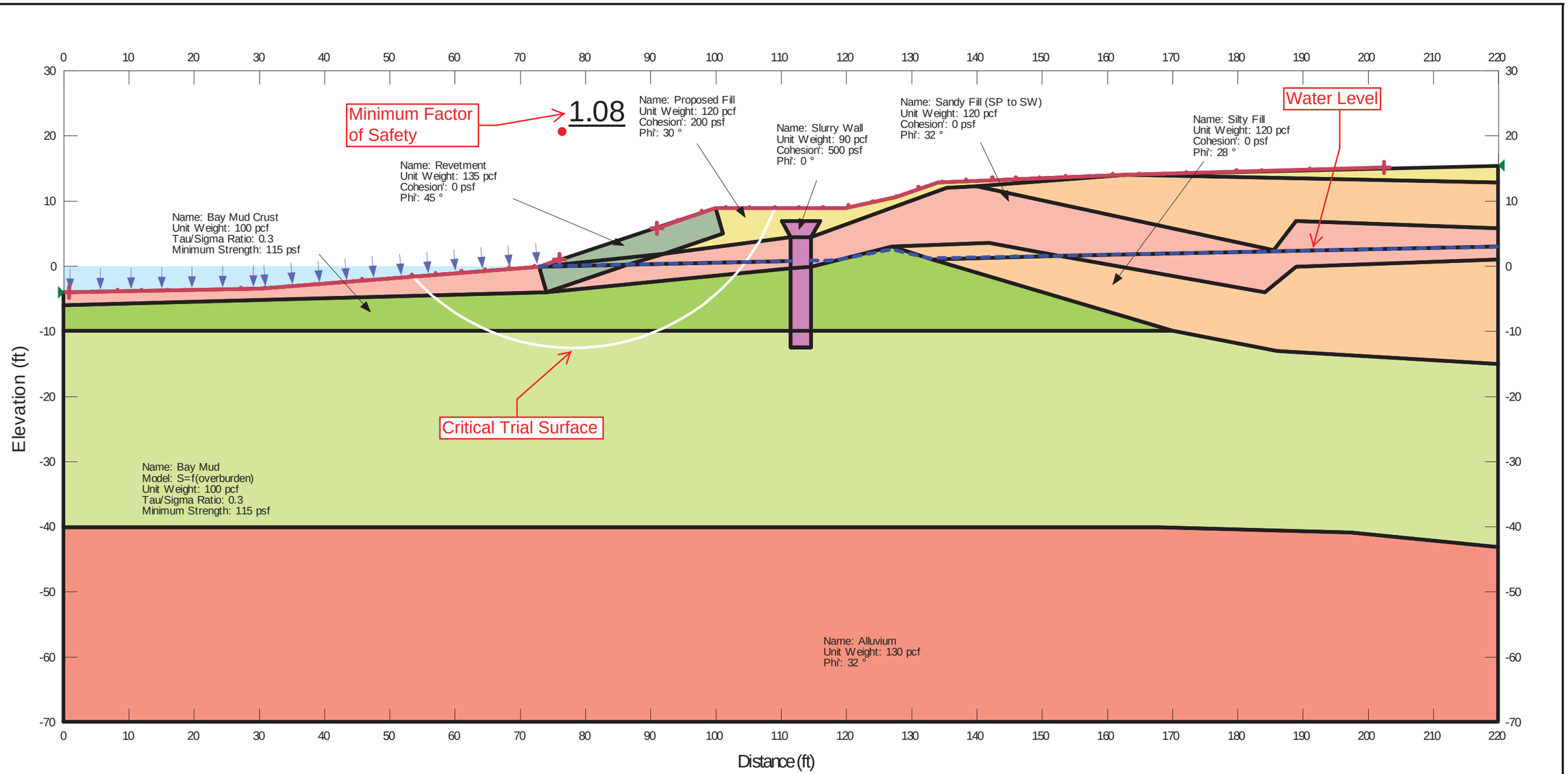
Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section A-A′, Excess Pore Pressure at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **11**



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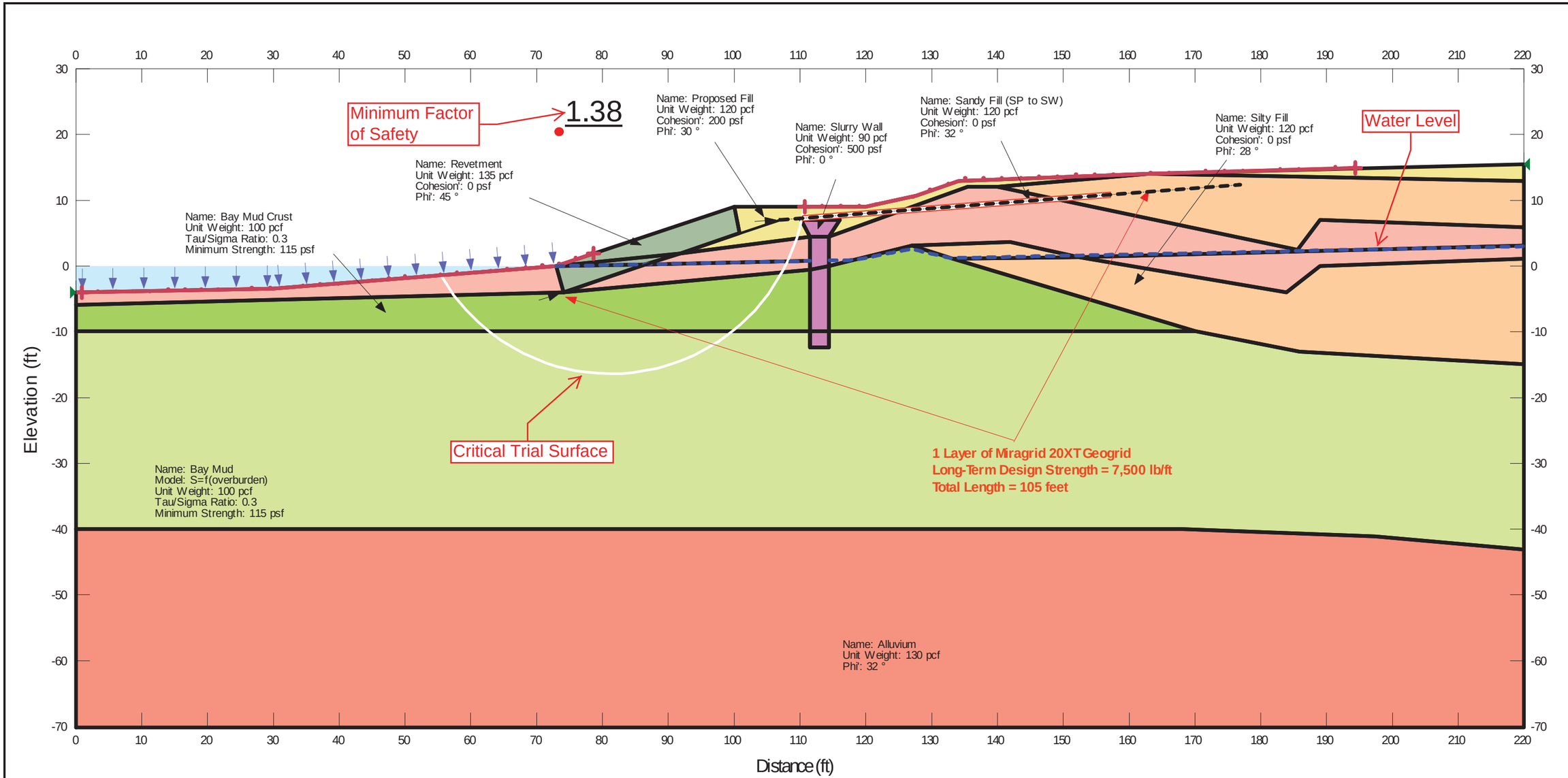
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Static Factor of Safety at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **12**



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Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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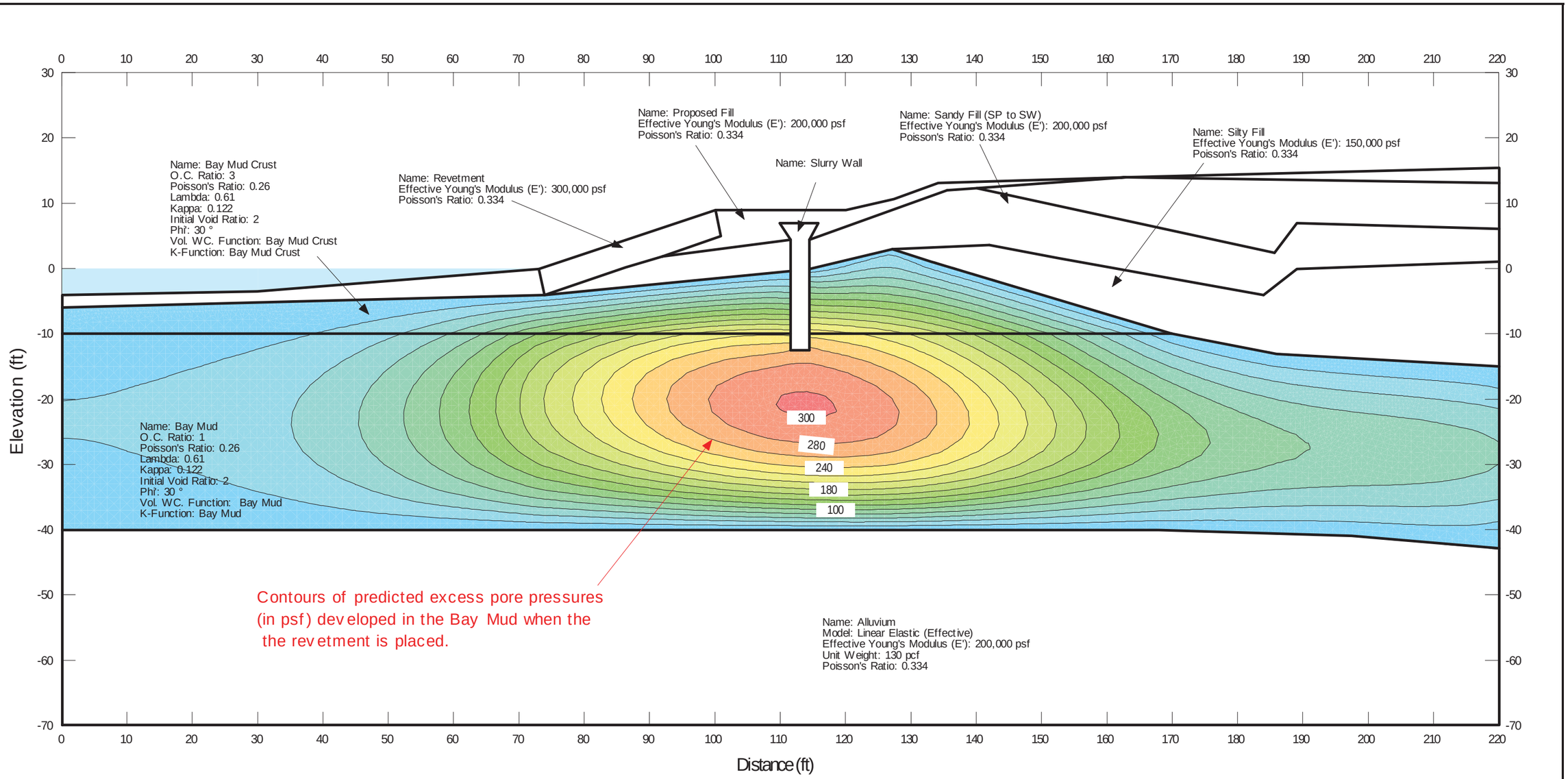
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Static Factor of Safety at End of Construction with Geogrid Reinforcement

Project No. **1402317** | Date: **November 2015** | Figure: **13**



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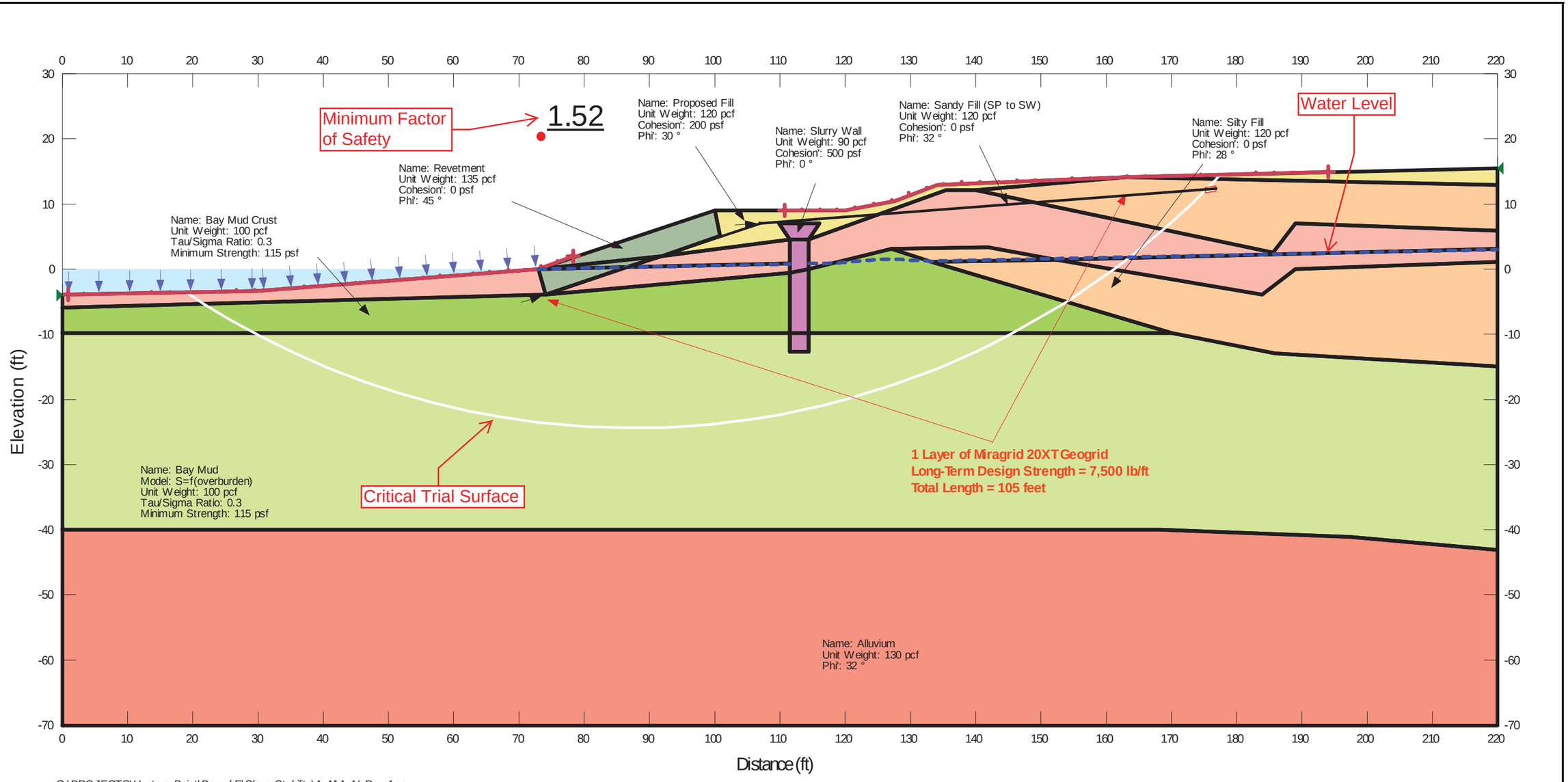
Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section A-A′, Excess Pore Pressure 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **14**



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Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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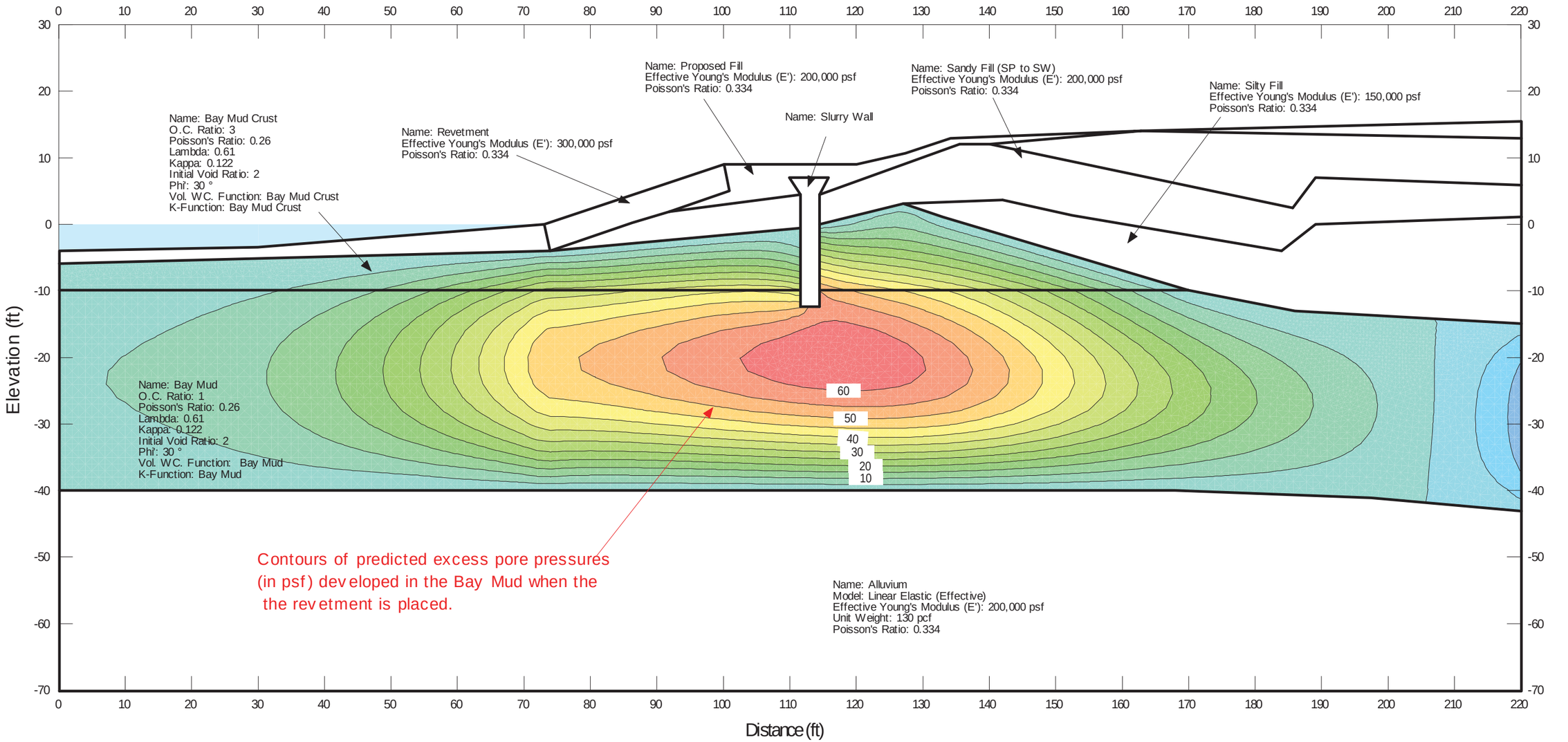
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Static Factor of Safety 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **15**



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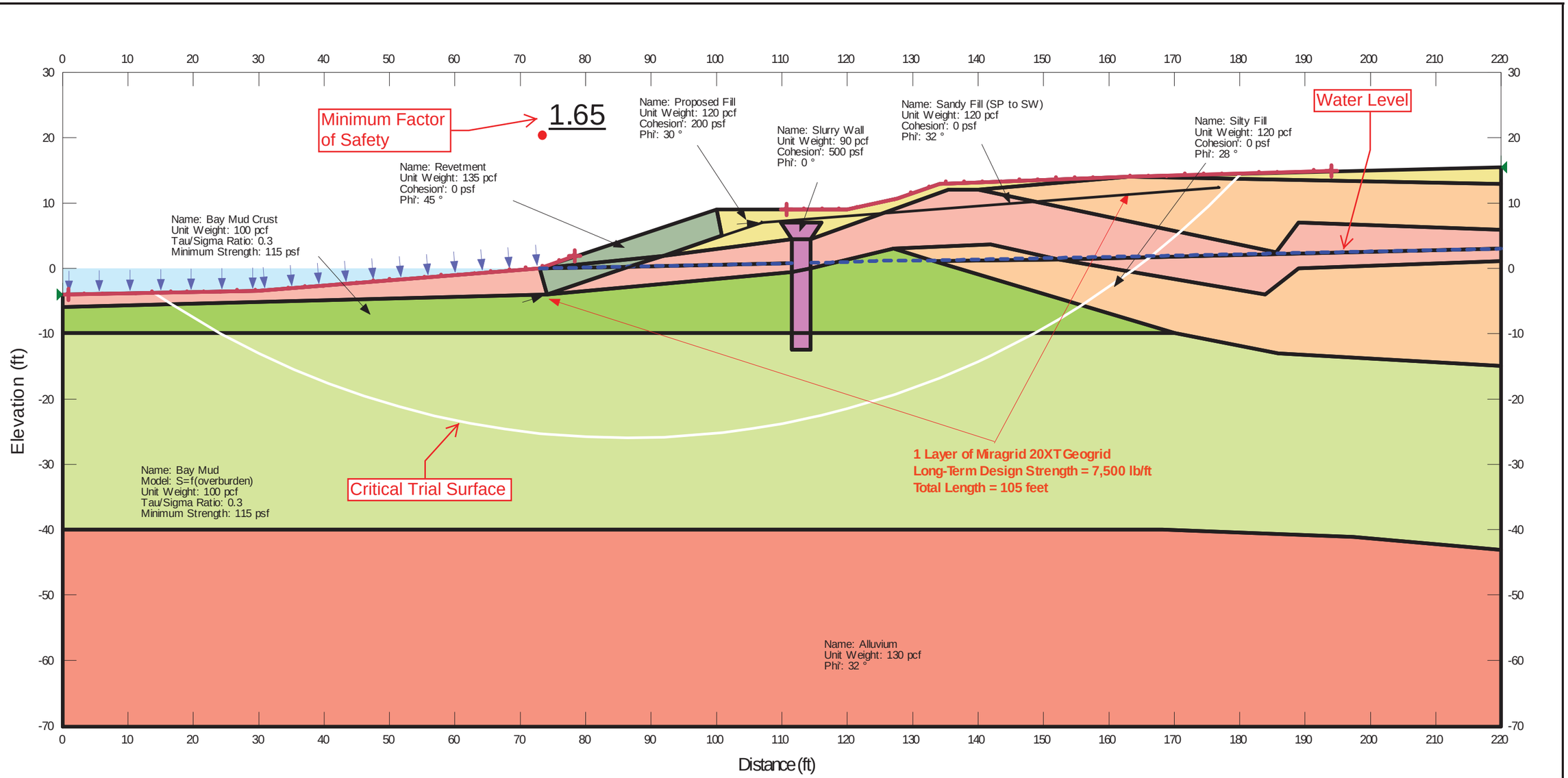
Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section A-A′, Excess Pore Pressure 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **16**



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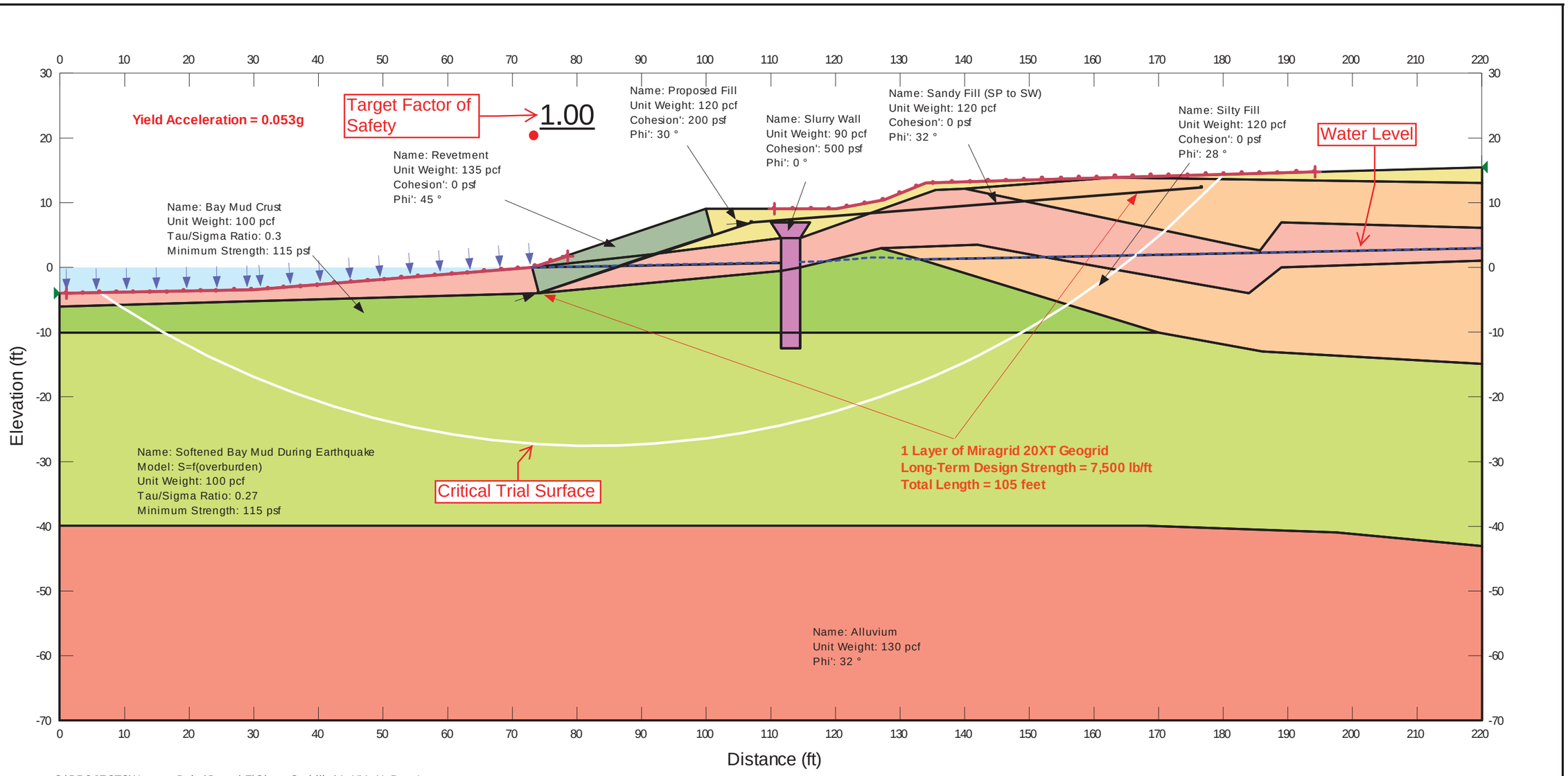
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Static Factor of Safety 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **17**



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\A-A'_Rev-4.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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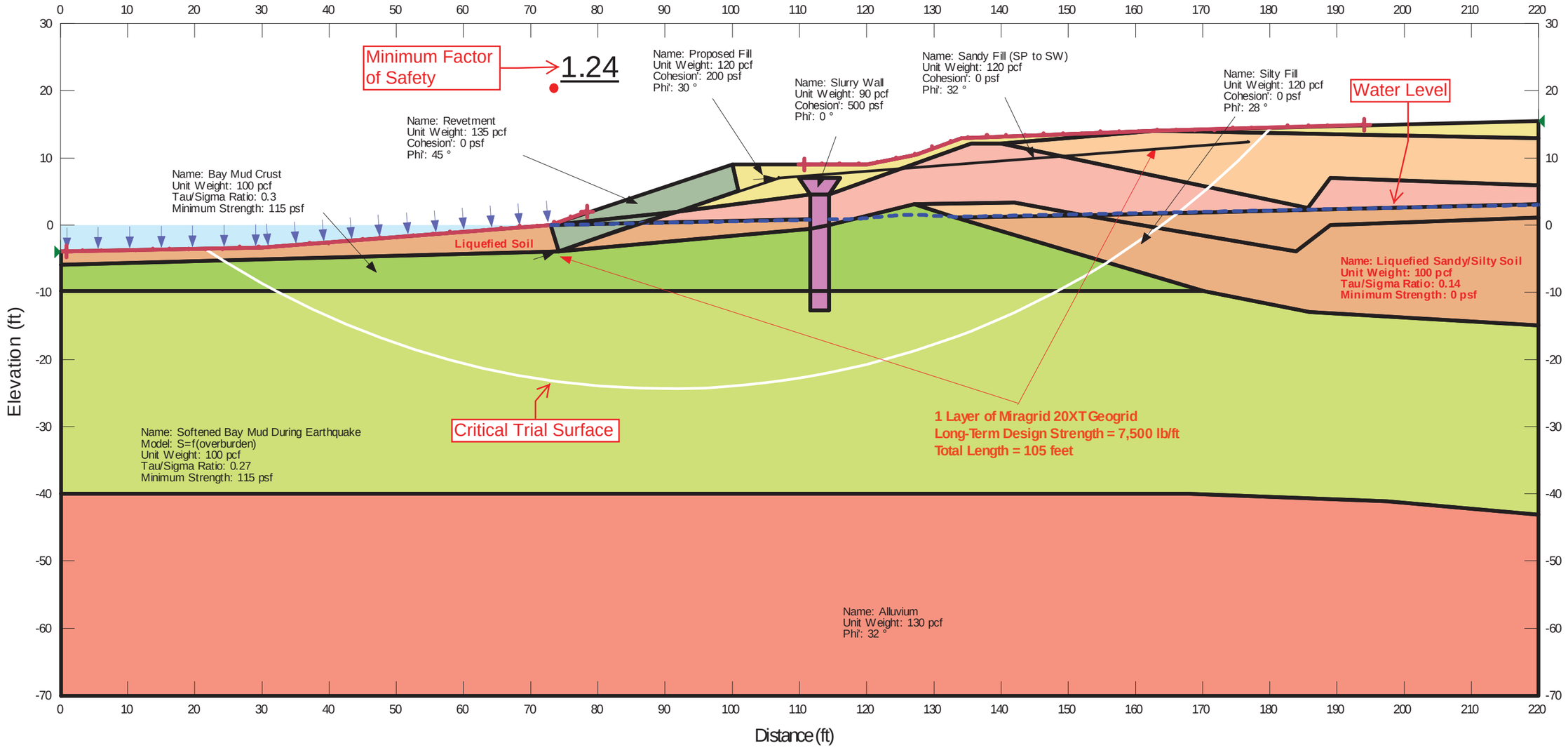
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Yield Acceleration 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **18**



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A\A-A'_Rev-4.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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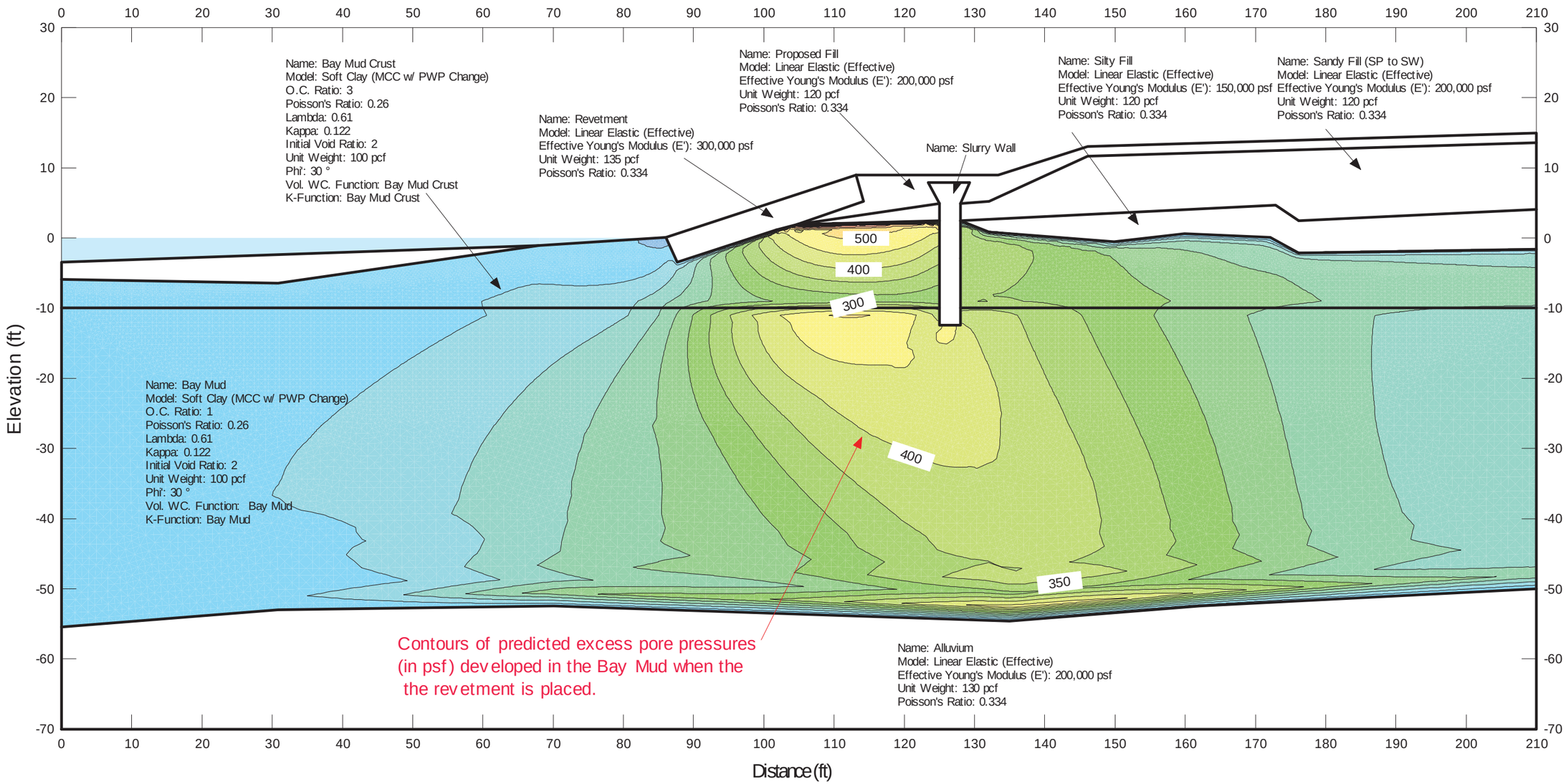
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section A-A′
Post-Liquefaction Stability 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **19**



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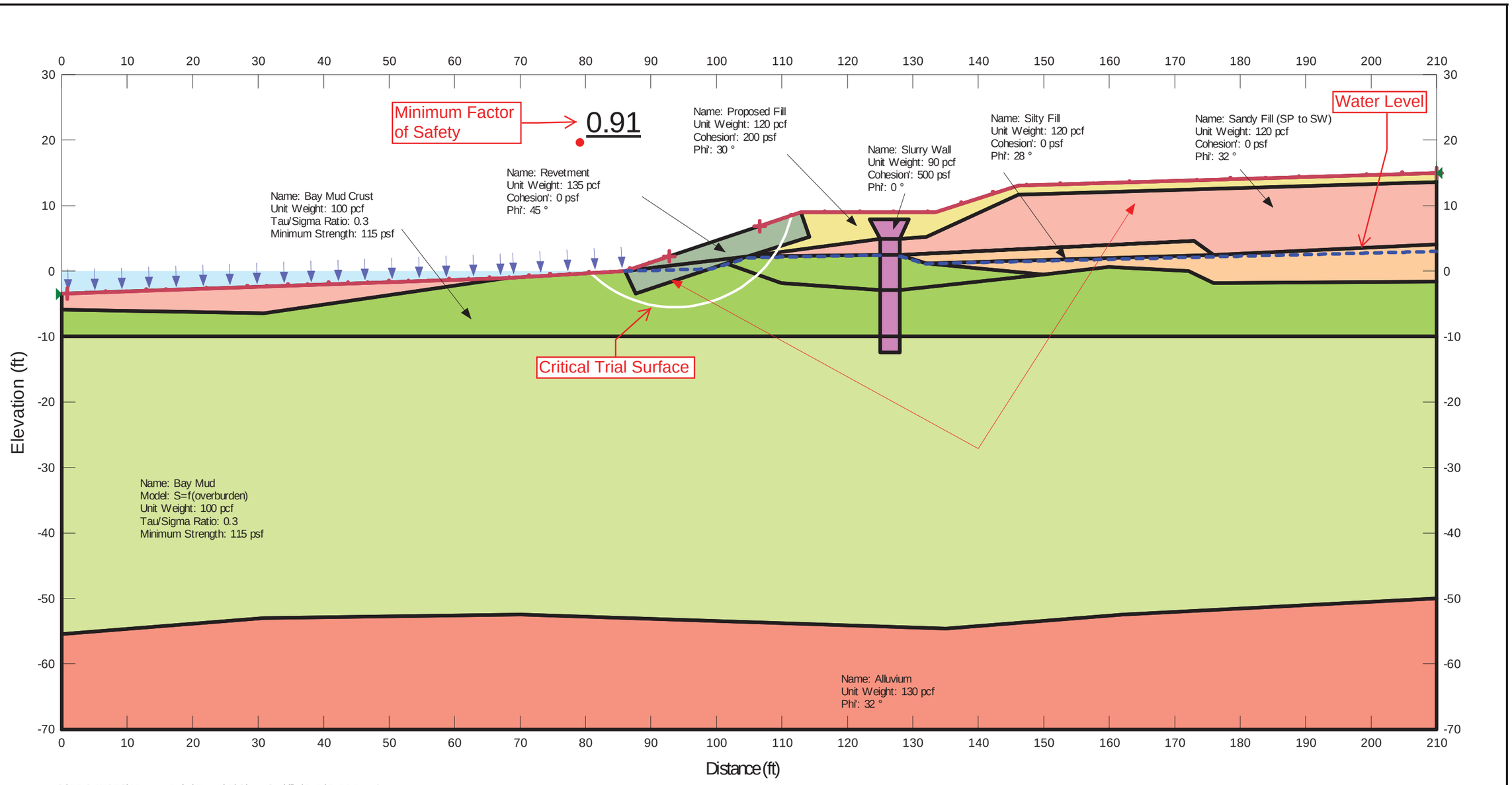
Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section B-B′, Excess Pore Pressure at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **20**



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Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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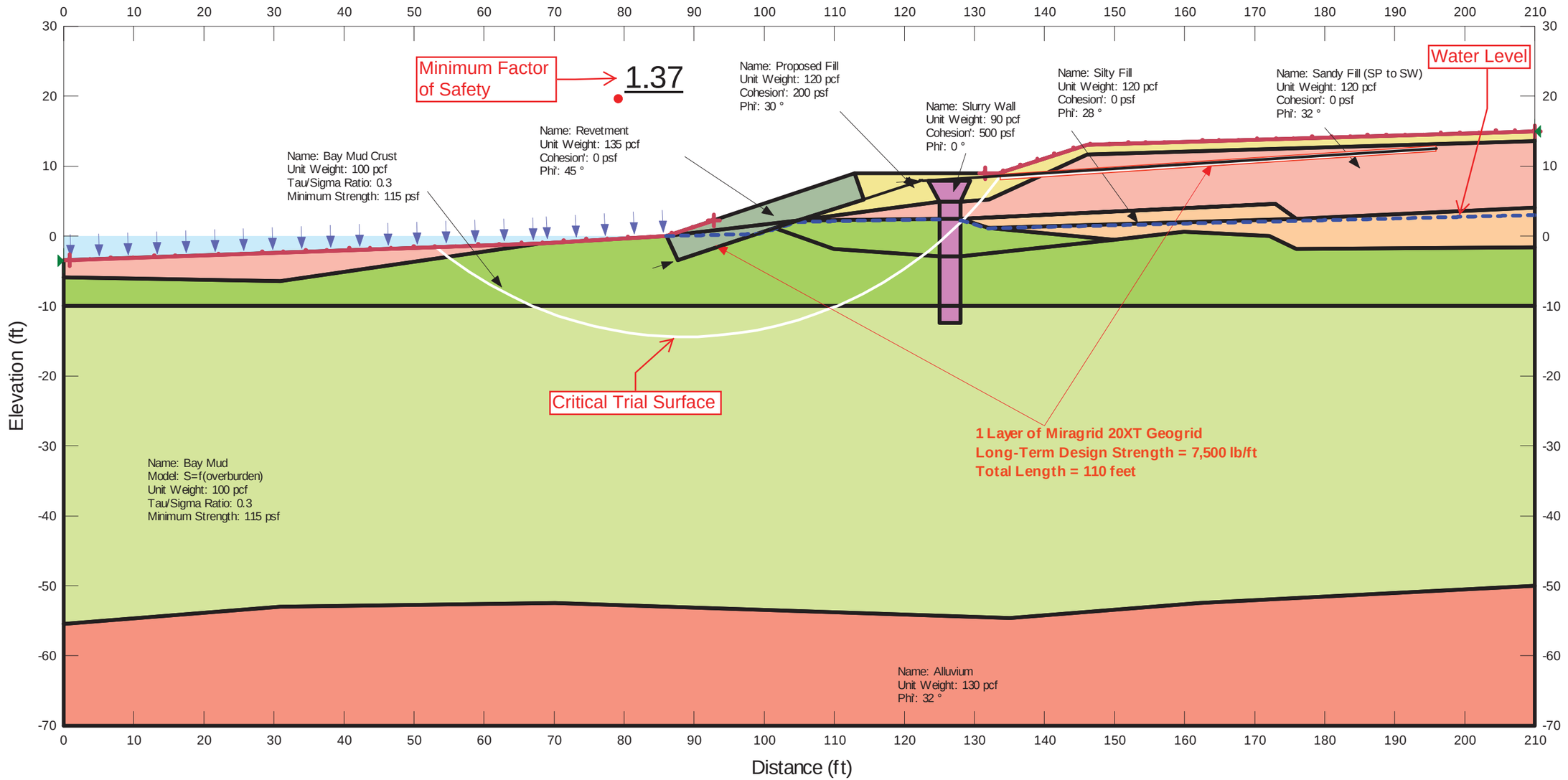
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Static Factor of Safety at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **21**



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Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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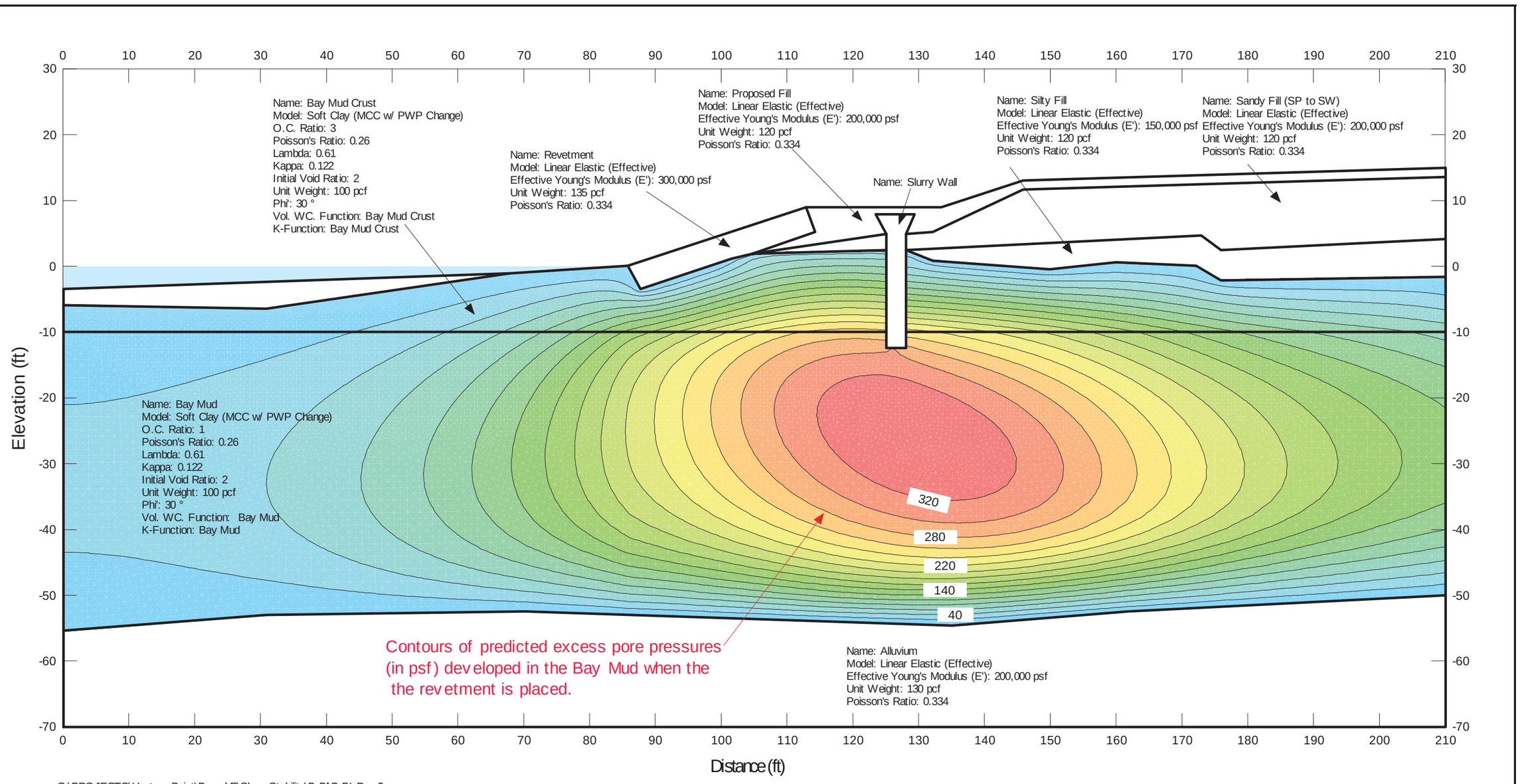
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Static Factor of Safety at End of Construction with Geogrid Reinforcement

Project No. **1402317** | Date: **November 2015** | Figure: **22**



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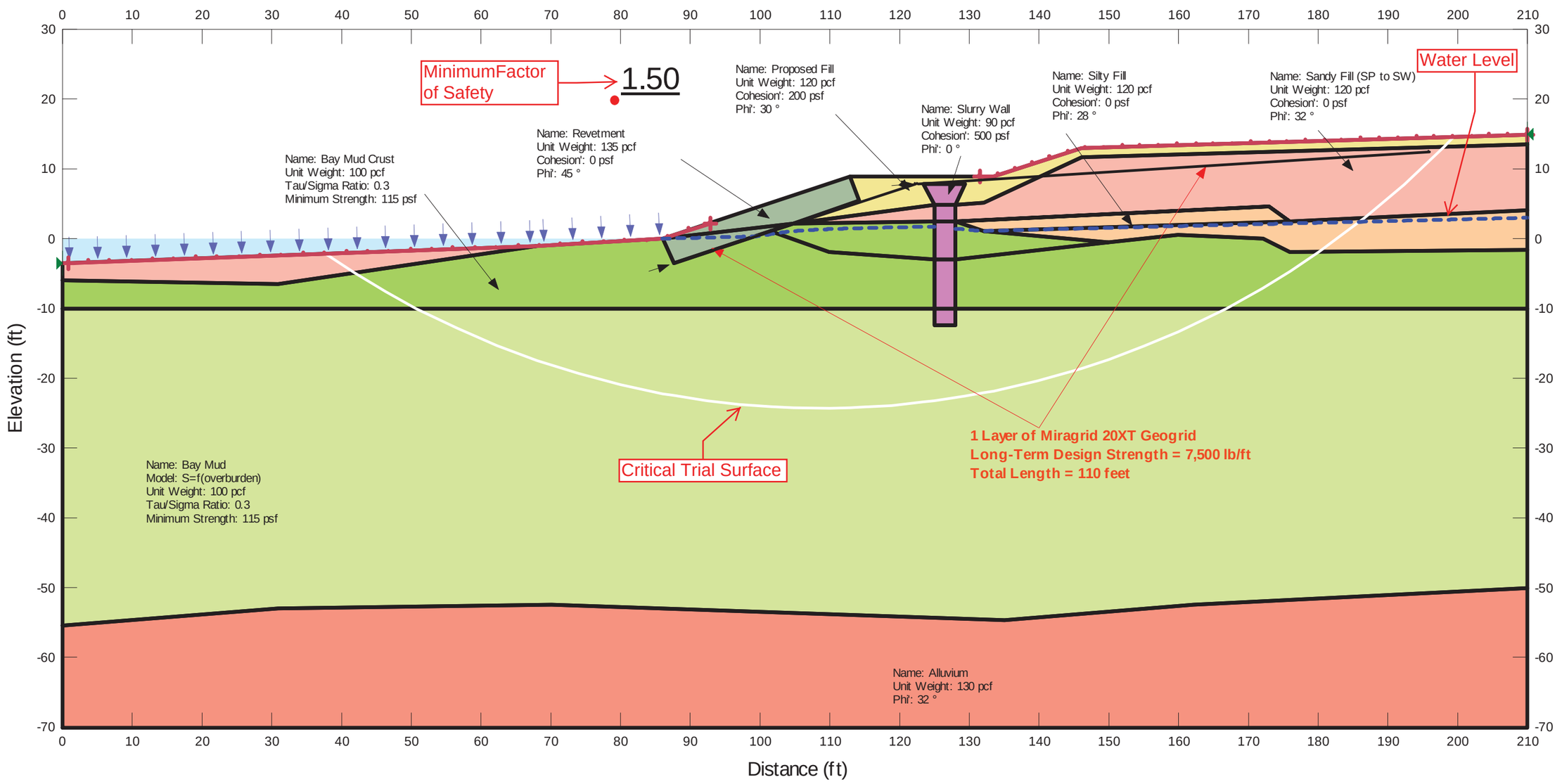
Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section B-B′, Excess Pore Pressure 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **23**



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Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

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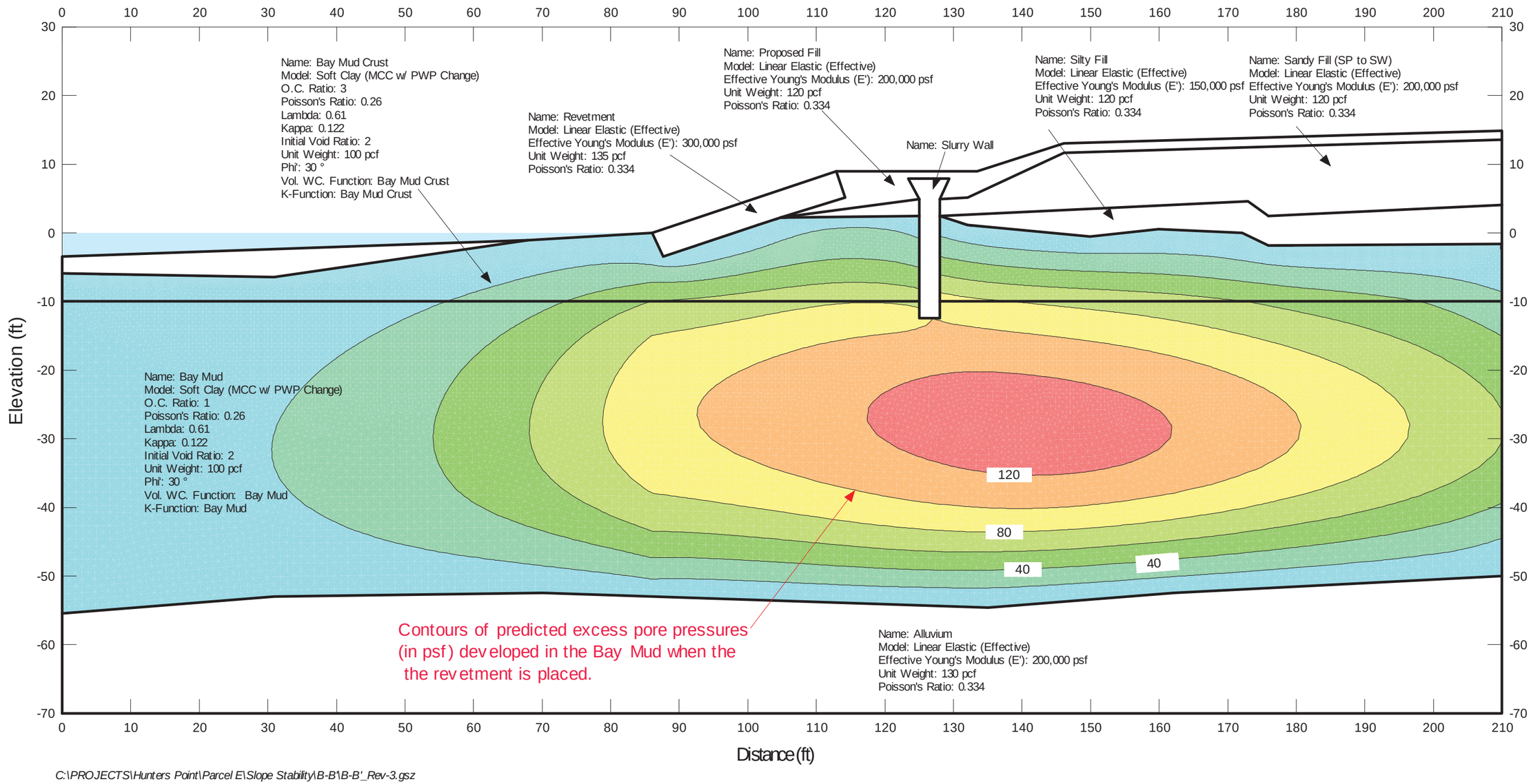
Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Static Factor of Safety 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **24**

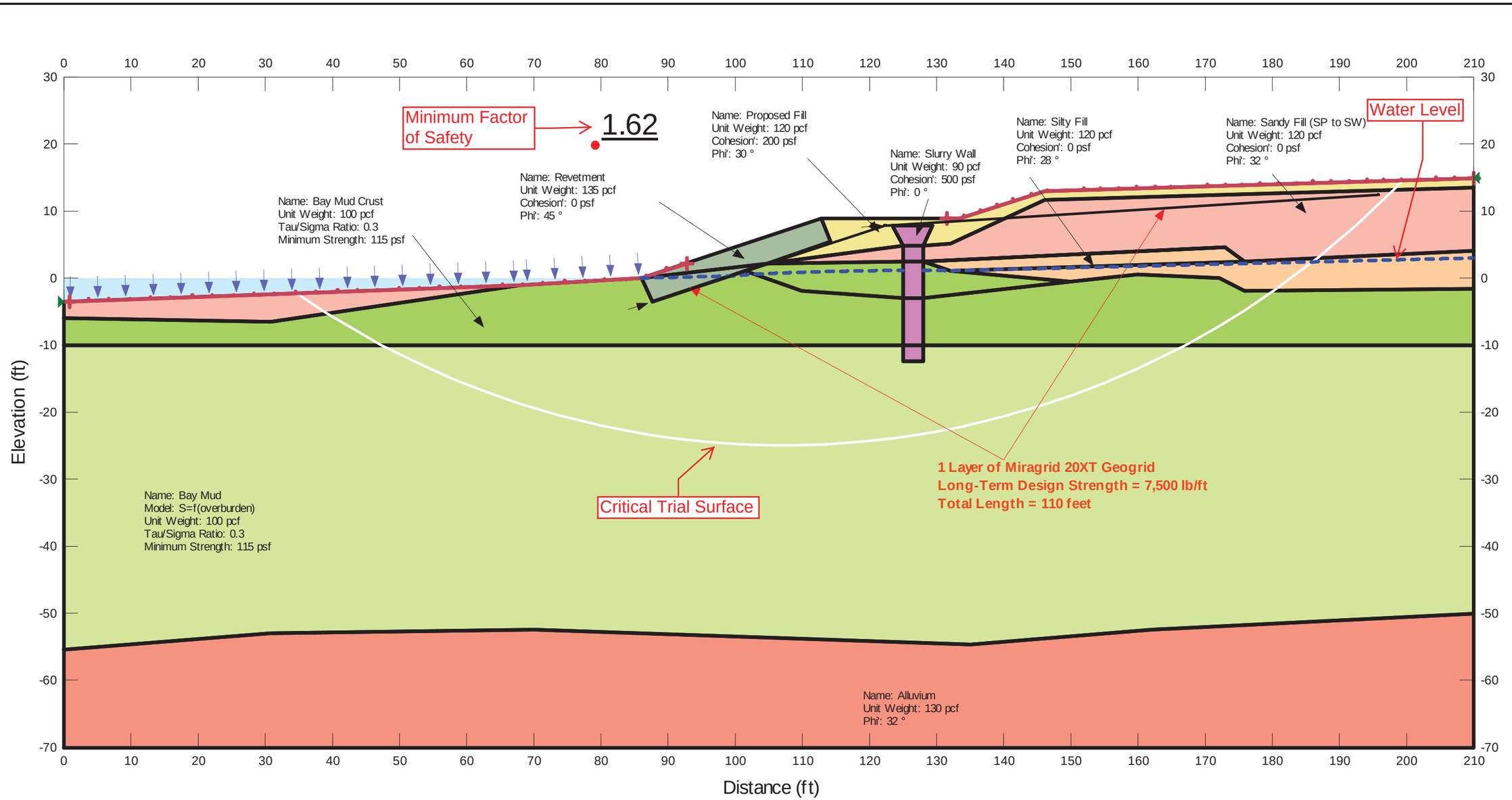


C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section B-B′, Excess Pore Pressure 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **25**



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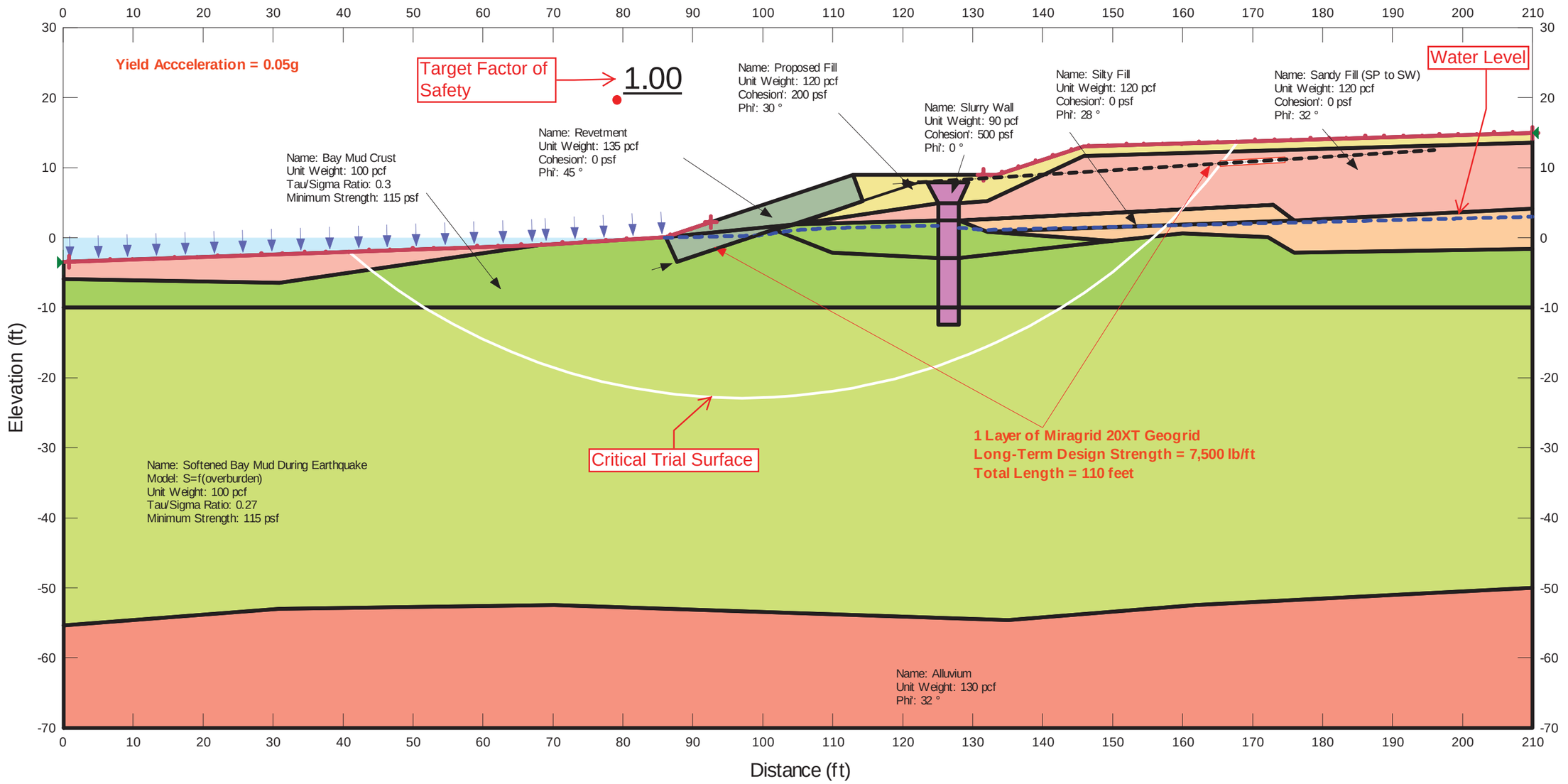
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Static Factor of Safety 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **26**



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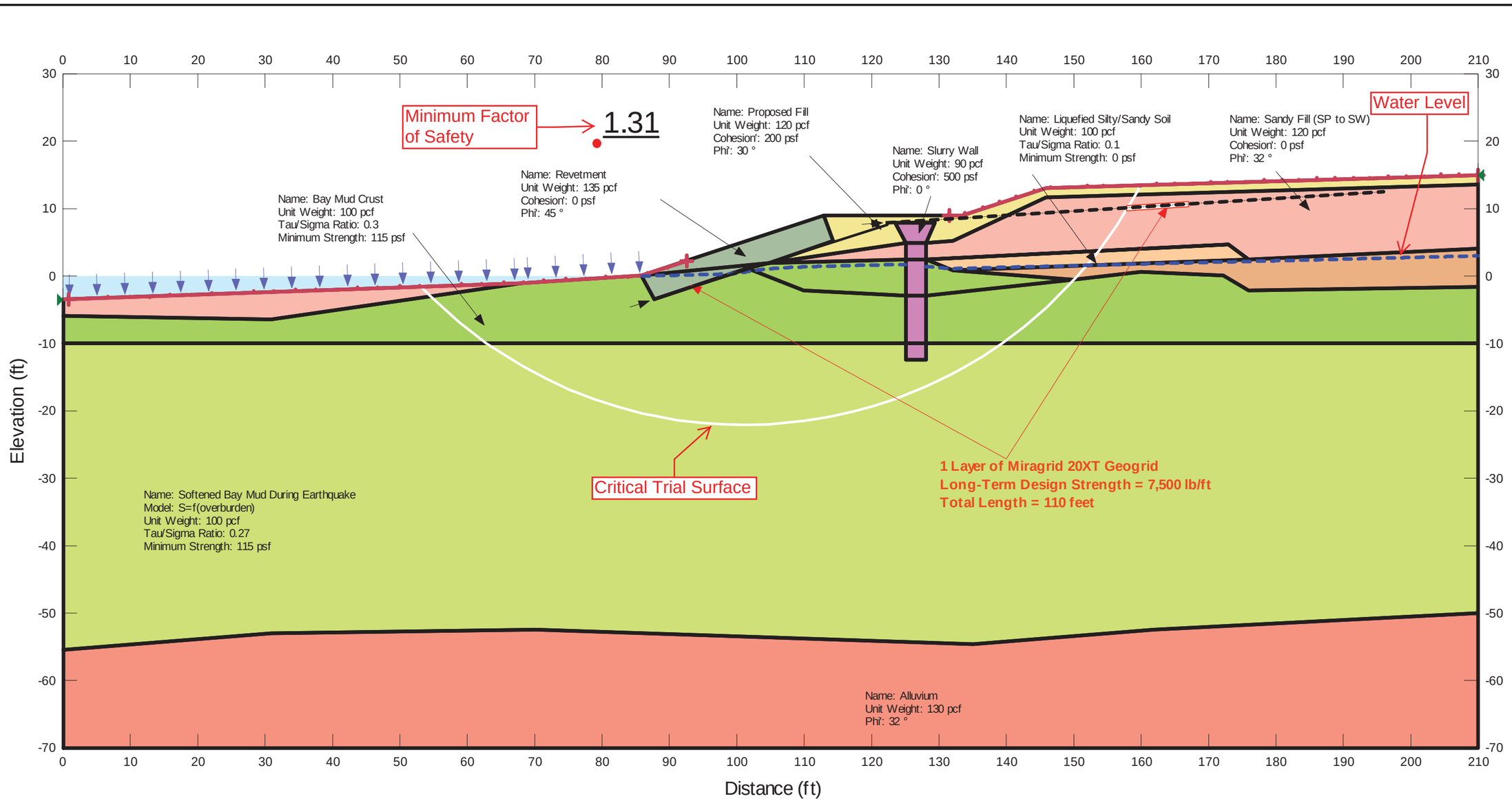
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Yield Acceleration 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **27**



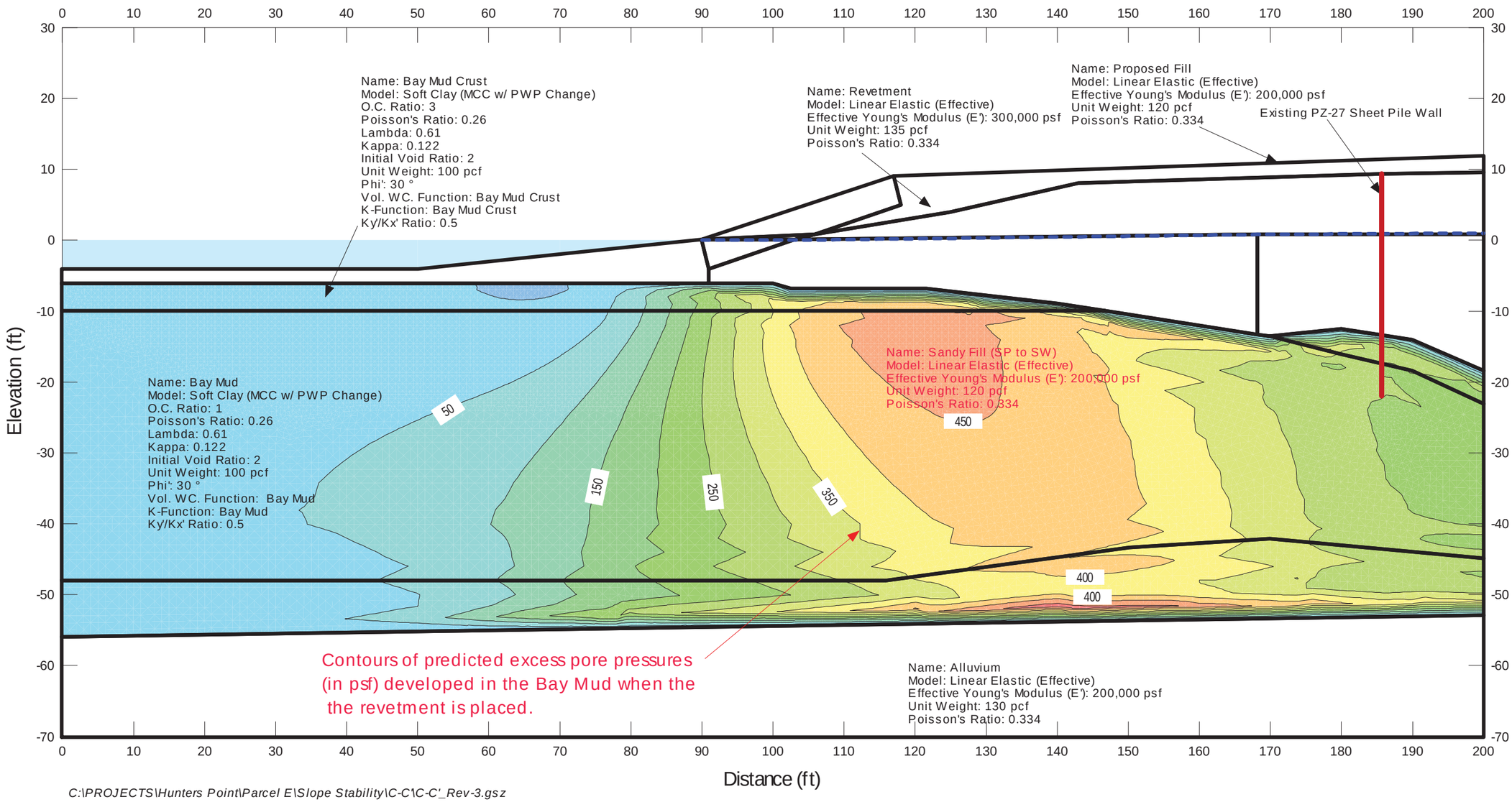
C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section B-B′
Post-Liquefaction Stability 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **28**



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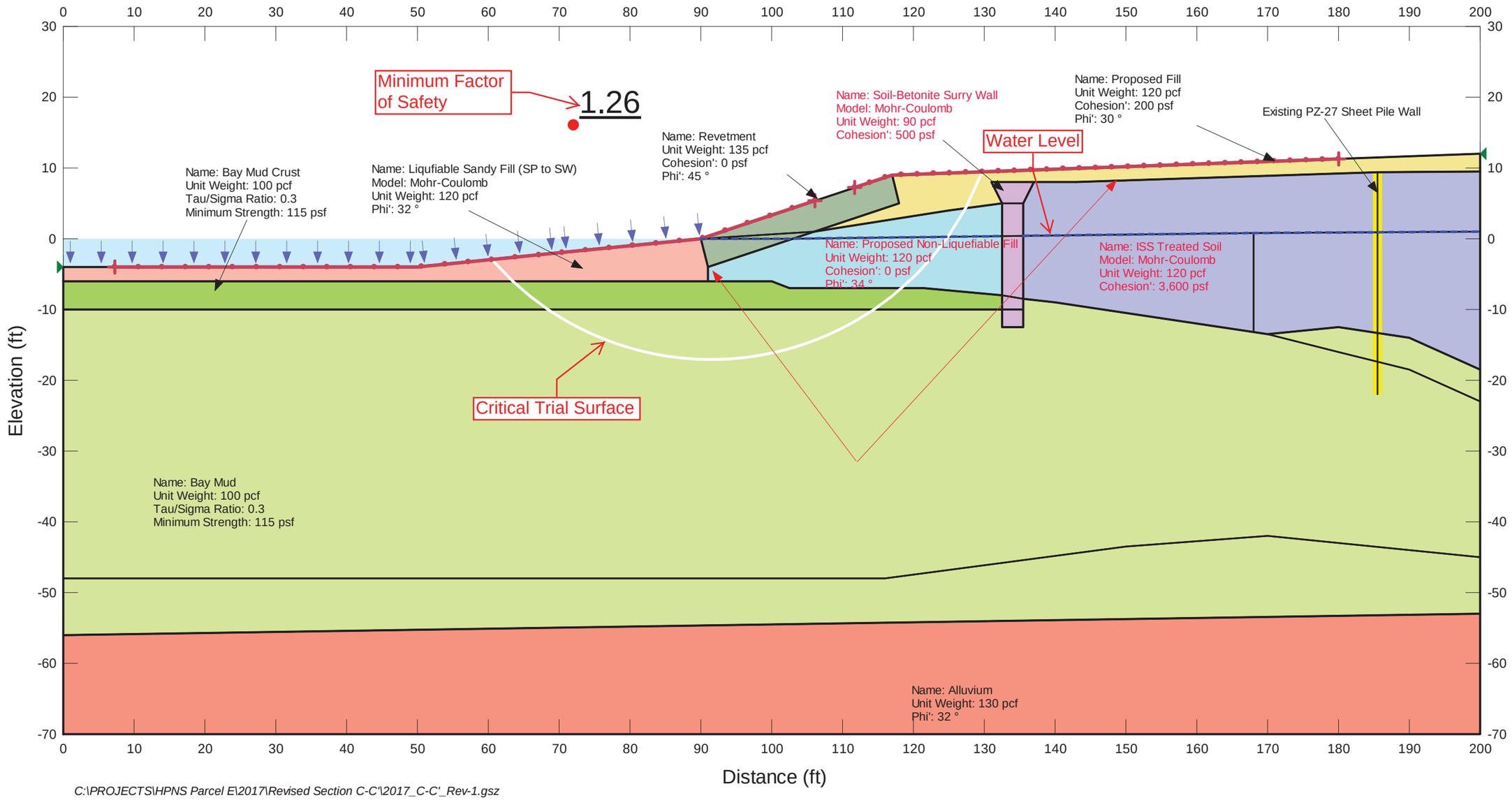
Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section C-C′, Excess Pore Pressure at End of Construction

Project No. **1402317** | Date: **August 2017** | Figure: **29**



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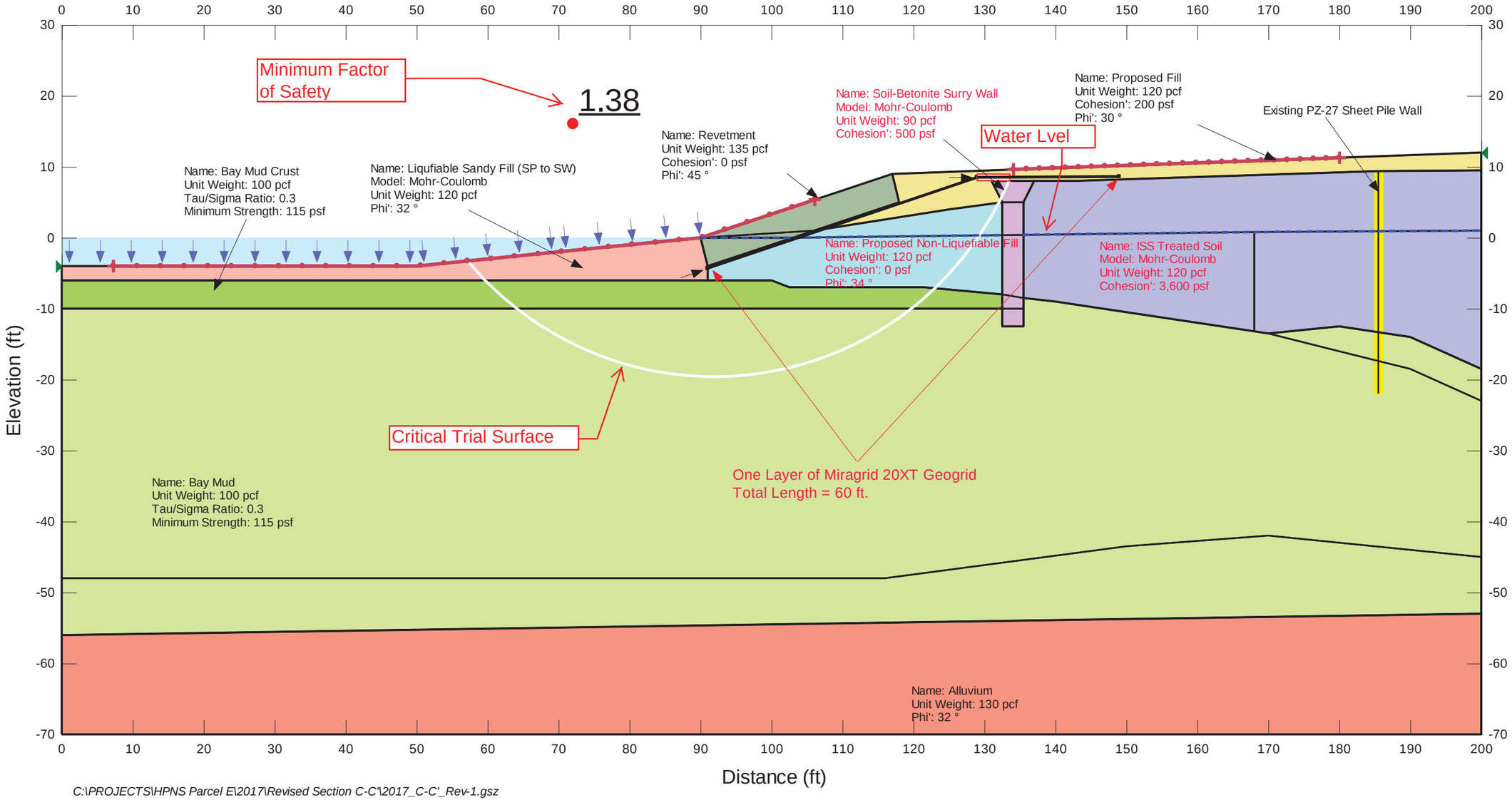
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Static Factor of Safety at End of Construction

Project No. **1402317** | Date: **August 2017** | Figure: **30**



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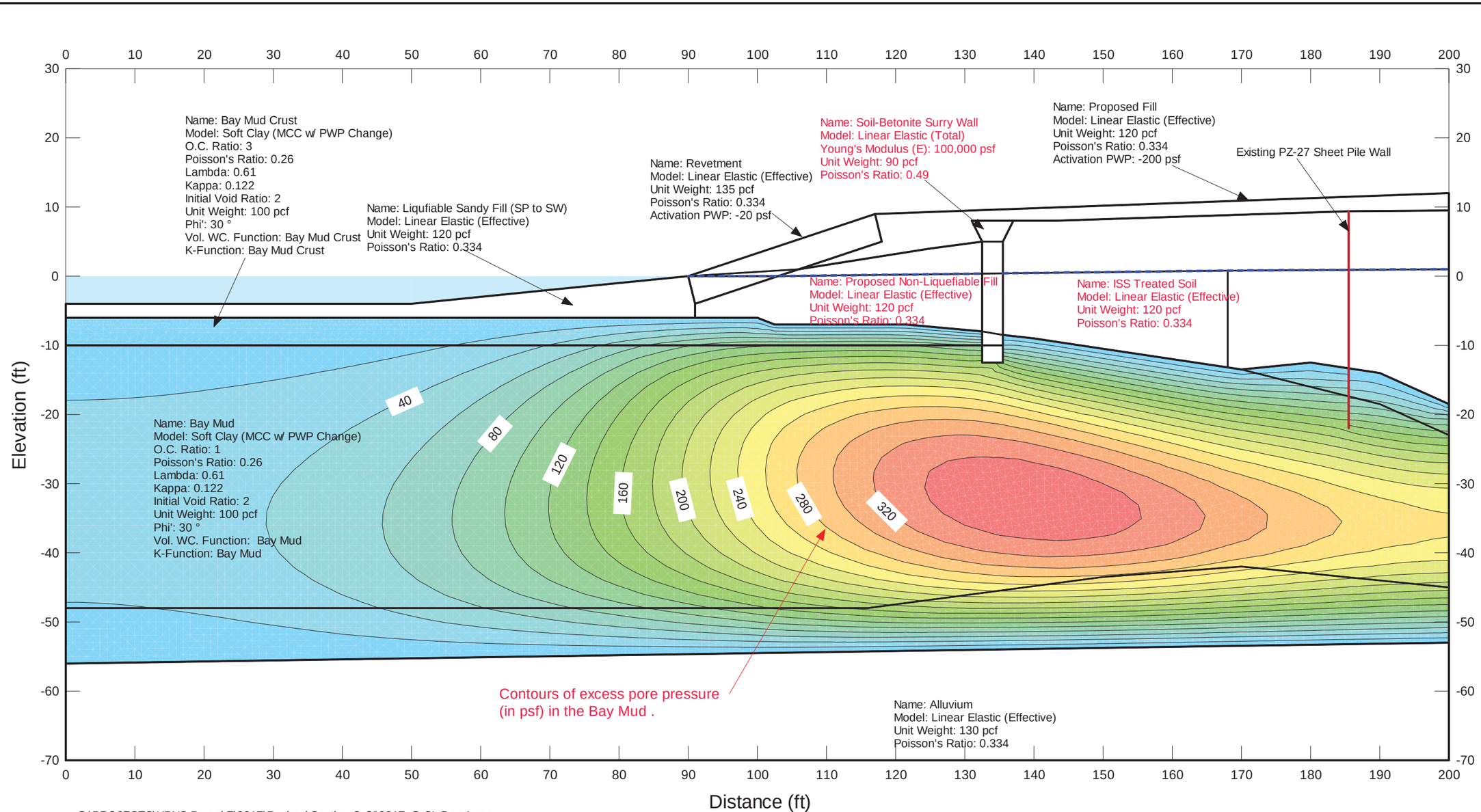
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Static Factor of Safety at End of Construction
With Geogrid Reinforcement

Project No. **1402317** | Date: **August 2017** | Figure: **31**



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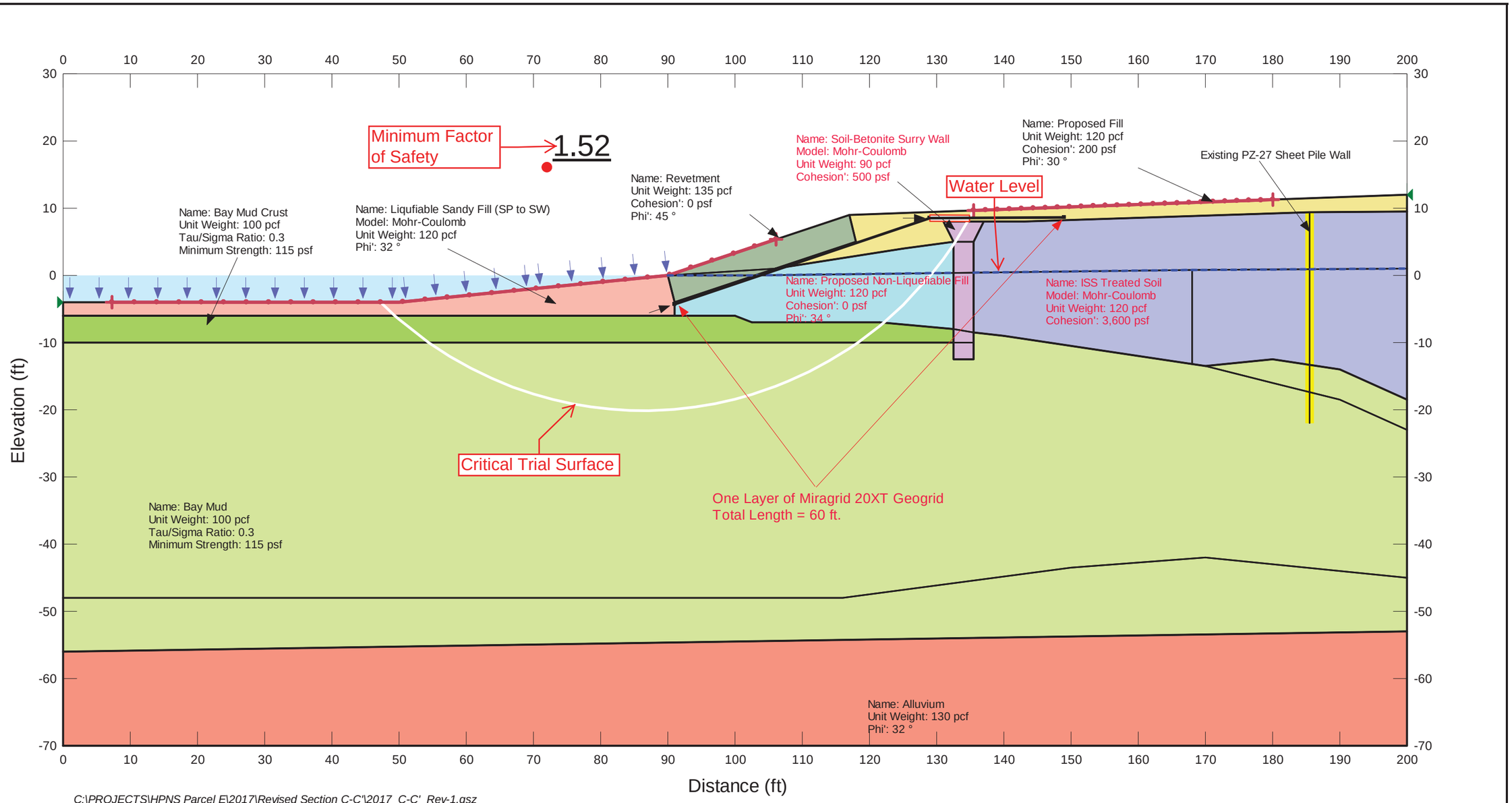
Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design

Pore Pressure Analysis, Cross Section C-C′, Excess Pore Pressure 5 Years after Construction

Project No. **1402317**	Date: **August 2017**	Figure: **32**



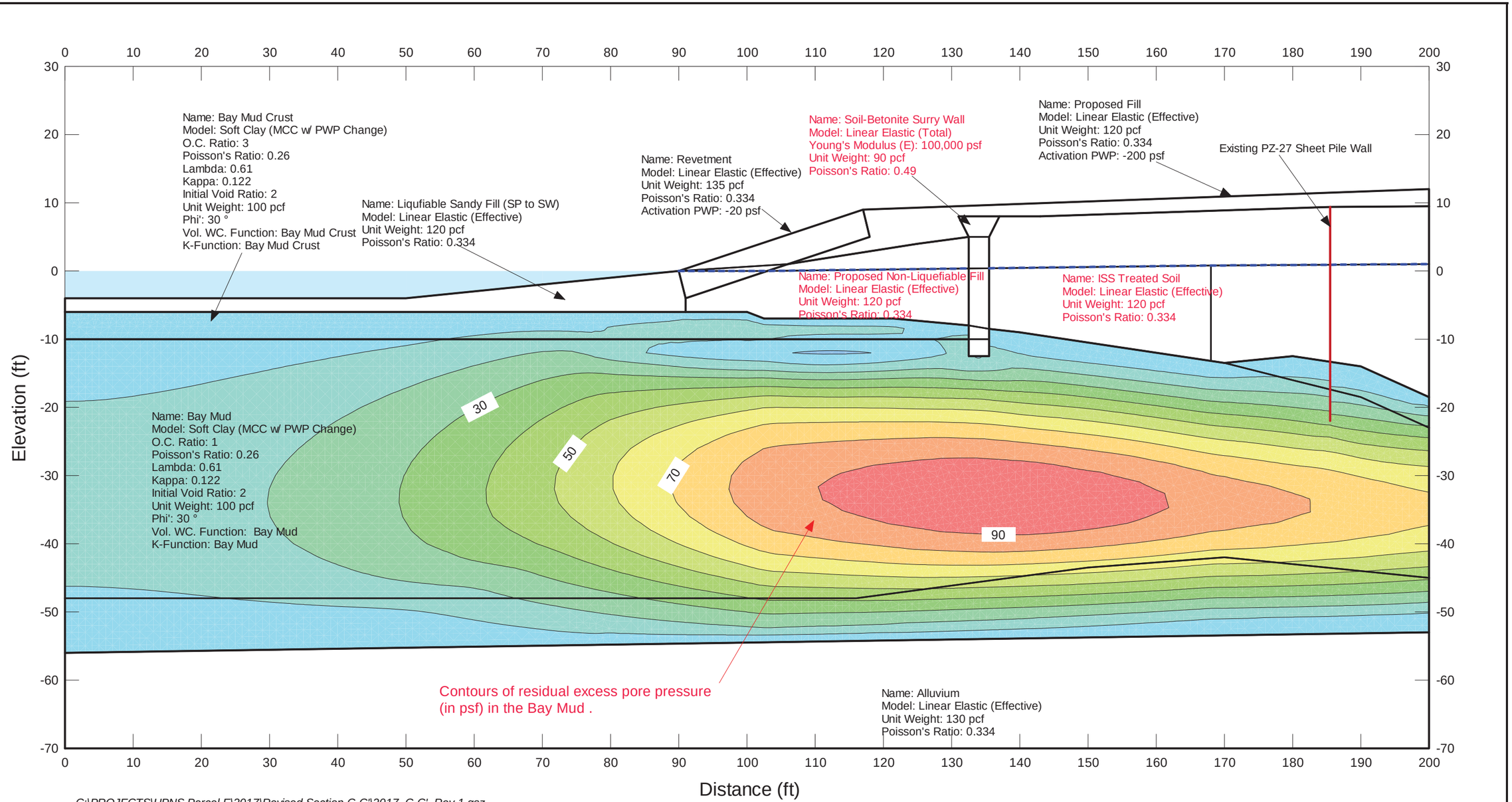
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Static Factor of Safety 5 Years after Construction

Project No. **1402317** | Date: **August 2017** | Figure: **33**

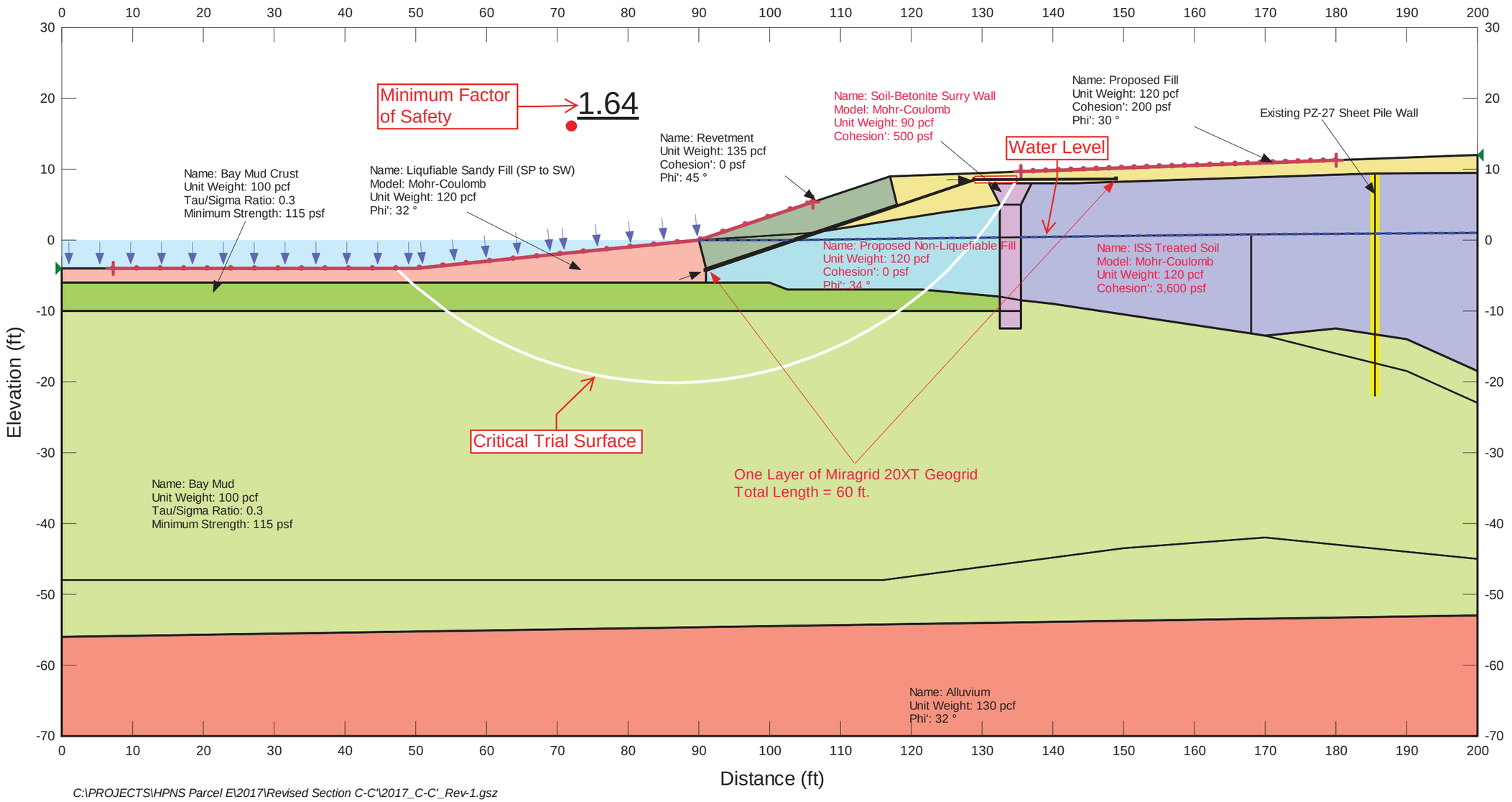


C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section C-C′, Excess Pore Pressure 30 Years after Construction

Project No. **1402317**	Date: **August 2017**	Figure: **34**



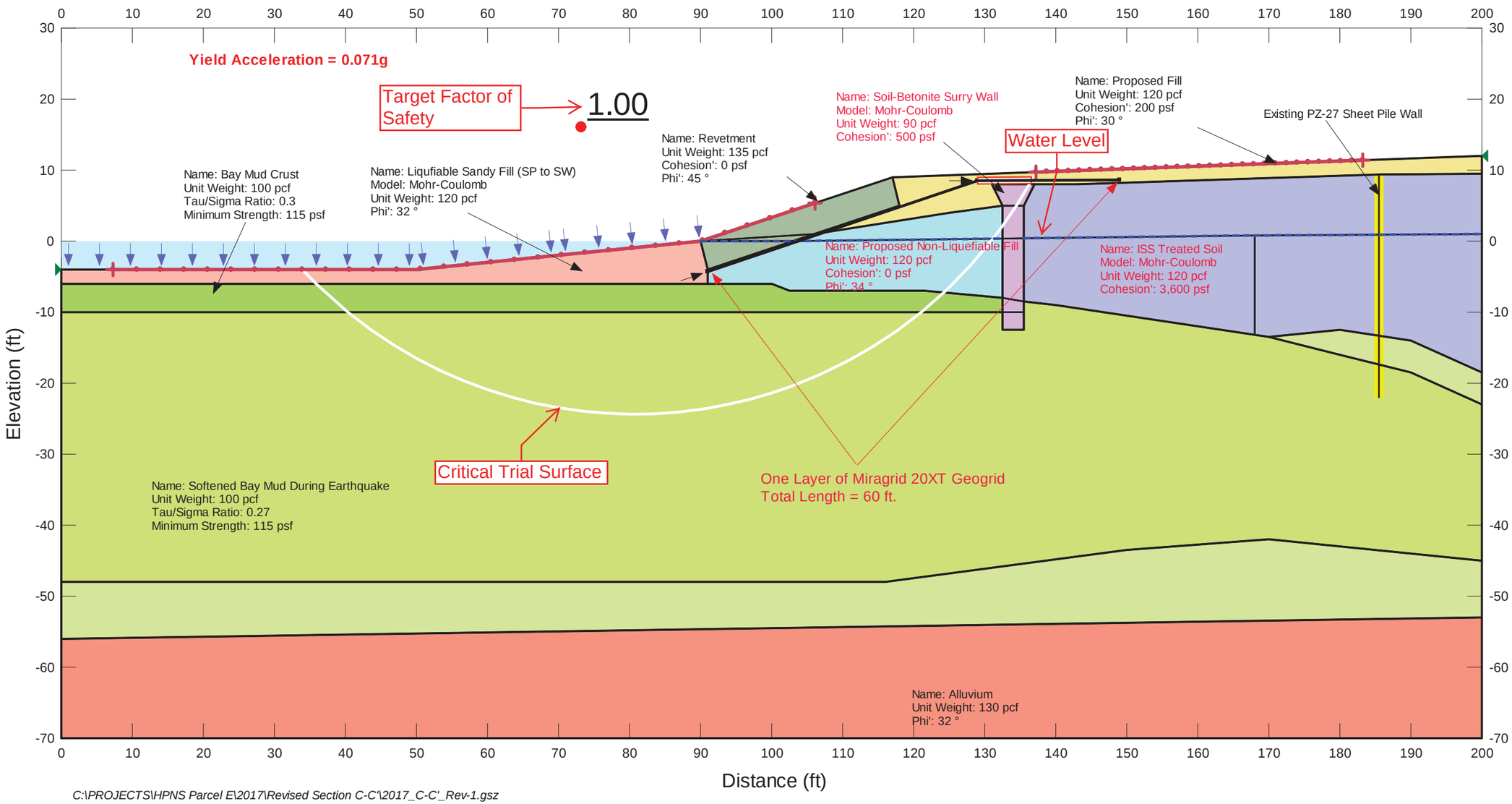
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Static Factor of Safety 30 Years after Construction

Project No. **1402317** | Date: **August 2017** | Figure: **35**



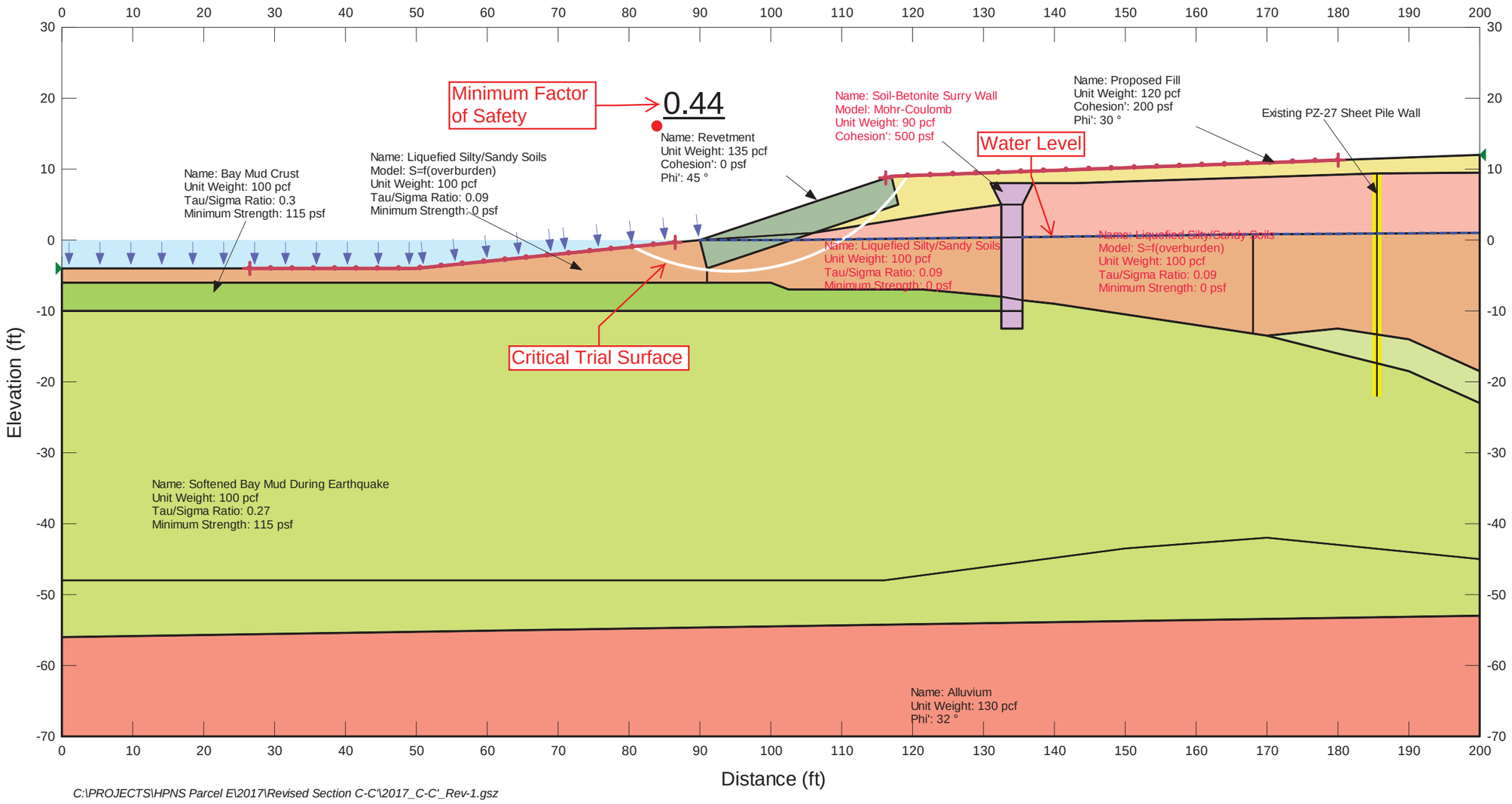
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Yield Acceleration 5 Years after Construction

Project No. **1402317** | Date: **August 2017** | Figure: **36**



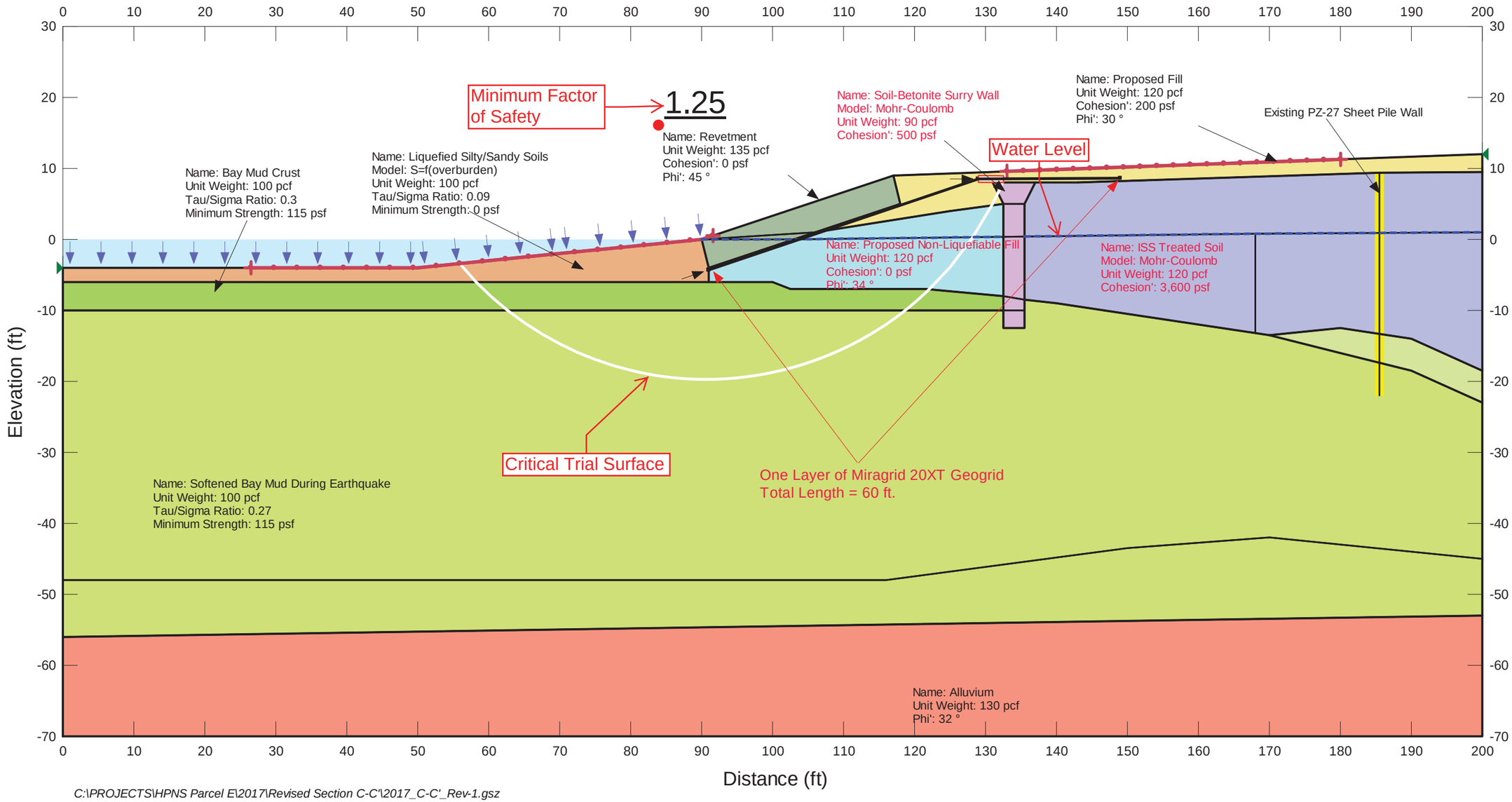
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Post-Liquefaction Stability 5 Years after Construction Without Treatment of Liquefiable Soil and No Geogrid Reinforcement

Project No. **1402317**	Date: **August 2017**	Figure: **37**



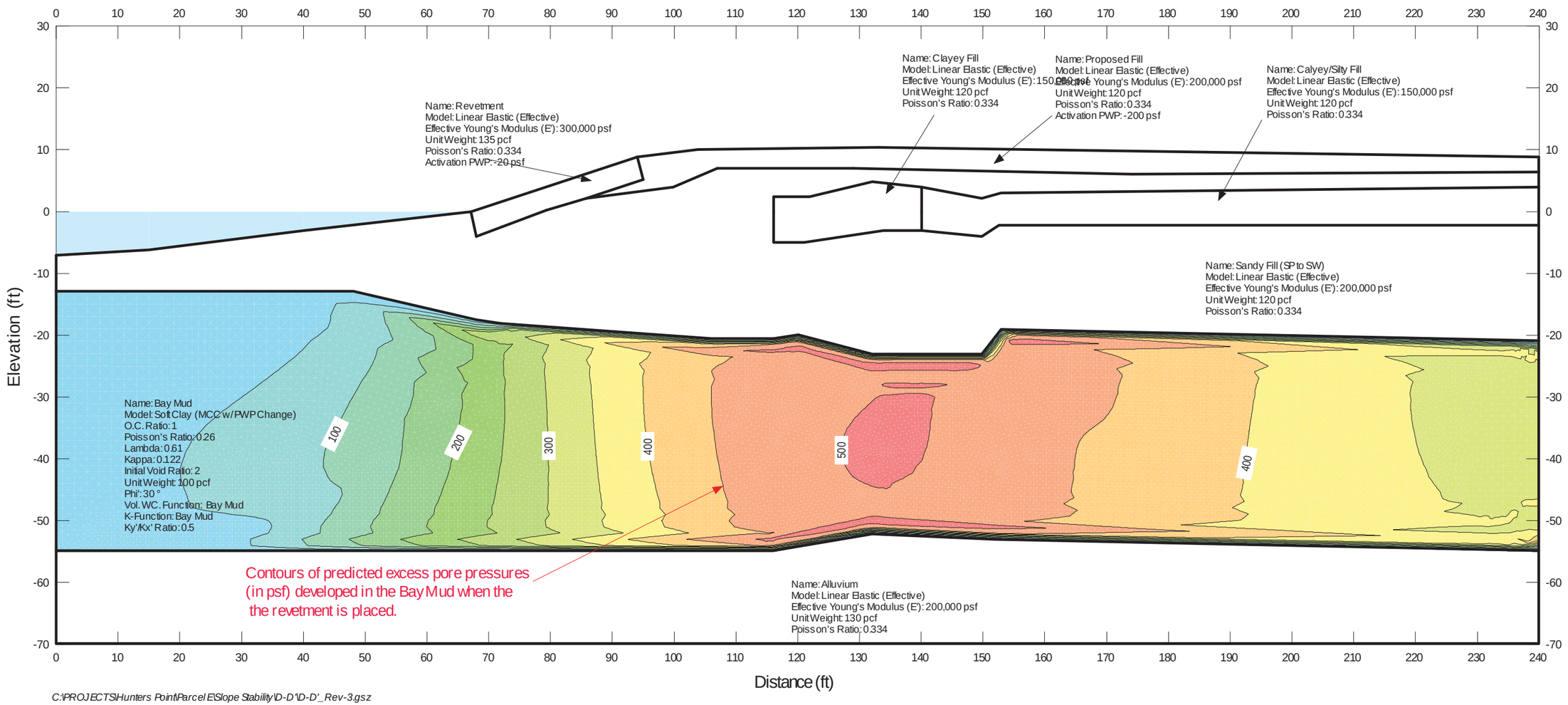
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section C-C′
Post-Liquefaction Stability 5 Years after Construction, With Geogrid Reinforcement

Project No. **1402317** | Date: **August 2017** | Figure: **38**



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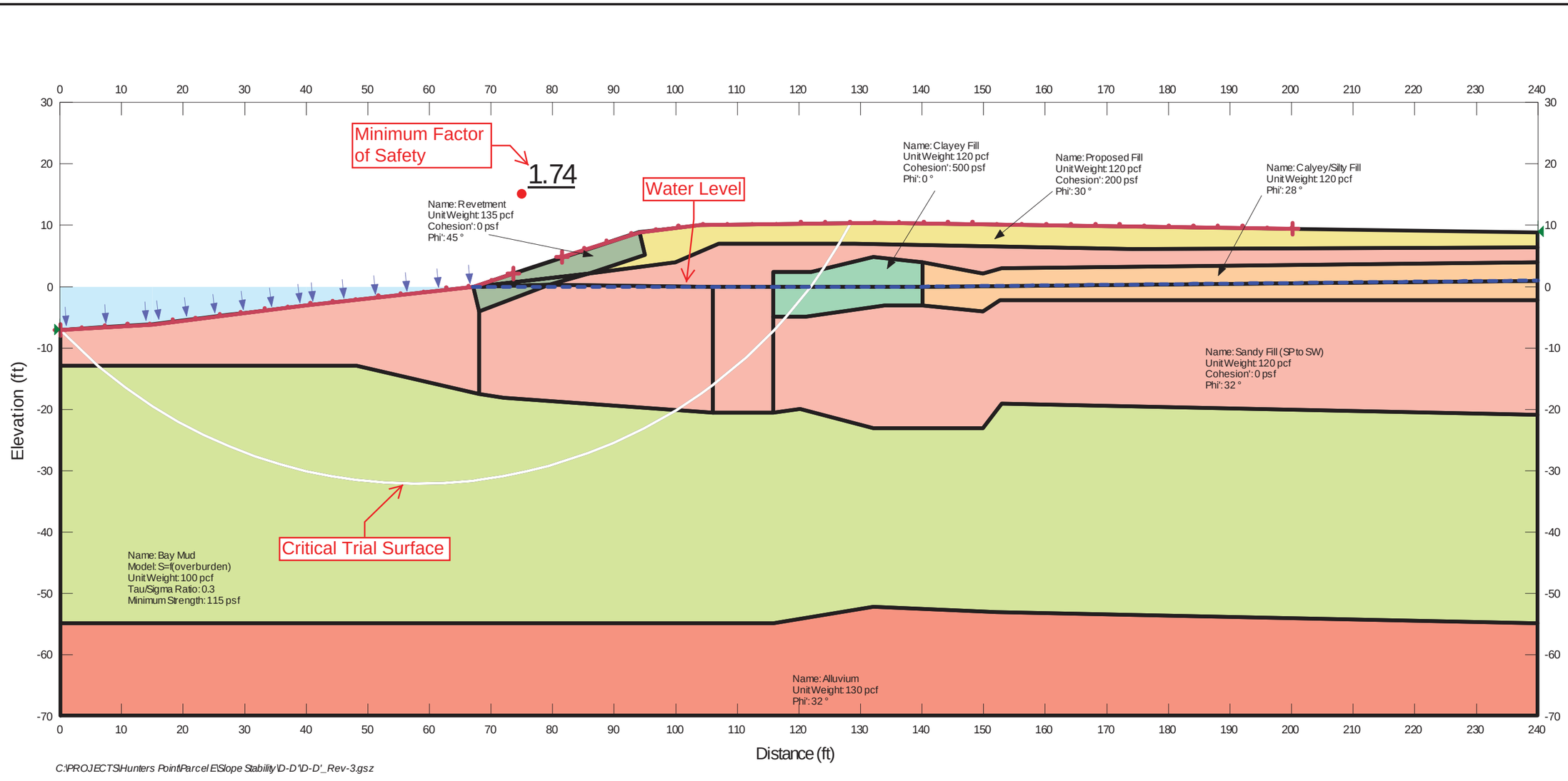
Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Pore Pressure Analysis, Cross Section D-D′, Excess Pore Pressure at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **39**



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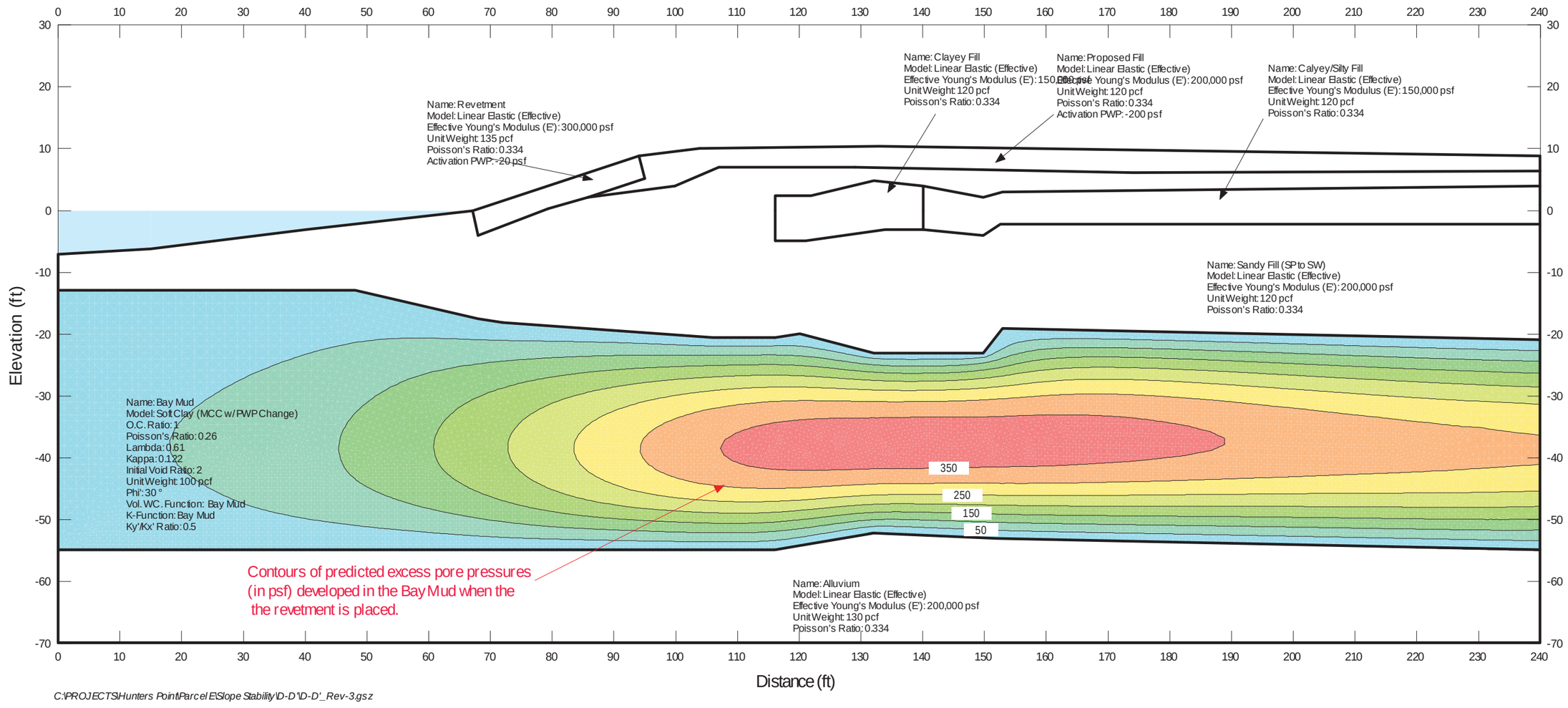
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section D-D′
Static Factor of Safety at End of Construction

Project No. **1402317** | Date: **November 2015** | Figure: **40**



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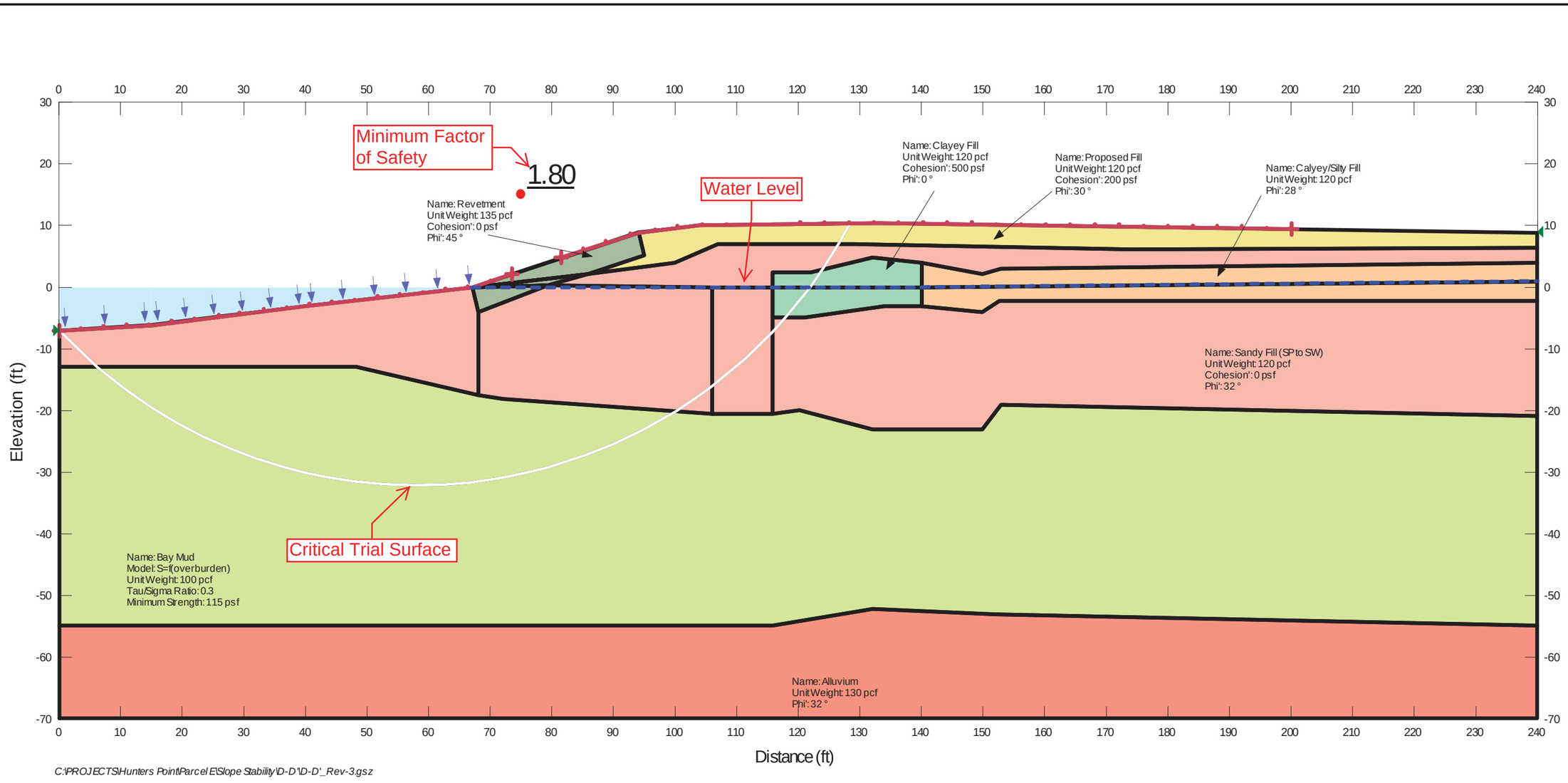
Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design

Pore Pressure Analysis, Cross Section D-D′, Excess Pore Pressure 5 Years after Construction

Project No. **1402317**	Date: **November 2015**	Figure: **41**



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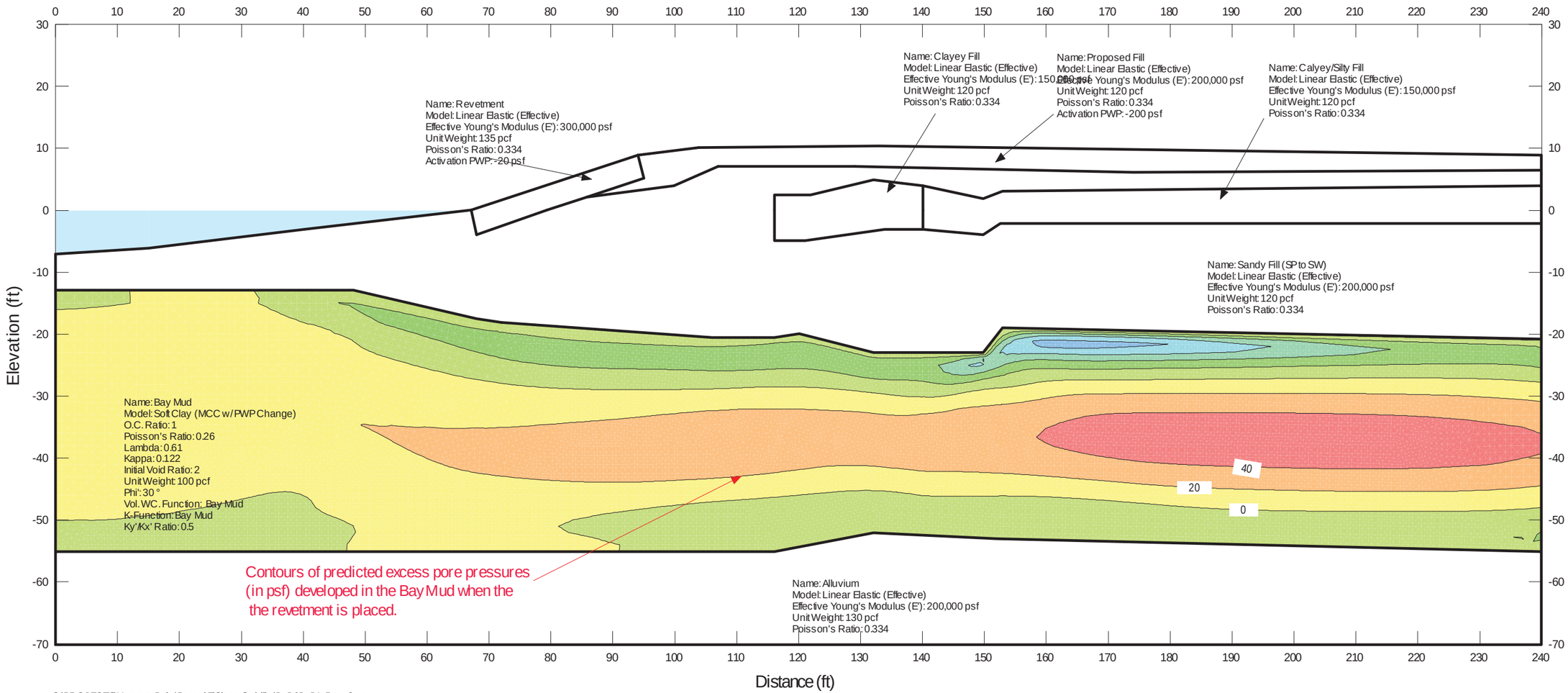
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section D-D′
Static Factor of Safety 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **42**



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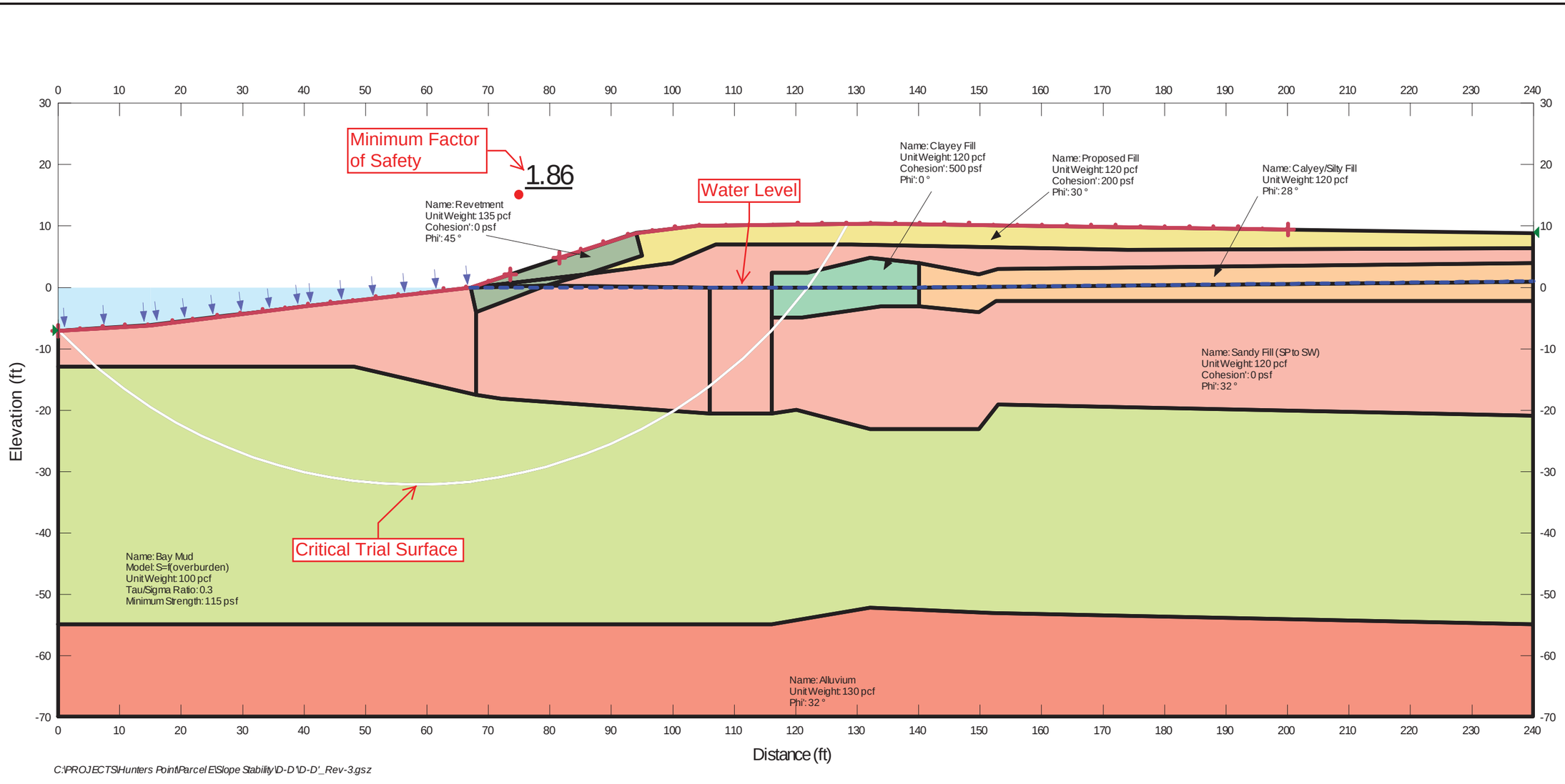
Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design

Pore Pressure Analysis, Cross Section D-D′, Excess Pore Pressure 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **43**



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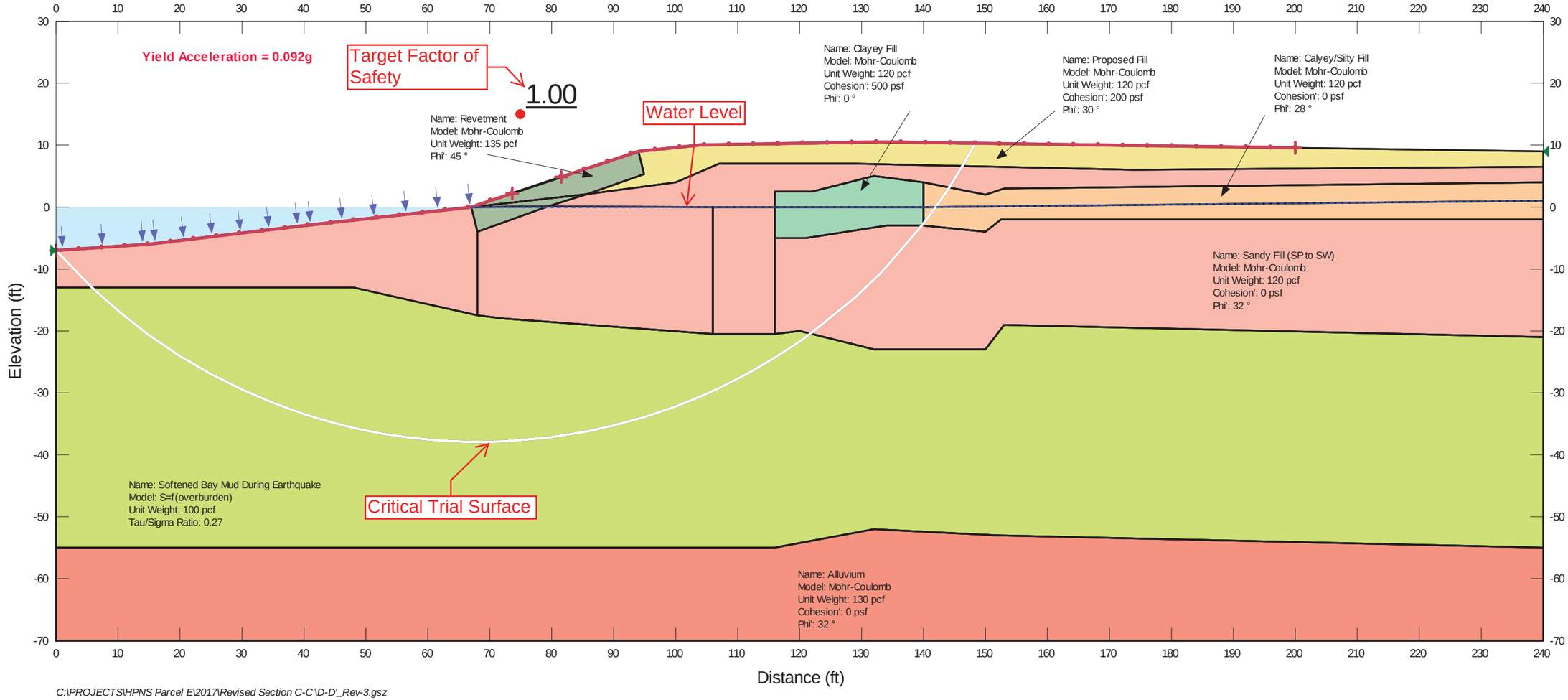
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section D-D′
Static Factor of Safety 30 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **44**



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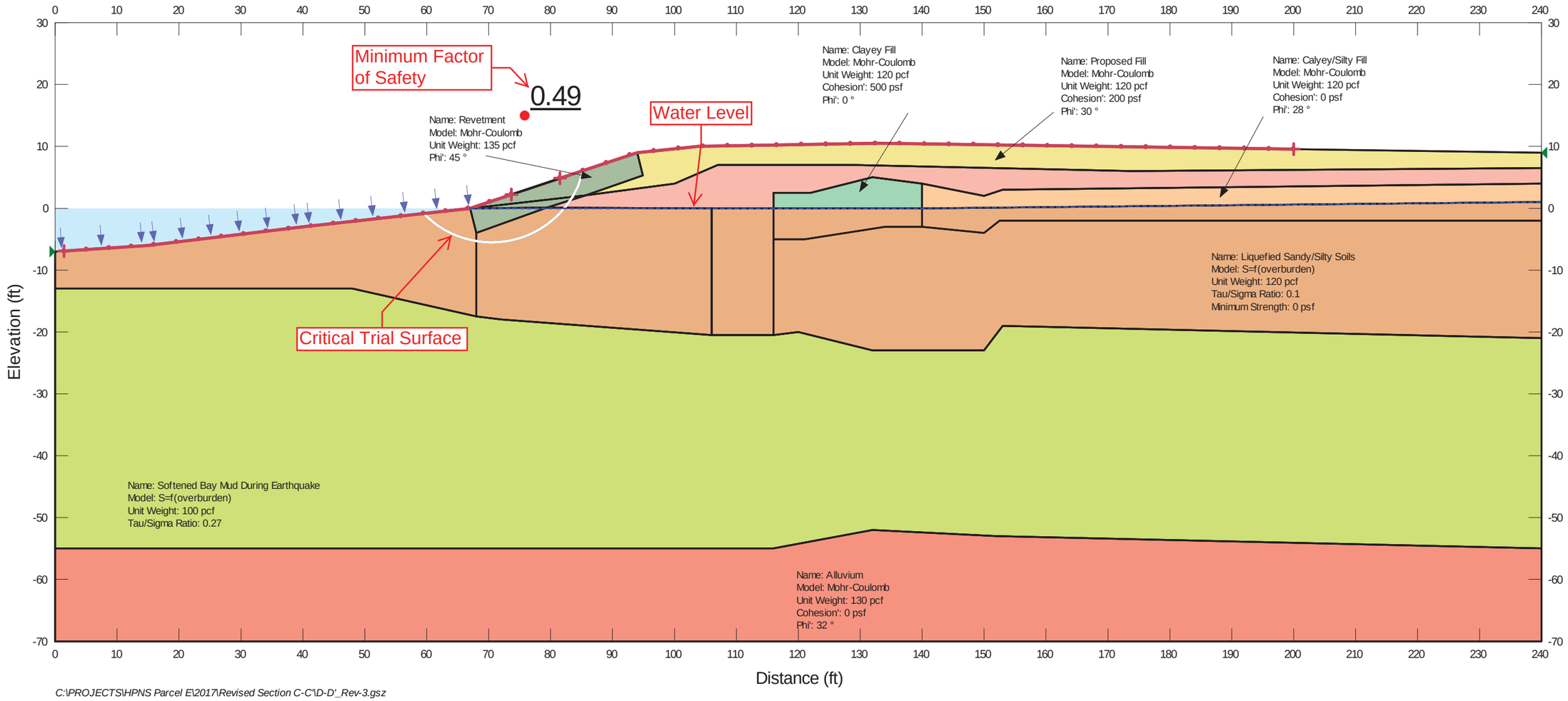
Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section D-D′
Yield Acceleration 5 Years after Construction

Project No. **1402317** | Date: **November 2015** | Figure: **45**



C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\D-D'_Rev-3.gsz

Note:
The red lines with + marks along the ground surface indicate trial surface initiation and termination limits

Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Slope Stability Analysis, Cross Section D-D′ Post-Liquefaction Stability 5 Years after Construction Without Treatment of Liquefiable Soil

Project No. **1402317**	Date: **November 2015**	Figure: **46**

JOB TITLE : .

FLAC (Version 8.00)

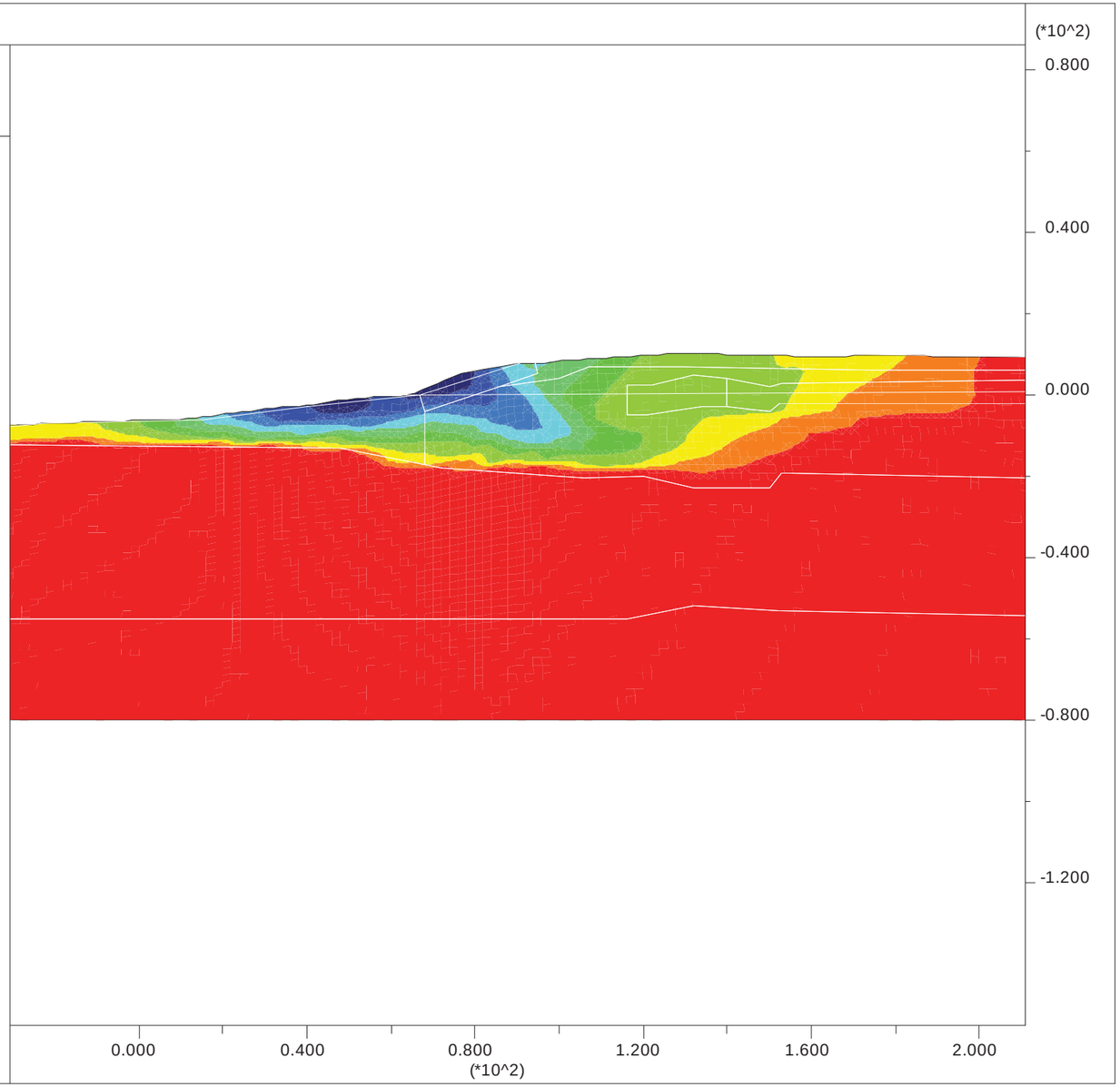
LEGEND

26-Jul-17 10:07
step 554319
Flow Time 1.9719E-07
Dynamic Time 9.0000E+01
-3.056E+01 <x< 2.107E+02
-1.551E+02 <y< 8.617E+01

Displacement contours
- 0.00E+00
- 5.00E-01
- 1.00E+00
- 1.50E+00
- 2.00E+00
- 2.50E+00
- 3.00E+00
- 3.50E+00
- 4.00E+00
- 4.50E+00

Contour interval= 5.00E-01
Boundary plot

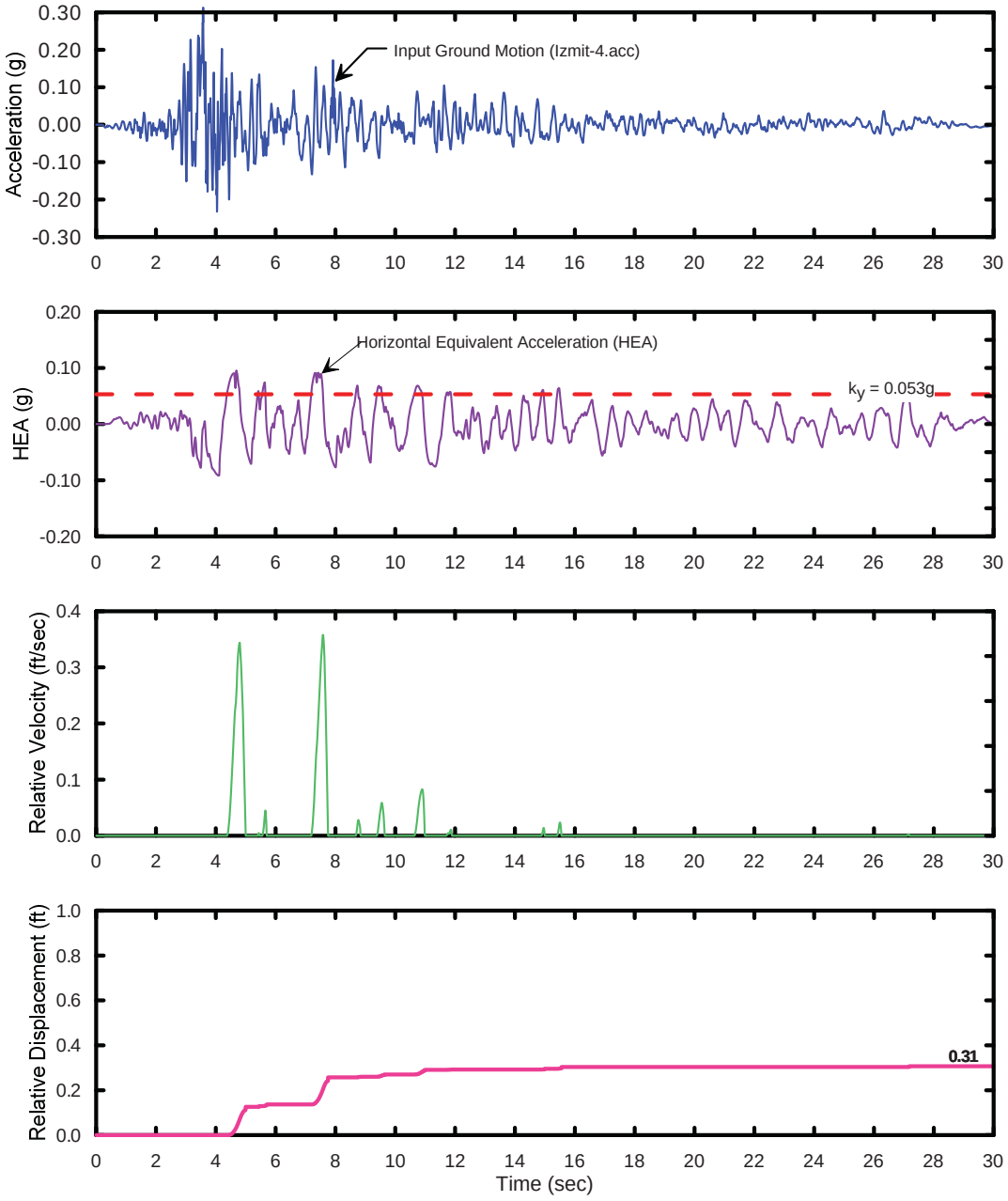
0 5E 1



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU076.acc
Contours of Computed Displacements

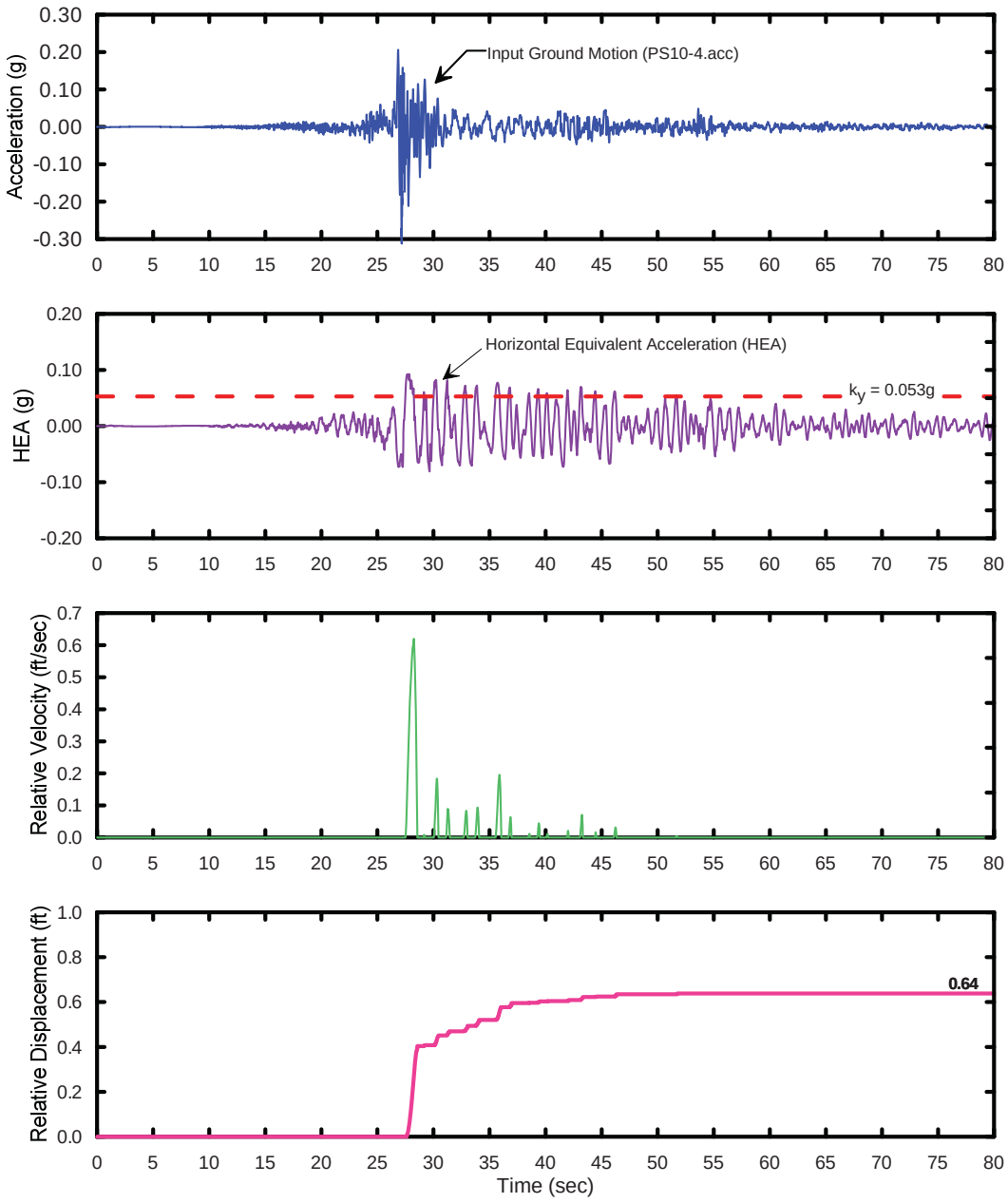
Project No. **1402317** | Date: **August 2017** | Figure: **47**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

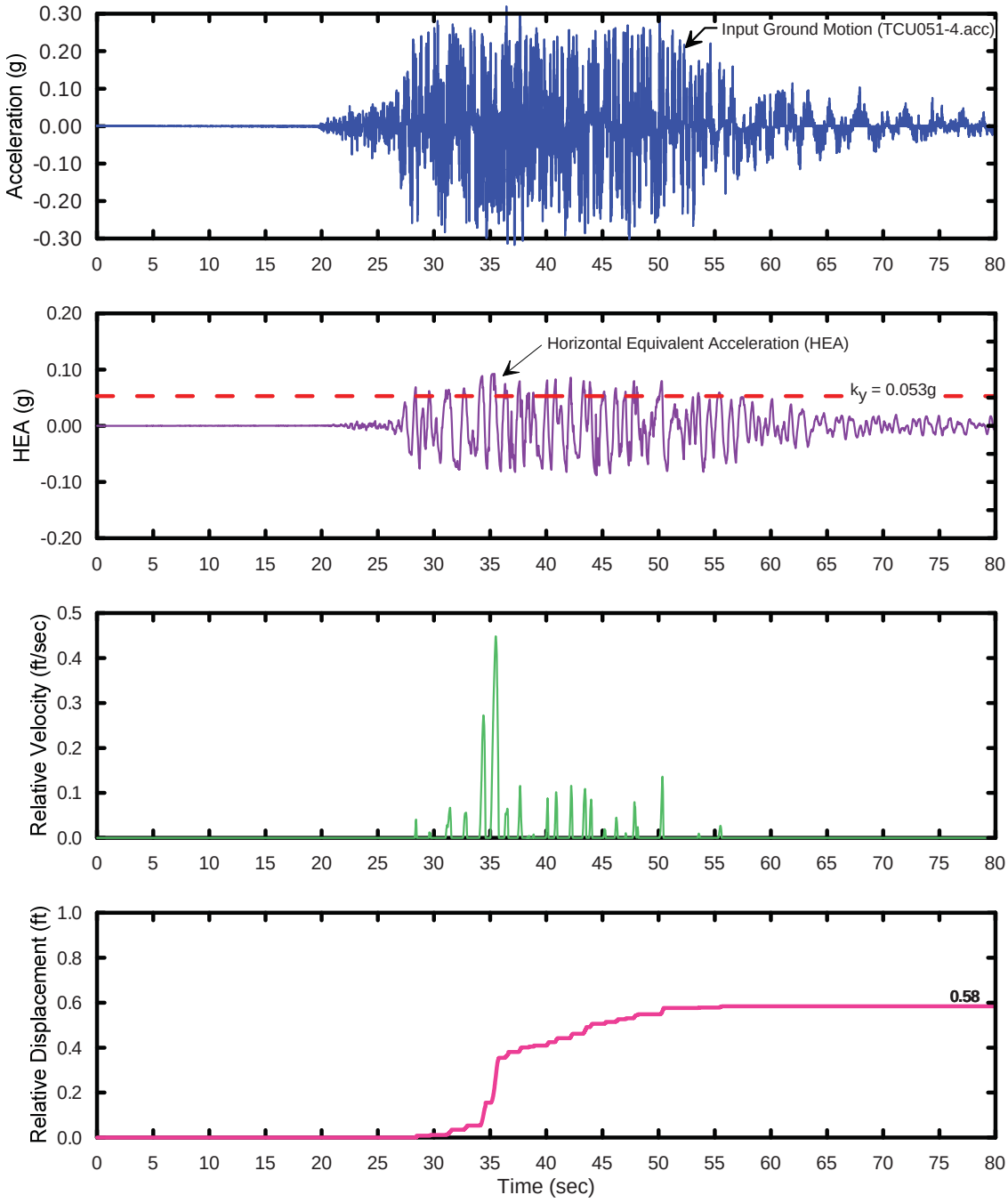
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section A-A′** **Permanent Displacement Analysis for MCE** **Kocaeli Earthquake, Izmit Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **48**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) $= \left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

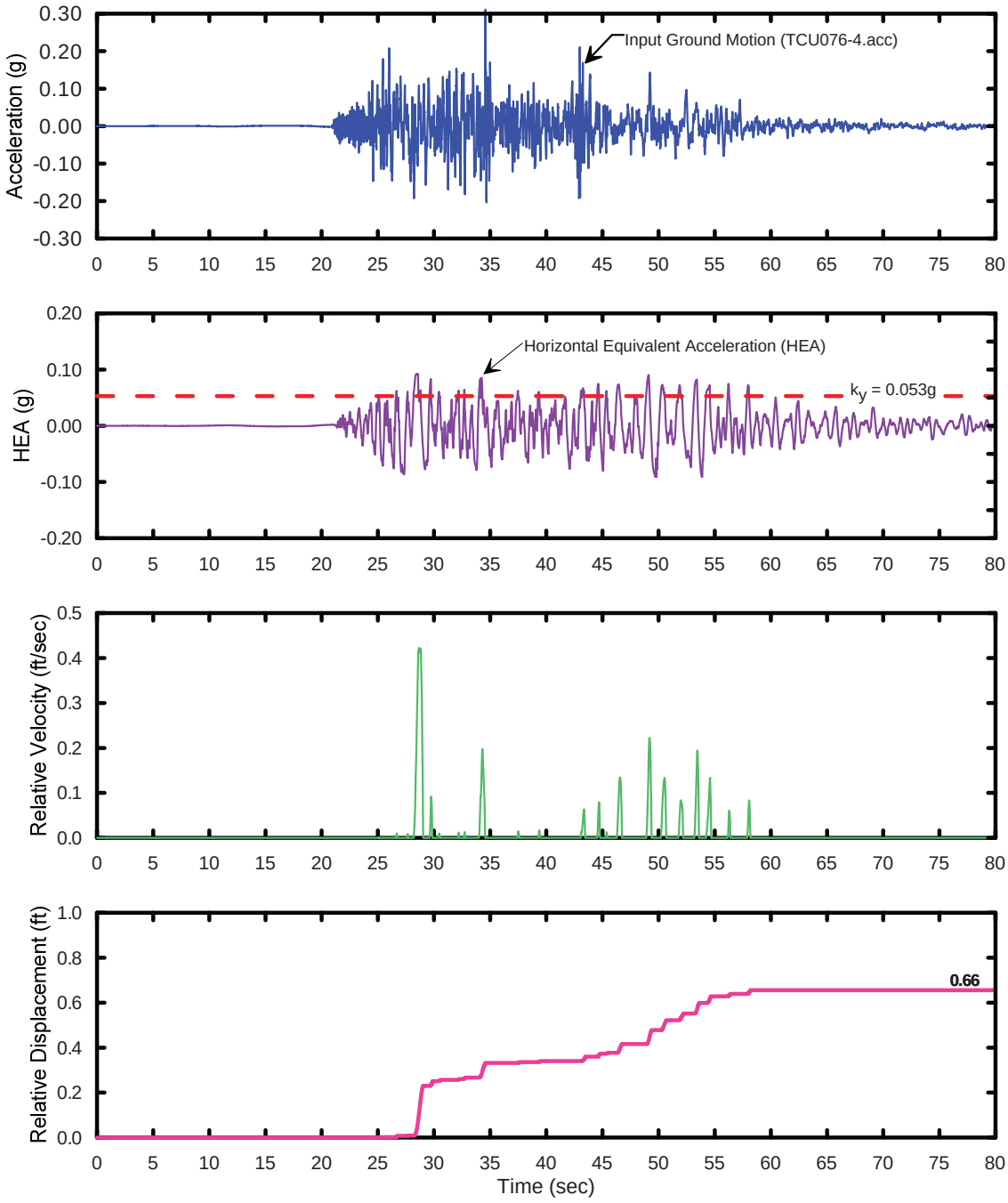
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section A-A′** **Permanent Displacement Analysis for MCE** **Denali Earthquake, PS10 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **49**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

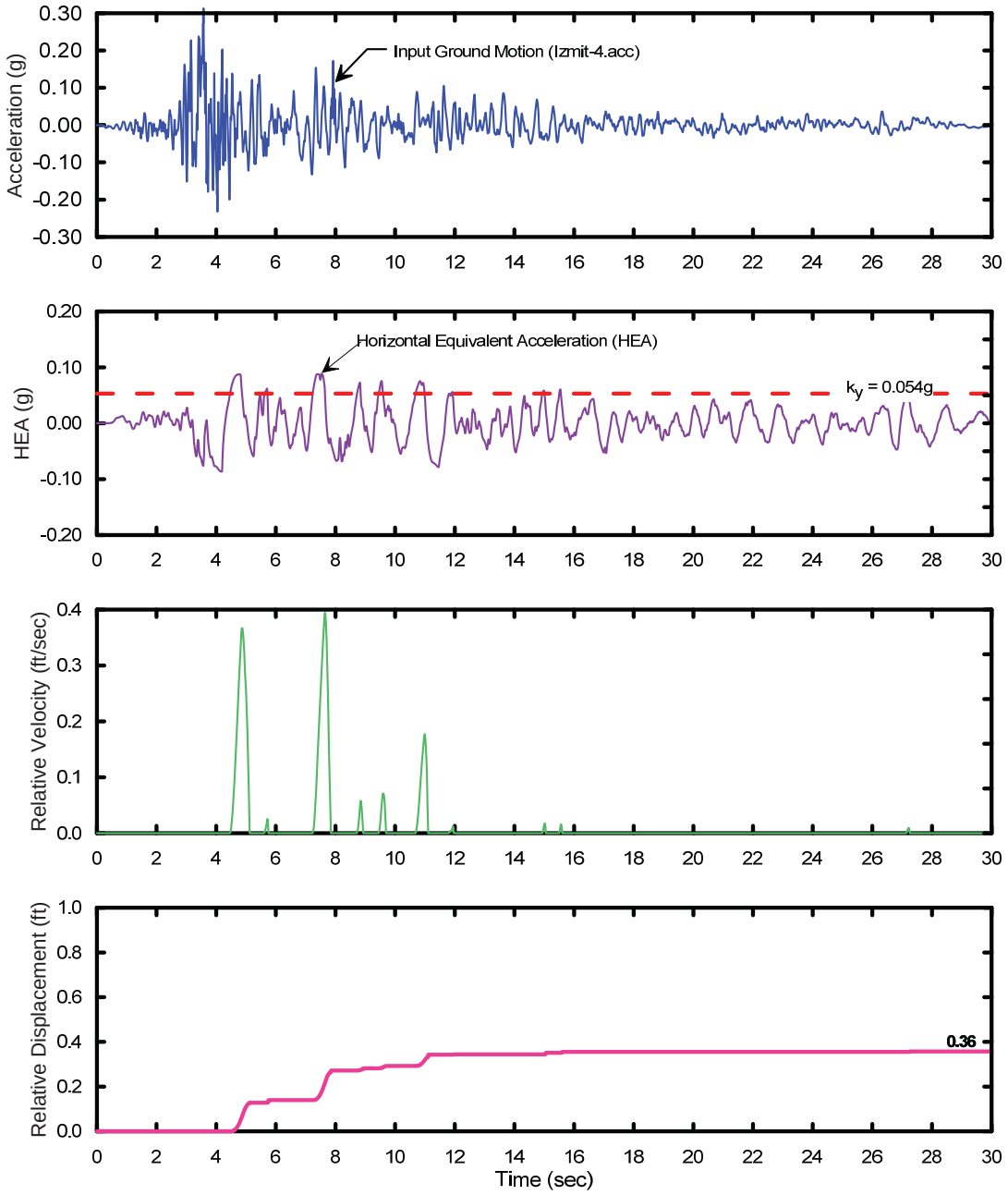
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section A-A′** **Permanent Displacement Analysis for MCE** **Chi Chi Earthquake, TCU051 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **50**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

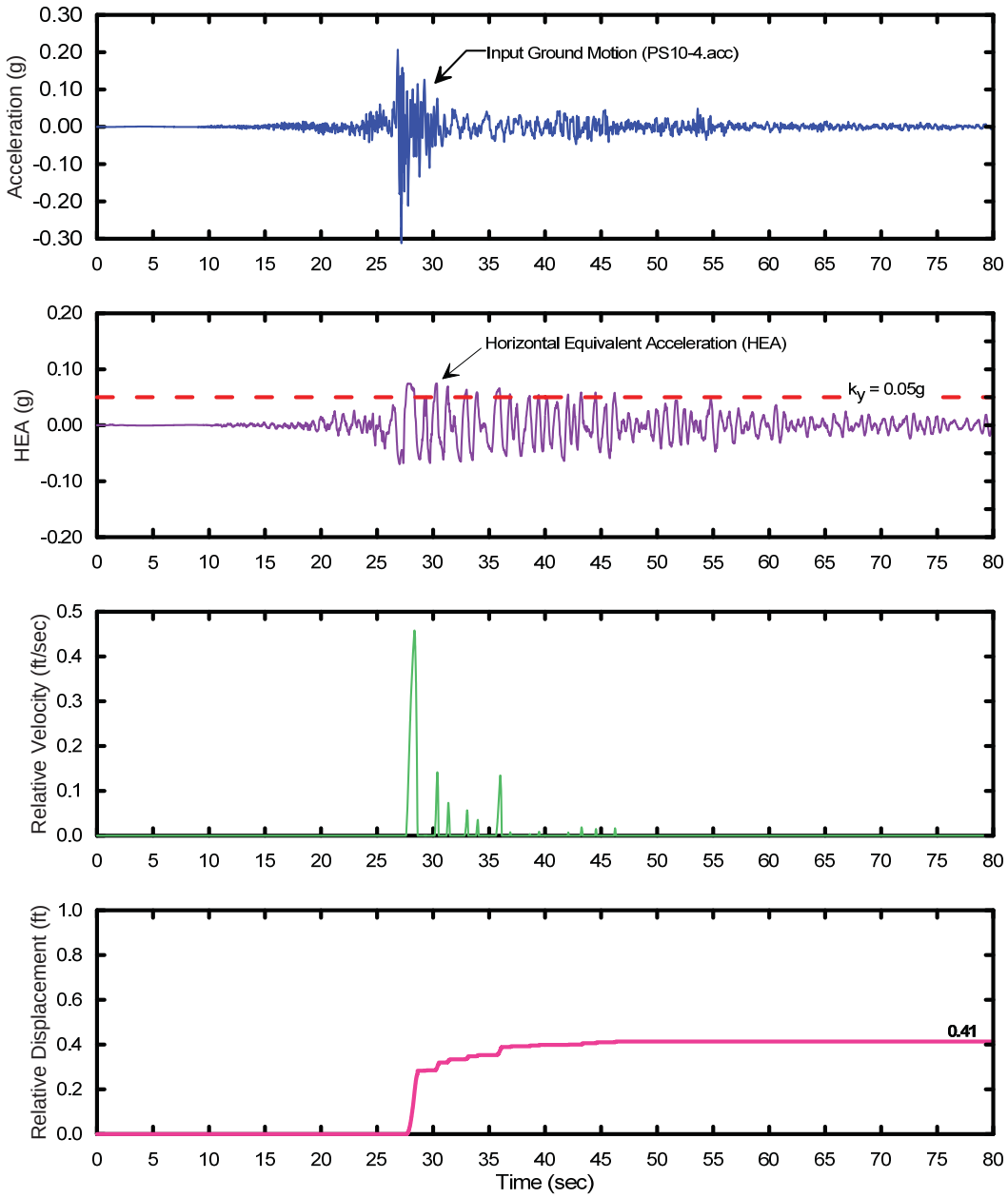
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section A-A′** **Permanent Displacement Analysis for MCE** **Chi Chi Earthquake, TCU076 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **51**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

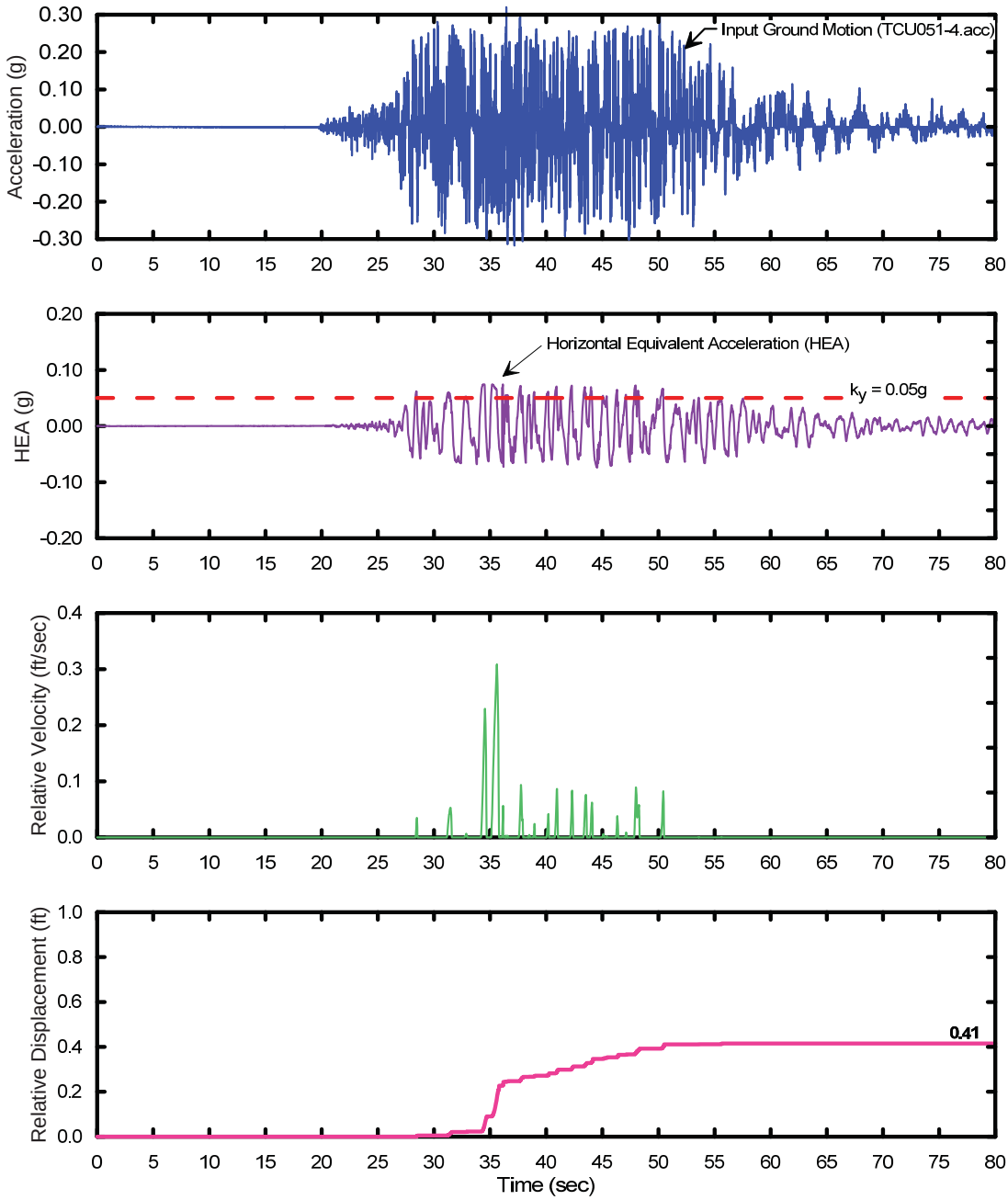
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section B-B′** **Permanent Displacement Analysis for MCE** **Kocaeli Earthquake, Izmit Record**	
Project No.: 1402317	Date: **November 2015**	Figure: 52



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

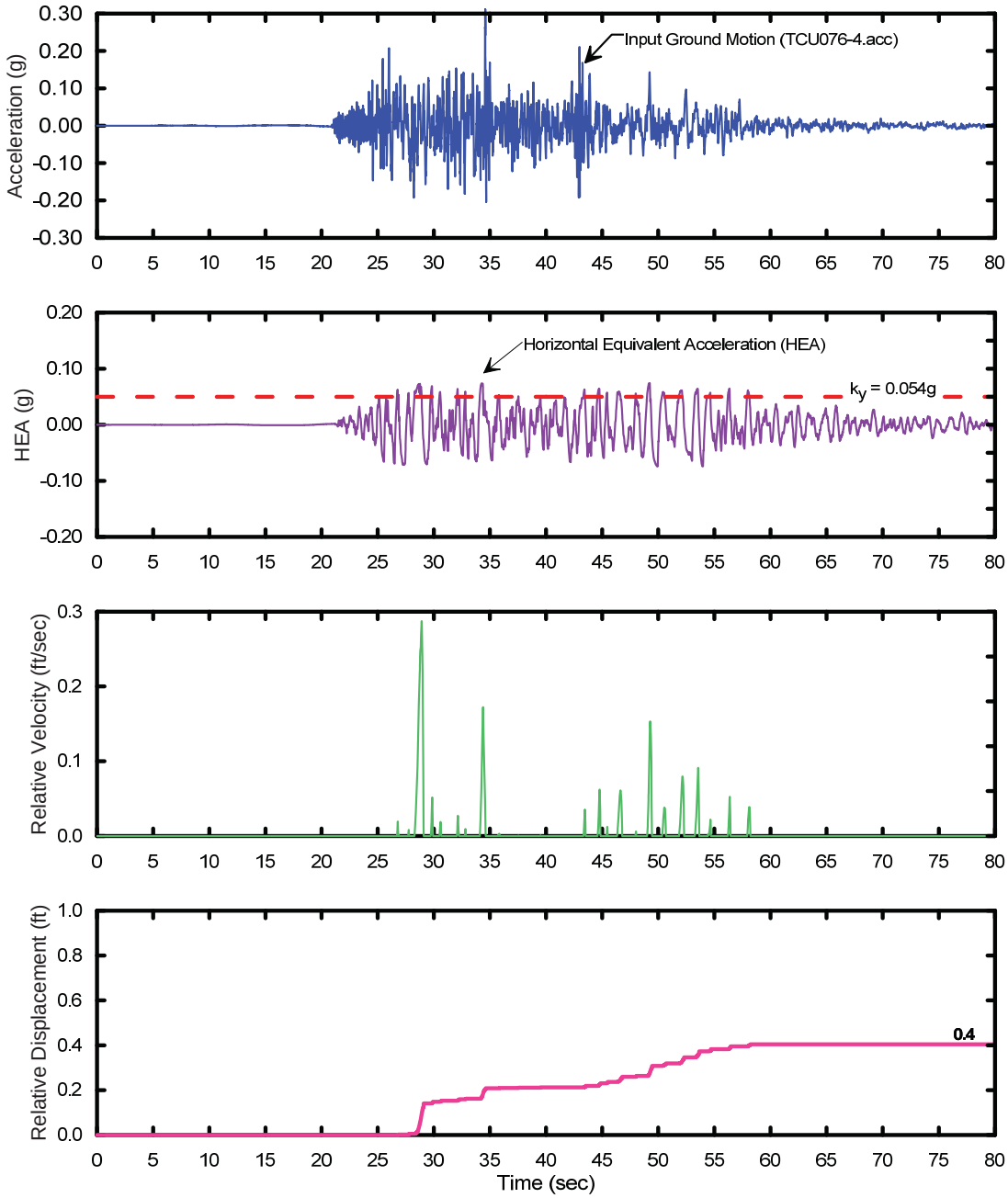
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section B-B′** **Permanent Displacement Analysis for MCE** **Denali Earthquake, PS10 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **53**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

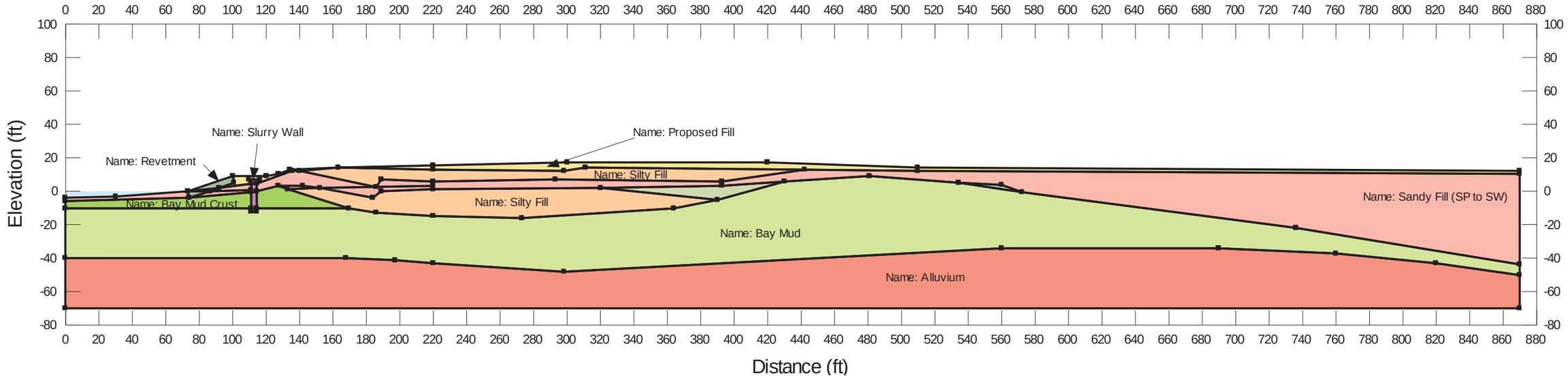
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section B-B′** **Permanent Displacement Analysis for MCE** **Chi Chi Earthquake, TCU051 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: **54**



Note:

1. HEA was computed based on the results of D-MOD2000 analysis; i.e., HEA (t) = $\left[\frac{\tau(t)}{\sigma_v}\right]$ g
2. Relative velocity is computed by numerical integration of HEA values exceeding the yield acceleration
3. Relative displacement was computed by numerical integration of the relative velocity

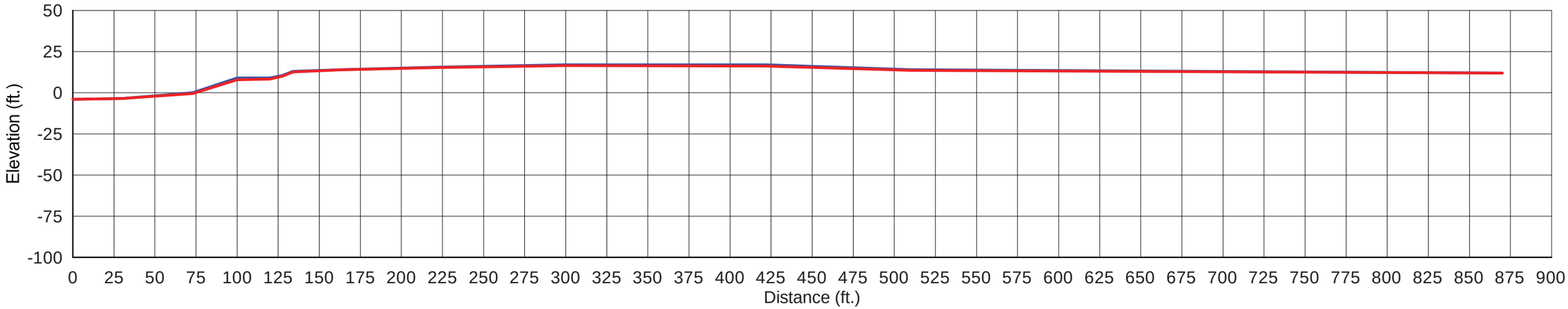
Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Seismic Slope Stability, Cross Section B-B′** **Permanent Displacement Analysis for MCE** **Chi Chi Earthquake, TCU076 Record**	
Project No.: 1402317	Date: **November 2015**	Figure: 55



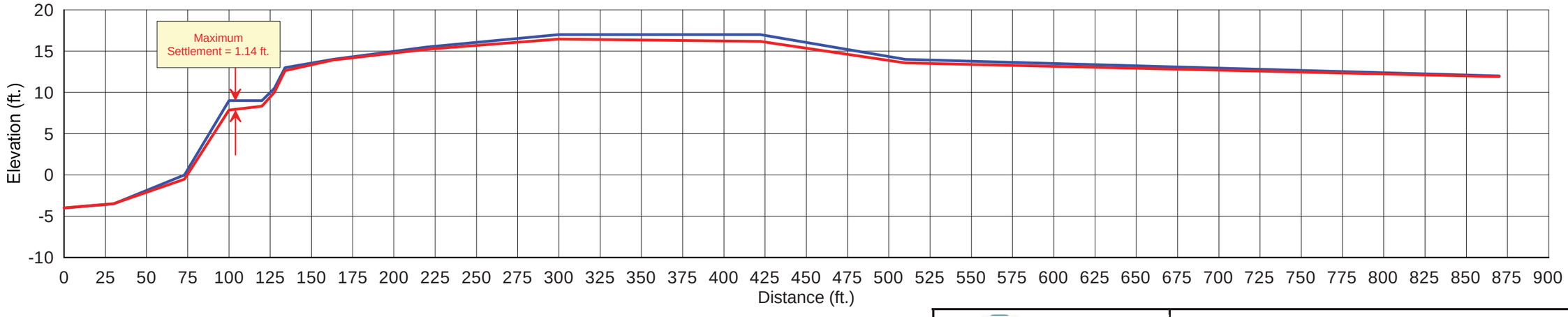
Hunters Point Naval Shipyard
Parcel E Remedial Design
Settlement Analysis, Cross Section A-A′
Finite Element Model Used

Project No. **1402317** | Date: **November 2015** | Figure: **56**

(a) Settelement Profile with Identical Horizontal and Vertical Sales



(b) Settelement Profile with Vertcial Scale Exaggerated 5 Times



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
Settlement Analysis, Cross Section A-A′
Settlement Profile 30 Years after Construction

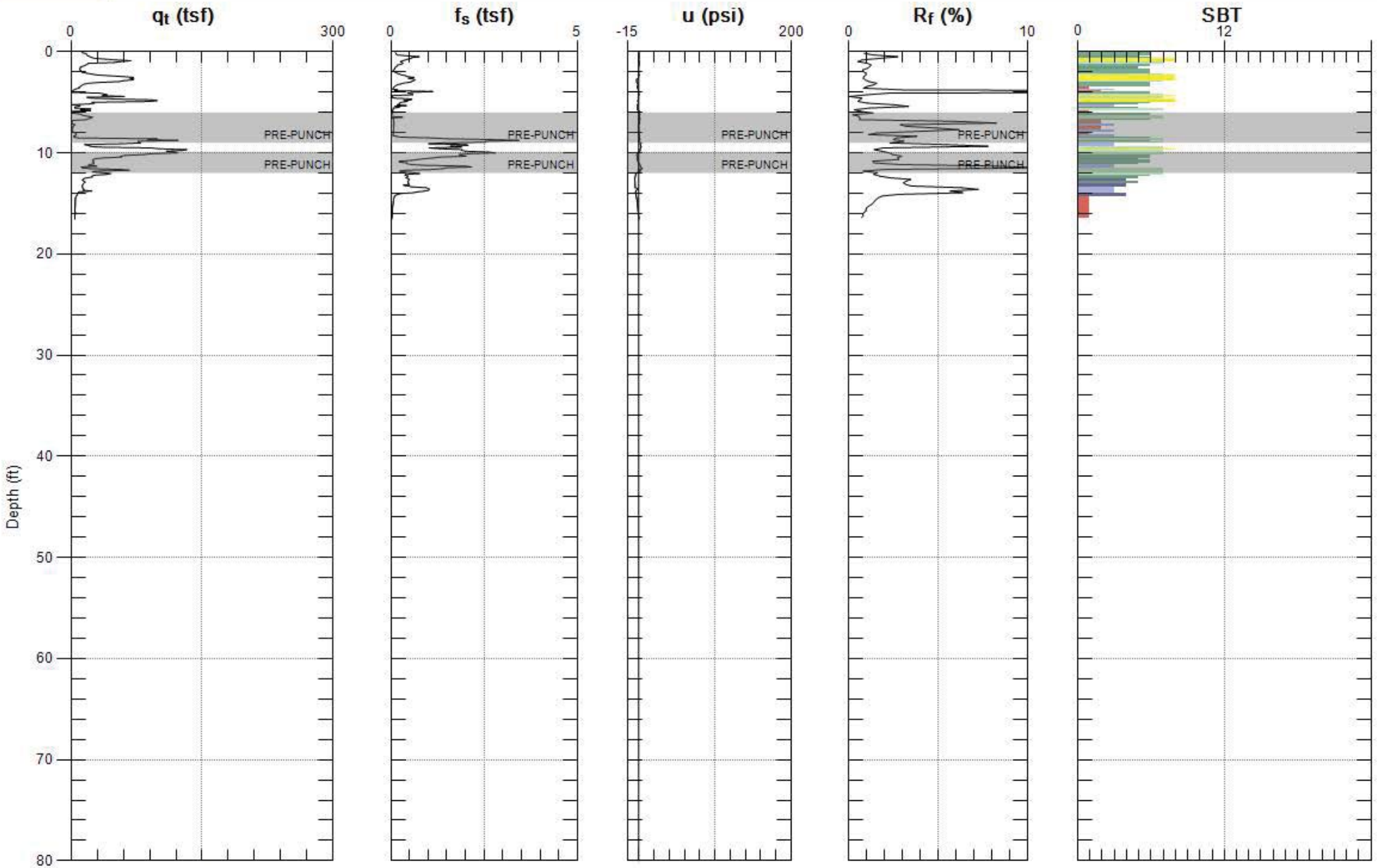
Project No. **1402317** | Date: **November 2015** | Figure: **57**

Attachment F1
CPT and Test Boring Logs

(This attachment is provided on CD only)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT50
Engineer: S.LEE
Date: 2/5/2015 01:23



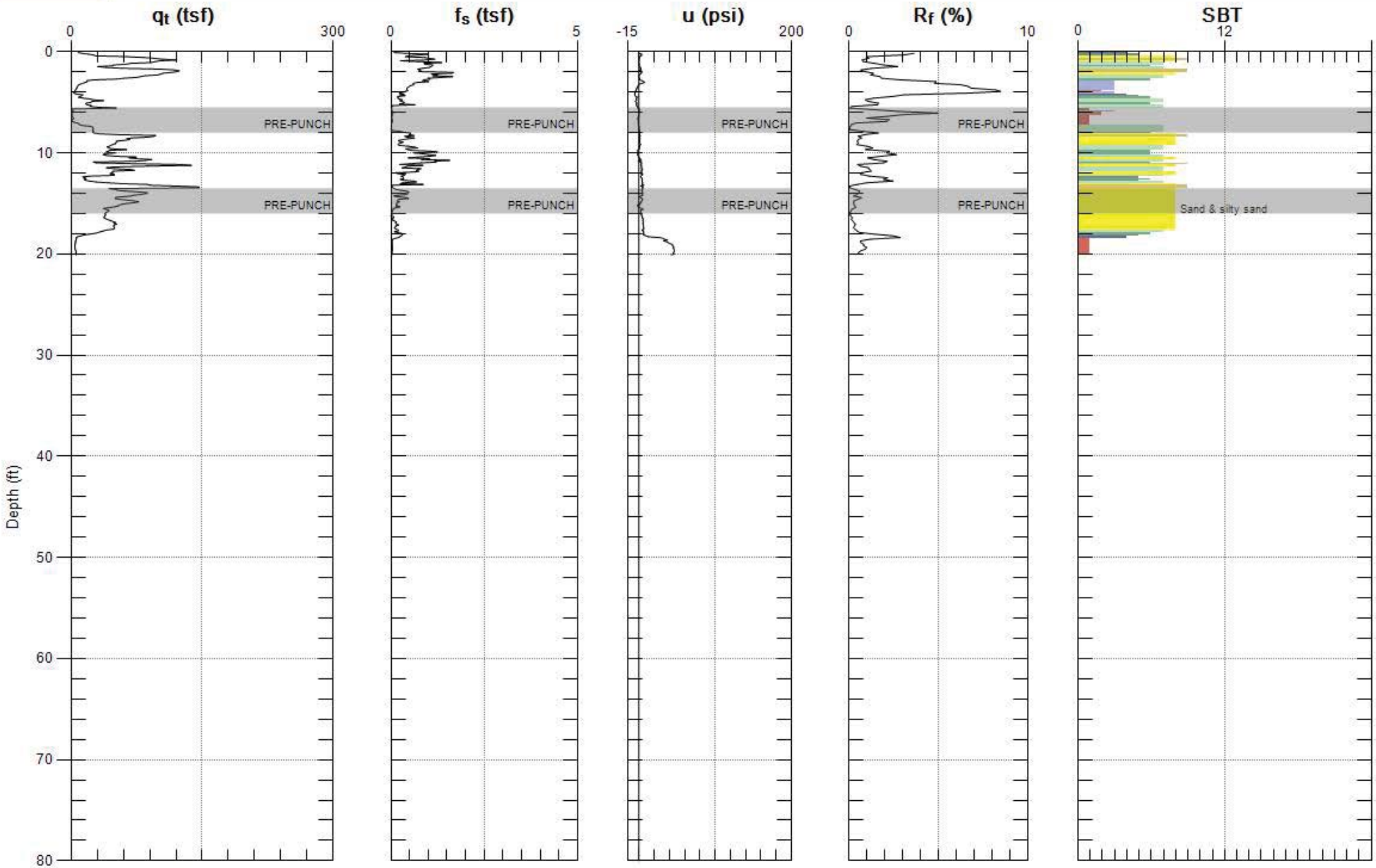
Max. Depth: 16.568 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT51

Engineer: S.LEE
Date: 2/9/2015 11:23



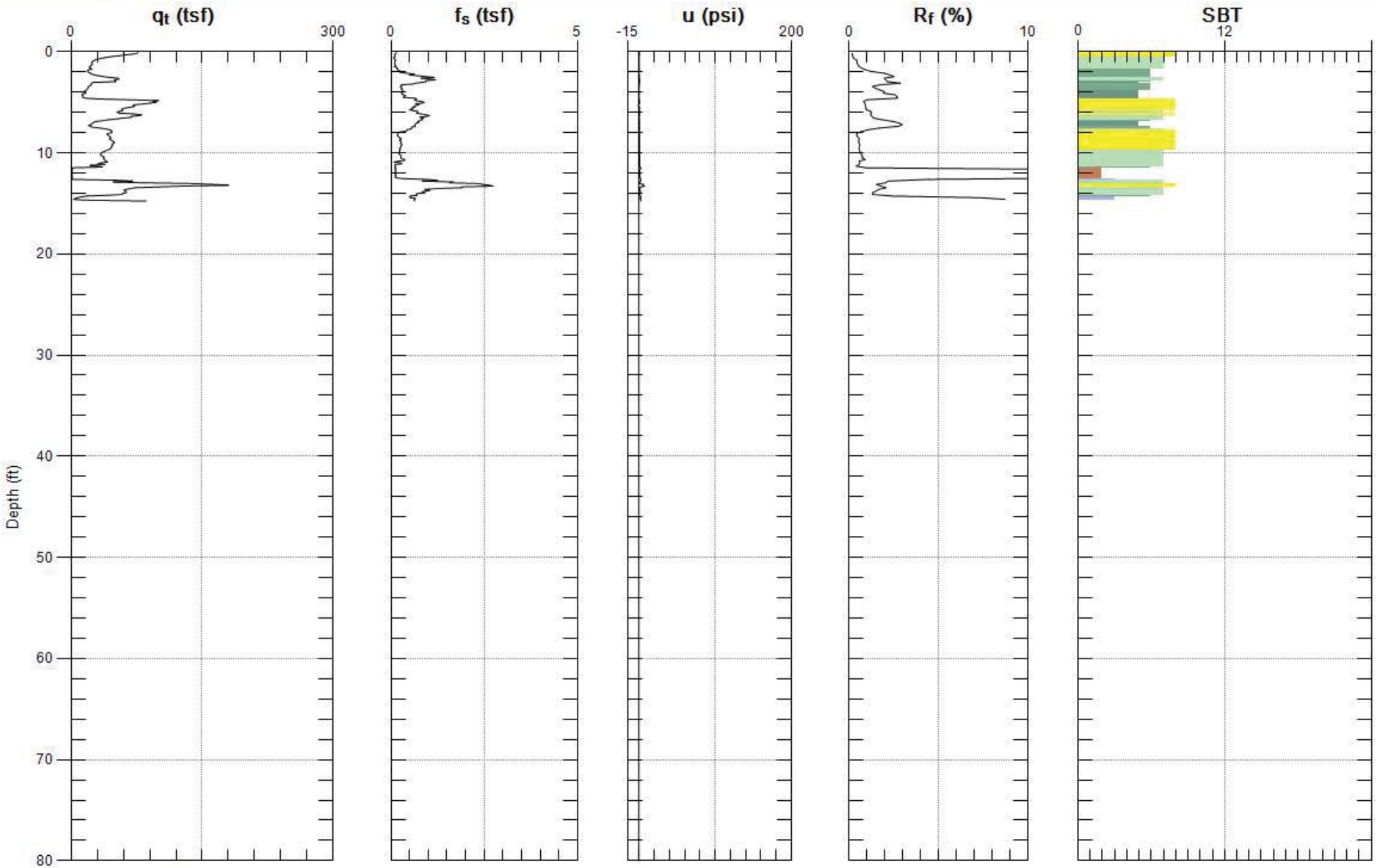
Max. Depth: 20.095 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52A

Engineer: S.LEE
Date: 2/5/2015 08:48



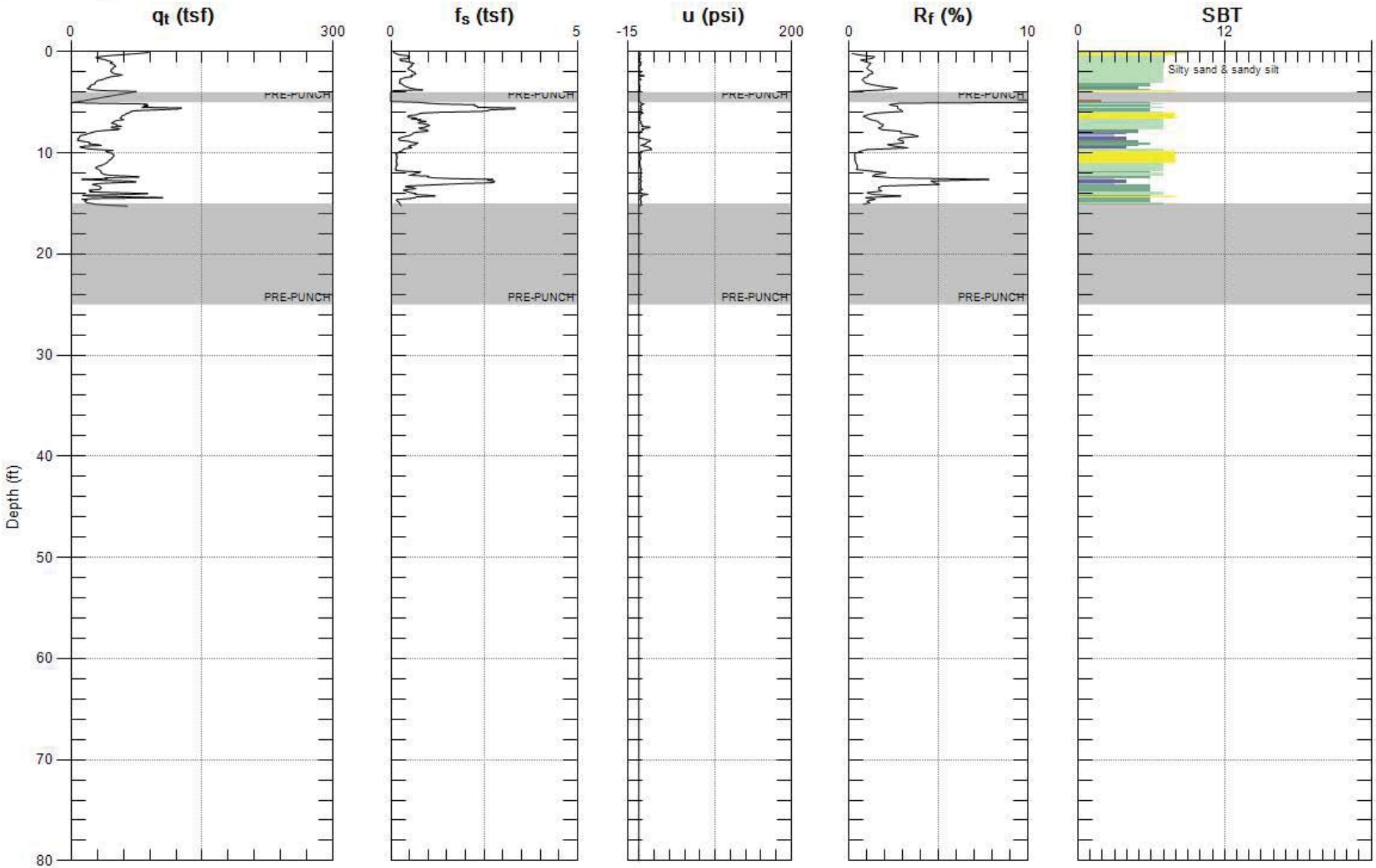
Max. Depth: 14.764 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52B

Engineer: S.LEE
Date: 2/5/2015 09:35



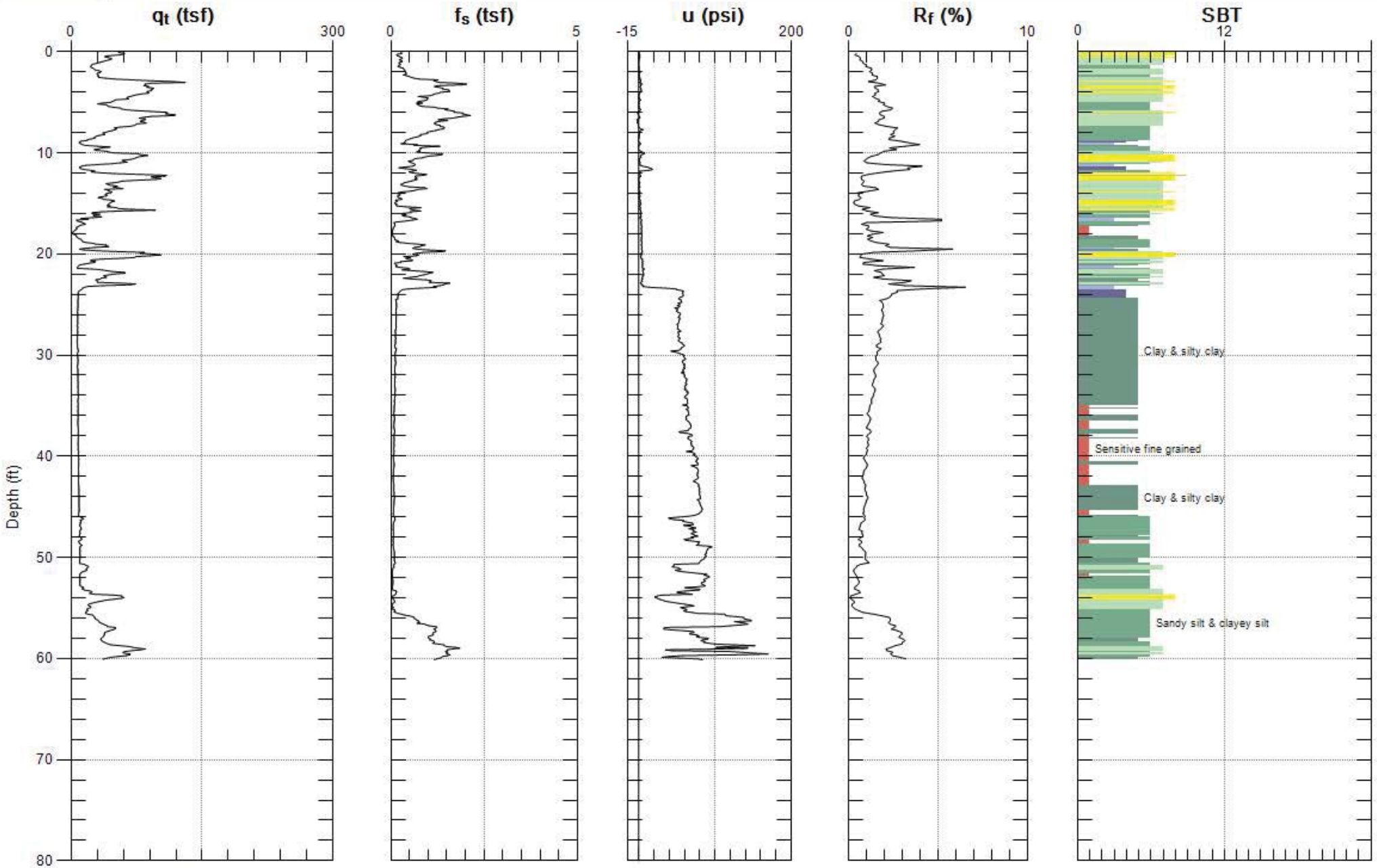
Max. Depth: 15.256 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52C

Engineer: S.LEE
Date: 2/5/2015 10:56



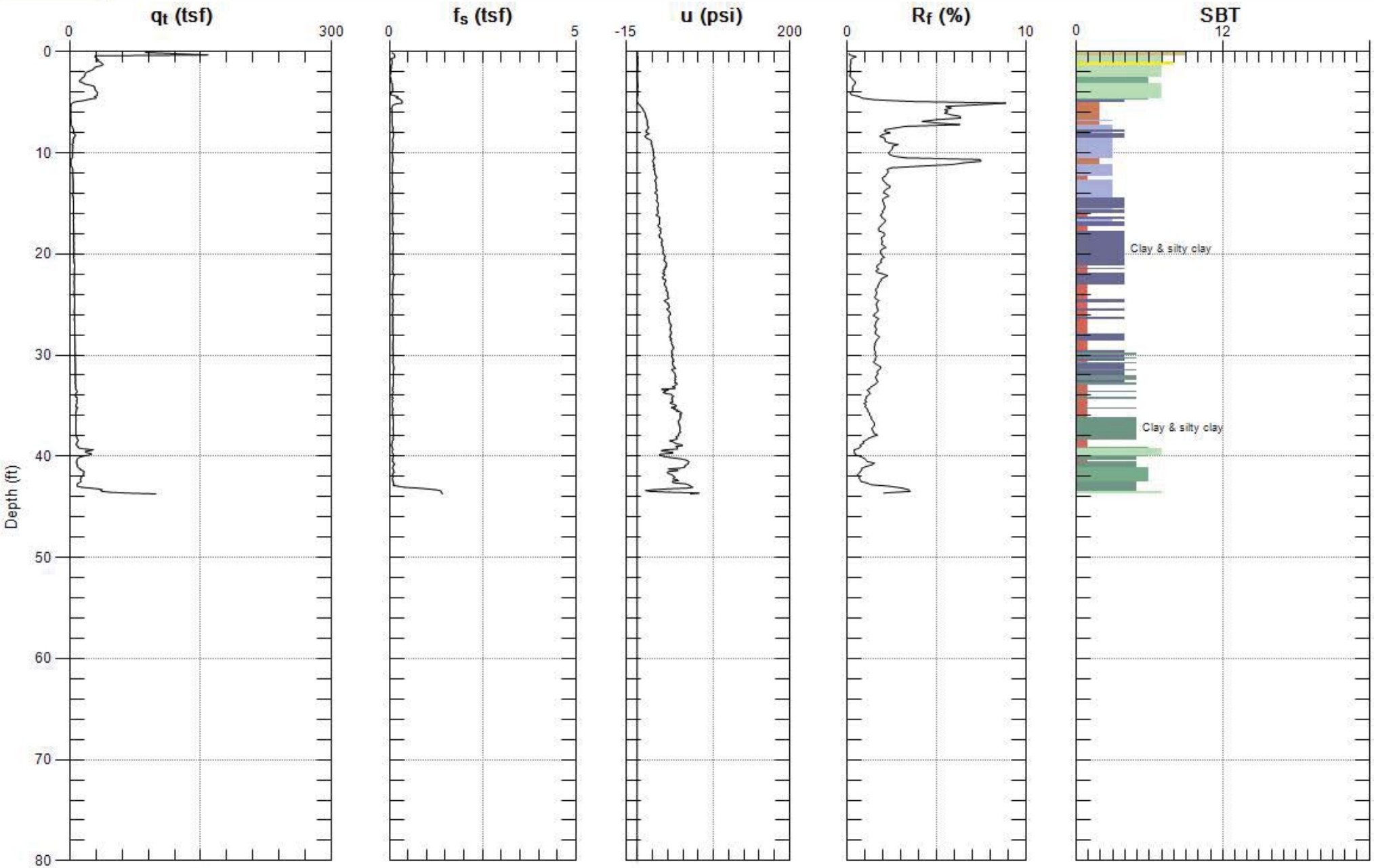
Max. Depth: 60.121 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT53

Engineer: S.LEE
Date: 2/9/2015 09:36



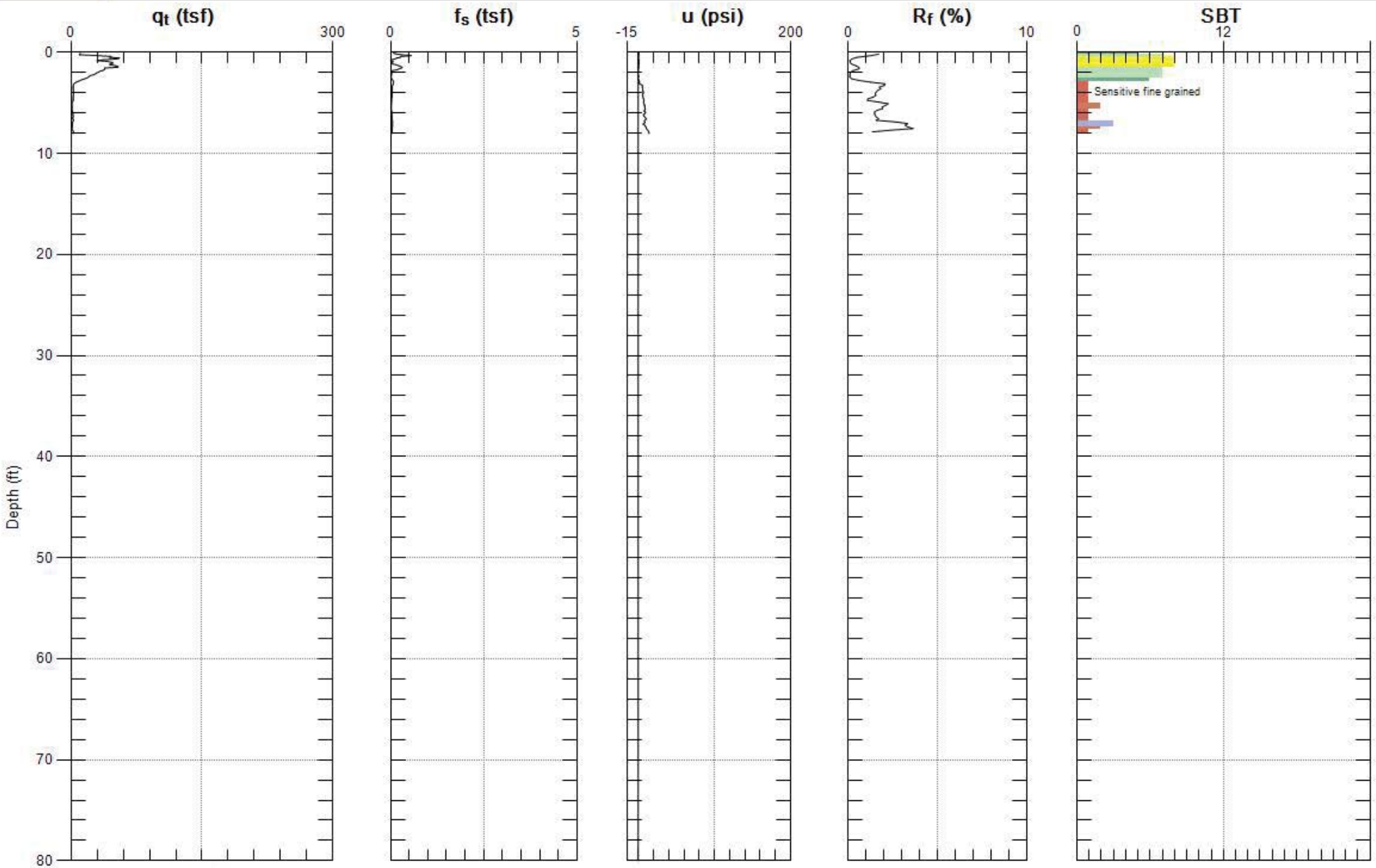
Max. Depth: 43.717 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT54

Engineer: S.LEE
Date: 2/9/2015 09:00

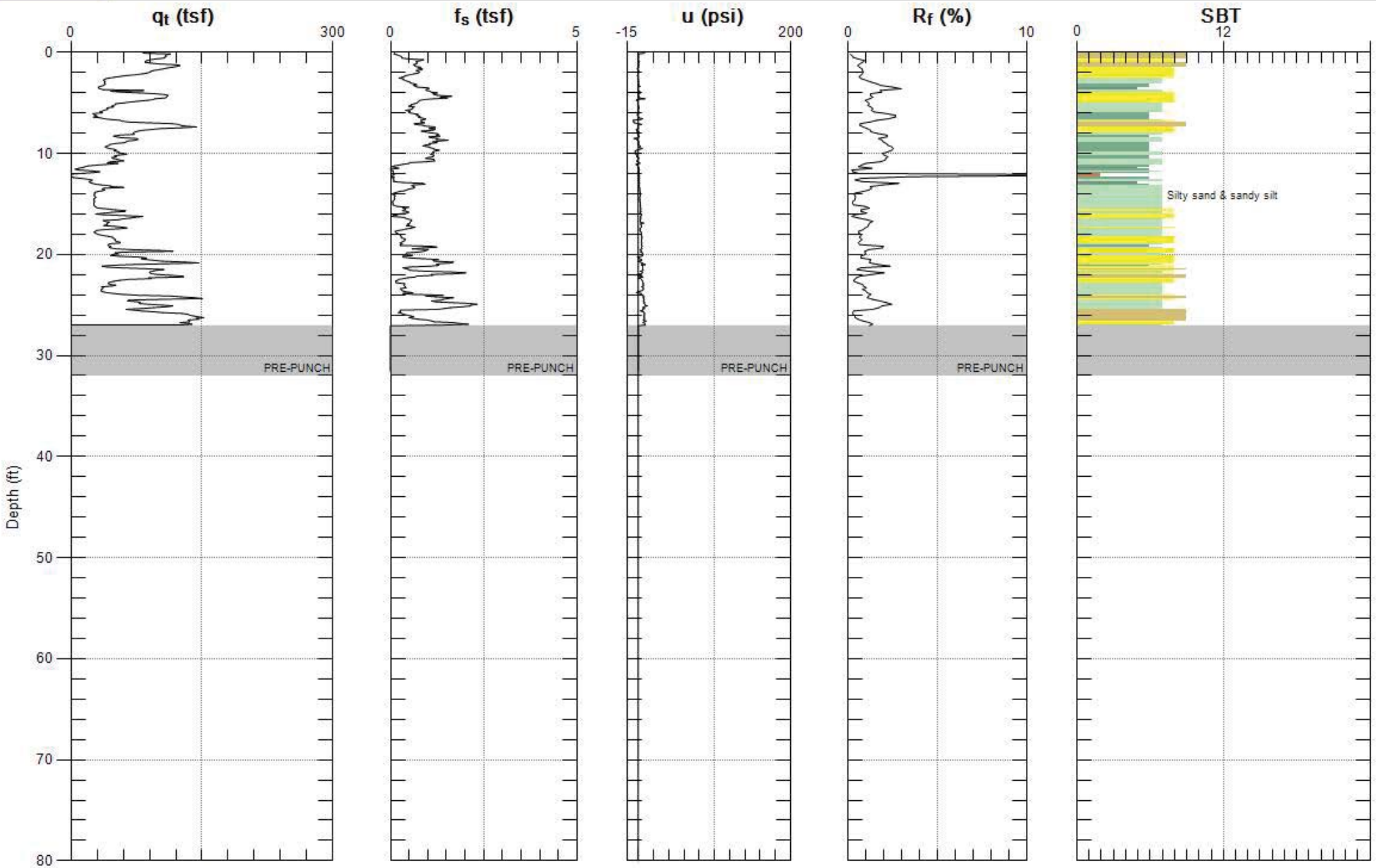


Max. Depth: 8.038 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT55
Engineer: S.LEE
Date: 2/4/2015 02:32

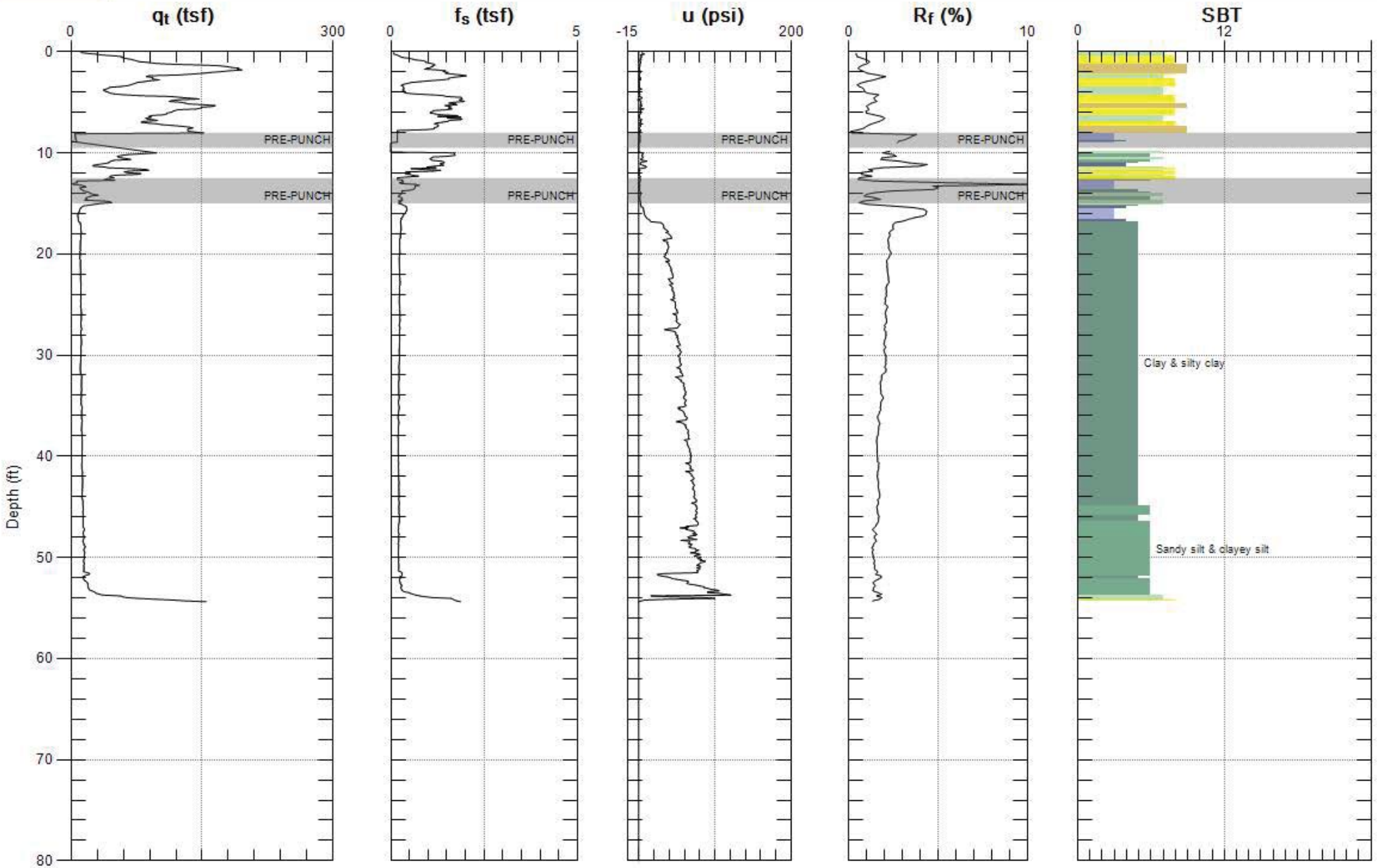


Max. Depth: 31.578 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT56
Engineer: S.LEE
Date: 2/3/2015 08:08



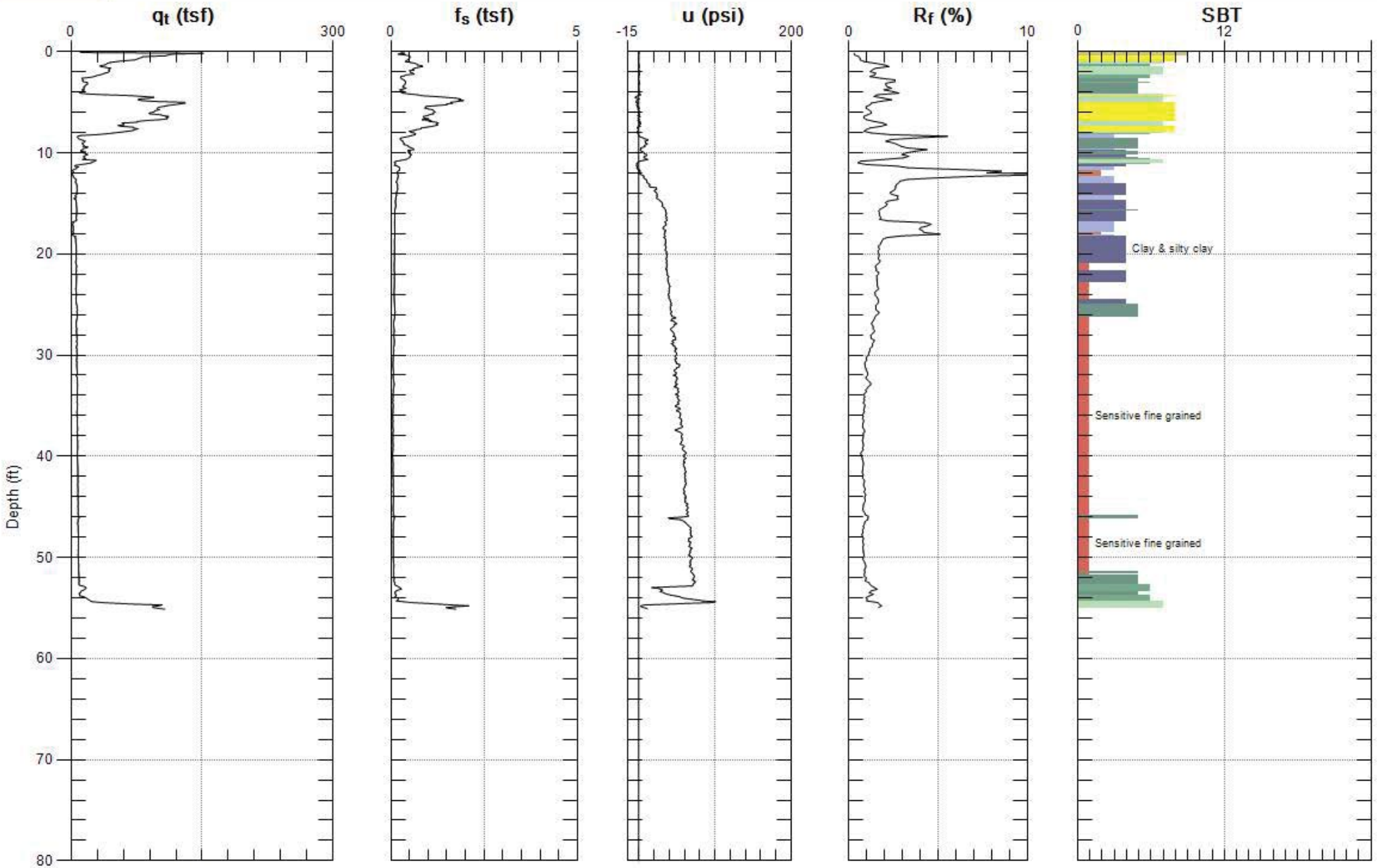
Max. Depth: 54.380 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT57

Engineer: S.LEE
Date: 2/3/2015 10:13



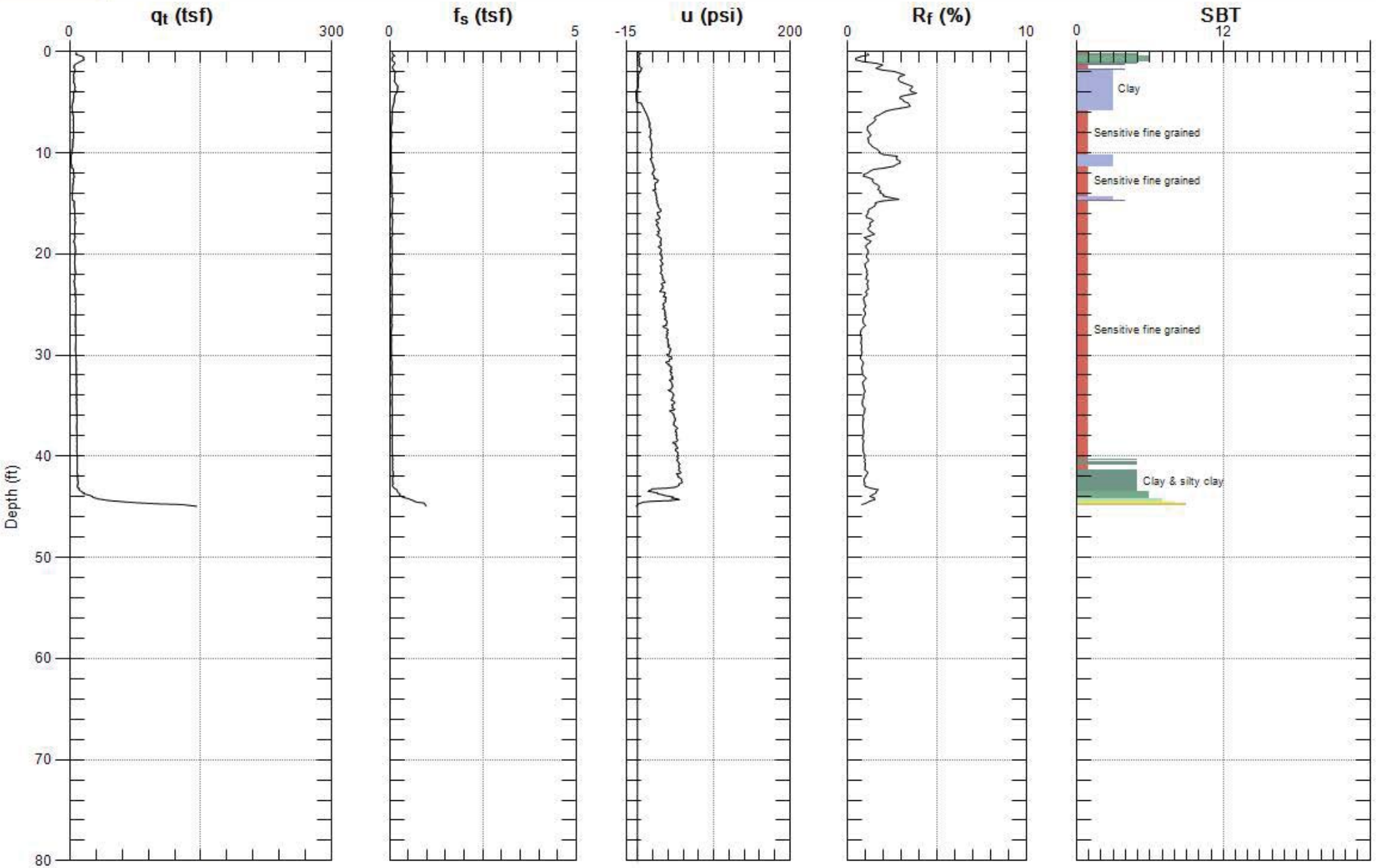
Max. Depth: 55.118 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT58

Engineer: S.LEE
Date: 2/10/2015 09:48

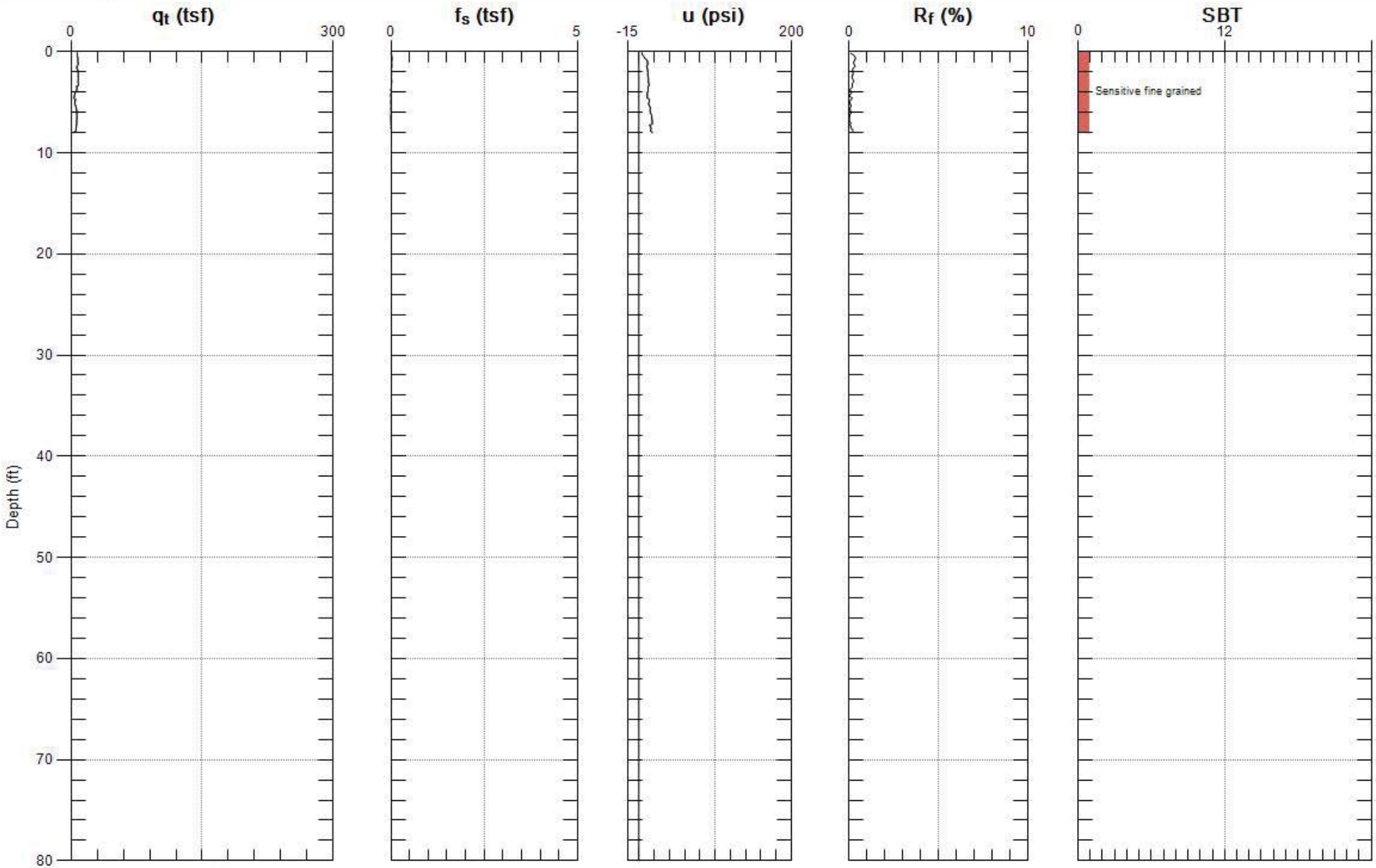


Max. Depth: 44.948 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT59
Engineer: S.LEE
Date: 2/10/2015 09:21



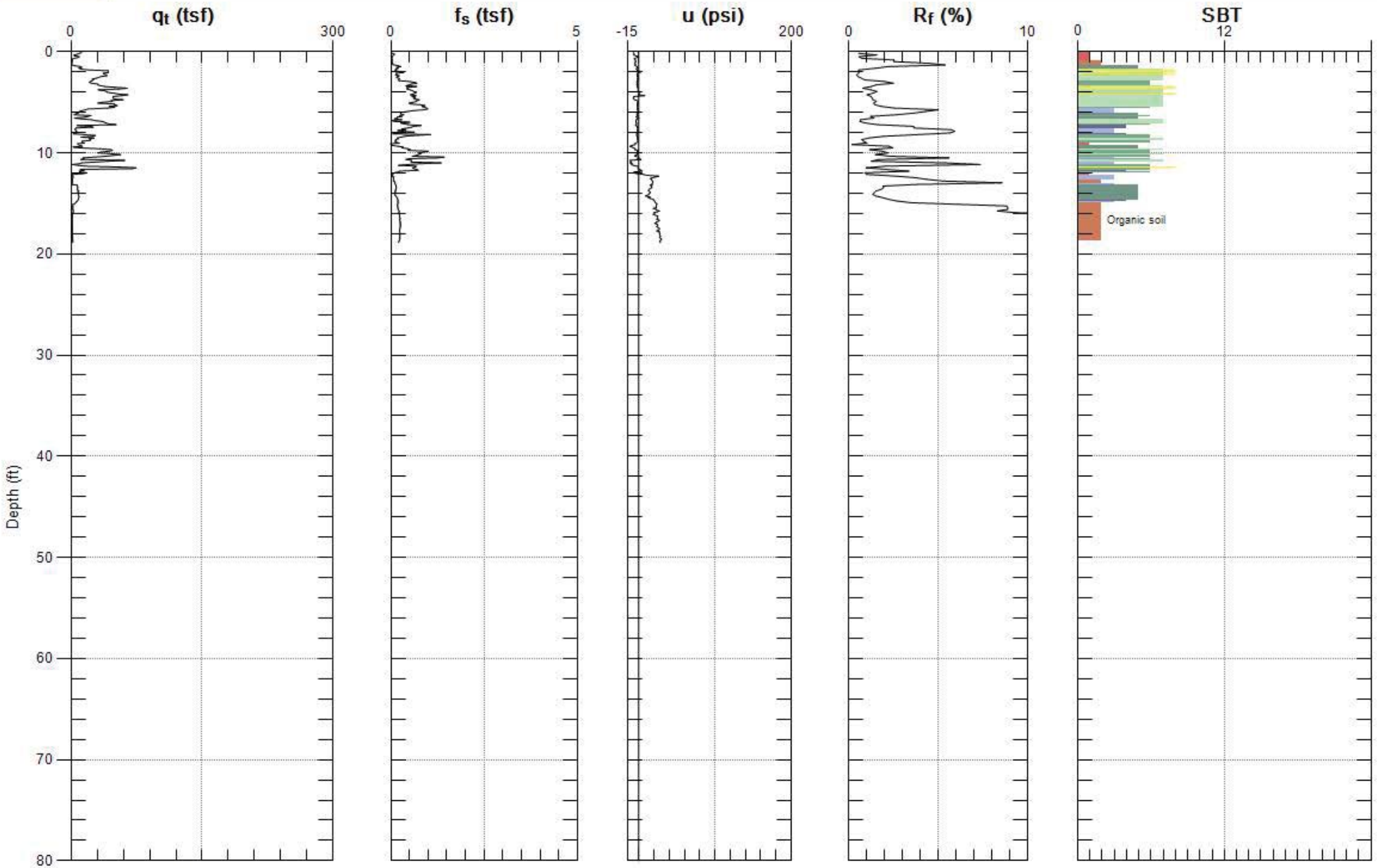
Max. Depth: 8.038 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT60

Engineer: S.LEE
Date: 2/3/2015 12:55



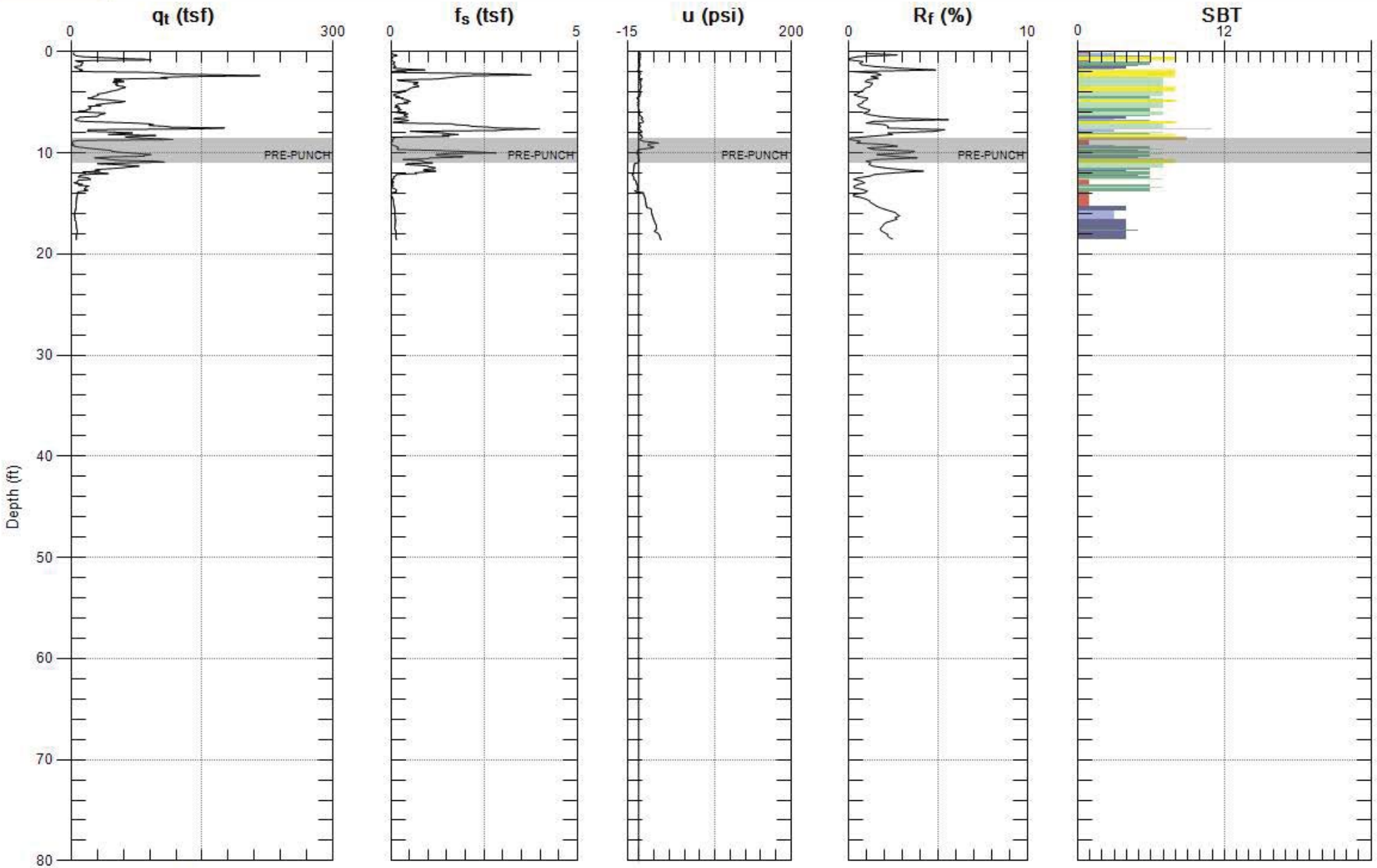
Max. Depth: 18.865 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT61

Engineer: S.LEE
Date: 2/10/2015 01:26



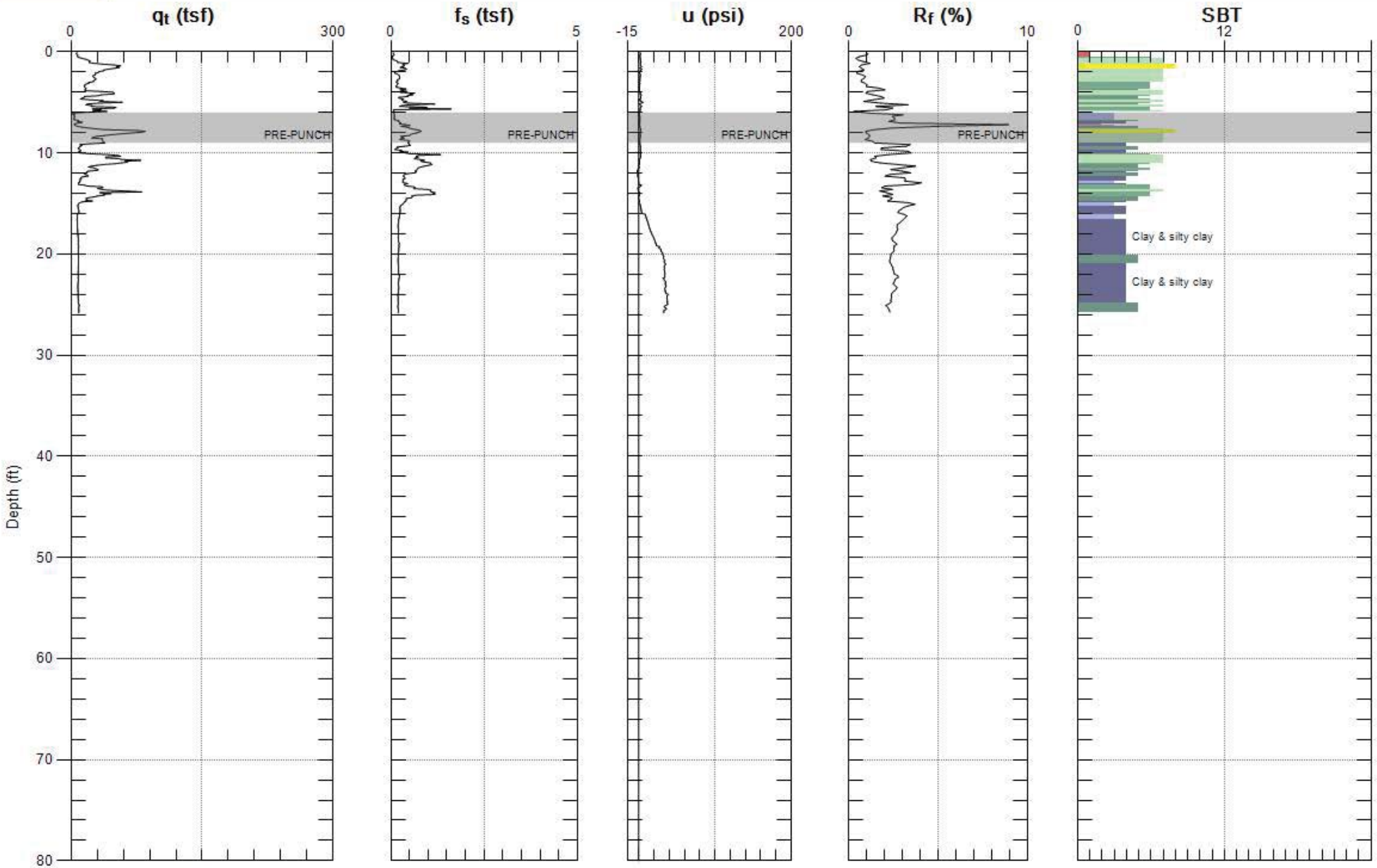
Max. Depth: 18.619 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT62

Engineer: S.LEE
Date: 2/11/2015 08:36

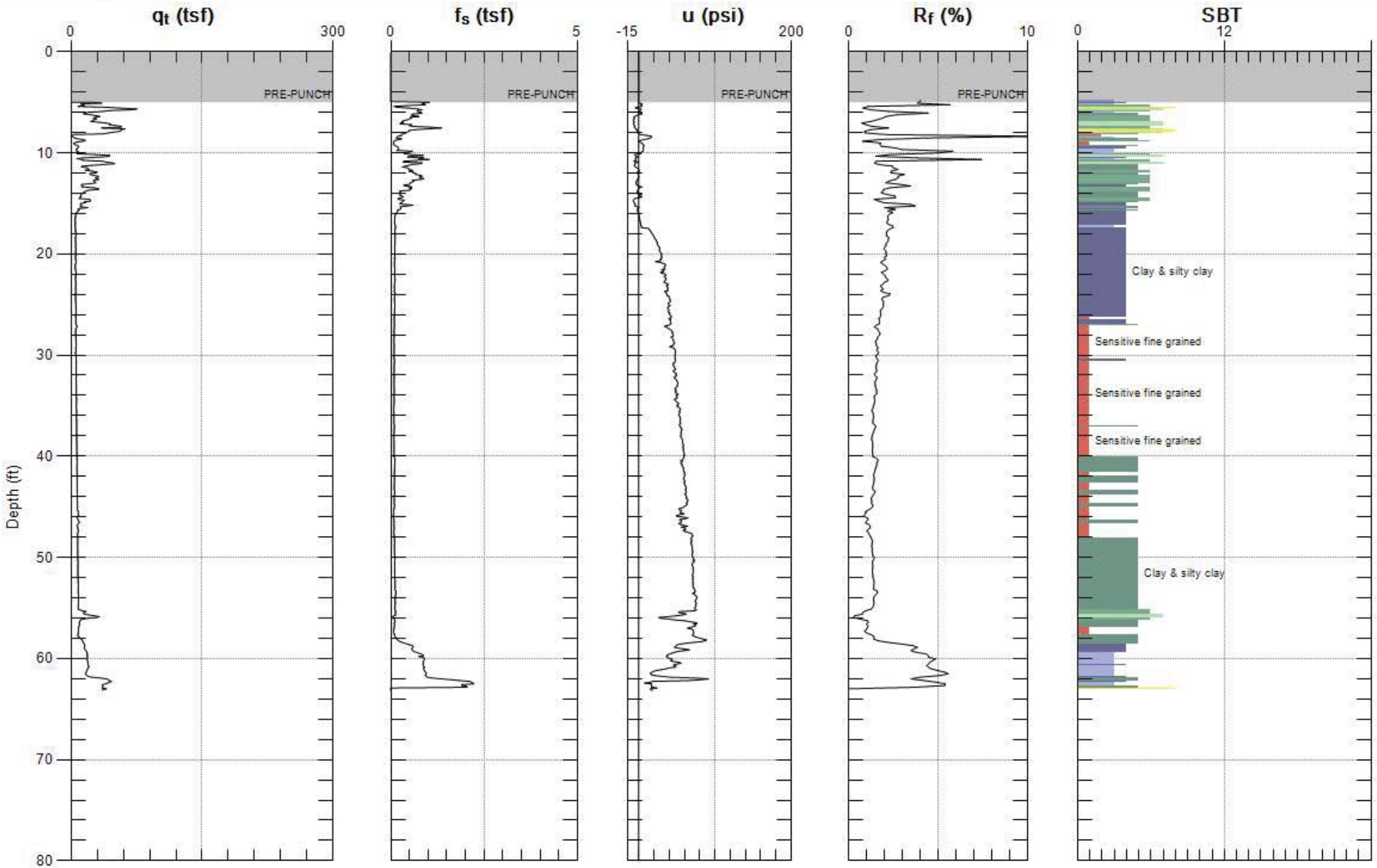


Max. Depth: 25.837 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT63
Engineer: S.LEE
Date: 2/17/2015 12:47



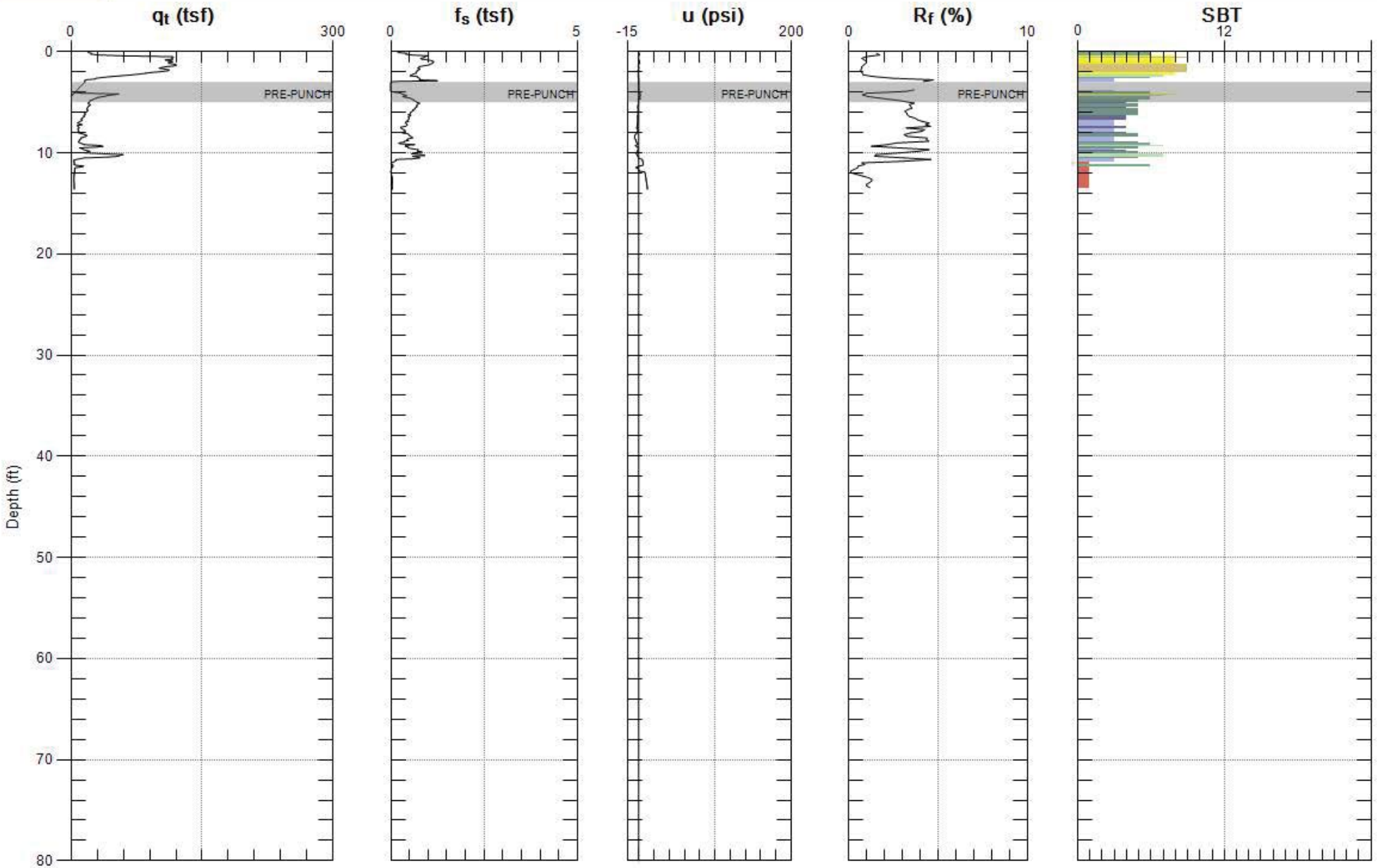
Max. Depth: 63.156 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT64

Engineer: S.LEE
Date: 2/3/2015 02:15



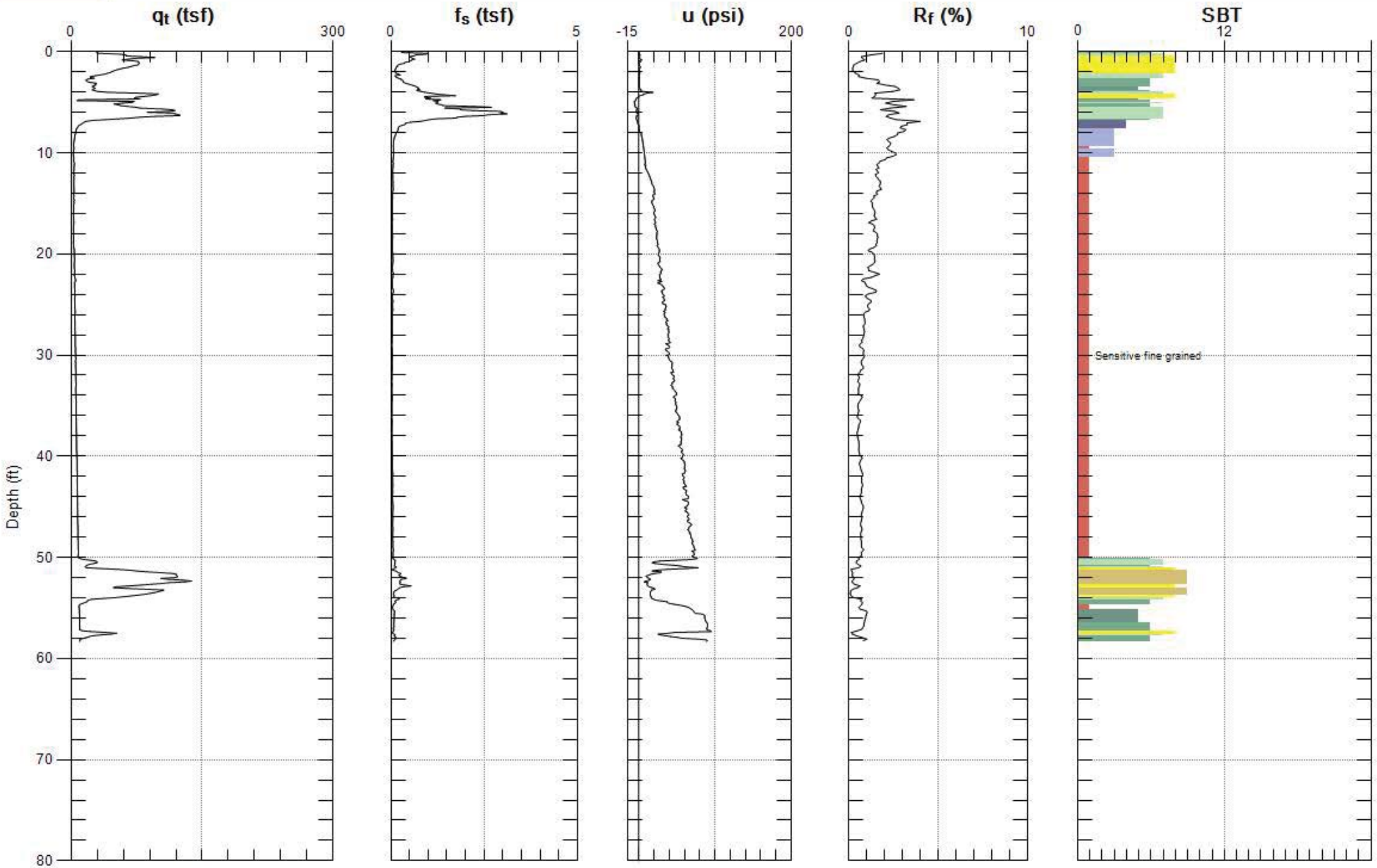
Max. Depth: 13.615 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT65

Engineer: S.LEE
Date: 2/2/2015 01:38

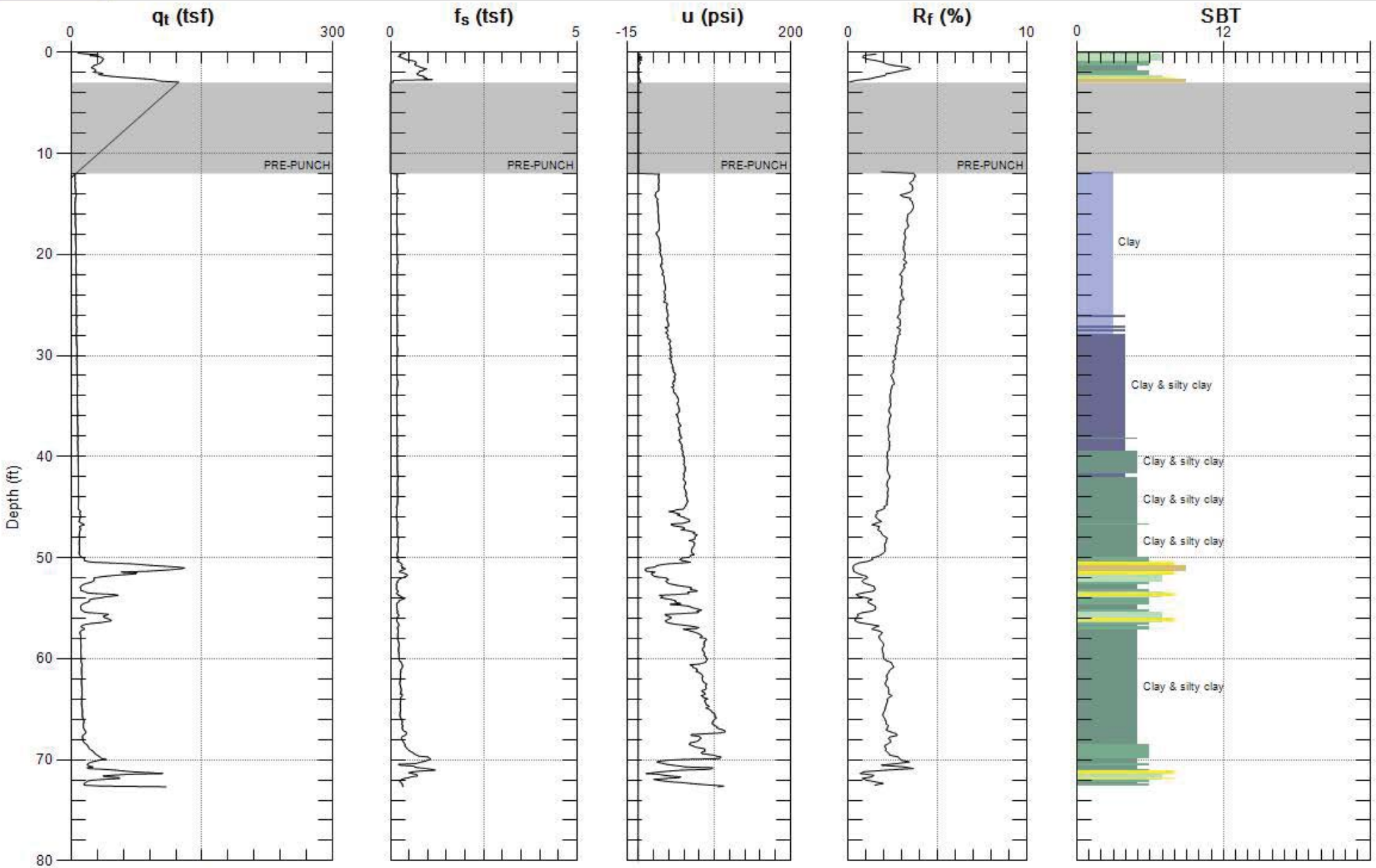


Max. Depth: 58.317 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT66b
Engineer: S.LEE
Date: 2/4/2015 09:04

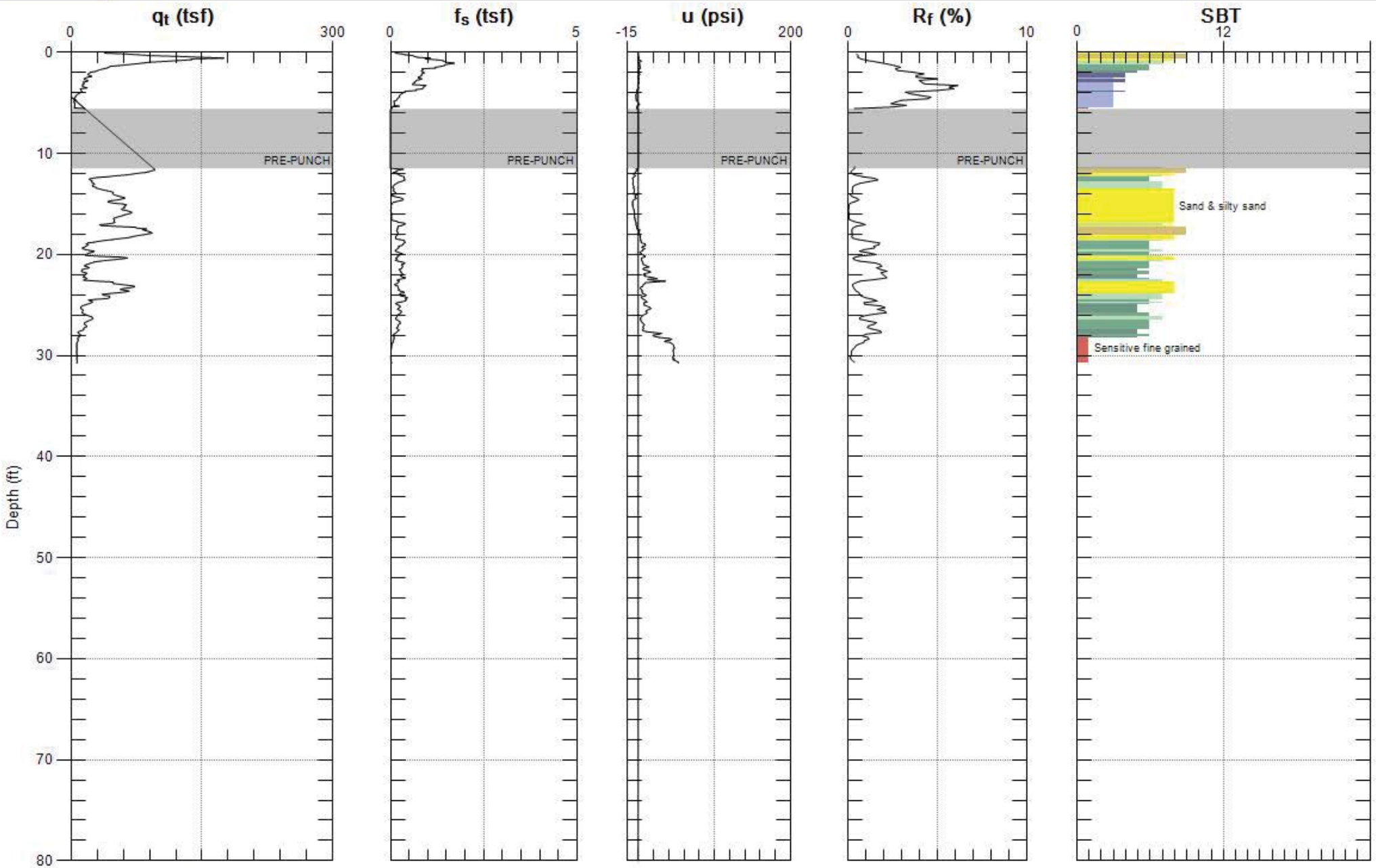


Max. Depth: 72.671 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT67
Engineer: S.LEE
Date: 2/12/2015 11:22



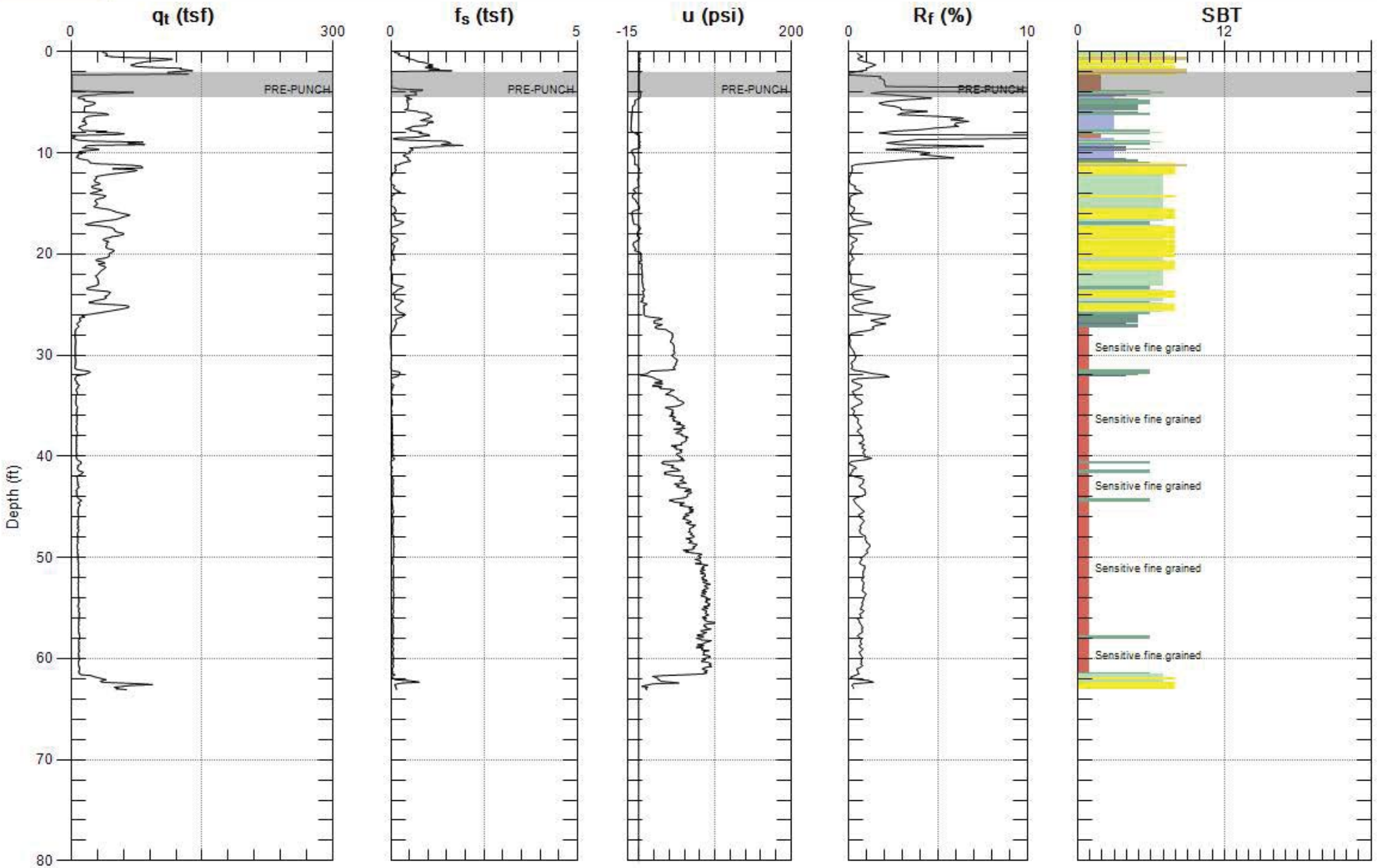
Max. Depth: 30.758 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT68

Engineer: S.LEE
Date: 2/12/2015 01:11



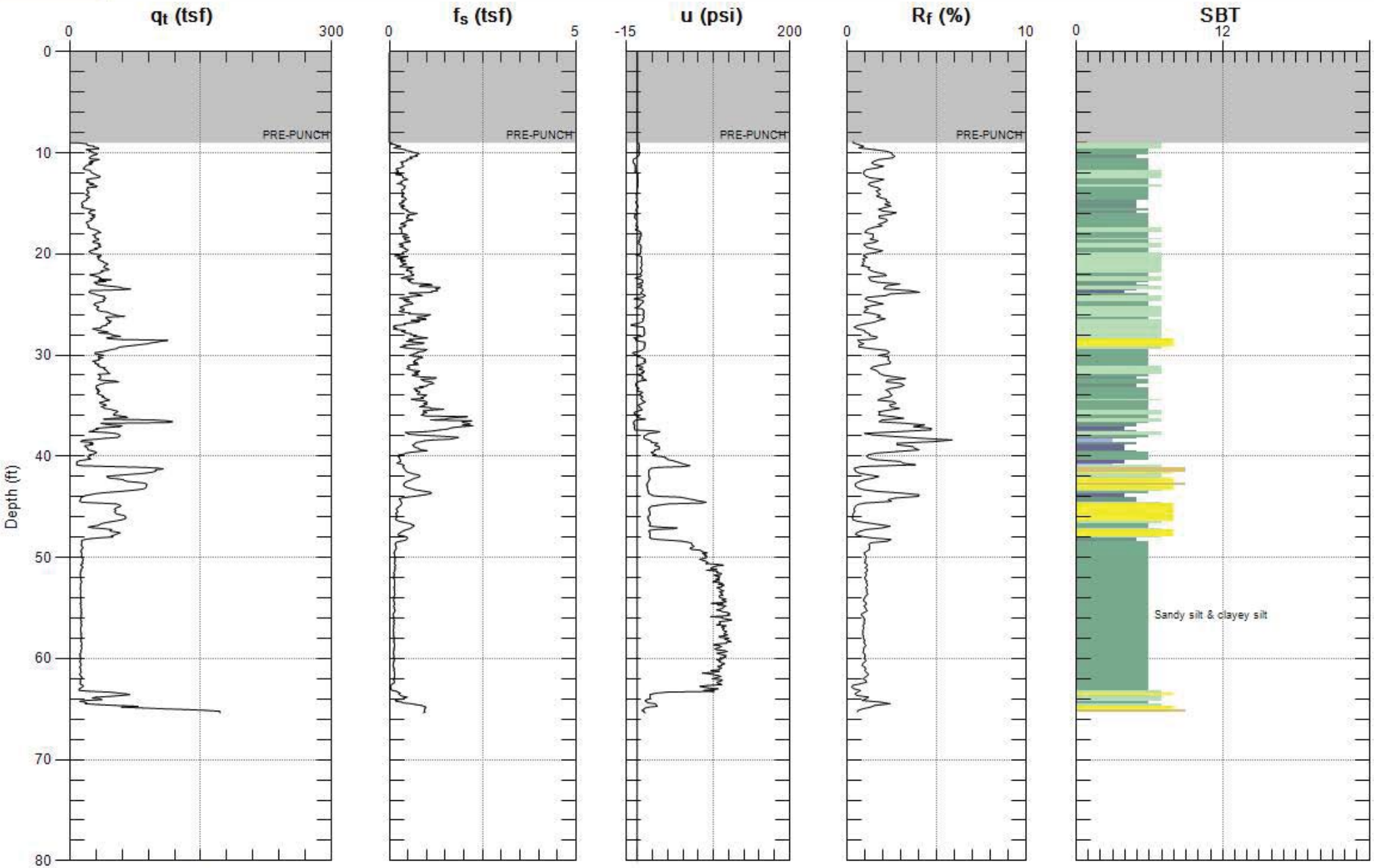
Max. Depth: 63.074 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT69

Engineer: S.LEE
Date: 2/12/2015 08:47



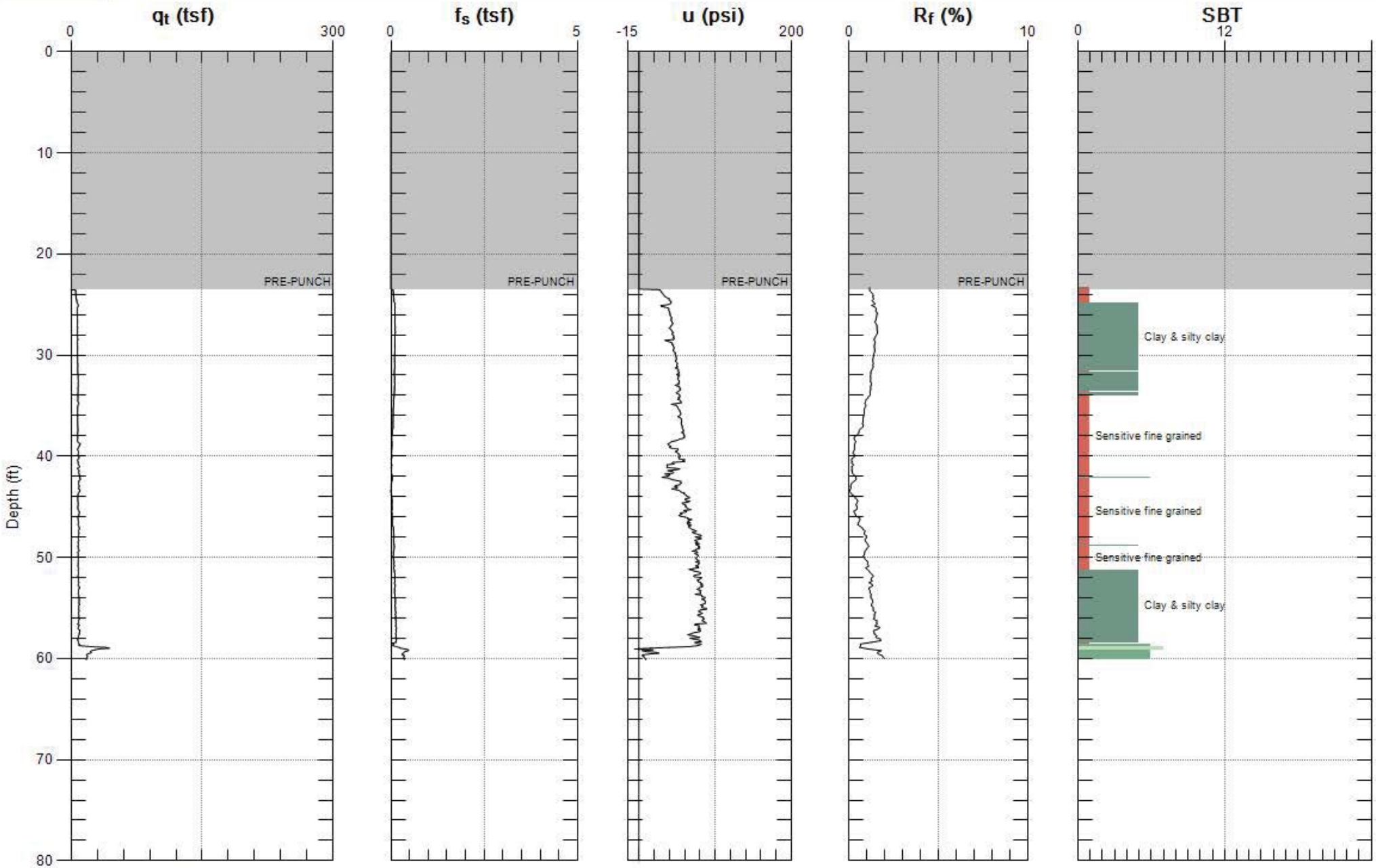
Max. Depth: 65.371 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO3CPT70

Engineer: S.LEE
Date: 2/13/2015 11:55



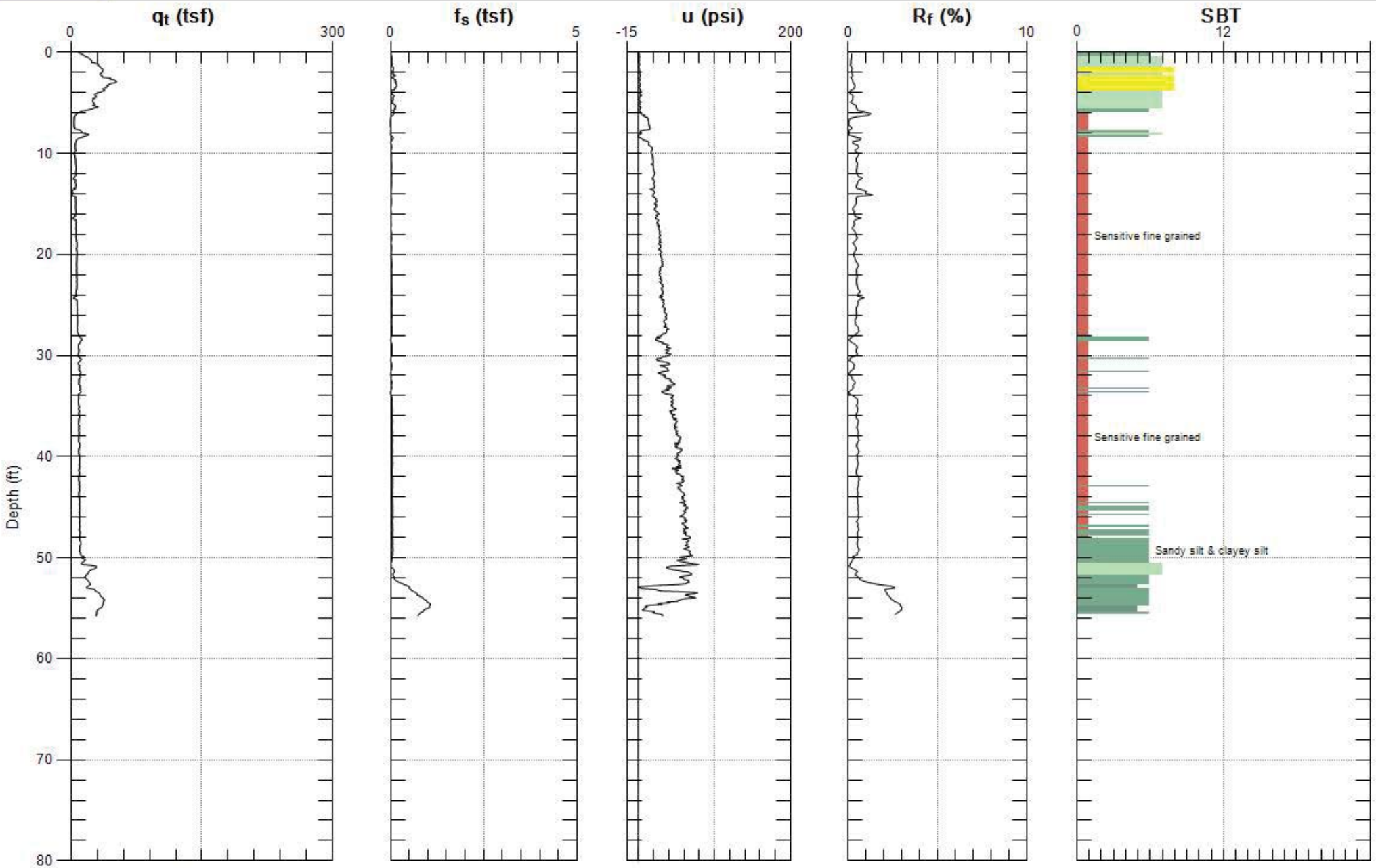
Max. Depth: 60.121 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO3CPT71

Engineer: S.LEE
Date: 2/11/2015 12:28



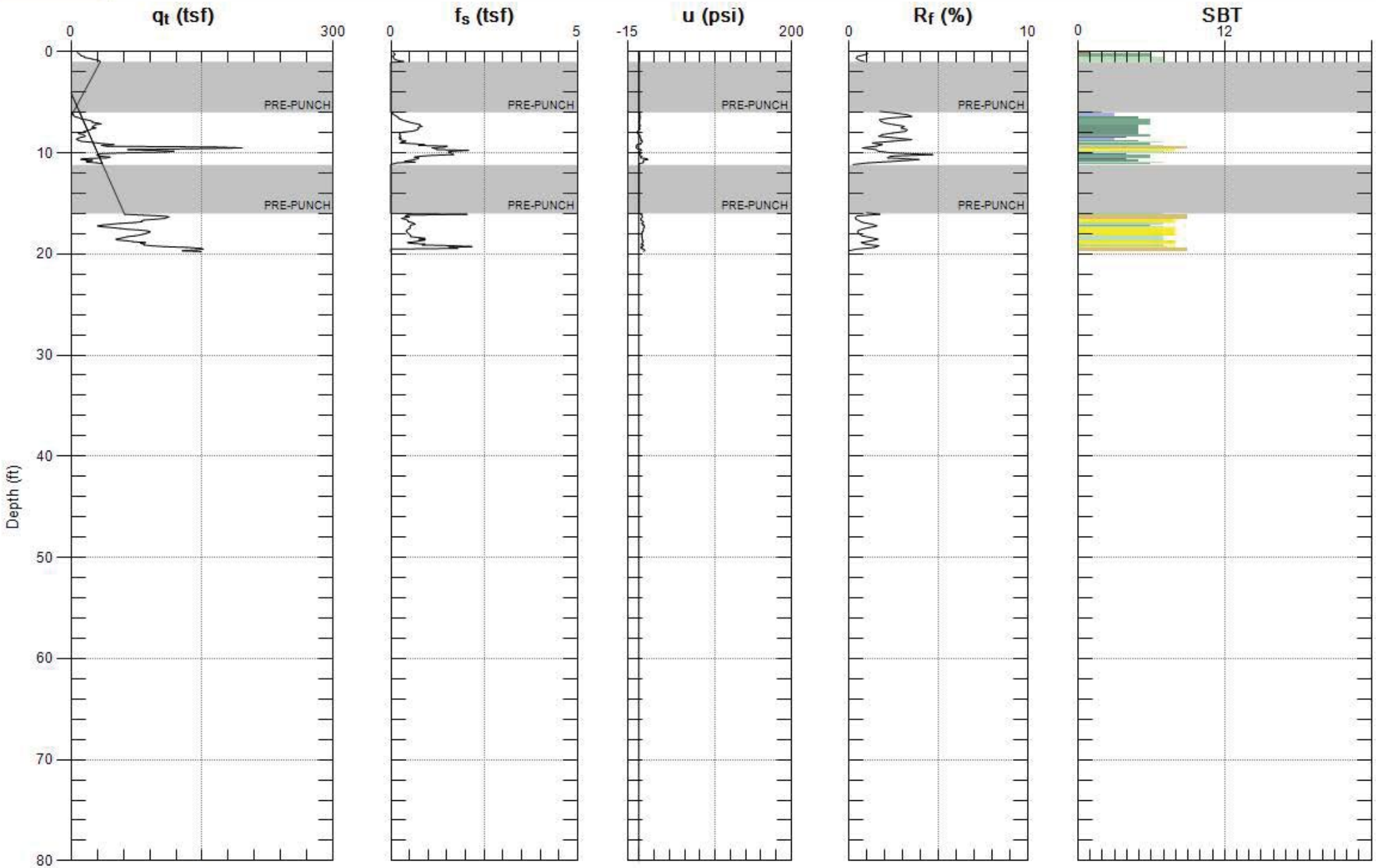
Max. Depth: 55.774 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO3CPT72

Engineer: S.LEE
Date: 2/17/2015 09:32

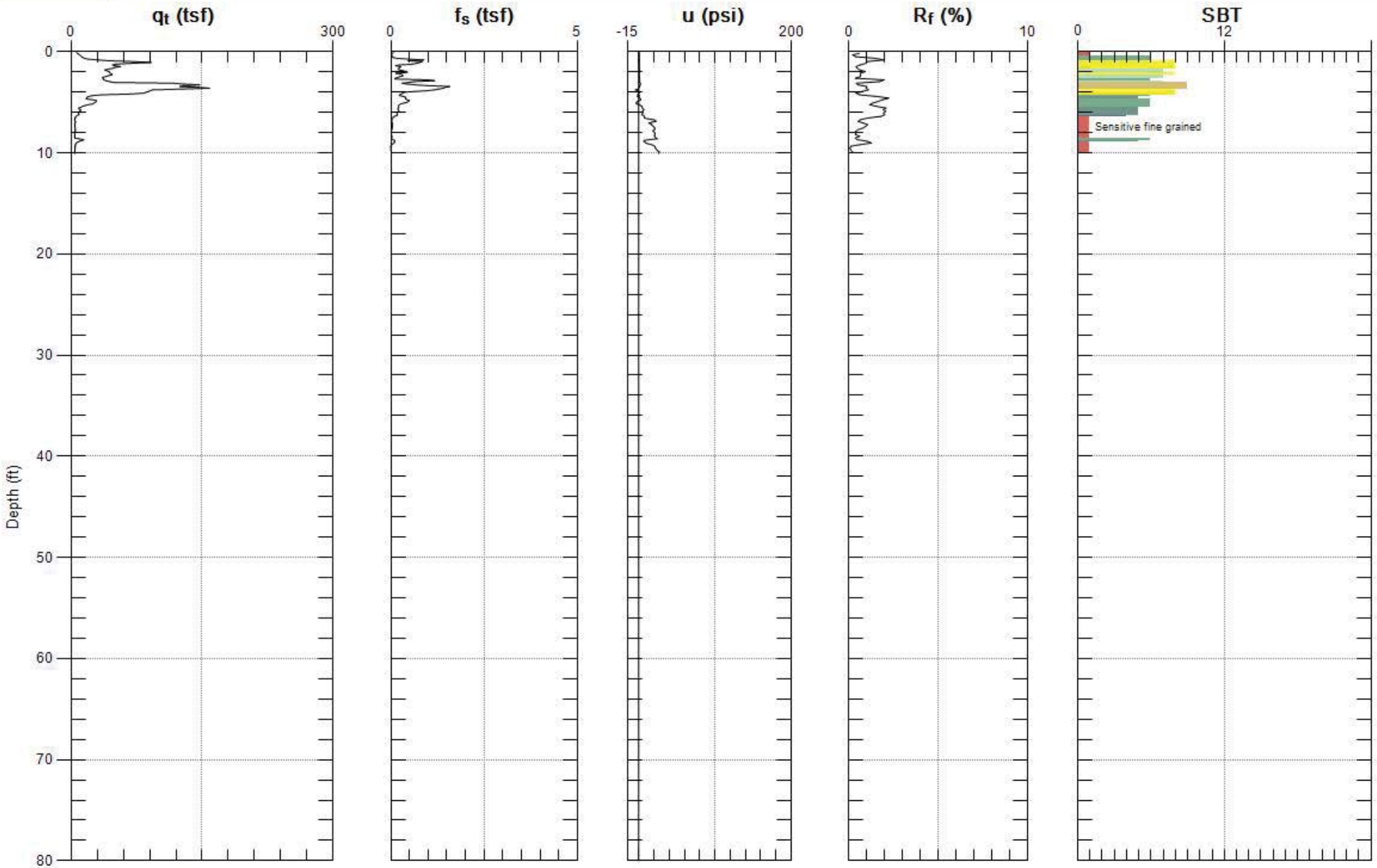


Max. Depth: 19.767 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO3CPT73
Engineer: S.LEE
Date: 2/11/2015 10:40



Max. Depth: 10.089 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B600** Sheet 1 of 2	ERRG

Date (s) Drilled 3/3/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 45.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 12.67
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	SILTY SAND WITH GRAVEL (SM): brown; dry to moist; stiff; fine to medium grained sand; moderately graded			
5		SPT		14			--Dark brown to reddish brown, dry, low plasticity fines, medium dense, medium grained sand	13.3		36.7% gravel; 44.7% sand; 18.6% fines
9		SPT		9			--No Recovery, loose			
14		SPT		10			--Wet, loose, medium to coarse grained, angular gravel (1/2 - 1" dia.), trace wood debris			
19		SPT		5			--No Recovery (trace wood debris in sand catcher), loose			
23		SH					--No Recovery			Osterberg Pressure = 500 psi

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B600

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): black/gray; moist; firm; high plasticity			
27										
28		SH								Osterberg Pressure = 400 psi
29										
30										
31										
32										
33		SH					--20% seashells, moist to wet			Osterberg Pressure = 175 psi
34										
35										
36										
37										
38										
39										
40										
41										
42										
43		SH								Osterberg Pressure = 400 psi
44										
45							Bottom of boring at 45.0 feet			
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B601** Sheet 1 of 2	ERRG

Date (s) Drilled 2/26/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 33.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 3.46
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SP	POORLY GRADED SAND (SP): with seashells; gray; moist; fine grained; loose			
6		SPT		0		CL	SANDY LEAN CLAY (CL): with seashells and gravel; black; wet; very soft; high plasticity; fine to medium grained; odor			
7						CH	FAT CLAY (CH): grayish black; moist; very soft; high plasticity; trace seashells			
10		SH					--Black			Osterberg Pressure = 25 psi
11								74.1	55.4	0.1% gravel; 2.6% sand; 97.3% fines; LL = 77; PL = 34; PI = 43; Pp = ~1,000 psf
20		SH					--Black			Osterberg Pressure = 50 psi

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B601

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29										
30										
31		SH								Osterberg Pressure = 50 psi
32										
33							Bottom of boring at 33.0 feet			
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B602** Sheet 1 of 2	ERRG

Date (s) Drilled 3/9/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 46.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 13.26
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	SILTY SAND (SM): light brown; dry; fine grained (trace course grained); loose; poorly graded			
6		SPT		40			--Silty sand, some clay, dark brown, wet, medium grained sand, dense, poorly graded, trace angular gravel (1/2-1" dia.), copper metal debris			
10		MC		7		ML	SANDY SILT (ML): brown; wet; fine grained; medium stiff; low plasticity; trace clay			
15		MC		3		CL	LEAN CLAY (CL): gray; dry to wet; soft; high plasticity			
19		SH								Osterberg Pressure = 200 psi
21							--Wet, soft, trace seashells			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B602

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26		SPT		1		CL	LEAN CLAY (CL): (continued) --Grayish black, moist, very soft high plasticity trace seashells			
27										
28										
29										
30		SH					--No Recovery			Osterberg Pressure = 400 psi
31										
32										
33										
34		SH								Osterberg Pressure = 125 psi
35										
36							--Grayish black, moist, soft, high plasticity			
37										
38										
39										
40										
41										
42										
43										
44		SH								Osterberg Pressure = 175 psi
45							--Grayish black, moist, very soft, high plasticity			
46							Bottom of boring at 46.0 feet			
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B603** Sheet 1 of 2	ERRG

Date (s) Drilled 2/25/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 37.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 3.57
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1						SP	POORLY GRADED SAND (SP): brownish gray; dry; fine grained; very loose			
2		SH				GC	CLAYEY GRAVEL WITH SAND (GC): black; soft; high plasticity; trace seashells (10%)	41.9		Osterberg Pressure = 200 psi 35.4% gravel; 29.6% sand; 35% fines;LL = 56; PL = 25; PI = 31
5						CH	FAT CLAY (CH): high plasticity; with seashells			V.S. @ ~5 feet (ft) Su = 1,530.8 psf, Su,r = 166.26 psf
17							--Very soft			
20		SH						65.5	60.3	Osterberg Pressure = 100 psi 0% gravel; 10.8% sand; 89.2% fines; LL = 67; PL = 31; PI = 36; Pp = ~1,500 psf; Phi = 13.1°; c = 200 psf; m/c (%) / Dry Unit Weight (pcf), 66.3 / 60.8, 65.4 / 61.5, 68.7 / 59.4; V.S. @ 23'; Su = 690.32 psf; Su,r = 176.15 psf
22							--Very soft, trace course sand			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E

Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA

Project Number: 2014-091

Log of Boring IR02B603

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29		SH						65.5	60.3	Osterberg Pressure = 125 psi; 0% gravel; 0.4% sand; 99.6% fines; LL = 64; PL = 28; PI = 36; Pp =~2,100 psf; Phi = 12.8°; c = 200 psf; mc (%) / Dry Unit Weight (pcf), 60.7 / 63.5, 58.4 / 65.3, 63.9 / 61.7
30										
31										
32										
33										
34		SH						72.2	56.2	Osterberg Pressure = 50 psi; LL = 75; PI = 43; Pp = ~2,200 psf
35										
36										
37							Bottom of boring at 37.0 feet			V.S @ 37 ft: Su = 799.09 psf; Su,r = 116.82 psf
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B604** Sheet 1 of 2	ERRG

Date (s) Drilled 3/10/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 46.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 11.63
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1						SM	SILTY SAND WITH GRAVEL (SM): olive brown; moist; moderate to course grained; loose; moderately graded			
2										
3		MC		13		CL-ML	SILTY CLAY WITH SAND (CL-ML): dark brown; moist; fine grained sand; stiff; moderate to low plasticity; grace 1/8" and 1/4" gravel			
4										
5										
6										
7										
8		SPT		2		CH	FAT CLAY (CH): grayish black; moist; very soft; high plasticity; trace seashells			
9										
10										
11										
12		SH								Osterberg Pressure = 75 psi
13										
14										
15										
16										
17										
18		SPT		0			--Increased Seashells (10%)			
19										
20										
21										
22										
23		SPT		0						
24							--5-10% seashells			
25										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B604

Sheet 2 of 2

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28		SH								Osterberg Pressure = 115 psi
29										
30										
31										
32										
33										
34		SPT		0			--<1% seashells; organic odor			
35										
36										
37										
38										
39		SPT		0			--<1% seashells; organic odor			
40										
41										
42										
43										
44		SH								Osterberg Pressure = 75 psi
45										
46										
47							Bottom of boring at 46.0 feet			
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B605** Sheet 1 of 3	ERRG

Date (s) Drilled 2/20/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 55.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 7.34
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	Silty sand; brown; moist; medium grained; loose; poorly graded			
8		SPT		6		GP	POORLY GRADED GRAVEL WITH SAND (GP): grayish black; wet; angular; loose; fine gravel; fine to medium grained sand; wood debri			
13		SPT		5		SP	POORLY GRADED SAND WITH GRAVEL (SP): gray; loose; fine to medium grained; sea shells present			
18		SPT		4						
23		SPT		7		SP	POORLY GRADED SAND (SP): grayish black; wet; loose; fine grained; trace seashells			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B605

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						SP	POORLY GRADED SAND (SP): (continued)			
27										
28		SPT		0		CH	FAT CLAY (CH): black; wet; high plasticity; very soft; homogenous; trace seashells; trace gravel			
29										
30										
31										
32		SH						56.2	66.6	0.5% gravel; 38.4% sand; 61.1% fines; LL = 76; PL = 32; PI = 44; Pp =~ 2,000 psf
33										
34										
35										V.S. @ 35'; Su = 980.76 psf; Su,r = 190.47 psf
36										
37										
38										
39		SPT		3			–Crushed seashells; black; low plasticity; soft; trace sand			
40										
41										
42										
43										
44		SH						48.9	71.6	Gus Sampler Pressure = 50 psi; Pp =~ 2,200 psf (possible disturbed sample); Phi = 12.1°; c = 200 psf; m/c (%) / Dry Unit Weight (pcf), 52.9 / 67.5, 35.2 / 80.9, 38.0 / 79.6
45										
46										
47										V.S. @ 47'; Su = 1,268.14 psf; Su,r = N/A
48										
49										
50										
51										
52		SH						61.0	61.1	Gus Sampler Pressure = 100 psi; 9.7% gravel; 16.4% sand; 73.9% fines; LL = 68; PL = 30; PI = 38; Pp =~ 1,200 psf (possible disturbed sample)
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B605

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
56							Bottom of boring at 55.0 feet			V.S. @ 55'; Su - 1,481.36 psf; Su,r = 116.82 psf
57										
58										
59										
60										
61										
62										
63										
64										
65										
66										
67										
68										
69										
70										
71										
72										
73										
74										
75										
76										
77										
78										
79										
80										
81										
82										
83										
84										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR03B606** Sheet 1 of 2	ERRG

Date (s) Drilled 3/2/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 50.5
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 9.1
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	SILTY SAND (SM): black; moist; medium grained; loose; poorly graded; trace gravel			
8		SPT		10			--Pieces of red brick			
13		SPT		0			--Very loose; no recovery			
18		SPT		7			--Loose; no recovery			
20						CH	FAT CLAY WITH SAND (CH): black; wet; fine grained sand			
22		SH								Osterberg Pressure = 100 psi

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR03B606

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY WITH SAND (CH): (continued)			
27										
28		SPT		0			--Moist; very soft; homogeneous; seashells present (5-10%)			
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39		SPT		0			--Seashells (50%); wet; very soft; moderate to high plasticity			
40										
41										
42										
43										
44		SH					--No Recovery			Osterberg Pressure = 75 psi
45										
46										
47										
48		SH								Osterberg Pressure = 200 psi
49										
50							--More sand; black; seashells present			
51							Bottom of boring at 50.5 feet			
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR03B607** Sheet 1 of 2	ERRG

Date (s) Drilled 2/27/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 40.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 2.39
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1		SPT		17		SP	POORLY GRADED SAND (SP): brown; moist to wet; fine grained; loose; poorly graded; trace gravel and seashells			
							--Gray; moist; fine grained;dense; angular gravel (1/4-1" dia.)			
2						SM	SILTY SAND (SM): dark gray to brown; moist; fine grained; medium dense; poorly graded			
8		SH				SP	POORLY GRADED SAND (SP): fine grained; poorly graded			Osterberg Pressure = 350 psi
10						CH	FAT CLAY (CH): black; high plasticity; very soft; seashells present			
22		SH						69.1	58.2	Osterberg Pressure = 75 psi; 0.8% grave; 5.1% sand; 94.1% fines; LL = 67; PL = 32; PI = 35; Pp =~ 1,400 psf
23							--Moist; soft; trace shells; trace gravel			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR03B607

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38		SH					–Some seashells			Osterberg Pressure = 75 psi
39										
40										
41							Bottom of boring at 40.0 feet			
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

GREGG DRILLING & TESTING, INC.
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

January 27, 2015

CES
Attn: Michael Goymerac

Subject: Field Vane Shear Test Site Investigation
Parcel E Pre-Design Investigation
Hunter's Point, San Francisco, California
Gregg Project Number: D2140090

Dear Mr. Goymerac:

The following report presents the results of GREGG Drilling & Testing's Field Vane Shear Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☐
2	Pore Pressure Dissipation Tests	(PPD)	☐
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	Resistivity Cone Penetration Tests	(RCPTU)	☐
5	UVOST Laser Induced Fluorescence	(UVOST)	☐
6	Groundwater Sampling	(GWS)	☐
7	Soil Sampling	(SS)	☐
8	Vapor Sampling	(VS)	☐
9	Vane Shear Testing	(VST)	☒
10	SPT Energy Calibration	(SPTE)	☐

The field vane shear tests were carried out in accordance with ASTM 2573-08. A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.

Peter Robertson
Technical Operations

Field Vane Shear Test Summary

-Table 1-

FVST Identification	Date	Test Depths (Feet)	Comments
IR02B605	2/19/15 - 2/23/15	35R, 47M, 55R	Changed from 65mm vane to 55mm vane after applying maximum torque
IR02B603	2/25/15	5R, 23R, 37R	

R: Remolded test also preformed, M: Max torque applied (no shear)

Bibliography

Greig, J.W., R.G. Campanella and P.K. Robertson, "Comparison of Field Vane Results With Other In-Situ Test Results", International Symposium on Laboratory and Field Vane Shear Strength Testing, ASTM, Tampa FL, Proceedings, 1987

Mayne, P.W., "NHI (2002) Manual on Subsurface Investigations: Geotechnical Site Characterization", available through www.ce.gatech.edu/~geosys/Faculty/Mayne/papers/index.html, Section 5.3, pp.107=112.

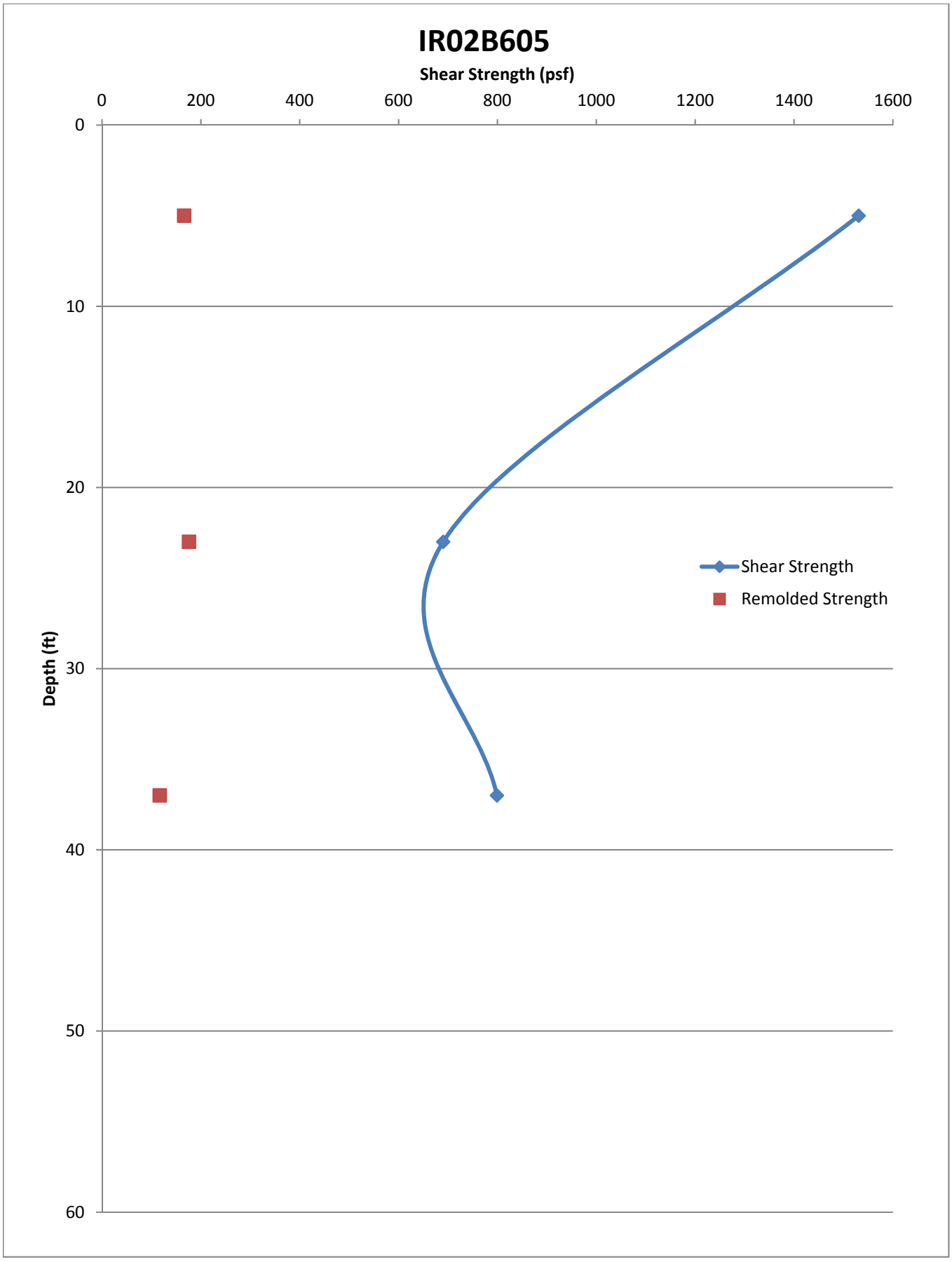
Richards, Adrian F. (Editor), "Vane Shear Testing in Soils", The International Symposium on Laboratory and Field Vane Shear Strength Testing, January 1987.

Chandler, R.J., "The In-Situ Measurement of the Undrained Shear Strength of Clays Using the Field Vane," Vane Shear Testing in Soils: Field and Laboratory Studies, ASTM STP 1014, A.F. Richards, Ed., American Society for Testing and Materials, Philadelphia, 1988, pp. 13-44.

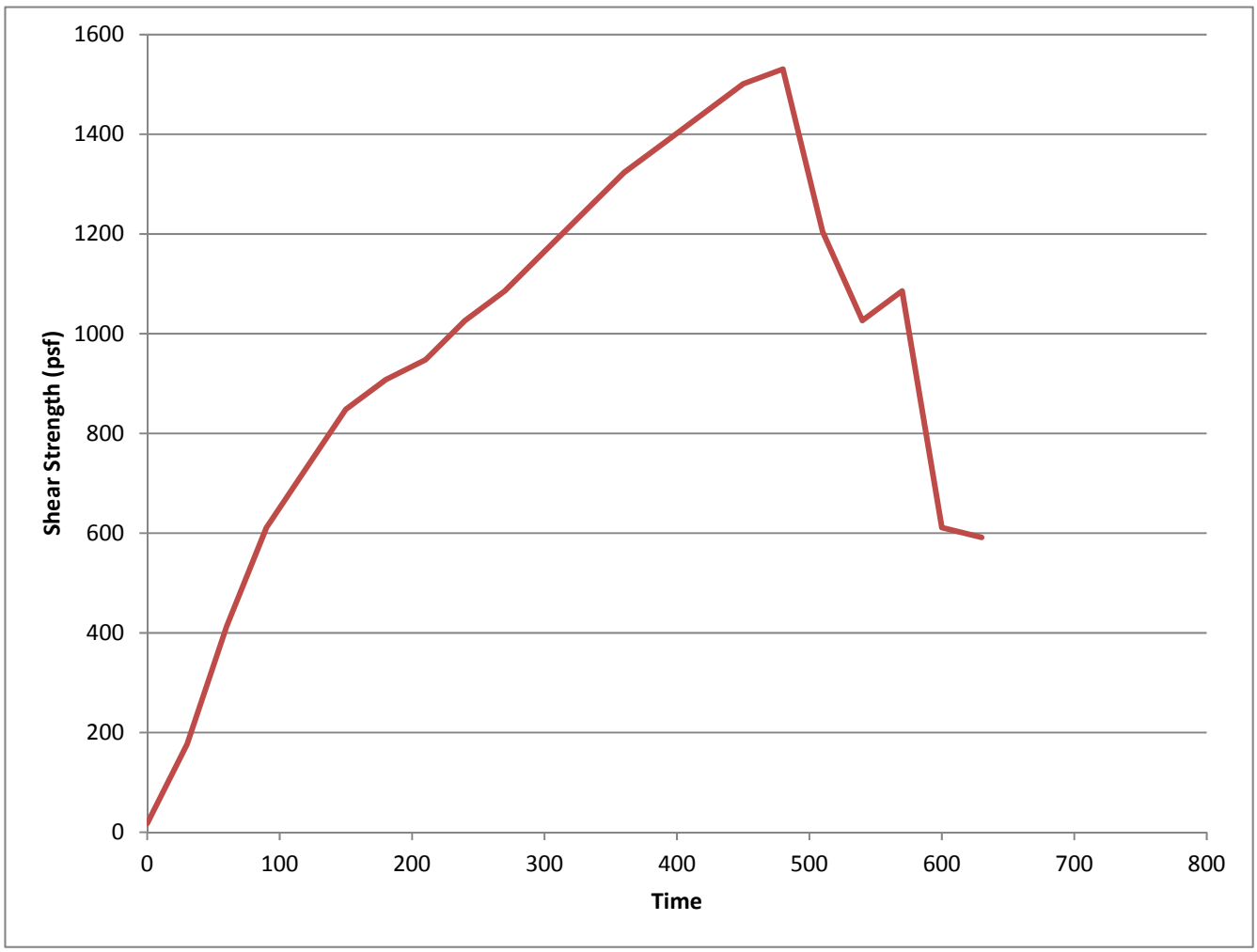
Copies of ASTM Standards are available through www.astm.org

CLIENT	CES
SITE	Hunter's Point
LOCATION	IR02B603
VANE TYPE	Geonor H-10
VANE DIAMETER, d (mm)	55
VANE LENGTH, l (mm)	110

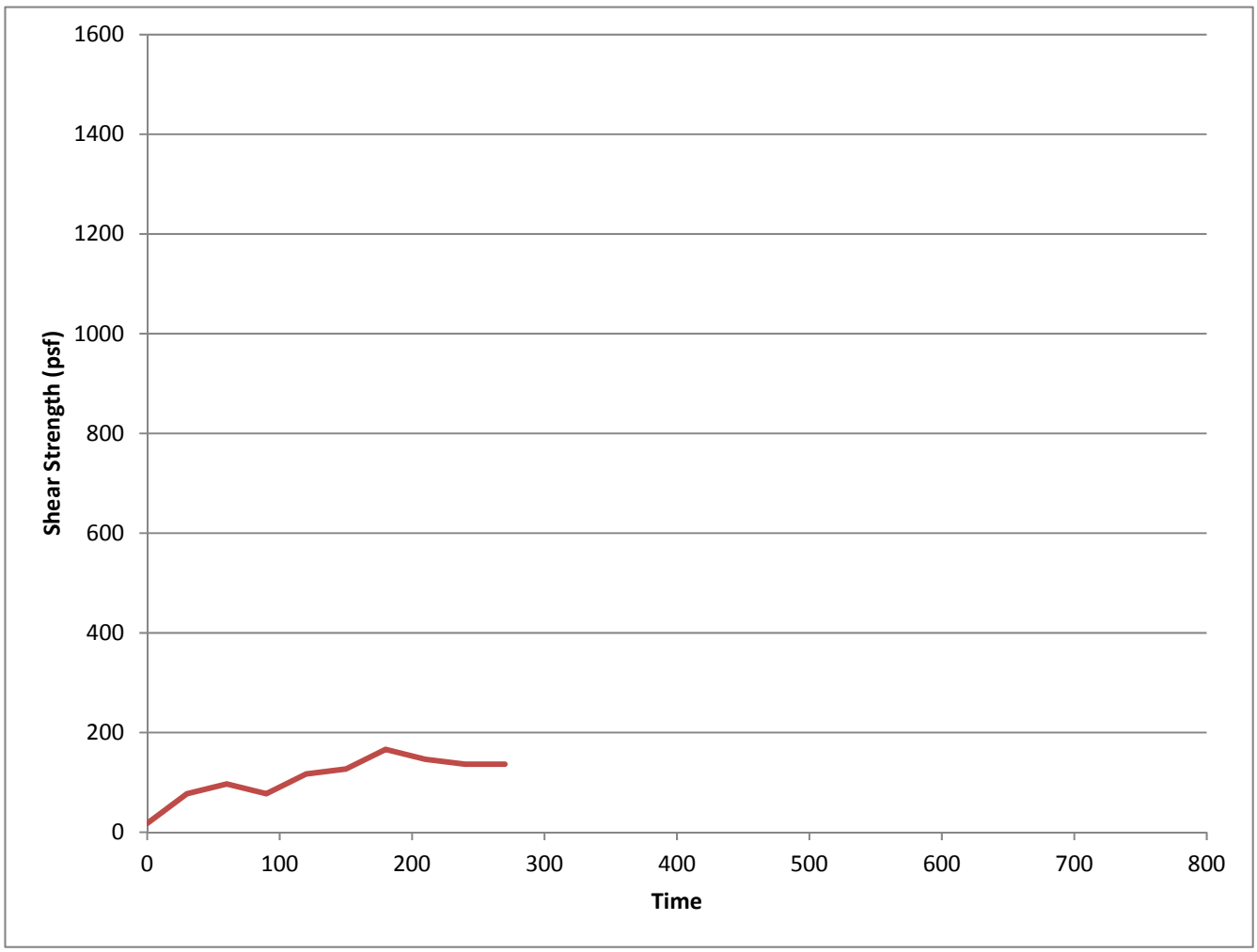
DEPTH	DEPTH	PEAK	SHEAR	SHEAR	REMOLDED			SENSITIVITY
					PEAK	SHEAR	SHEAR	
(m)	(ft)	(N)	(kPa)	(psf)	(N)	(kPa)	(psf)	
1.52	5.00	255.33	73.28	1530.80	27.73	7.96	166.26	9.21
7.01	23.00	115.14	33.05	690.32	29.38	8.43	176.15	3.92
11.28	37.00	133.28	38.25	799.09	19.48	5.59	116.82	6.84


IR02B605
Shear Strength (psf)
0
200
400
600
800
1000
1200
1400
1600
Depth (ft)
0
10
20
30
40
50
60
Shear Strength
Remolded Strength

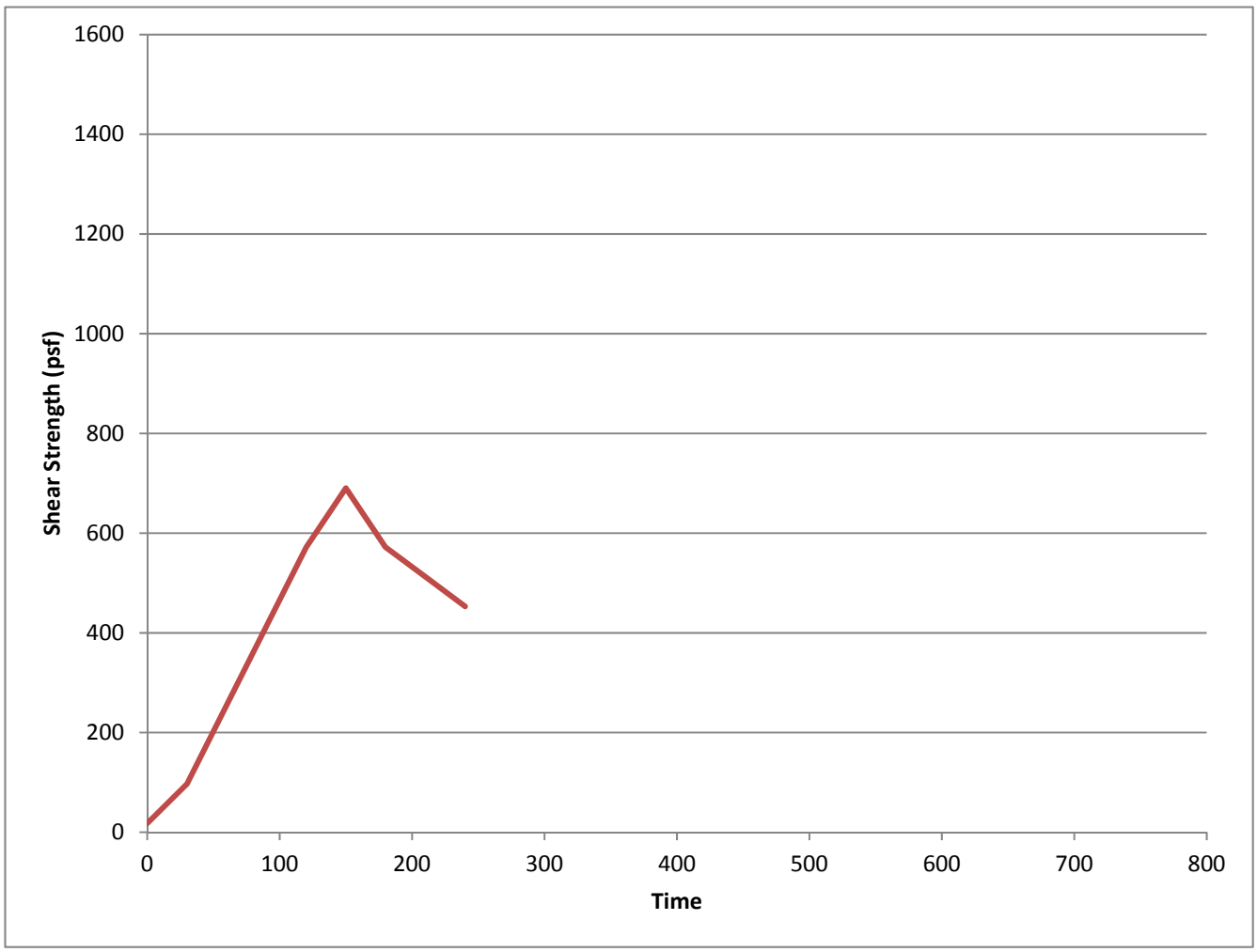
Location: IR02B603 **Max Shear** 73.28 kPa
Depth: 5 **Strength:** 1530.80 psf



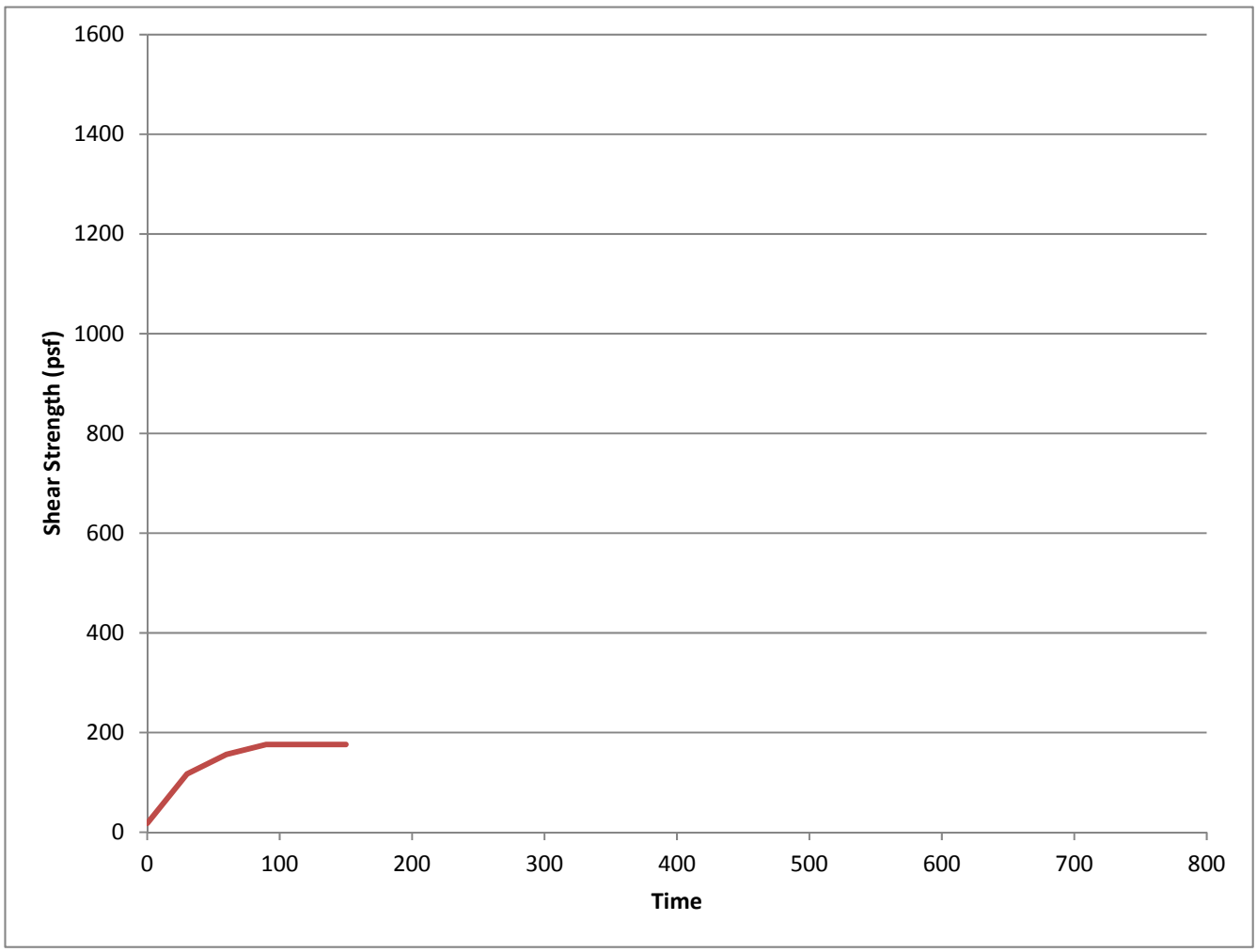
Location: IR02B603 **Max Shear** 7.96 kPa
Depth: 5 Remolded **Strength:** 166.26 psf



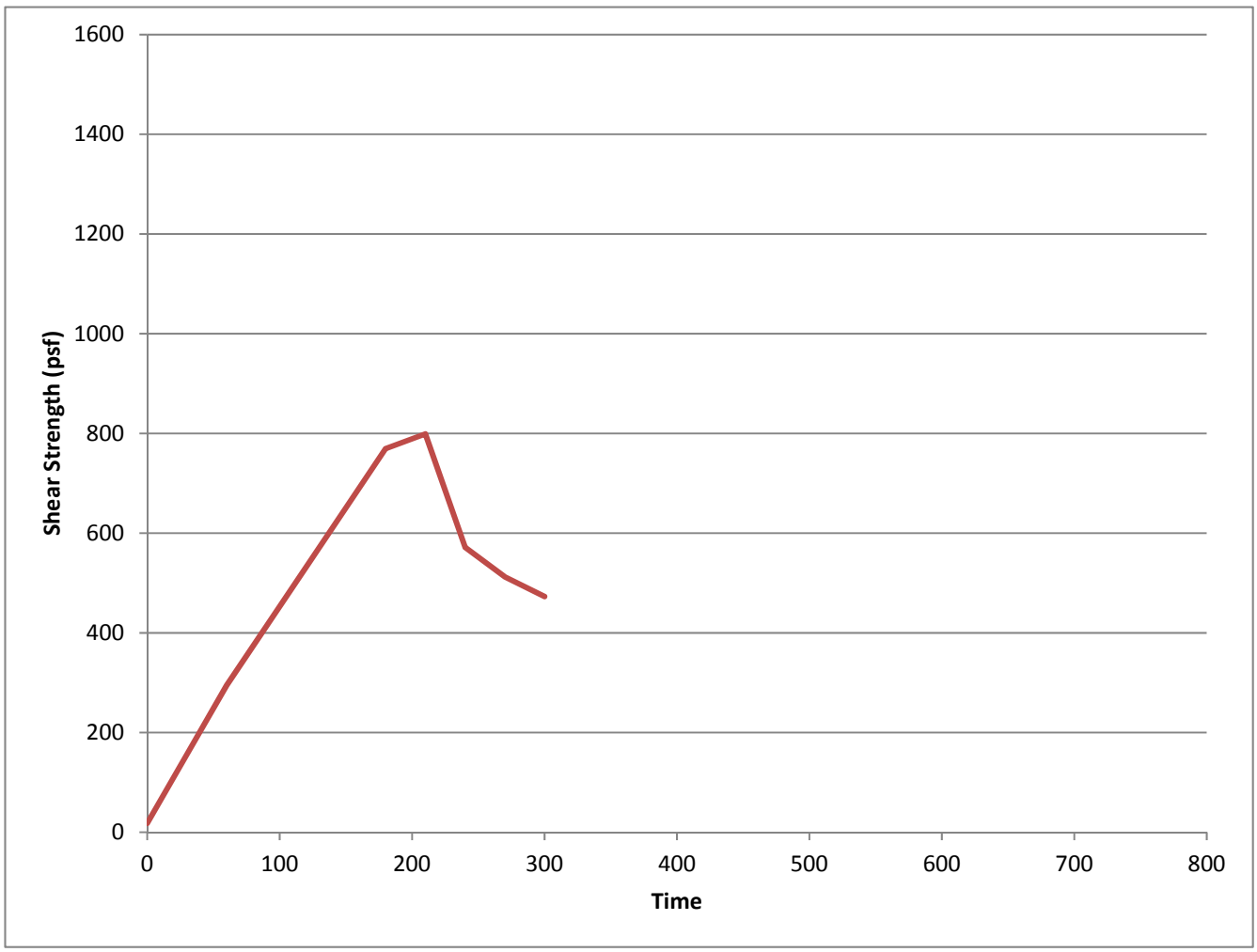
Location: IR02B603 **Max Shear** 33.05 kPa
Depth: 23 **Strength:** 690.32 psf



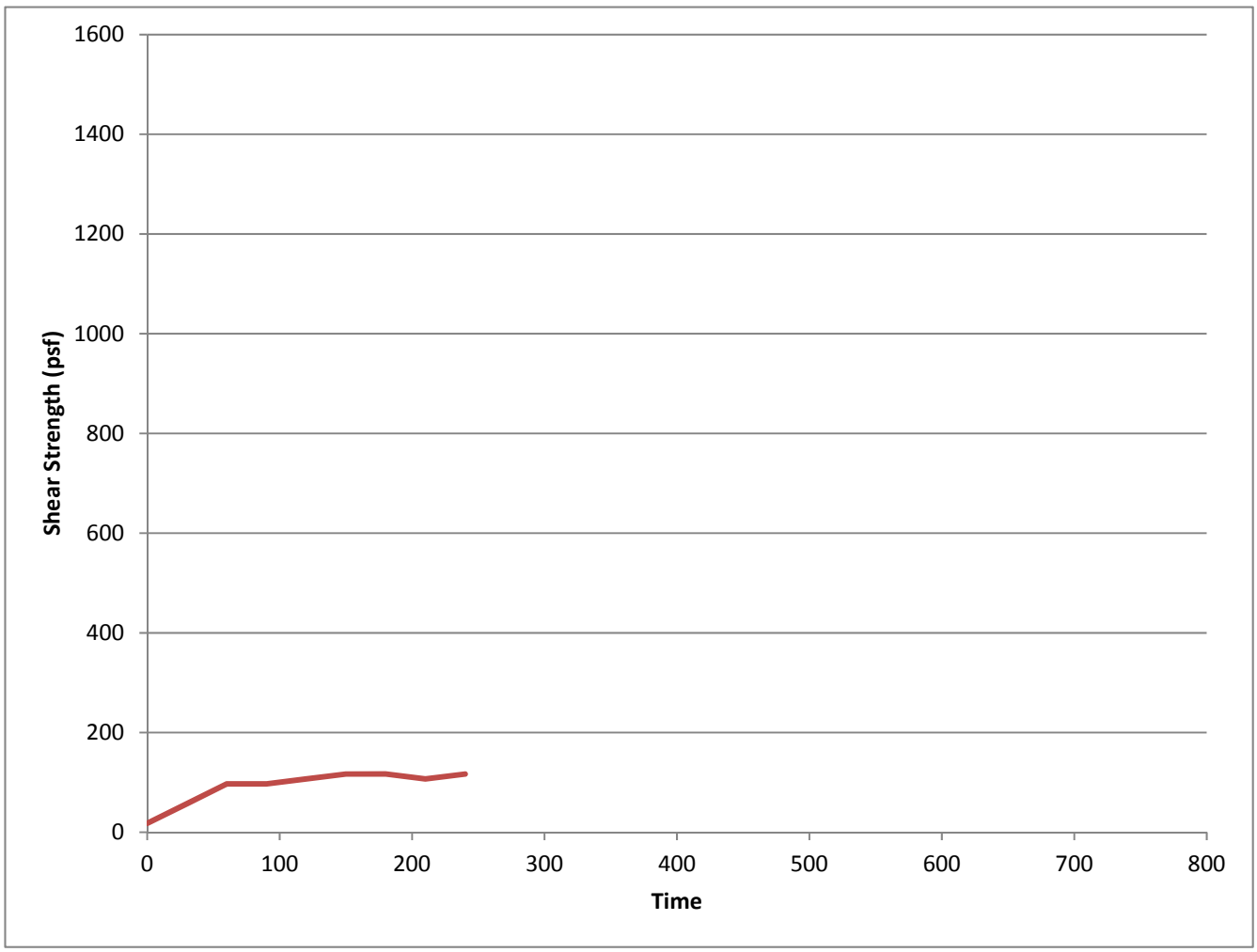
Location: IR02B603 **Max Shear** 8.43 kPa
Depth: 23 Remolded **Strength:** 176.15 psf



Location: IR02B603 **Max Shear** 38.25 kPa
Depth: 37 **Strength:** 799.09 psf

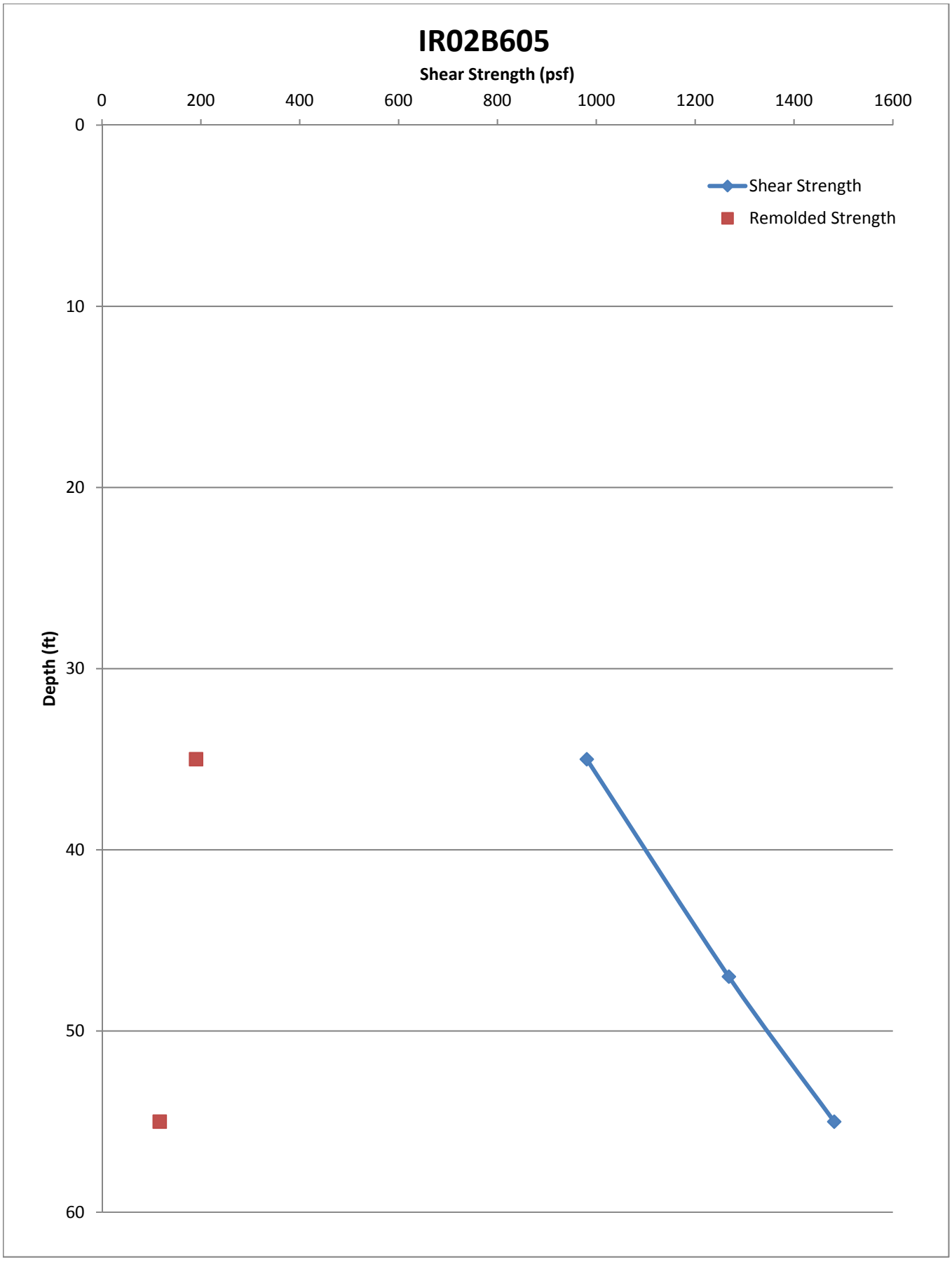


Location: IR02B603 **Max Shear** 5.59 kPa
Depth: 37 Remolded **Strength:** 116.82 psf

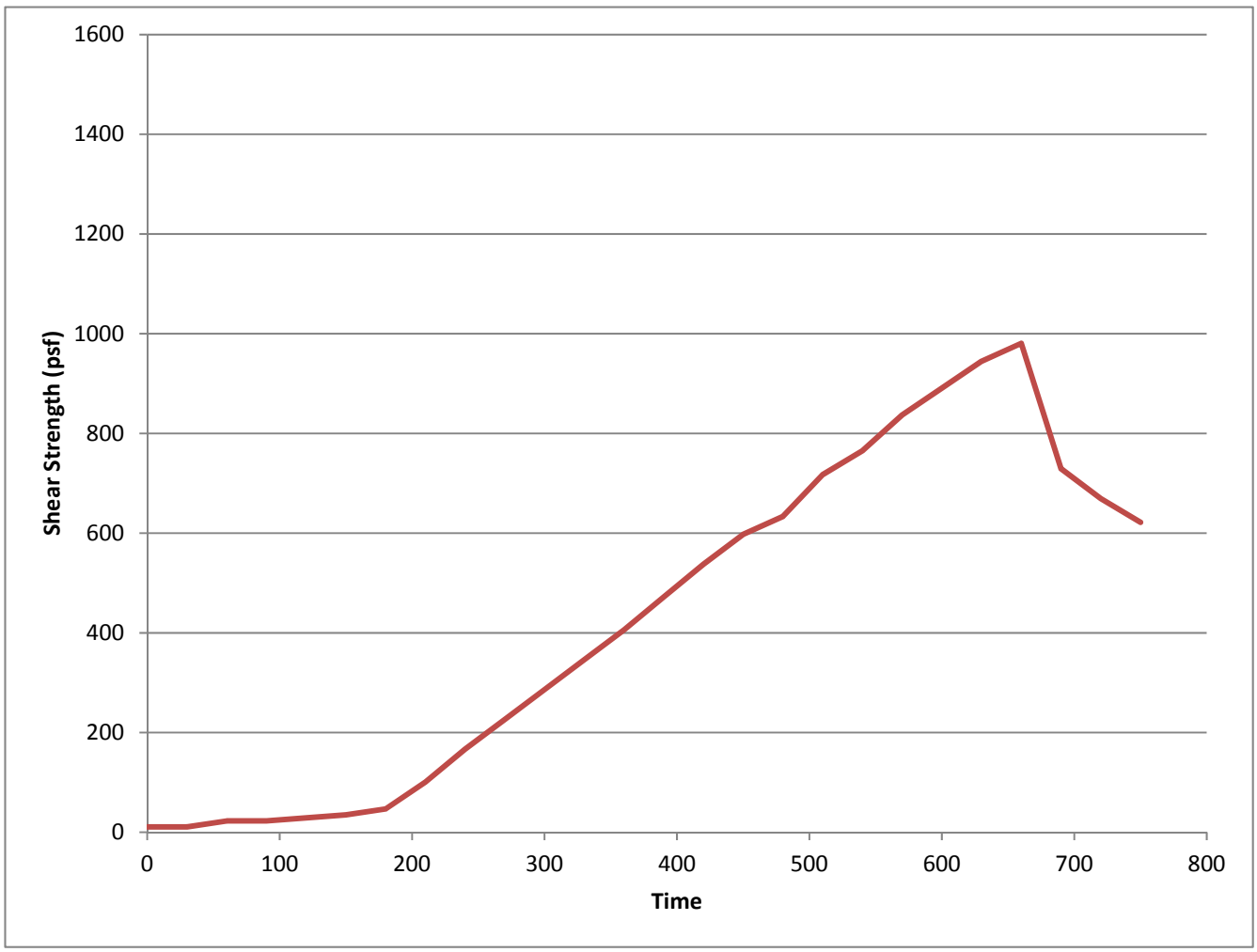


CLIENT	CES
SITE	Hunter's Point
LOCATION	IR02B605
VANE TYPE	Geonor H-10
VANE DIAMETER, d (mm)	65 & 55
VANE LENGTH, l (mm)	130 & 110

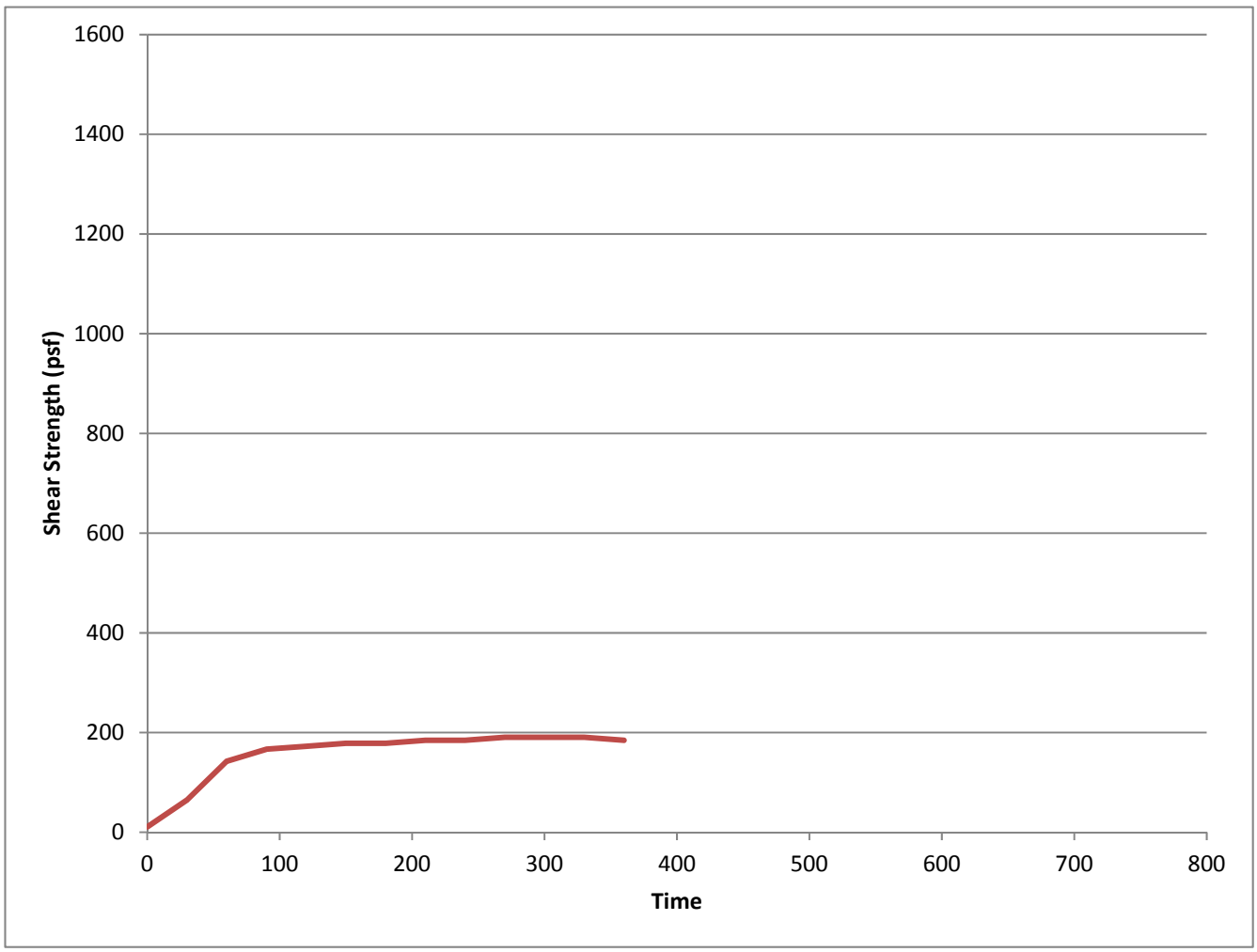
DEPTH	DEPTH	PEAK	SHEAR	SHEAR	REMOLDED			SENSITIVITY
					PEAK	SHEAR	SHEAR	
(m)	(ft)	(N)	(kPa)	(psf)	(N)	(kPa)	(psf)	
10.67	35.00	270.17	46.95	980.76	52.47	9.12	190.47	5.15
14.33	47.00	349.33	60.71	1268.14	MAX TORQUE APPLIED/ NO SHEAR			
16.77	55.00	247.08	70.91	1481.36	19.48	5.59	116.82	12.68


IR02B605
Shear Strength (psf)
0
200
400
600
800
1000
1200
1400
1600
Depth (ft)
0
10
20
30
40
50
60
Shear Strength
Remolded Strength

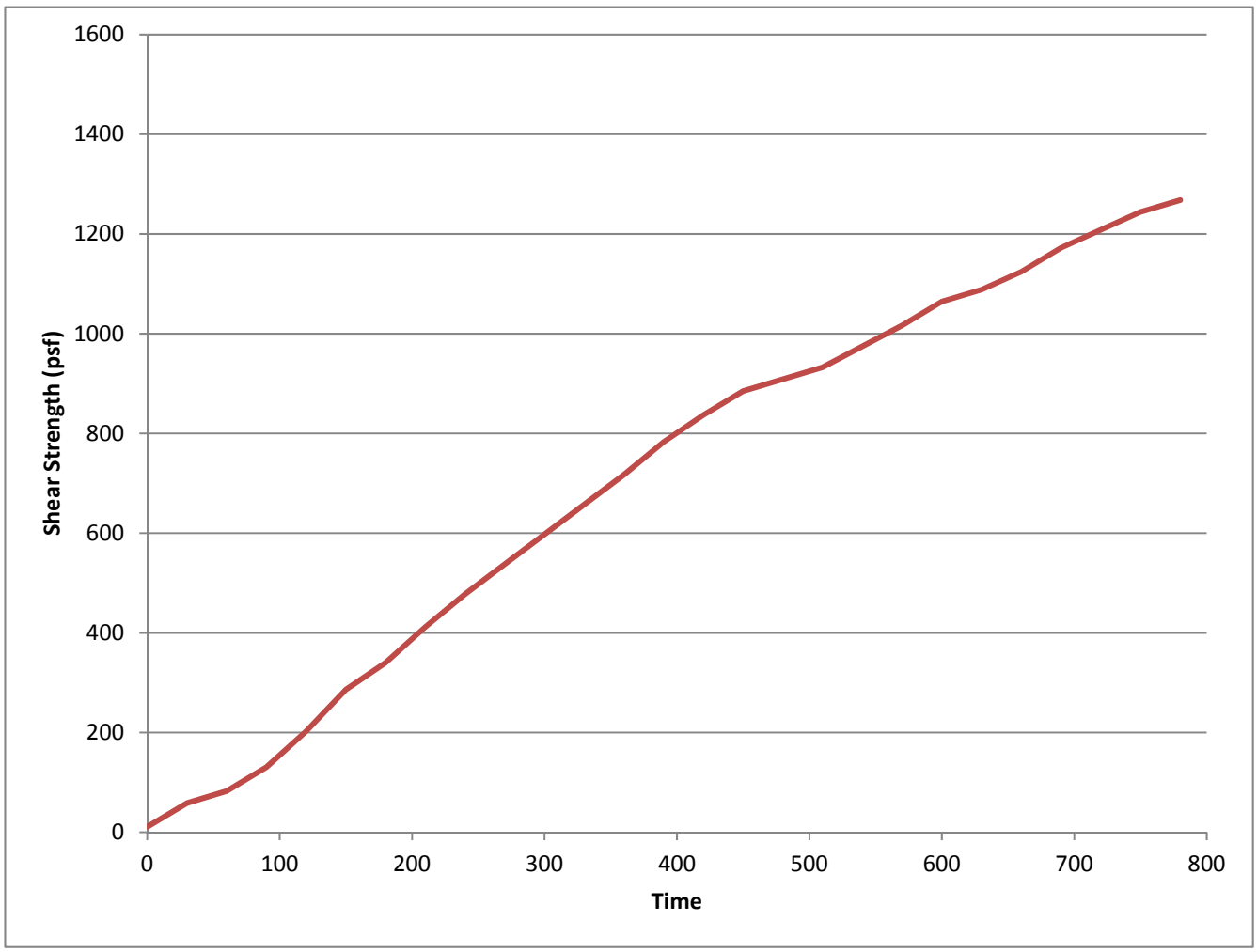
Location: IR02B605 **Max Shear** 46.95 kPa
Depth: 35 **Strength:** 980.76 psf



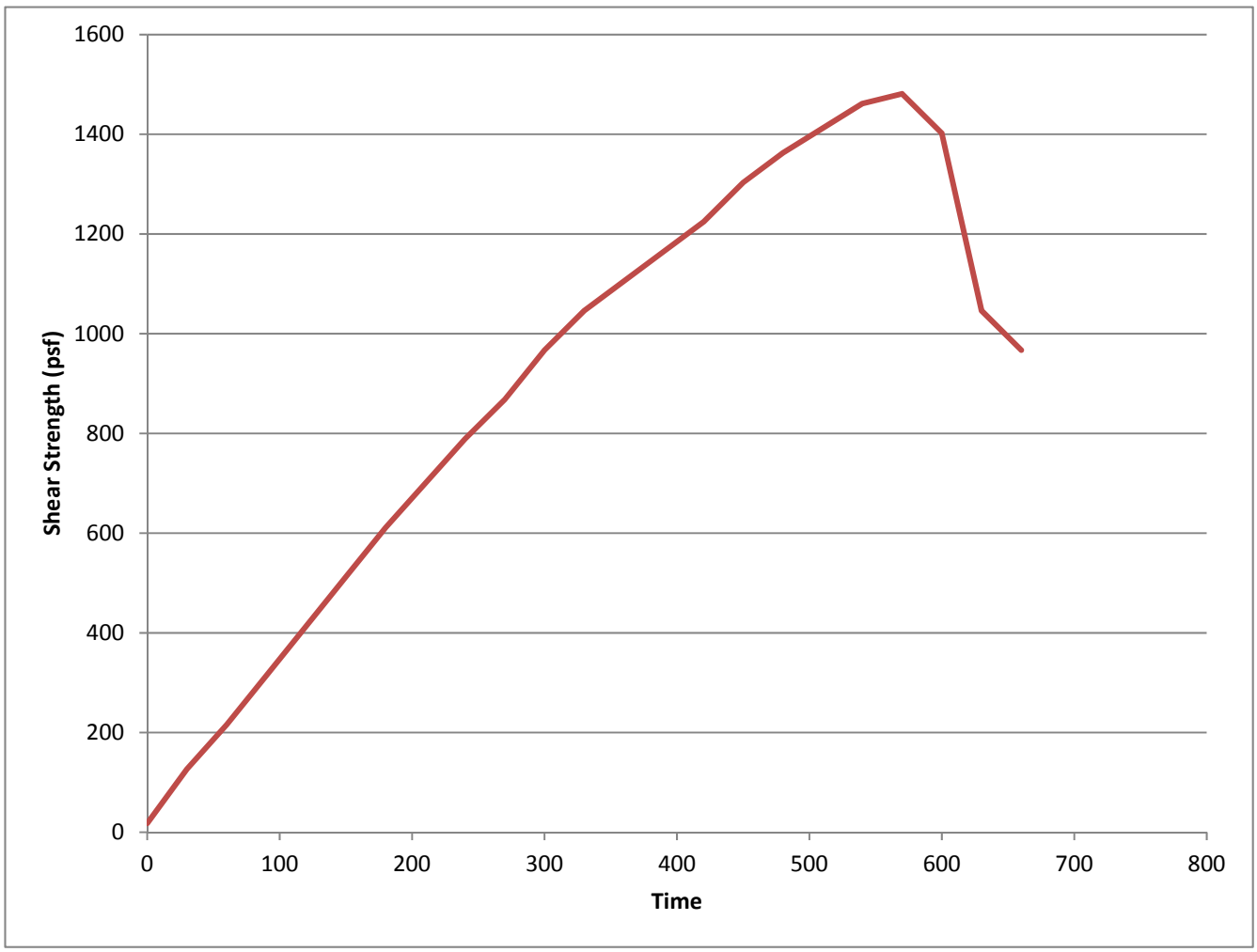
Location: IR02B605 **Max Shear** 9.12 kPa
Depth: 35 Remolded **Strength:** 190.47 psf



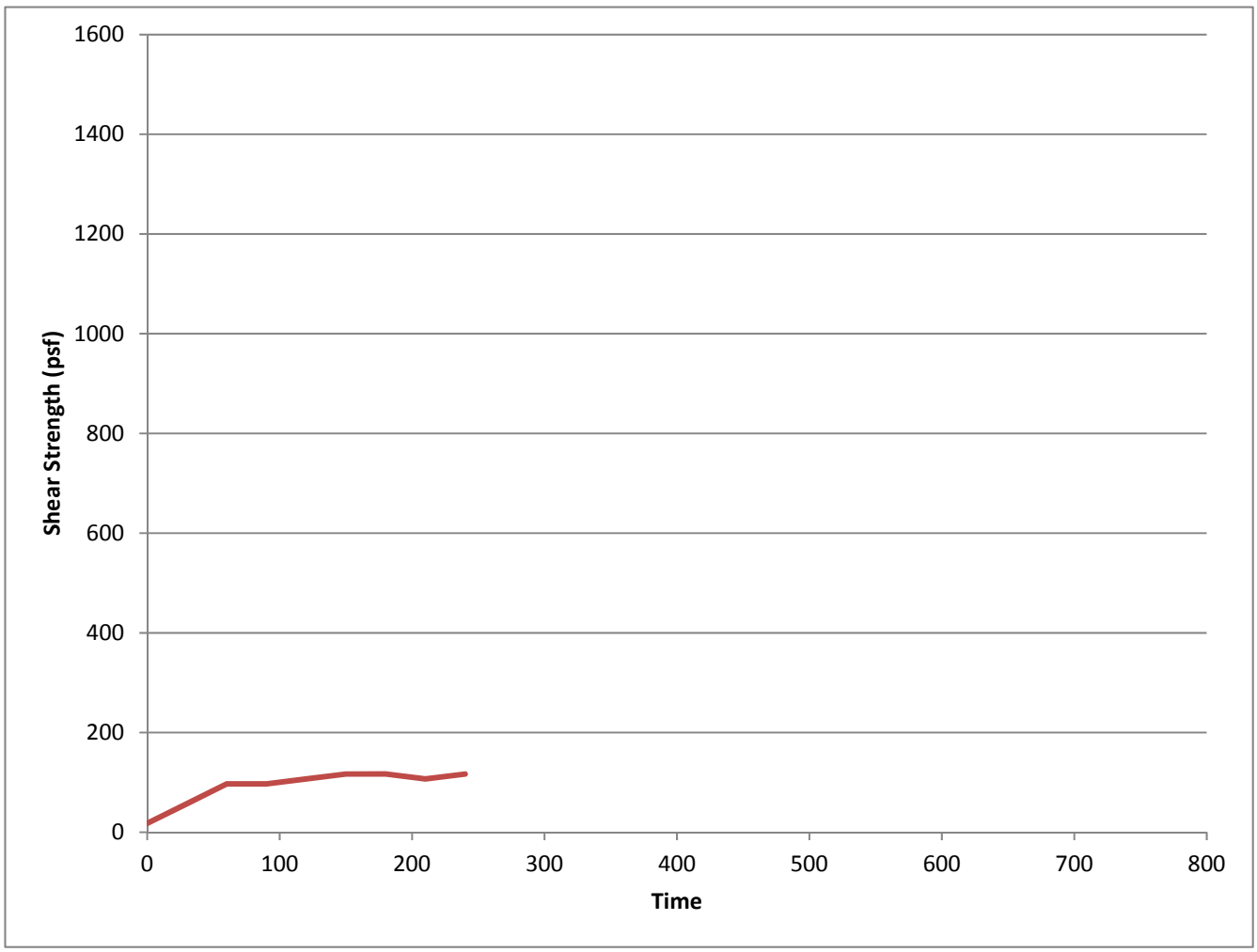
Location: IR02B605 **Max Shear** 60.71 kPa
Depth: 47 **Strength:** 1268.14 psf



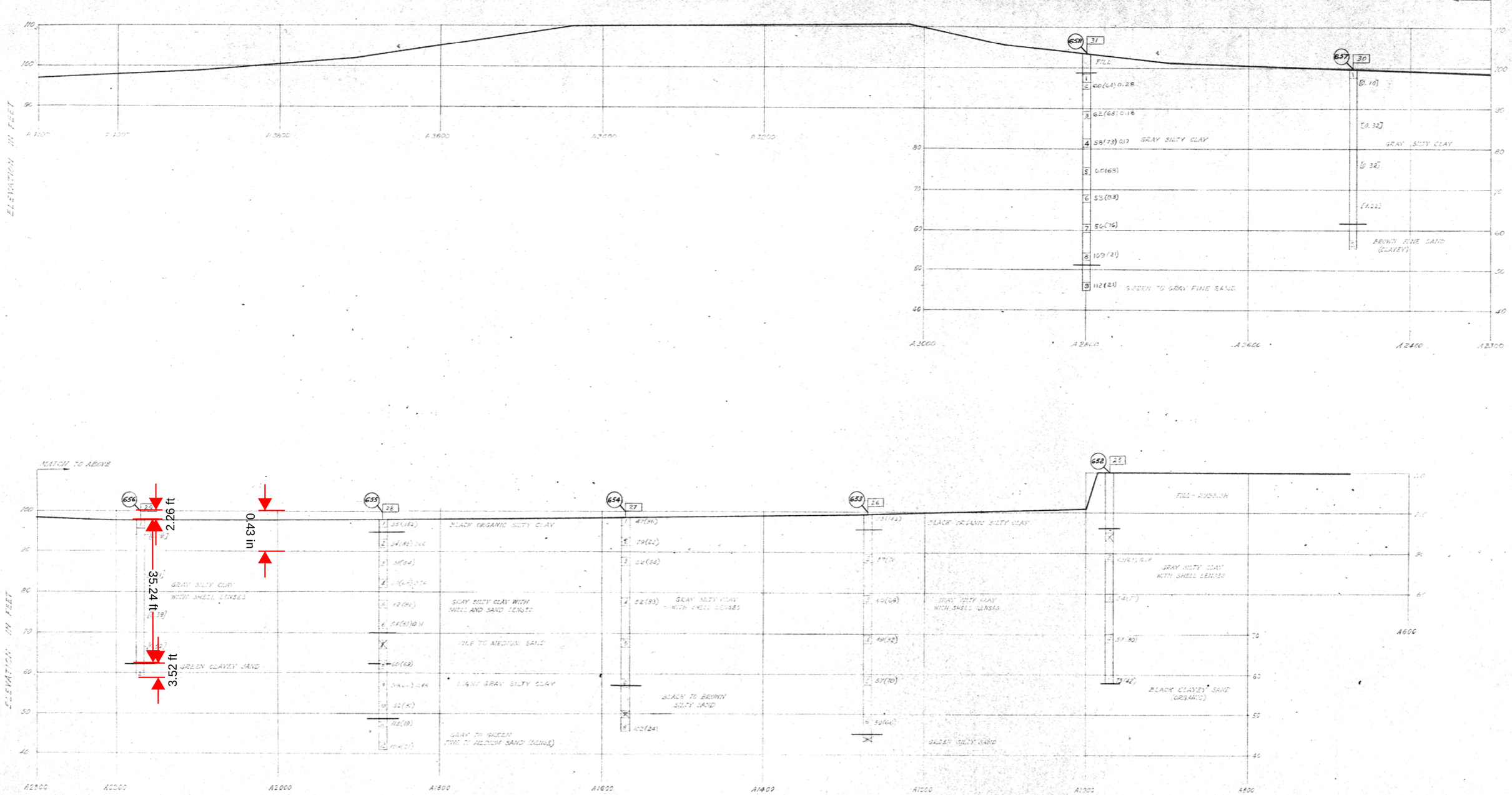
Location: IR02B605 **Max Shear** 70.91 kPa
Depth: 55 **Strength:** 1481.36 psf



Location: IR02B605 **Max Shear** 5.59 kPa
Depth: 55 Remolded **Strength:** 116.82 psf



Logs Used for Cross Section A-A'



SHIPYARD BORING NO.

630 — BORING NO.

CHANGE IN SOIL STRATA

SAMPLING DRIVE NO.

SAMPLE NOT RECOVERED

SOIL DENSITY - DRY UNIT WEIGHT (LBS/CU.FT.)

(60/20) Q - UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ.FT.)

MOISTURE CONTENT - PERCENT

(0.40) VANE SHEAR STRENGTH (TONS/SQ.FT.)

P.W. DWG. NO. 16026-120

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
DISTRICT PUBLIC WORKS OFFICE — 12TH ND SAN BRUNO, CALIF
PORTER, URQUHART, McCREARY & O'BRIEN
1140 HOWARD STREET — CONSULTING ENGINEERS — SAN FRANCISCO, CALIF

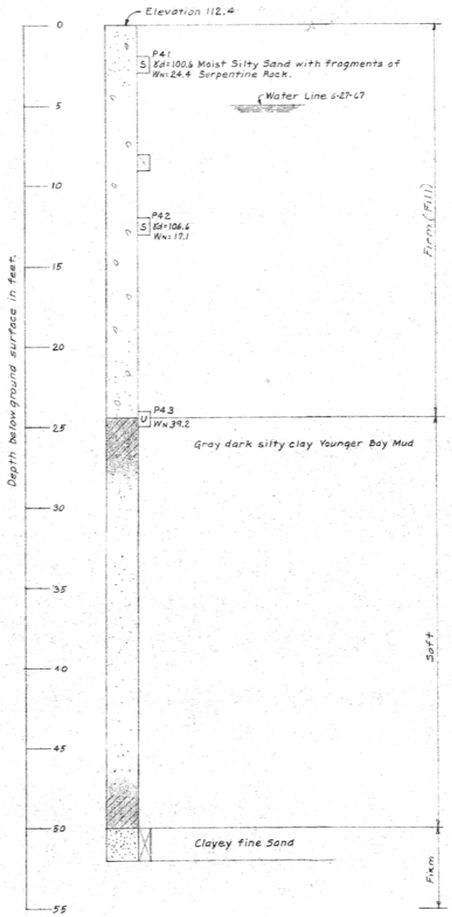
DESIGNED H.S.
DRAWN DWK
CHECKED H.W.O'B.
SUBMITTED
DIR. DES.
P&D OFF.

SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA
ADVANCE PLANNING
LAND EXCAVATION AND FILL
BORINGS 652 TO 658
SOIL BORING PROFILE

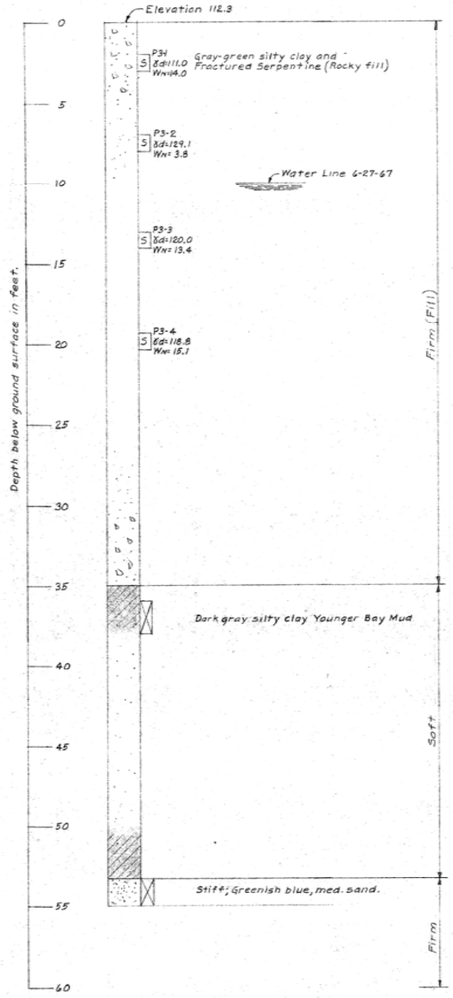
DPWO DRWG. NO. B-52921
APPROVED — DATE
DPWO FOR CHIEF OF BUREAU

SATISFACTORY TO — SIGNATURE — DATE — TITLE
SATISFACTORY TO — SIGNATURE — DATE — TITLE
SCALE — E.S.
SHEET A11 OF 16 — NB, 9325
Y B & D DRAWING NO.

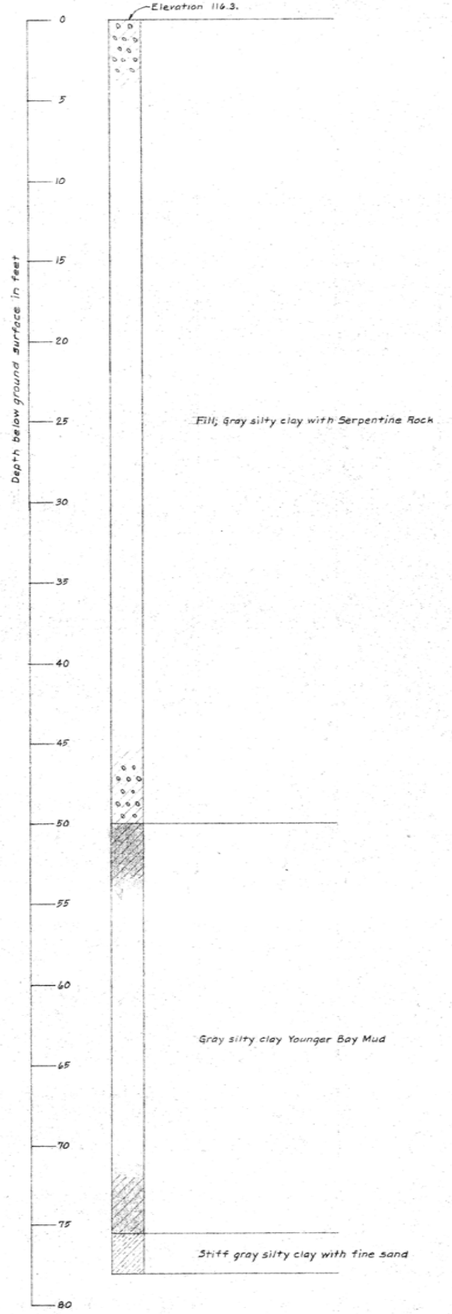
BORING No. 791
(Gribaldo & Associates #P4)



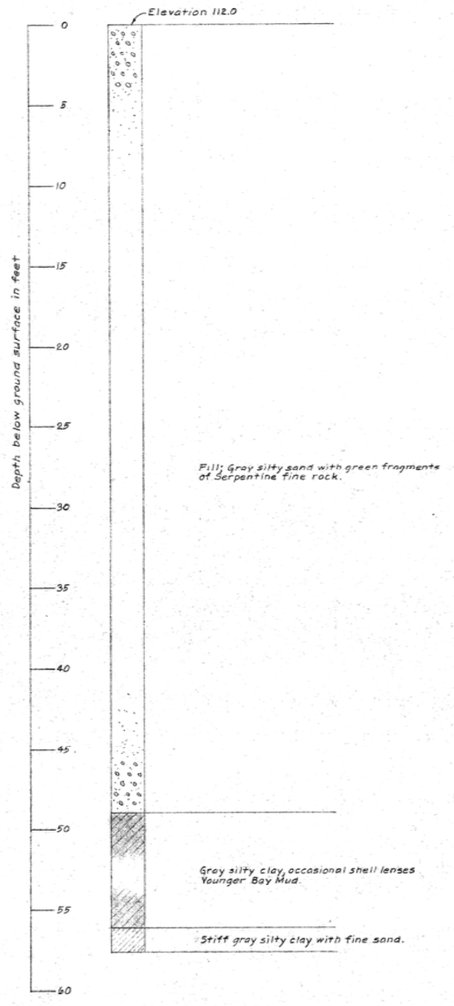
BORING No. 792
(Gribaldo & Associates #P3.)



BORING No. 793
(Gribaldo & Associates B1)



BORING No. 794
(Gribaldo & Associates B3)



LEGEND

N = blows per 12 inch (Using 140# Hammer, 30" Drop)
U = 2⅜" I.D. Shelby Tube Sampler
S = 2" I.D. Split-Spoon Sampler
☒ = Sample not recovered.
δd = Dry density (p.c.f.)
Wn = Natural Moisture Content, % of Dry Weight.
Au = Shear Strength, p.s.f. (Unconfined Confined Compression Tests)
(Au)vs 410/210 = Shear Strength, p.s.f. (Field Vane Shear Test) Max. Value / Remolded Value

GENERAL NOTES

1. Boring No. 791 Thru No. 794 made by Gribaldo, Jacobs, Jones & Associates during August 1967.
2. Boring No. 791 Thru No. 794 plotted from data shown on Gribaldo, Jacobs, Jones & Associates Dwgs Figure #1, 5, 6, and #7, 1 their File No. E 6414-51, Date of August 1967.

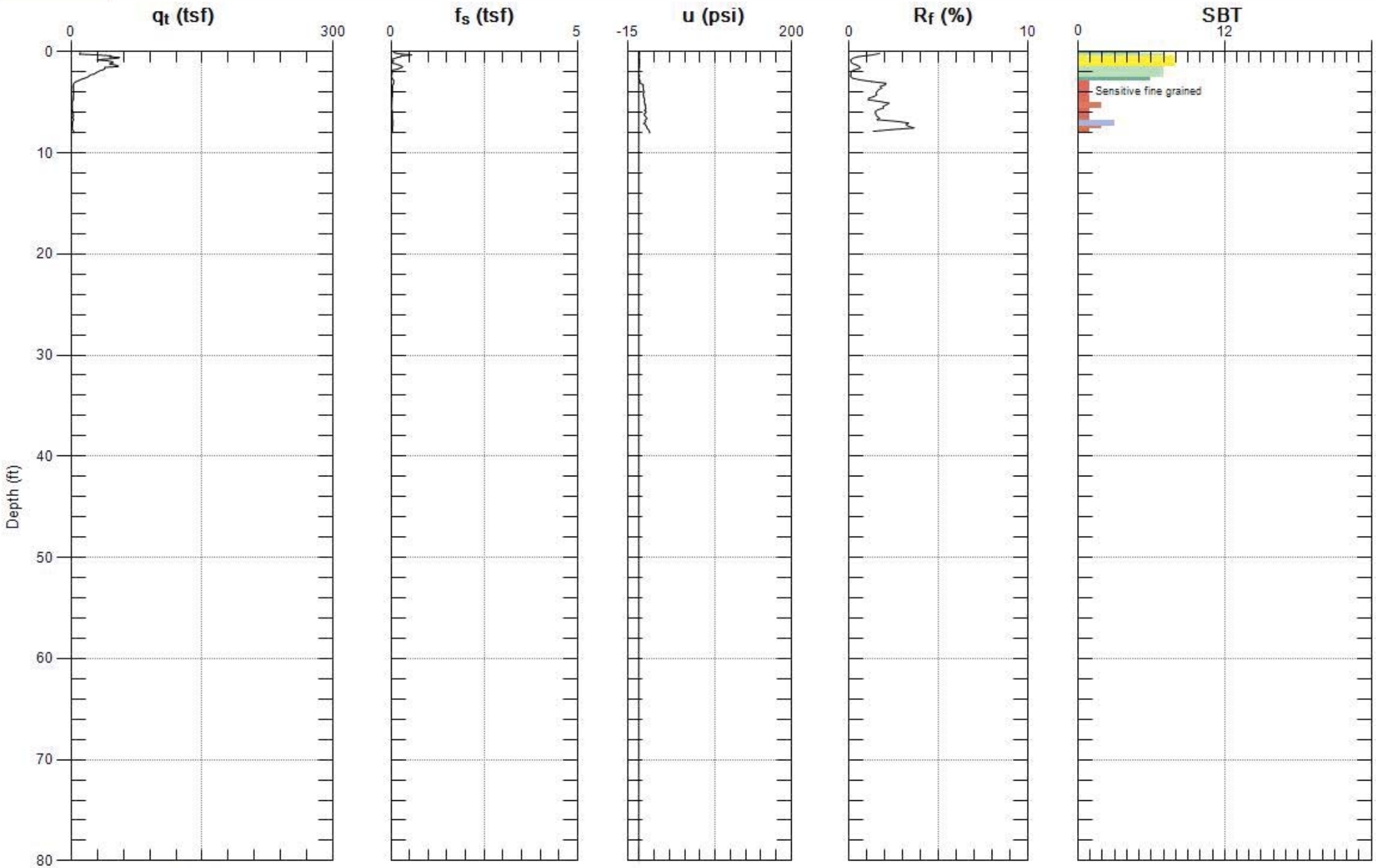
PWO DRAWING NO. 16026-140	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND	
DESIGN ORDER NO. 8.45	SAN FRANCISCO BAY NAVAL SHIPYARD, SAN FRANCISCO, CALIF.	
DRAWN BY Rafash / CHECKED BY	SEC. HD. / PROJ. SUPV. / DESIGN ENGR.	BORINGS 791 THRU 794
SATISFACTORY TO / DATE		
TITLE / APPROVED / DATE	SIZE F; CODE IDENT NO. 80091; NAVFAC DRAWING NO.; CONSTR. CONTR. NO.	
PUBLIC WORKS OFFICER	SCALE Vertical 1"=4'-0; SPEC.; SHEET 105 OF	

PRINTED ON KEUFFEL AND ESSER CO. MADE IN U.S.A.

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT54

Engineer: S.LEE
Date: 2/9/2015 09:00



Max. Depth: 8.038 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B601** Sheet 1 of 2	ERRG

Date (s) Drilled 2/26/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 33.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 3.46
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SP	POORLY GRADED SAND (SP): with seashells; gray; moist; fine grained; loose			
6		SPT		0		CL	SANDY LEAN CLAY (CL): with seashells and gravel; black; wet; very soft; high plasticity; fine to medium grained; odor			
7						CH	FAT CLAY (CH): grayish black; moist; very soft; high plasticity; trace seashells			
10		SH					--Black			Osterberg Pressure = 25 psi
11								74.1	55.4	0.1% gravel; 2.6% sand; 97.3% fines; LL = 77; PL = 34; PI = 43; Pp = ~1,000 psf
20		SH					--Black			Osterberg Pressure = 50 psi

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B601

ERRG

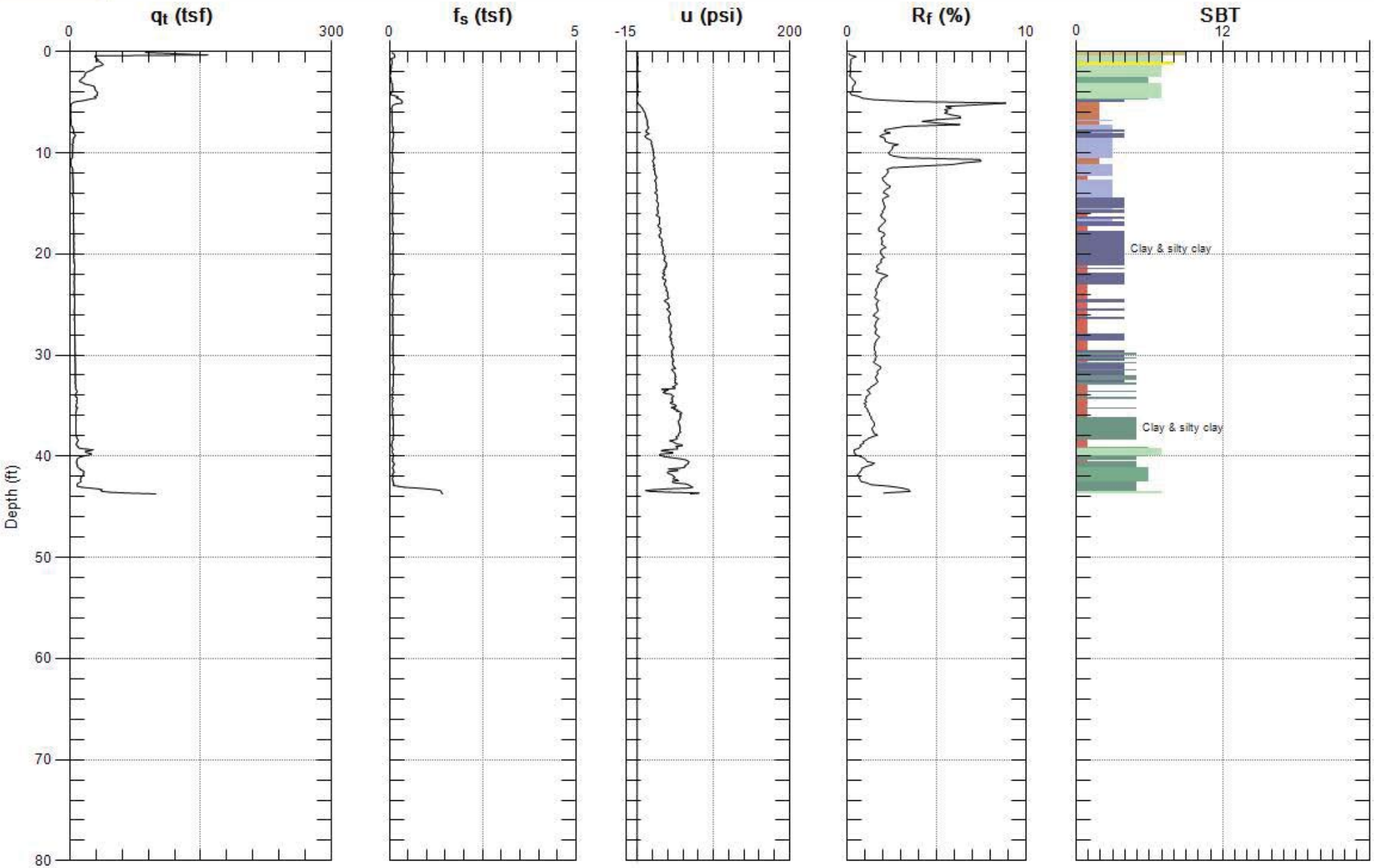
Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29										
30										
31		SH								Osterberg Pressure = 50 psi
32										
33							Bottom of boring at 33.0 feet			
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT53

Engineer: S.LEE
Date: 2/9/2015 09:36



Max. Depth: 43.717 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B600** Sheet 1 of 2	ERRG

Date (s) Drilled 3/3/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 45.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 12.67
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	SILTY SAND WITH GRAVEL (SM): brown; dry to moist; stiff; fine to medium grained sand; moderately graded			
5		SPT		14			--Dark brown to reddish brown, dry, low plasticity fines, medium dense, medium grained sand	13.3		36.7% gravel; 44.7% sand; 18.6% fines
9		SPT		9			--No Recovery, loose			
14		SPT		10			--Wet, loose, medium to coarse grained, angular gravel (1/2 - 1" dia.), trace wood debris			
19		SPT		5			--No Recovery (trace wood debris in sand catcher), loose			
23		SH					--No Recovery			Osterberg Pressure = 500 psi

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B600

ERRG

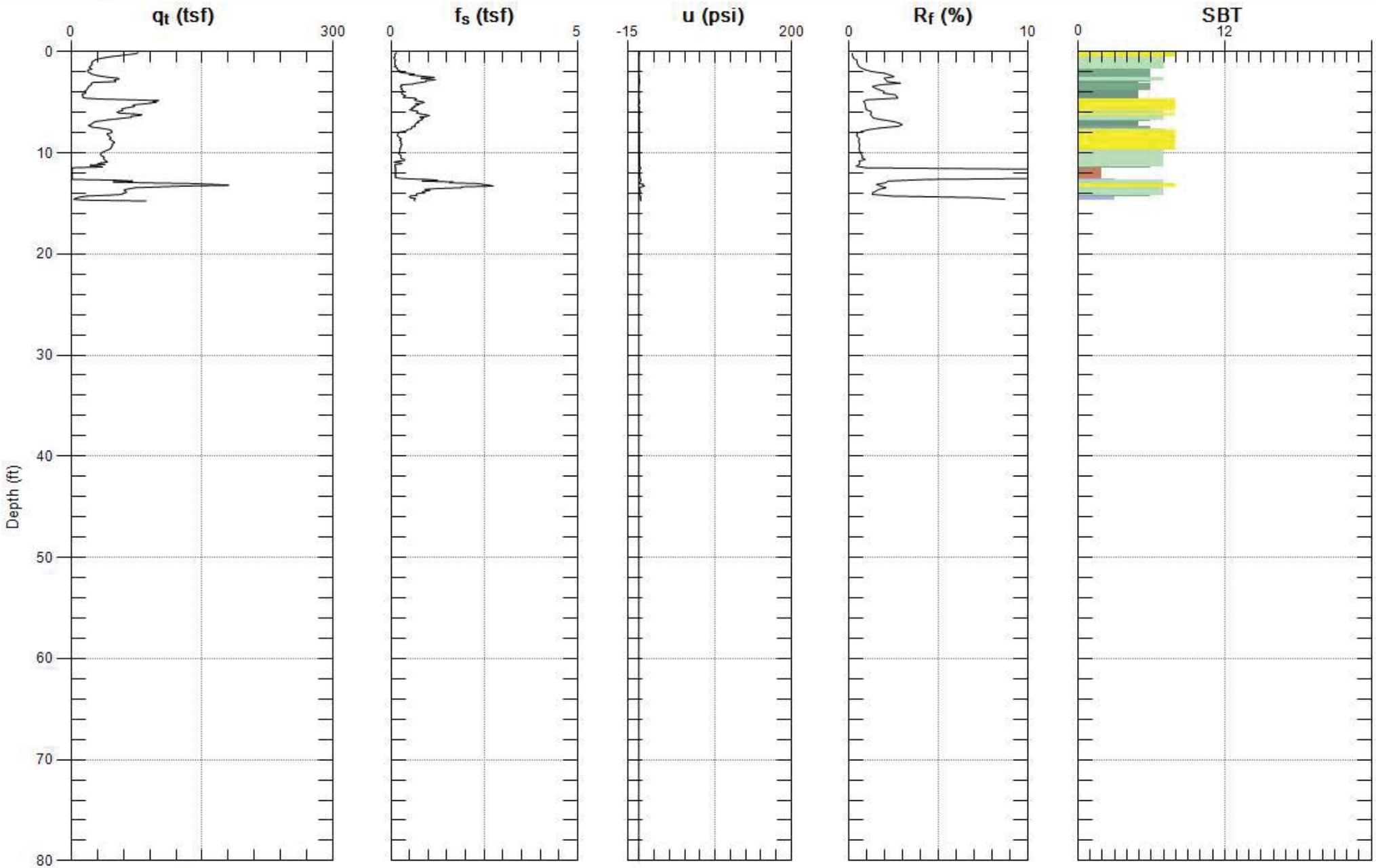
Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): black/gray; moist; firm; high plasticity			
27										
28		SH								Osterberg Pressure = 400 psi
29										
30										
31										
32										
33		SH					--20% seashells, moist to wet			Osterberg Pressure = 175 psi
34										
35										
36										
37										
38										
39										
40										
41										
42										
43		SH								Osterberg Pressure = 400 psi
44										
45							Bottom of boring at 45.0 feet			
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52A

Engineer: S.LEE
Date: 2/5/2015 08:48



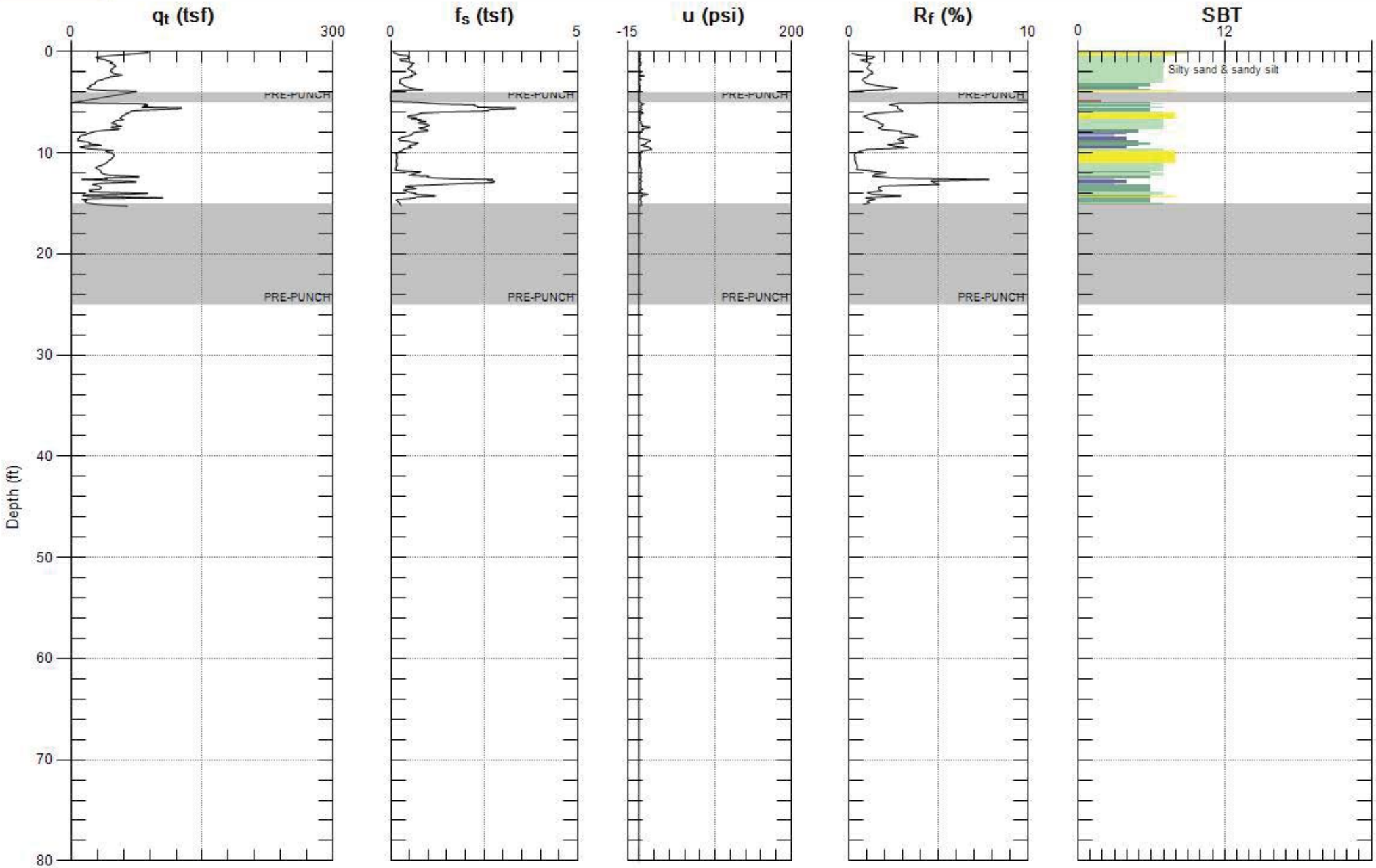
Max. Depth: 14.764 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52B

Engineer: S.LEE
Date: 2/5/2015 09:35



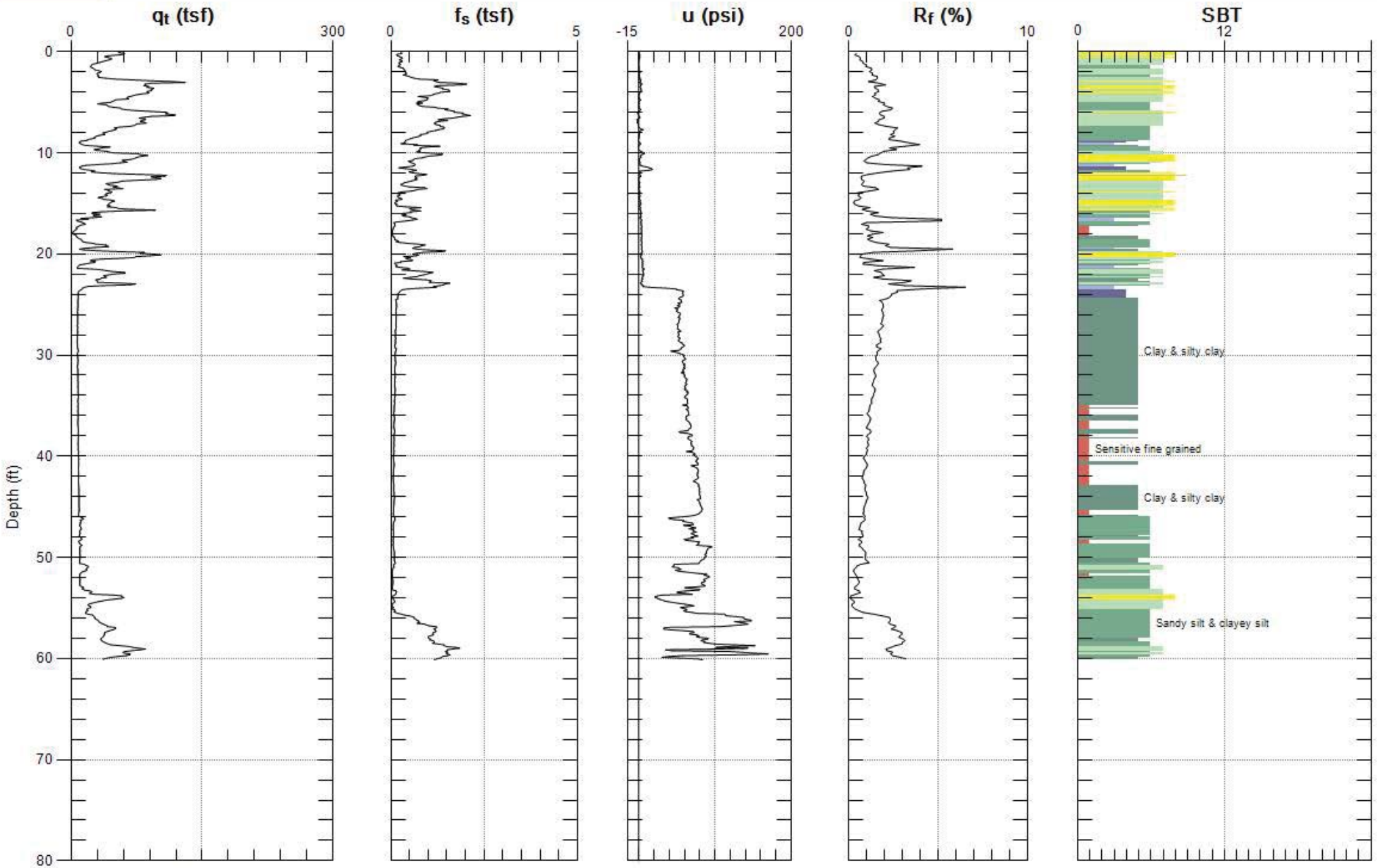
Max. Depth: 15.256 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

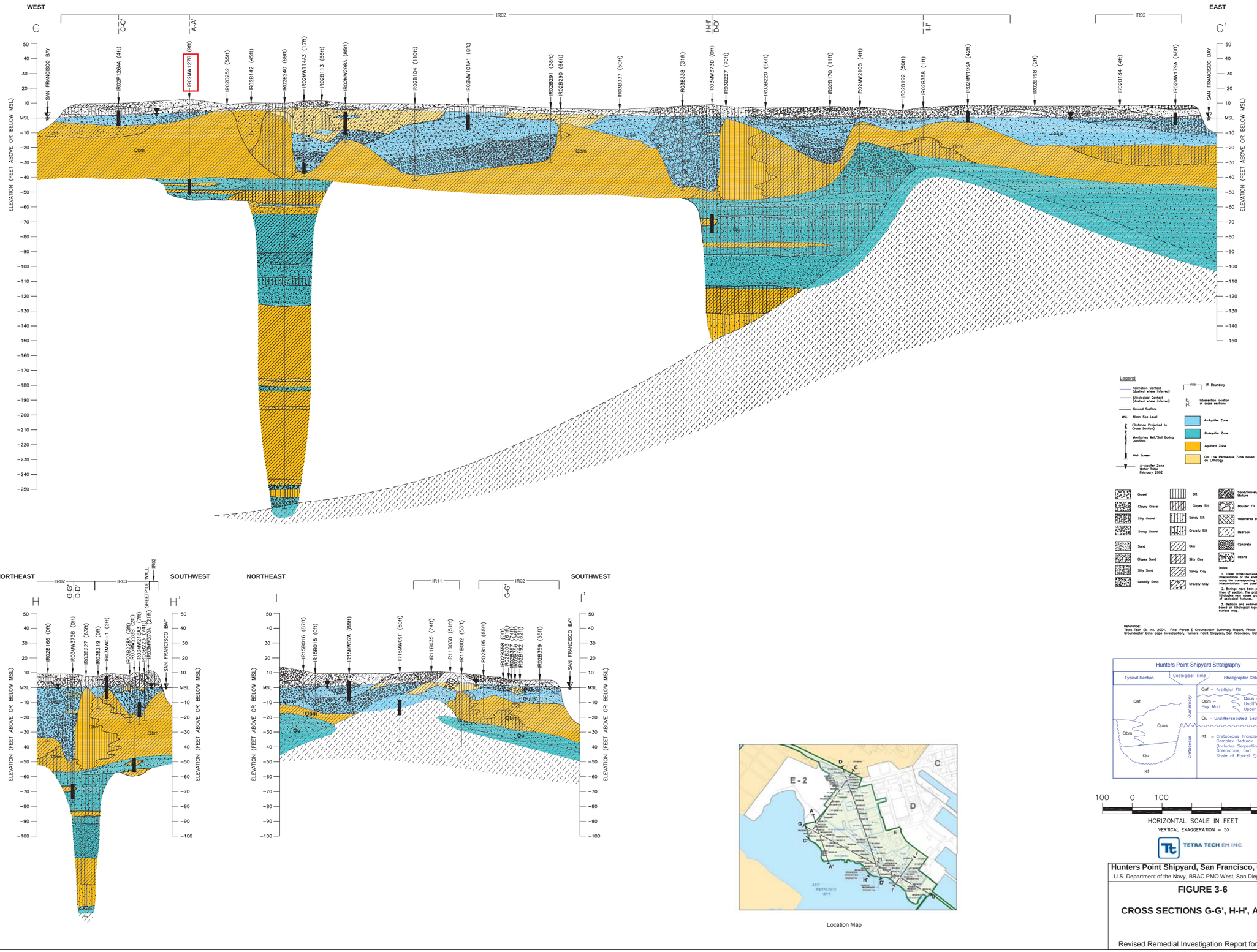
Site: HUNTERS PT PAR.E
Sounding: IRO2CPT52C

Engineer: S.LEE
Date: 2/5/2015 10:56

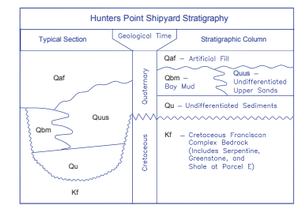


Max. Depth: 60.121 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)



Location Map



100 0 100 500

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 5X

TETRA TECH EM INC.

Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 3-6

CROSS SECTIONS G-G', H-H', AND I-I'

Revised Remedial Investigation Report for Parcel E

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B604** Sheet 1 of 2	ERRG

Date (s) Drilled 3/10/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 46.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 11.63
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1						SM	SILTY SAND WITH GRAVEL (SM): olive brown; moist; moderate to course grained; loose; moderately graded			
2										
3		MC		13		CL-ML	SILTY CLAY WITH SAND (CL-ML): dark brown; moist; fine grained sand; stiff; moderate to low plasticity; grace 1/8" and 1/4" gravel			
4										
5										
6										
7										
8		SPT		2		CH	FAT CLAY (CH): grayish black; moist; very soft; high plasticity; trace seashells			
9										
10										
11										
12		SH								Osterberg Pressure = 75 psi
13										
14										
15										
16										
17										
18		SPT		0			--Increased Seashells (10%)			
19										
20										
21										
22										
23		SPT		0						
24							--5-10% seashells			
25										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B604

Sheet 2 of 2

ERRG

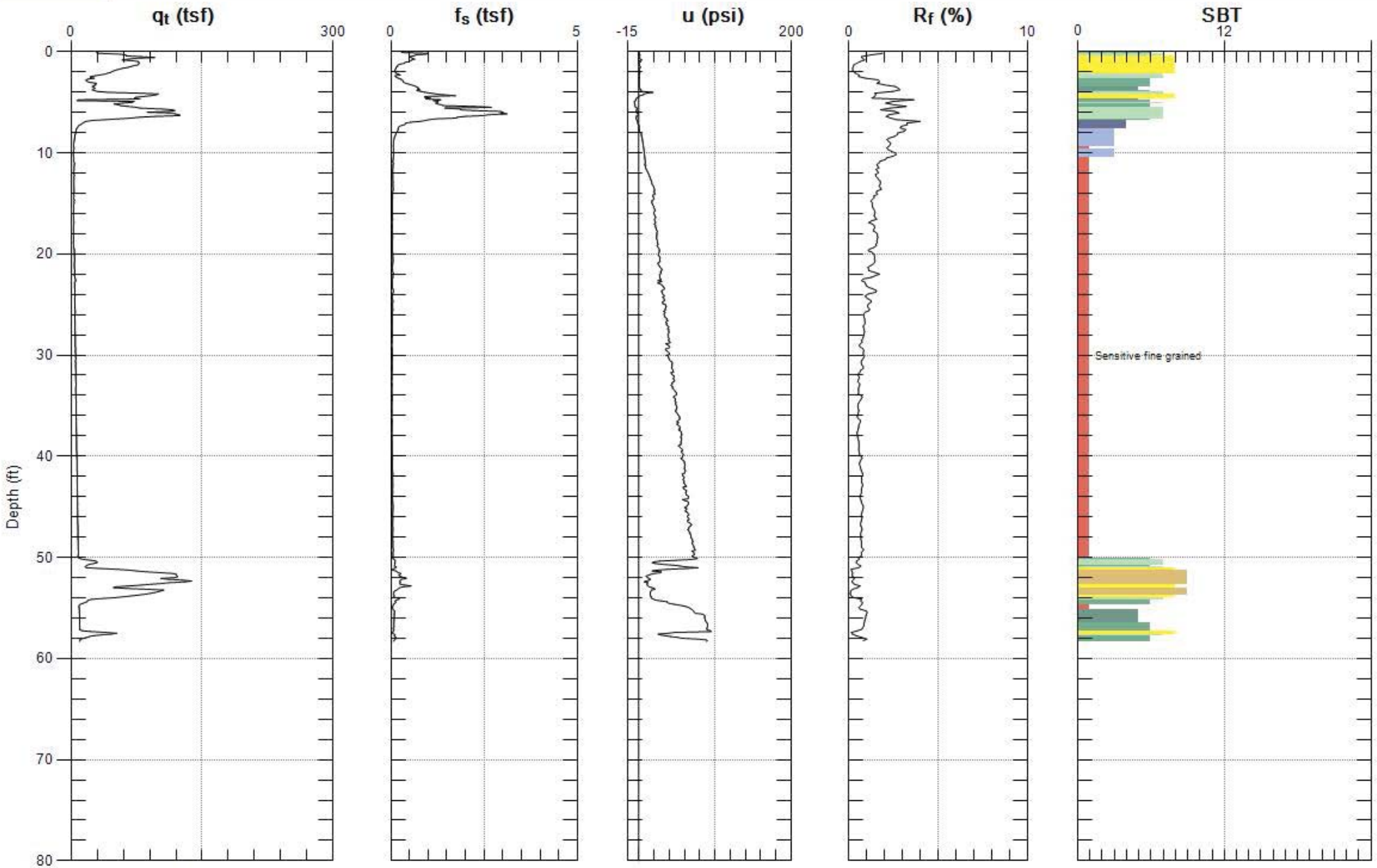
Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28		SH								Osterberg Pressure = 115 psi
29										
30										
31										
32										
33										
34		SPT		0			--<1% seashells; organic odor			
35										
36										
37										
38										
39		SPT		0			--<1% seashells; organic odor			
40										
41										
42										
43										
44		SH								Osterberg Pressure = 75 psi
45										
46										
47							Bottom of boring at 46.0 feet			
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT65

Engineer: S.LEE
Date: 2/2/2015 01:38



Max. Depth: 58.317 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Logs Used for Cross Section B-B'

ELEVATION IN FEET

MATCH TO ABOVE

656 29 — [0.9] — [0.31] GRAY SILTY CLAY WITH SHELL LENSES — [0.39] — [9.52] GREEN CLAYEY SAND

655 28 — 1 35(182) — 2 34(89) SLC — 3 54(84) — 4 (4+2) CLAY — 5 42(94) — 6 54(53) SILT — 7 60(68) — 8 SAND 9 CLAY — 9 92(42) — 10 113(19) — 11 (19+21) — BLACK ORGANIC SILTY CLAY — GRAY SILTY CLAY WITH SHELL AND SAND LENSES — FINE TO MEDIUM SAND — LIGHT GRAY SILTY CLAY — GRAY TO GREEN FINE TO MEDIUM SAND (SHELL)

654 27 — 1 47(96) — 2 79(21) — 3 52(84) — 4 52(93) — 5 102(24) — BLACK ORGANIC SILTY CLAY — GRAY SILTY CLAY WITH SHELL LENSES — BLACK TO BROWN SILTY SAND

653 26 — 1 51(142) — 2 47(74) — 3 60(106) — 4 49(92) — 5 57(70) — 6 50(66) — BLACK ORGANIC SILTY CLAY — GRAY SILTY CLAY WITH SHELL LENSES — GREEN SILTY SAND

652 25 — FILL - RUBBISH — GRAY SILTY CLAY WITH SHELL LENSES — BLACK CLAYEY SAND (ORGANIC)

A2800 A2600 A2400 A2200 A2000 A1800 A1600 A1400 A1200 A1000 A800 A600

B 2500 LINE

658 31 — 4.76 ft — 6.45 ft — F.

1 2 CC(64) 0.28 — 3 62(68) 0.18 — 4 58(78) 0.17 GRAY SILTY CLAY — 5 60(68) — 6 53(88) — 7 56(76) — 8 (21) — 9 112(2 GREEN TO GRAY FINE SAND

10.04 ft — 47.04 ft — 6.34 ft

657 30 — [0.10] — [0.32] GRAY SILTY CLAY — [0.32] — [1.22] BROWN FINE SAND (CLAYEY)

A3000 A2800 A2600 A2400 A2200

SHIPYARD BORING NO.

630 3 — BORING NO. — CHANGE IN SOIL STRATA — SAMPLING DRIVE NO. — SAMPLE NOT RECOVERED — SOIL DENSITY - DRY UNIT WEIGHT (LBS/CU.FT.) — (20/20) Q - UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ.FT.) — MOISTURE CONTENT - PERCENT — (0.40) VANE SHEAR STRENGTH (TONS/SQ. FT.)

P.W. DWG. NO. 16026-120

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
DISTRICT PUBLIC WORKS OFFICE — 12TH ND SAN BRUNO, CALIF.
PORTER, URQUHART, McCREARY & O'BRIEN
1140 HOWARD STREET — CONSULTING ENGINEERS — SAN FRANCISCO, CALIF.

DESIGNED H.S.
DRAWN DWK
CHECKED H.W.O'B.
SUBMITTED
DIR.DES.
P.&D. OFF.

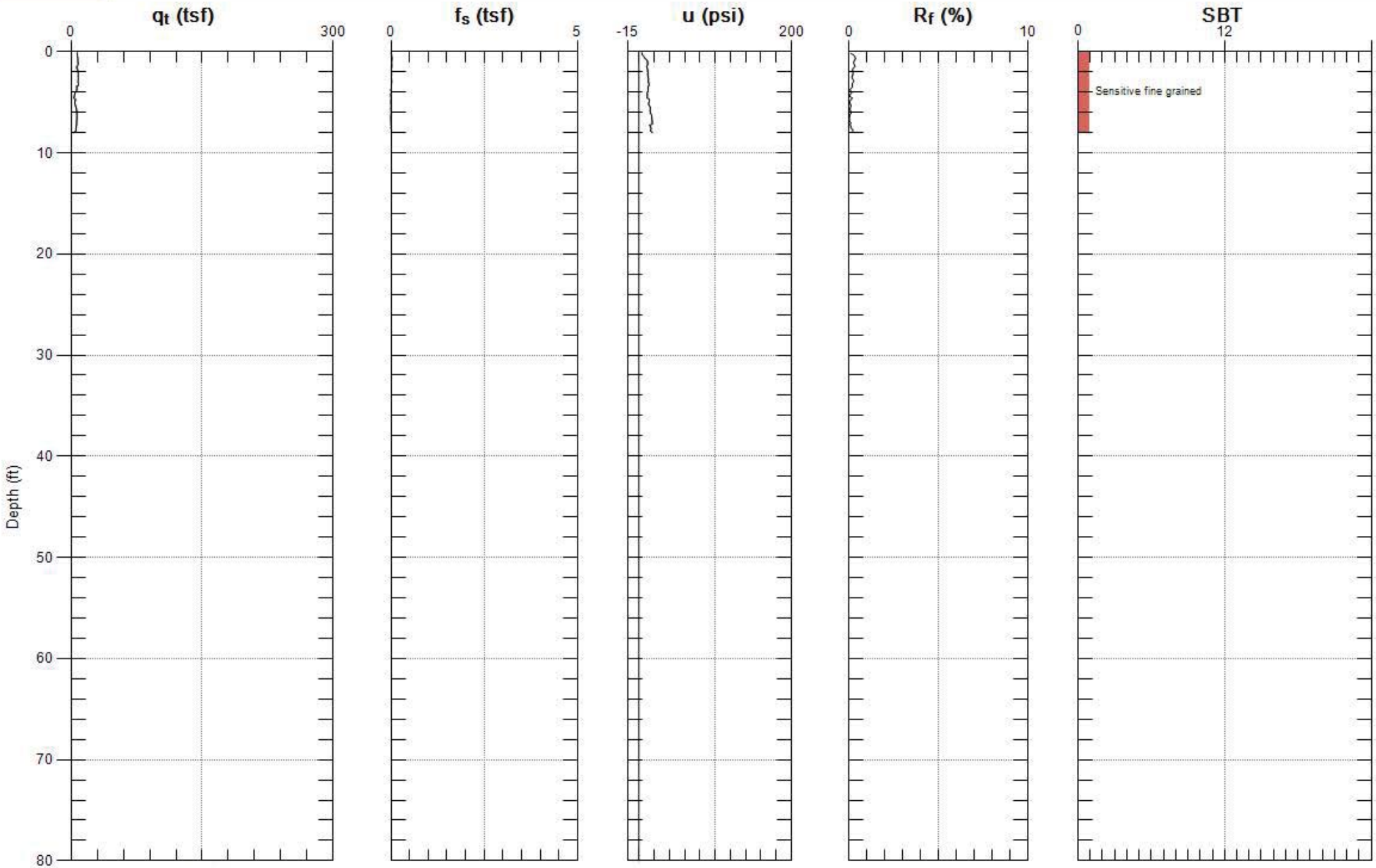
SAN FRANCISCO NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA
ADVANCE PLANNING
LAND EXCAVATION AND FILL
BORINGS 652 TO 658
SOIL BORING PROFILE

DPWO DRWG. NO. B-52921
APPROVED — DATE
DPWO FOR CHIEF OF BUREAU

SATISFACTORY TO — SIGNATURE — DATE — TITLE
SATISFACTORY TO — SIGNATURE — DATE — TITLE
SCALE — E.S.
SHEET A11 OF 16 — NO. 9325
Y & D DRAWING NO.

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT59
Engineer: S.LEE
Date: 2/10/2015 09:21



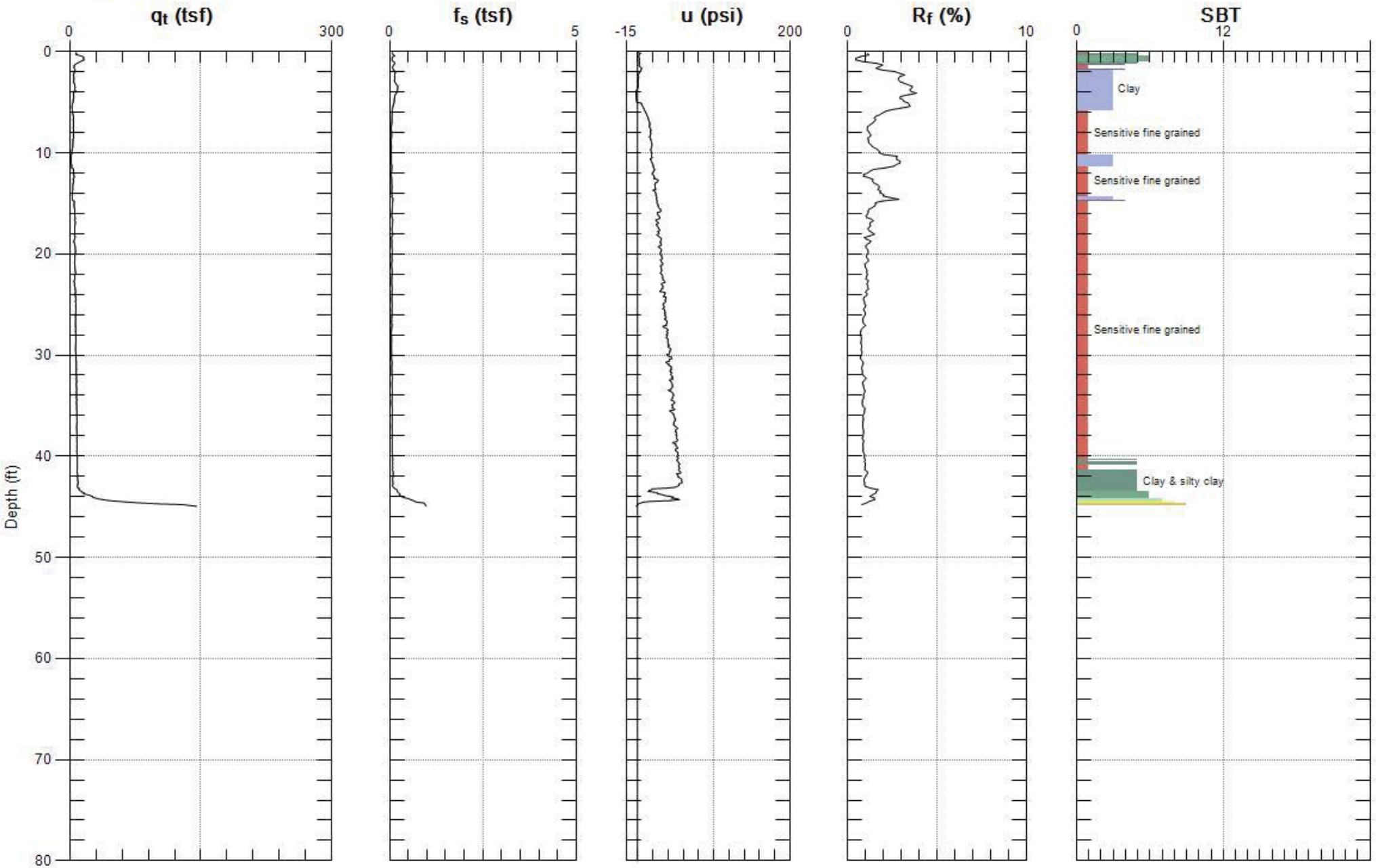
Max. Depth: 8.038 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT58

Engineer: S.LEE
Date: 2/10/2015 09:48



Max. Depth: 44.948 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B603** Sheet 1 of 2	ERRG

Date (s) Drilled 2/25/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 37.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 3.57
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1						SP	POORLY GRADED SAND (SP): brownish gray; dry; fine grained; very loose			
2		SH				GC	CLAYEY GRAVEL WITH SAND (GC): black; soft; high plasticity; trace seashells (10%)	41.9		Osterberg Pressure = 200 psi 35.4% gravel; 29.6% sand; 35% fines;LL = 56; PL = 25; PI = 31
5						CH	FAT CLAY (CH): high plasticity; with seashells			V.S. @ ~5 feet (ft) Su = 1,530.8 psf, Su,r = 166.26 psf
17							--Very soft			
20		SH						65.5	60.3	Osterberg Pressure = 100 psi 0% gravel; 10.8% sand; 89.2% fines; LL = 67; PL = 31; PI = 36; Pp = ~1,500 psf; Phi = 13.1°; c = 200 psf; m/c (%) / Dry Unit Weight (pcf), 66.3 / 60.8, 65.4 / 61.5, 68.7 / 59.4; V.S. @ 23'; Su = 690.32 psf; Su,r = 176.15 psf
22							--Very soft, trace course sand			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E

Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA

Project Number: 2014-091

Log of Boring IR02B603

ERRG

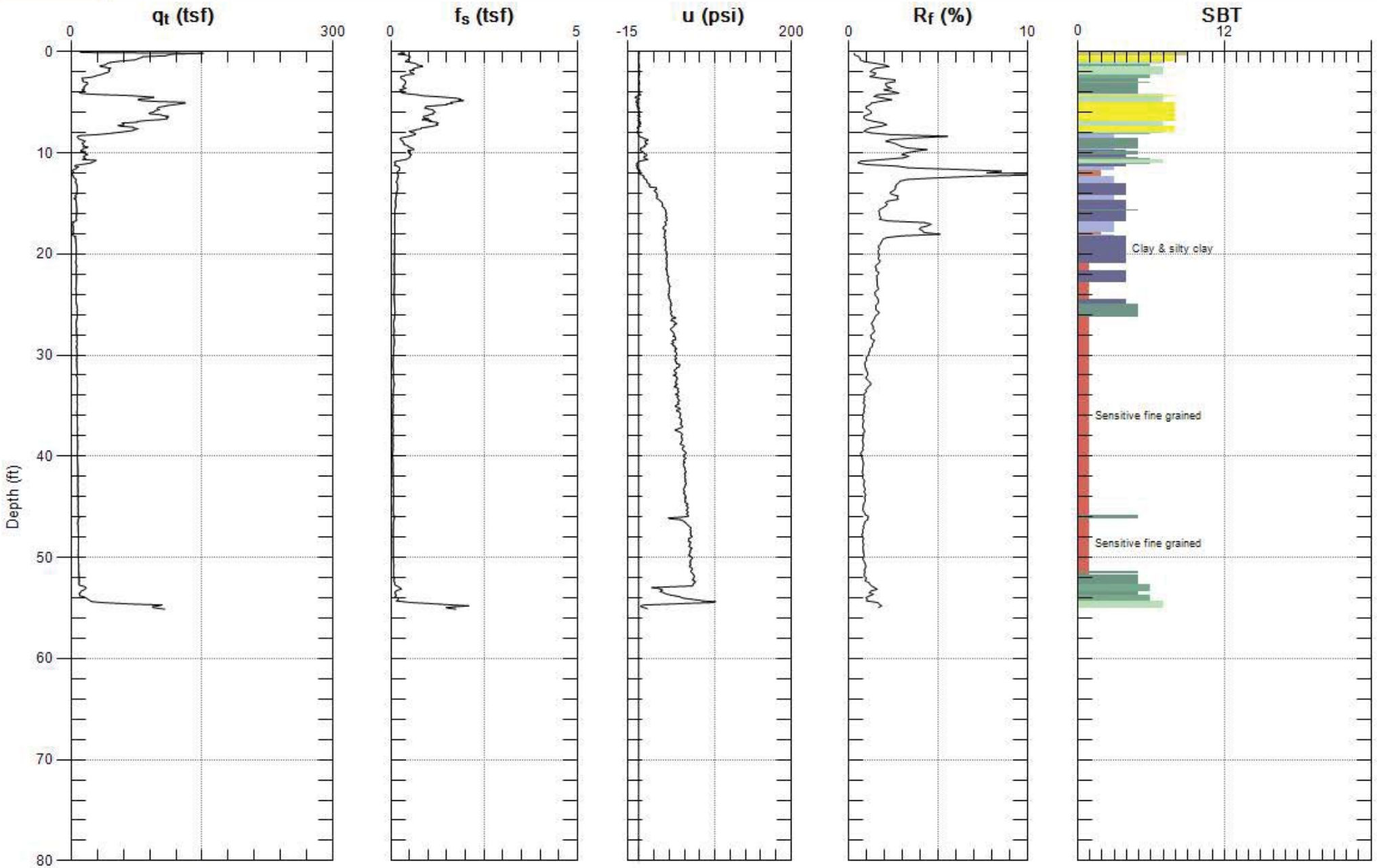
Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29		SH						65.5	60.3	Osterberg Pressure = 125 psi; 0% gravel; 0.4% sand; 99.6% fines; LL = 64; PL = 28; PI = 36; Pp =~2,100 psf; Phi = 12.8°; c = 200 psf; mc (%) / Dry Unit Weight (pcf), 60.7 / 63.5, 58.4 / 65.3, 63.9 / 61.7
30										
31										
32										
33										
34		SH						72.2	56.2	Osterberg Pressure = 50 psi; LL = 75; PI = 43; Pp = ~2,200 psf
35										
36										
37							Bottom of boring at 37.0 feet			V.S @ 37 ft: Su = 799.09 psf; Su,r = 116.82 psf
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO2CPT57

Engineer: S.LEE
Date: 2/3/2015 10:13



Max. Depth: 55.118 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B602** Sheet 1 of 2	ERRG

Date (s) Drilled 3/9/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 46.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 13.26
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	SILTY SAND (SM): light brown; dry; fine grained (trace course grained); loose; poorly graded			
6		SPT		40			--Silty sand, some clay, dark brown, wet, medium grained sand, dense, poorly graded, trace angular gravel (1/2-1" dia.), copper metal debris			
10		MC		7		ML	SANDY SILT (ML): brown; wet; fine grained; medium stiff; low plasticity; trace clay			
15		MC		3		CL	LEAN CLAY (CL): gray; dry to wet; soft; high plasticity			
19		SH								Osterberg Pressure = 200 psi
21							--Wet, soft, trace seashells			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

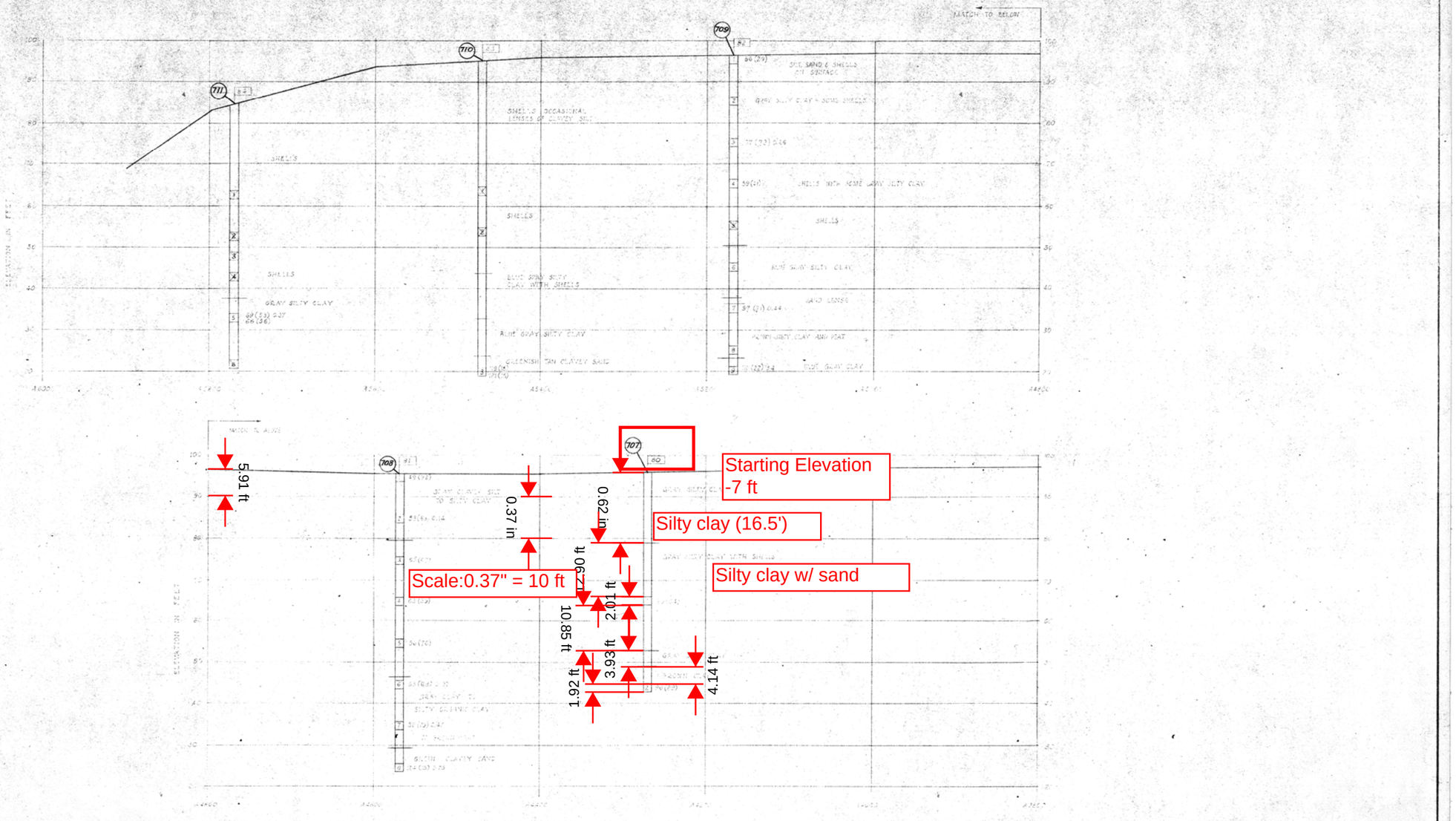
Log of Boring IR02B602

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26		SPT		1		CL	LEAN CLAY (CL): (continued) --Grayish black, moist, very soft high plasticity trace seashells			
27										
28										
29										
30		SH					--No Recovery			Osterberg Pressure = 400 psi
31										
32										
33										
34		SH								Osterberg Pressure = 125 psi
35										
36							--Grayish black, moist, soft, high plasticity			
37										
38										
39										
40										
41										
42										
43										
44		SH								Osterberg Pressure = 175 psi
45							--Grayish black, moist, very soft, high plasticity			
46							Bottom of boring at 46.0 feet			
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Logs Used for Cross Section C-C'



SHIPYARD BORING NO.

LEGEND

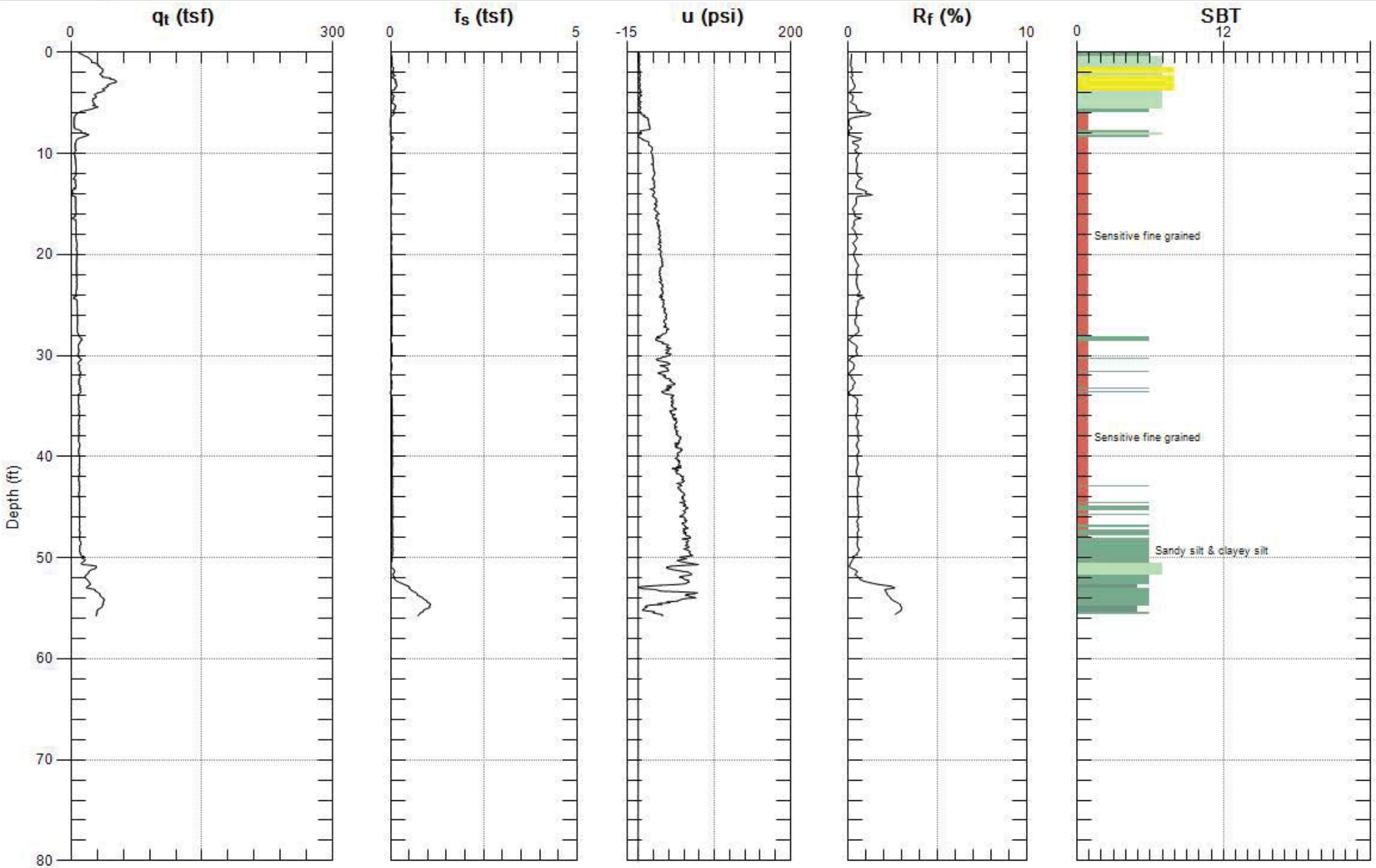
DESIGNED:	DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS DISTRICT PUBLIC WORKS OFFICE — 12TH ND SAN BRUNO, CALIF PORTER, URQUHART, McCREARY & O'BRIEN CONSULTING ENGINEERS 140 HOWARD STREET — SAN FRANCISCO, CALIF
DRAWN:	SAN FRANCISCO NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA ADVANCE PLANNING
CHECKED: H.W.C.E.P.	LAND EXCAVATION AND FILL
SUBMITTED:	BORINGS 707 TO 711
DIR. DES.	SOIL BORING PROFILE
P & D. OFF.	
P.W. DWG. NO. 16026-126	DPWO DRWG. NO. B-52928
APPROVED	DATE DPWO FOR CHIEF OF BUREAU
SATISFACTORY TO	SIGNATURE / TITLE / DATE
SATISFACTORY TO	SIGNATURE / TITLE / DATE
SCALE	E.S.
SHEET 92 OF 5	NBy 9325
Y B&D DRAWING NO.	

SHEET NO. 92

ENGINEERING REMEDIATION RES.

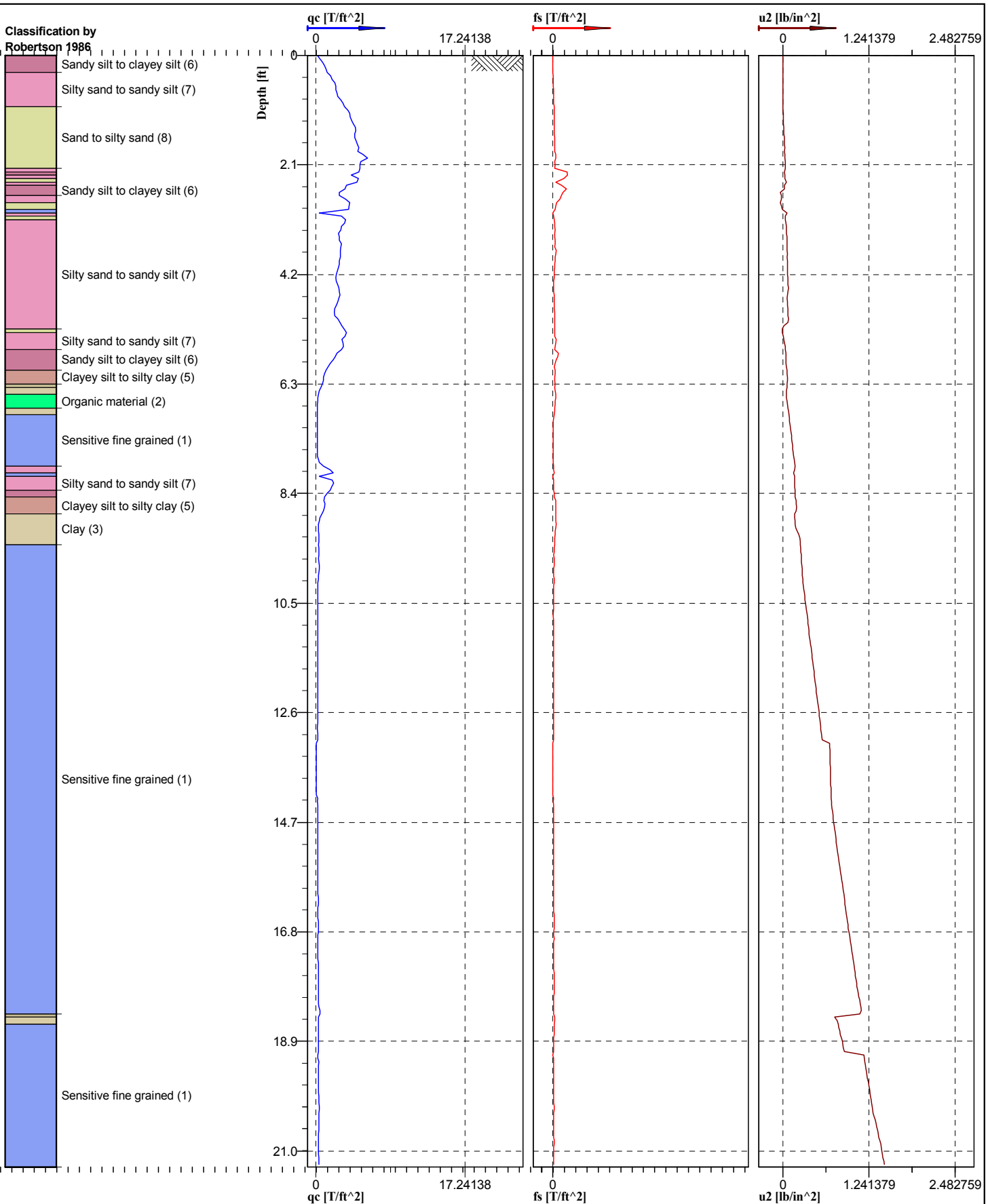
Site: HUNTERS PT PAR.E
Sounding: IRO3CPT71

Engineer: S.LEE
Date: 2/11/2015 12:28



Max. Depth: 55.774 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

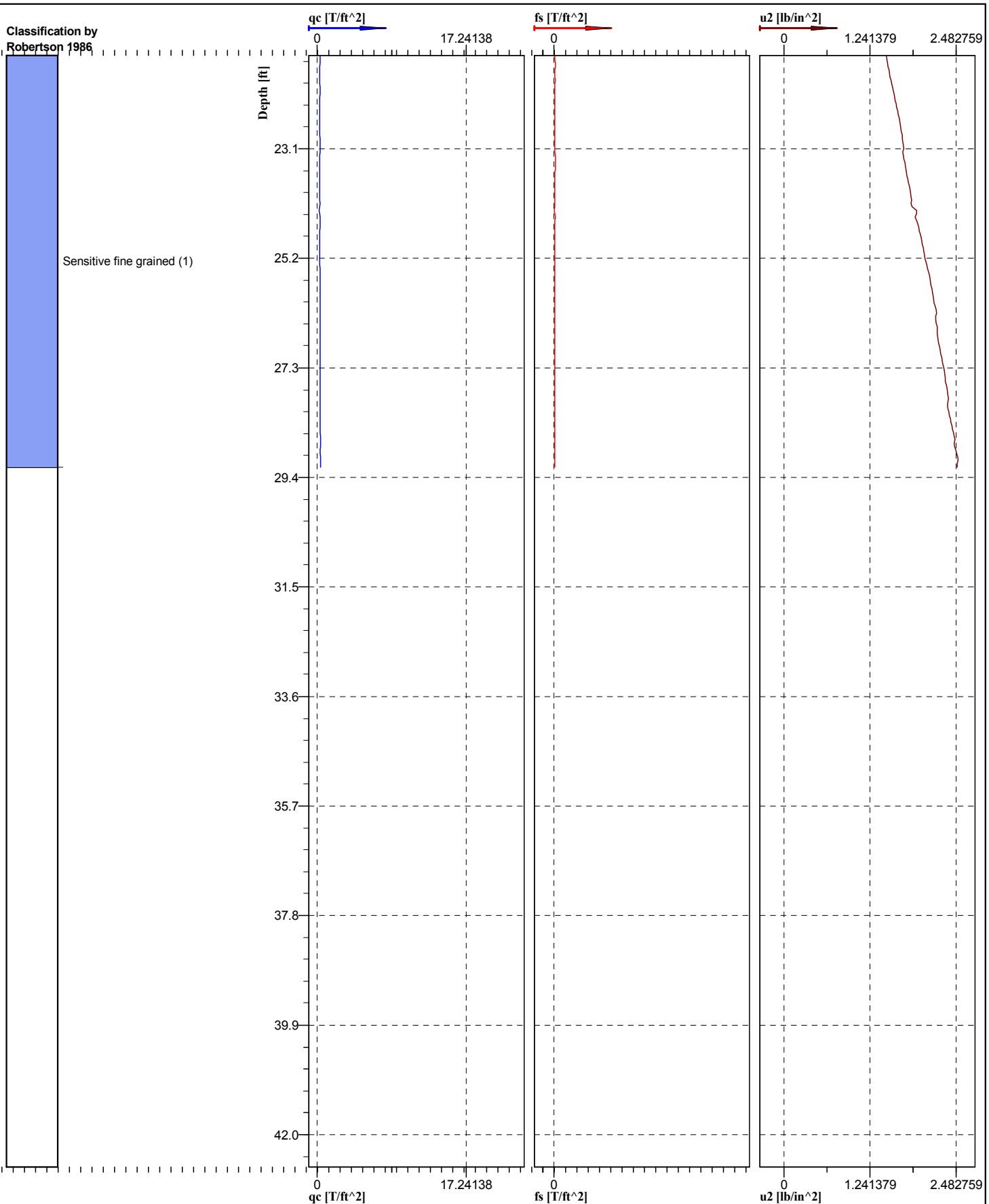


Location: HPT-CPT-04	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: ISTR-CPT-01
Project ID: R3174	Client: CDM	Date: 7/8/2013	Scale: 1 : 30
Project: Hunters Point Naval Shipyard - IR03		Page: 1/2	Fig:
		File: ISTR-CPT-HPT-01.cpt	

CASCADE DRILLING, L.P.

U2

Cone No: 4280
Tip area [cm2]: 10
Sleeve area [cm2]: 150



U2

Cone No: 4280
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HPT-CPT-04	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: ISTR-CPT-01
Project ID: R3174	Client: CDM	Date: 7/8/2013	Scale: 1 : 30
Project: Hunters Point Naval Shipyard - IR03		Page: 2/2	Fig:
		File: ISTR-CPT-HPT-01.cpt	

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR03B607** Sheet 1 of 2	ERRG

Date (s) Drilled 2/27/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 40.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 2.39
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
1		SPT		17		SP	POORLY GRADED SAND (SP): brown; moist to wet; fine grained; loose; poorly graded; trace gravel and seashells			
							--Gray; moist; fine grained;dense; angular gravel (1/4-1" dia.)			
2						SM	SILTY SAND (SM): dark gray to brown; moist; fine grained; medium dense; poorly graded			
8		SH				SP	POORLY GRADED SAND (SP): fine grained; poorly graded			Osterberg Pressure = 350 psi
10						CH	FAT CLAY (CH): black; high plasticity; very soft; seashells present			
22		SH						69.1	58.2	Osterberg Pressure = 75 psi; 0.8% grave; 5.1% sand; 94.1% fines; LL = 67; PL = 32; PI = 35; Pp =~ 1,400 psf
23							--Moist; soft; trace shells; trace gravel			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR03B607

ERRG

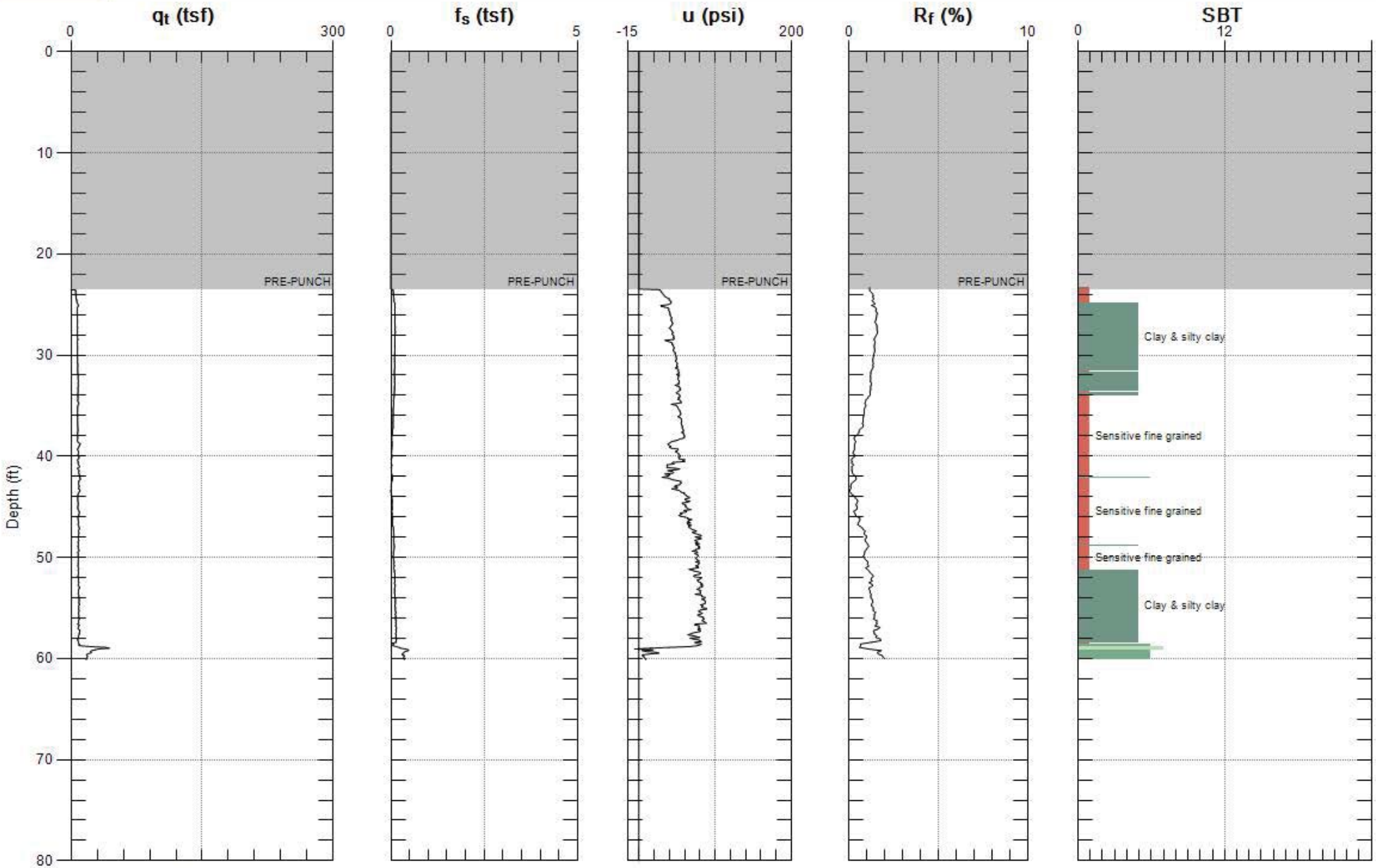
Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						CH	FAT CLAY (CH): (continued)			
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38		SH					–Some seashells			Osterberg Pressure = 75 psi
39										
40										
41							Bottom of boring at 40.0 feet			
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

Site: HUNTERS PT PAR.E
Sounding: IRO3CPT70

Engineer: S.LEE
Date: 2/13/2015 11:55



Max. Depth: 60.121 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

LOG OF EXPLORATORY BORING

PROJECT NUMBER 365-02.02 BORING NO. 0Ø3

PROJECT NAME HPNS-Oil Reclamation Ponds Area PAGE 1 OF 1

BY JDB DATE 8/25/86 SURFACE ELEV.* 112.12

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
		17		v m s	1	SW	SAND-FILL; black (5Y, 2.5/1); <5% low-plasticity fines; 85-90% fine to coarse sand; 10-15% coarse gravel; medium dense; dry.
		22			2	GC	CLAYEY GRAVEL-FILL; olive gray (5Y,4/2); 10-20% low-plasticity fines; 15-25% fine to coarse sand; 55-75% fine to coarse angular gravel; medium dense; damp.
		20			3		
		18		5 m v	4	CL	GRAVELLY CLAY-FILL; black (5Y, 2.5/1); 45-65% low-plasticity fines; 15-25% fine to coarse sand; 20-30% fine and coarse gravel; some oil coating on sand grains; wood fragments; very soft; moist to wet.
		10	▽		5		
		12		m v,s	6	SC-GC	CLAYEY SAND TO GRAVELLY SAND; black (5Y, 2.5/1); 10-30% low-plasticity fines; 35-45% fine to coarse sand; 30-45% fine and coarse gravel; wood fragments; oily; medium dense; wet.
		21		10	7	SP ?	
		47			8		
		24			9		
		20		15	10		@14': abundant metal fragments.
		15			11	SP	SAND; very dark gray (5Y, 3/1); <5% low-plasticity fines; 95% fine sand; <2% shell fragments; oily; medium dense; wet.
		24			12		
		11			13		
				20			BOTTOM OF BORING AT 20 FEET.

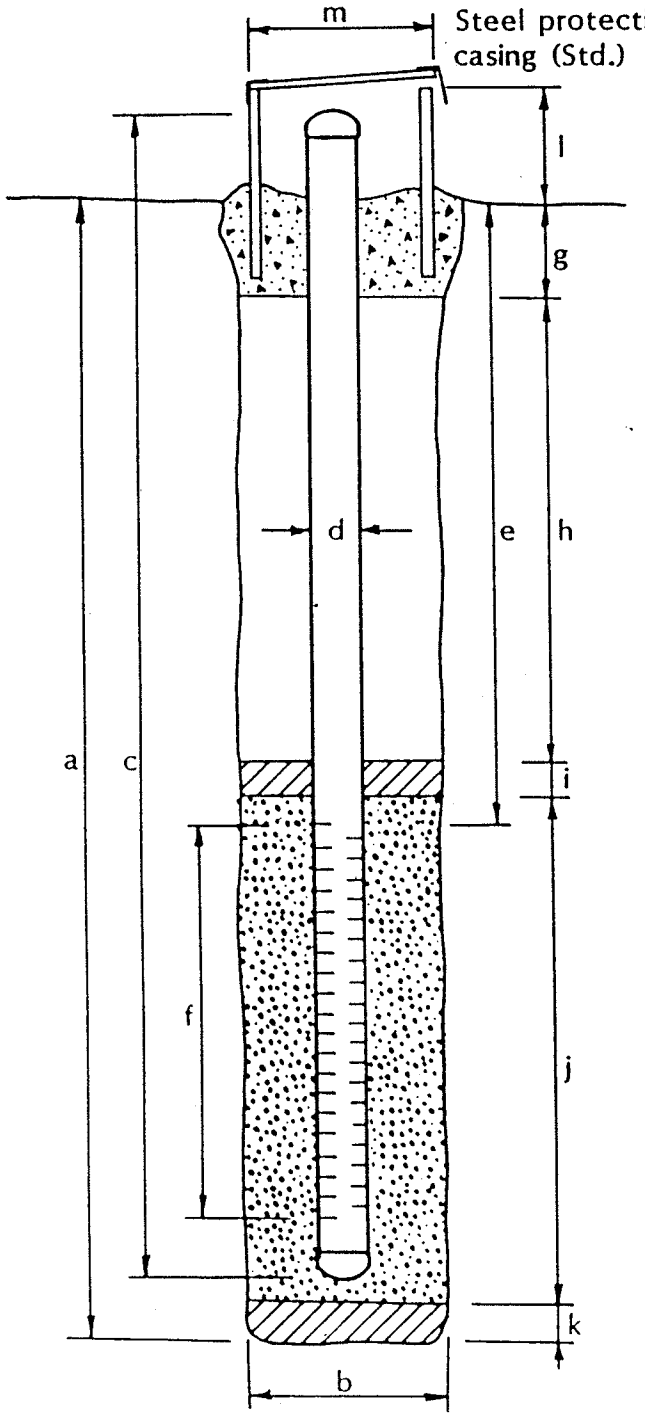
REMARKS

Drilled with 8-inch hollow-stem auger; sampled with 2-inch I.D. California modified split-spoon sampler fitted with stainless steel liners. Boring was converted to a 2-inch ground-water monitoring well as detailed on Plate A7. *Casing elevation is relative to Navy datum.

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 365-02.02 BORING / WELL NO. 0Ø3
PROJECT NAME HPNS-Oil Reclamation Ponds TOP OF CASING ELEV. 112.12'
COUNTY San Francisco GROUND SURFACE ELEV. 111 +/-
WELL PERMIT NO. DATUM Navy



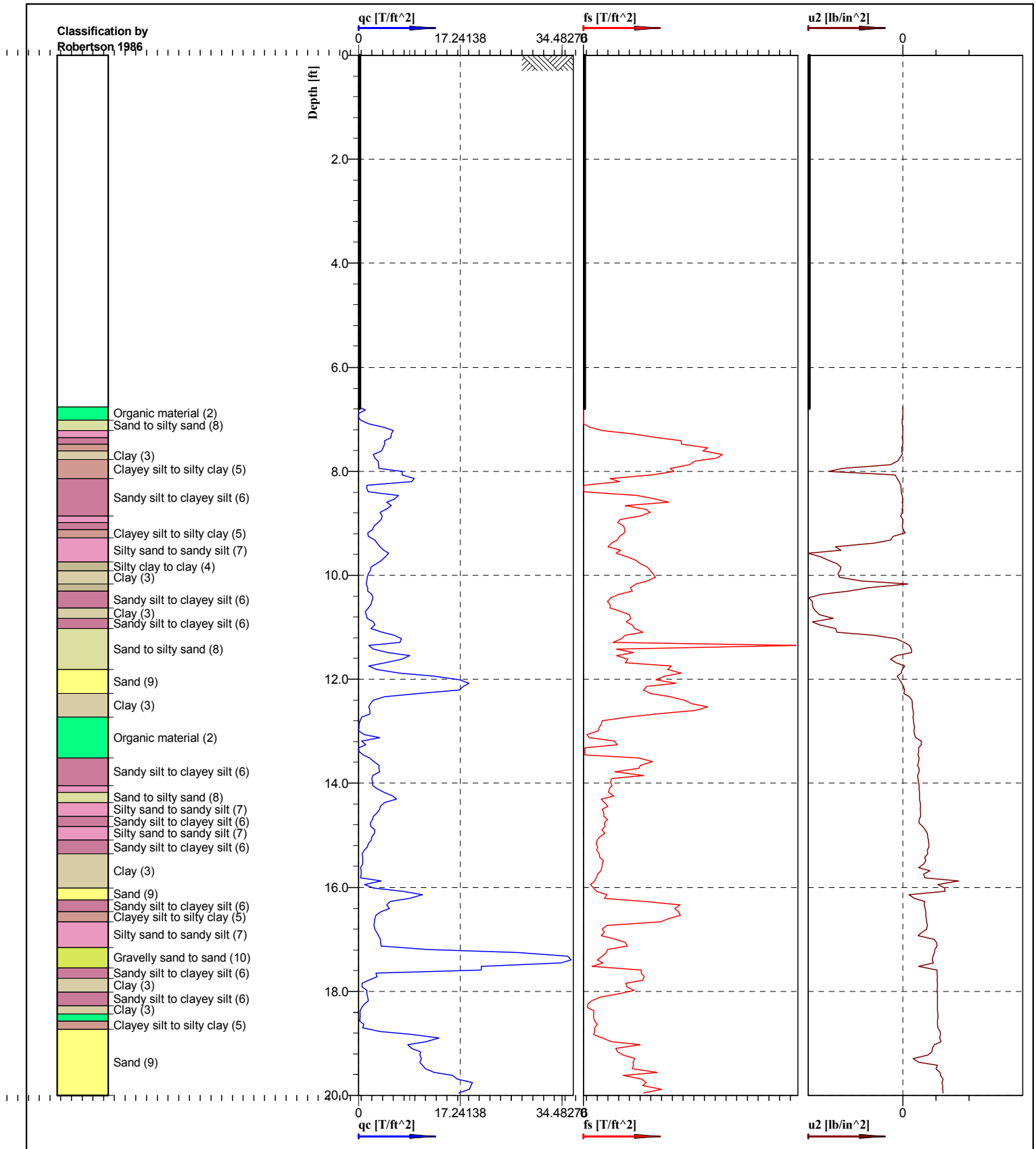
EXPLORATORY BORING

a. Total depth 20 ft.
b. Diameter 8 in.
Drilling method Hollow-stem auger

WELL CONSTRUCTION

c. Casing length 20 ft.
Material stainless steel
d. Diameter 2 in.
e. Depth to top perforations 4 ft.
f. Perforated length 15 ft.
Perforated interval from 19 to 4 ft.
Perforation type screen
Perforation size 0.010 inch
g. Surface seal (1 - 0') 1 ft.
Seal material cement-bentonite grout
h. Backfill (2 - 1') 1 ft.
Backfill material cement-bentonite grout
i. Seal (3 - 2') 1 ft.
Seal material bentonite
j. Gravel pack (15.5 - 3') 12.5 ft.
Pack material 12x20 sand
k. Bottom seal N/A ft.
Seal material N/A
l. Casing height 1.5 ft.
m. Protective casing diameter 10 in.

Note: Boring caved to 15.5 feet when augers removed.



CASCADE DRILLING, L.P.

U2

Cone No: 4312
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HPT-CPT-02	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: ISTR-CPT-02
Project ID: R3174	Client: CDM	Date: 7/9/2013	Scale: 1 : 30
Project: Hunters Point Naval Shipyard - IR03		Page: 1/2	Fig:
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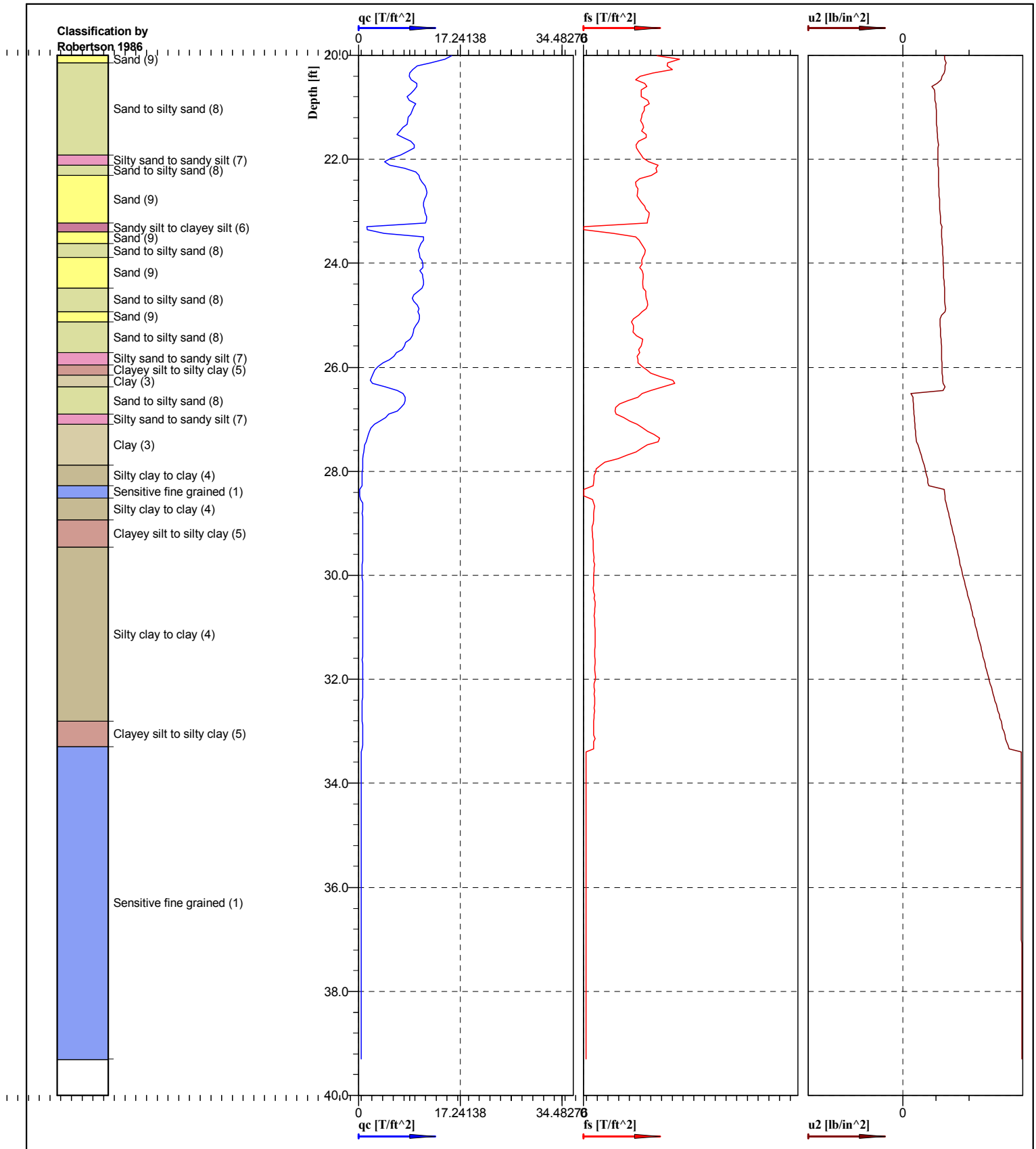


U2

Cone No: 4312
Tip area [cm2]: 10
Sleeve area [cm2]: 150

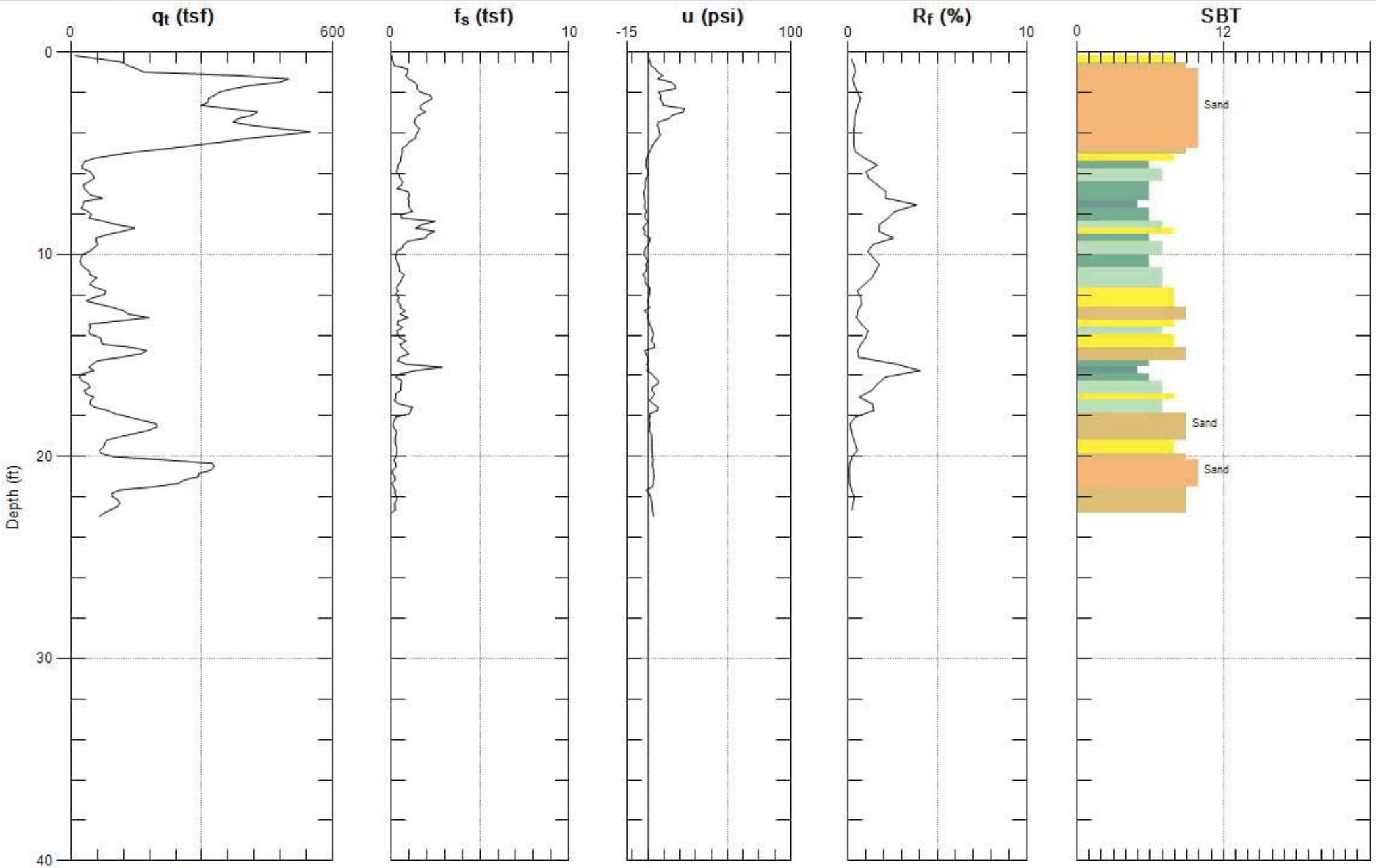
Location: HPT-CPT-02	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: ISTR-CPT-02
Project ID: R3174	Client: CDM	Date: 7/9/2013	Scale: 1 : 30
Project: Hunters Point Naval Shipyard - IR03		Page: 2/2	Fig:
		File: ISTR-CPT-02 (corrected).cpt	

GREGG

ITSI

Site: HUNTERS POINT
Sounding: IR03B-393

Engineer: F.MCFARLAND
Date: 9/14/2011 01:24



Max. Depth: 22.966 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

REVISIONS				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED

EXPLORATORY BORING LOG — BORING NO. 6

DRILL RIG: Rotary Wash - Failing 750 | SURFACE ELEVATION: 109.3 | LOGGED BY: F.M.L.
DEPTH TO GROUNDWATER: 6 feet | BORING DIAMETER: 4.875 inches | DATE DRILLED: 3 3 72

Description and Remarks	Color	Consist.	Soil Type
Asphalt and base rock			
SAND, clayey, fine to coarse grained with some gravel	grey & brown mottled	very dense	SC-SP
CLAY, sandy to gravelly	grey-brown	stiff	CL
SAND and GRAVEL, fine to coarse grained with some clay and silt, broken concrete — FILL	grey-brown	loose	SP-GP
CLAY, silty with some shells (Bay Mud)	dark grey	soft	CH
CLAY, sandy; with some gravel	light brown	stiff	CL-CH; CL
GRAVEL, sandy with some clay	light brown	medium dense	GP-GC
CLAY, silty to sandy	light brown	stiff	CL
SAND, silty, fine grained; trace of gravel and clay	orange-brown	very dense	SM-SP
CLAY, sandy to gravelly with some lenses of silty sand	grey & green mottled	hard	CL
BEDROCK - Franciscan formation, severely weathered serpentine with some clay seams	green-grey		
Bottom of boring = 97.5 feet			

Sampler	Moisture Content %	Penetration Resistance Blows/ft
Split spoon	7	65
Split spoon	No Recovery	7
Shelby tube	64	
Shelby tube		
Shelby tube		
Split spoon	23	15
Split spoon		76
Shelby tube		

LOWNEY-KALDVEER ASSOCIATES, Foundation/Soil/Geological Engineers — EXPLORATORY BORING LOG — WATER POLLUTION ABATEMENT FACILITIES, San Francisco, California — Project No. 168-4 — Date April 1972 — Sheet No. — Boring No. 6

EXPLORATORY BORING LOG — BORING NO. 7

DRILL RIG: Hollow Stem Auger | SURFACE ELEVATION: 110.2 | LOGGED BY: [illegible]
DEPTH TO GROUNDWATER: 7.5 feet | BORING DIAMETER: 6.5 inches | DATE DRILLED: 2 2 72

Description and Remarks	Color	Consist.	Soil Type
Asphalt and base rock			
SAND, gravelly, fine to coarse grained, with varying amounts of silt and clay, traces of decomposed wood — FILL	grey & dark brown	dense; loose	SW
CLAY, silty with occasional shells, some pockets of peat, sand lenses, locally very silty (Bay Mud)	grey	very soft; soft	CH-OH
SAND, silty, fine to medium grained, with thin layers of stiff grey and brown clay	medium brown	dense	SM-SP
CLAY, silty, with traces of decomposed organic matter	grey	stiff	CL
SAND, clayey, fine to medium grained	tan	medium dense	SC
CLAY, silty	grey	stiff	CL
SAND, silty, medium to coarse grained, with some gravel	tan	medium dense	SW-GW
CLAY, gravelly	medium to dark brown	hard	CL-GC
Bottom of Boring = 115 feet			

Sampler	Moisture Content %	Penetration Resistance Blows/ft
Split spoon		60
Split spoon		51
Split spoon		7
Split spoon	71	0
Shelby tube	68	
Shelby tube	47	
Shelby tube	56	
Shelby tube	56	
Shelby tube	58	
Shelby tube	54	
Shelby tube		
Split spoon	29	51
Split spoon	30	15
Shelby tube	24	

LOWNEY-KALDVEER ASSOCIATES, Foundation/Soil/Geological Engineers — EXPLORATORY BORING LOG — WATER POLLUTION ABATEMENT FACILITIES, San Francisco, California — Project No. 168-4 — Date April 1972 — Sheet No. — Boring No. 7

EXPLORATORY BORING LOG — BORING NO. 8

DRILL RIG: Rotary Wash - Failing 750 | SURFACE ELEVATION: 112.0 | LOGGED BY: F.M.L.
DEPTH TO GROUNDWATER: 7 feet | BORING DIAMETER: 4.875 inches | DATE DRILLED: 3 3 - 3 8 72

Description and Remarks	Color	Consist.	Soil Type
Asphalt and base rock			
CLAY, sandy to gravelly with some broken concrete	grey-brown	very stiff	CL-SC
GRAVEL, sandy with broken concrete, occasional pockets of clay; with some shells	green	medium dense; dense	GP
SAND, coarse grained with some gravel and silt	medium brown	medium dense	SP-SM
GRAVEL, fine to coarse grained with some sand and shells	green	dense	GP-GW
CLAY, silty with shells	grey	very soft	CH
GRAVEL, coarse grained with cobbles, scattered concrete rubble	green & dark brown	loose; dense to very dense	GP
CLAY, silty with some coarse sand	green-grey	stiff	CH
Bottom of Boring = 60 feet			

Sampler	Moisture Content %	Penetration Resistance Blows/ft
Split spoon		23
Split spoon		32
Shelby tube		
Split spoon		60/6"
Shelby tube	No Recovery	

LOWNEY-KALDVEER ASSOCIATES, Foundation/Soil/Geological Engineers — EXPLORATORY BORING LOG — WATER POLLUTION ABATEMENT FACILITIES, San Francisco, California — Project No. 168-4 — Date April 1972 — Sheet No. — Boring No. 8

EXPLORATORY BORING LOG — BORING NO. 9

DRILL RIG: Rotary Wash - Failing 750 | SURFACE ELEVATION: 110.0 | LOGGED BY: F.M.L.
DEPTH TO GROUNDWATER: 7 feet | BORING DIAMETER: 4.875 inches | DATE DRILLED: 3 1 72

Description and Remarks	Color	Consist.	Soil Type
Asphalt and base rock			
SAND, gravelly, fine to coarse grained with some silt and clay	green-grey	dense	SW
CLAY, silty with some sand, gravel and decomposed wood	green-grey	stiff	CH
SAND, medium to coarse grained, with some clay and gravel	grey	medium dense	SP-SC
GRAVEL, coarse grained with some cobbles; with a trace of clay and some shells	green	loose to medium dense; medium dense	GP
SAND, fine grained, with some silt — FILL	tan	very loose	SP
CLAY, silty with some shells (Bay Mud)	dark grey	soft	CH
CLAY, silty	green	very stiff	CH
SAND, silty, fine grained with a trace of clay	yellow-brown	very dense	SM
CLAY, sandy to silty with occasional sand lenses and pockets of high plasticity clay	light brown	very stiff to hard	CL
SAND, fine grained	medium brown	very dense	SP
CLAY, sandy	[illegible]	stiff	CL
CLAY, silty	green-grey	stiff	CH
SAND, clayey, fine grained	grey-brown	very dense	SC
SAND, fine grained with traces of silt and clay	medium brown	very dense	SP
CLAY, silty with some gravel	green-grey	very stiff to hard	CH
Bottom of boring - 140 feet			

Sampler	Moisture Content %	Penetration Resistance Blows/ft
Split spoon		47
Split spoon	No Recovery	19
Split spoon		2
Shelby tube	No Recovery	
Shelby tube		
Shelby tube	No Recovery	
Shelby tube	52	
Split spoon / Shelby tube	53	0
Shelby tube	24	
Split spoon	26	34
Split spoon		78/8"
Shelby tube	58	
Split spoon		120/9"

LOWNEY-KALDVEER ASSOCIATES, Foundation/Soil/Geological Engineers — EXPLORATORY BORING LOG — WATER POLLUTION ABATEMENT FACILITIES, San Francisco, California — Project No. 168-4 — Date April 1972 — Sheet No. — Boring No. 9

EXPLORATORY BORING LOG — BORING NO. 10

DRILL RIG: Rotary Wash - Failing 750 | SURFACE ELEVATION: 109.6 | LOGGED BY: F.M.L.
DEPTH TO GROUNDWATER: 5 feet | BORING DIAMETER: 4.875 inches | DATE DRILLED: 3 2 72

Description and Remarks	Color	Consist.	Soil Type
Asphalt and base rock			
SAND, fine to medium grained with some silt and fine gravel	medium brown	medium dense	SP
CLAY, silty, to SAND, fine to coarse grained with some gravel	dark grey	stiff to medium dense	CL-SC
SAND, medium to coarse grained with some silt and clay pockets	medium brown	medium dense	SP
GRAVEL, coarse grained, with some boulders (grades to) GRAVEL, sandy with some clay and shells	green; green & red-brown mottled	medium dense	GP
SAND, gravelly, medium to coarse grained with some clay and shells	green to brown	medium dense	SP
SAND, fine to medium grained with some shells, trace of clay — FILL	grey	medium dense	SC-SM
CLAY, silty with some shells (Bay Mud)	dark grey	soft	CL-CH
CLAY, silty to sandy with some shells	green-grey	stiff	CH
SAND, fine grained	medium brown	very dense	SP
CLAY, silty to sandy with occasional sand lenses	medium brown	hard	CH
SAND, fine grained with scattered pockets of clay	medium brown	very dense	SP
CLAY, silty to sandy with lenses of clean fine grained sand	green-grey	very stiff to hard	CH
CLAY, silty	green-grey	stiff	CH
SAND, fine grained with some clay	grey	dense	SP
CLAY, silty	green-grey	stiff	CH
CLAY, silty to sandy	lt brown	very stiff	CL
SAND, clayey, fine to medium grained	light brown	very dense	SC-SP
CLAY, silty to sandy with some lenses of fine grained sand	light brown	very stiff	CL
SAND, silty, fine grained	light brown	very dense	SM
Bottom of Boring = 111 feet			

Sampler	Moisture Content %	Penetration Resistance Blows/ft
Split spoon	19	16
Split spoon		13
Split spoon		13
Shelby tube	55	
Shelby tube	51	
Shelby tube	63	
Split spoon		156
Split spoon	19, 24	49
Split spoon		[illegible]
Split spoon	55	10
Split spoon		111
Split spoon		100

LOWNEY-KALDVEER ASSOCIATES, Foundation/Soil/Geological Engineers — EXPLORATORY BORING LOG — WATER POLLUTION ABATEMENT FACILITIES, San Francisco, California — Project No. 168-4 — Date April 1972 — Sheet No. — Boring No. 10

NOTE

SOIL BORING LOGS FROM SOIL REPORT ARE INCLUDED HEREIN ONLY FOR THE INFORMATION OF THE CONTRACTOR. NO WARRANTY IS MADE OR IMPLIED AS TO THE ACCURACY OR COMPLETENESS OF THESE BORINGS. OTHER SOIL BORINGS ARE AVAILABLE AT THE HUNTER'S POINT PUBLIC WORKS OFFICE FOR THE CONTRACTOR TO STUDY. NO WARRANTY IS MADE OR IMPLIED AS TO THE ACCURACY OR COMPLETENESS OF THESE OTHER SOIL BORINGS. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO ASCERTAIN EXISTING SOIL CONDITIONS AND IF HE CHOOSES TO BASE HIS DECISIONS ON INFORMATION CONTAINED IN THESE SOIL BORINGS HE SHALL MAKE NO CLAIMS BECAUSE OF PROBLEMS ARISING THEREOF. THESE BORINGS ARE SPECIFICALLY MADE NOT A PORTION OF THIS CONTRACT.

IF SHEET IS LESS THAN 28" X 40" IT IS A REDUCED PRINT — SCALE REDUCED ACCORDINGLY

A-E NO. 62474-72-C-0060
CONSOER, TOWNSEND & ASSOCIATES
SAN JOSE, CALIFORNIA
CONSULTING ENGINEERS

DSGN. | DR. | CHK. | SUPV. | CH. ENGR. | SUBMITTED BY | FIRM MEMBER (TITLE) | DATE | E.I.C. | FIRE PROT. | BR. HD. | DIR. | SATISFACTORY TO | TITLE | DATE | APPROVED | DATE | EFD FOR COMMANDER NAVFAC

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION
SAN BRUNO, CALIFORNIA

HUNTERS POINT NAVAL SHIPYARD — SAN FRANCISCO, CALIFORNIA

WATER POLLUTION ABATEMENT

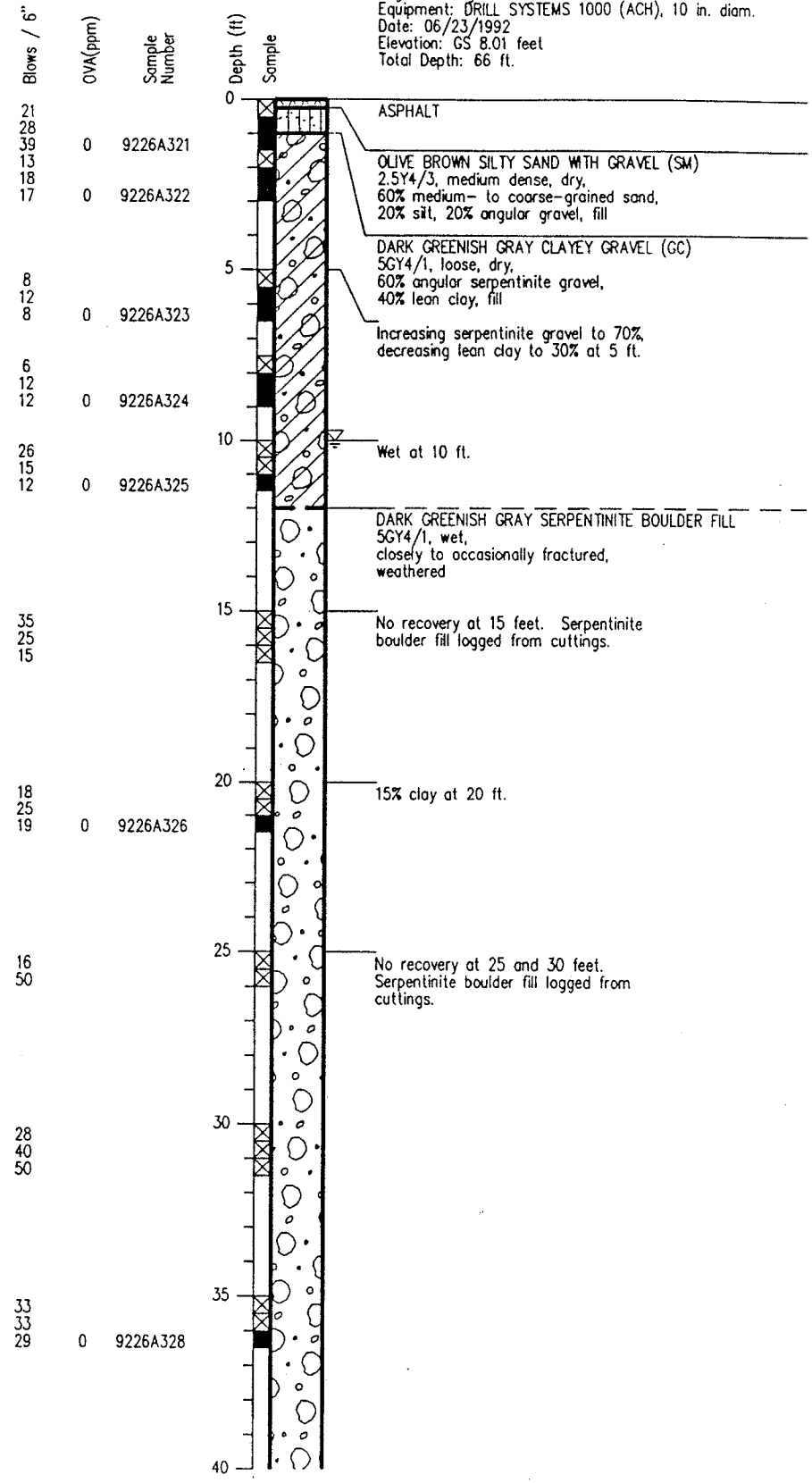
SOIL BORING LOGS
BORING NO. 6 TO NO. 10

SIZE	CODE IDENT. NO.	NAVFAC. DRAWING NO.
F	80091	6020025
SCALE		CONST. CONTR. NO. N62474-72-C-0061
	SPEC. 12-72-0061	SHEET 61 OF

WESTDIV. DWG. NO.

B-2

Log of Boring: IR03B339
Equipment: DRILL SYSTEMS 1000 (ACH), 10 in. diam.
Date: 06/23/1992
Elevation: GS 8.01 feet
Total Depth: 66 ft.



Harding Lawson Associates
Engineering and Environmental Services

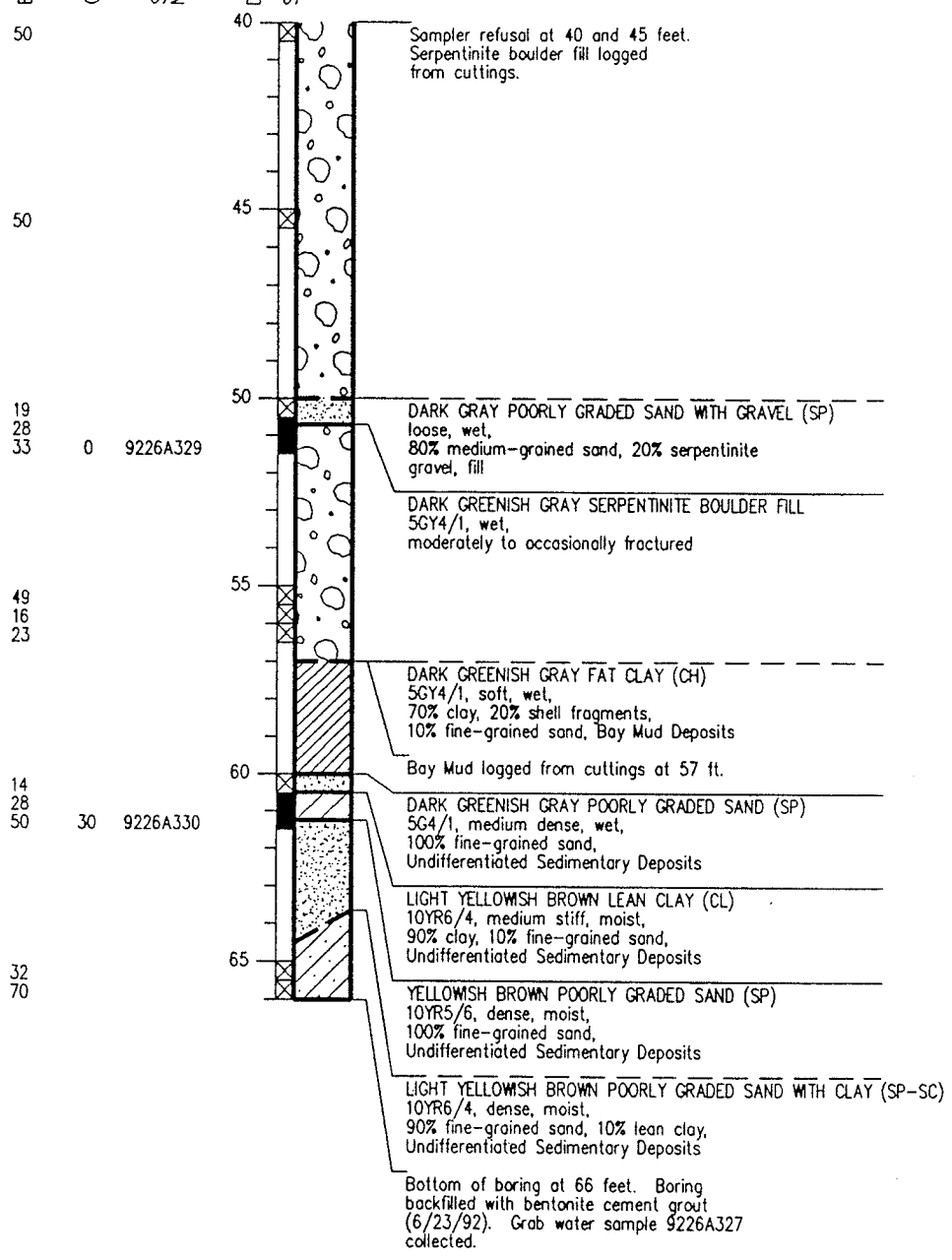
Log of Boring IR03B339

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/30/92	

Log of Boring: IR03B339 (p. 2)
Equipment: DRILL SYSTEMS 1000 (ACH), 10 in. diam.
Date: 06/23/1992
Elevation: GS 8.01 feet
Total Depth: 66 ft.



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR03B339

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/30/92	

Logs Used for Cross Section D-D'

Project: Geotechnical Investigation at Parcel E Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA Project Number: 2014-091	**Log of Boring IR02B605** Sheet 1 of 3	ERRG

Date (s) Drilled 2/20/2015	Logged By S. Lee	Checked By D. Tang
Drilling Method Mud Rotary	Drill Bit Size / Type 2.265	Total Depth Drilled (feet) 55.0
Drill Rig Type Fraste	Drilled By Gregg Drilling	Hammer Weight / Drop (lb/in) 140 / 30
Groundwater Depth (feet) Not Measured Due to Mud Rotary Drilling	Date Measured N/A	Surface Elevation (feet) 7.34
Location Parcel E		Borehole Backfill Grout

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
0						SM	Silty sand; brown; moist; medium grained; loose; poorly graded			
8		SPT		6		GP	POORLY GRADED GRAVEL WITH SAND (GP): grayish black; wet; angular; loose; fine gravel; fine to medium grained sand; wood debri			
13		SPT		5		SP	POORLY GRADED SAND WITH GRAVEL (SP): gray; loose; fine to medium grained; sea shells present			
18		SPT		4						
23		SPT		7		SP	POORLY GRADED SAND (SP): grayish black; wet; loose; fine grained; trace seashells			

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B605

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
26						SP	POORLY GRADED SAND (SP): (continued)			
27										
28		SPT		0		CH	FAT CLAY (CH): black; wet; high plasticity; very soft; homogenous; trace seashells; trace gravel			
29										
30										
31										
32		SH						56.2	66.6	0.5% gravel; 38.4% sand; 61.1% fines; LL = 76; PL = 32; PI = 44; Pp =~ 2,000 psf
33										
34										
35										V.S. @ 35'; Su = 980.76 psf; Su,r = 190.47 psf
36										
37										
38										
39		SPT		3			–Crushed seashells; black; low plasticity; soft; trace sand			
40										
41										
42										
43										
44		SH						48.9	71.6	Gus Sampler Pressure = 50 psi; Pp =~ 2,200 psf (possible disturbed sample); Phi = 12.1°; c = 200 psf; m/c (%) / Dry Unit Weight (pcf), 52.9 / 67.5, 35.2 / 80.9, 38.0 / 79.6
45										
46										
47										V.S. @ 47'; Su = 1,268.14 psf; Su,r = N/A
48										
49										
50										
51										
52		SH						61.0	61.1	Gus Sampler Pressure = 100 psi; 9.7% gravel; 16.4% sand; 73.9% fines; LL = 68; PL = 30; PI = 38; Pp =~ 1,200 psf (possible disturbed sample)
53										
54										

2014-091 HPS PARCEL E.GPJ 11/20/15

Project: Geotechnical Investigation at Parcel E
Project Location: Parcel E, Hunters Point Naval Shipyard, San Francisco, CA
Project Number: 2014-091

Log of Boring IR02B605

ERRG

Depth, feet	Sample Name	Sample Type	Sample	Corrected To SPT Blow counts/Foot	Lithology	Soil Classification	MATERIAL DESCRIPTION	Water Content %	Dry Unit Weight, pcf	Lab Tests / Maximum Sampling Pressure
56							Bottom of boring at 55.0 feet			V.S. @ 55'; Su - 1,481.36 psf; Su,r = 116.82 psf
57										
58										
59										
60										
61										
62										
63										
64										
65										
66										
67										
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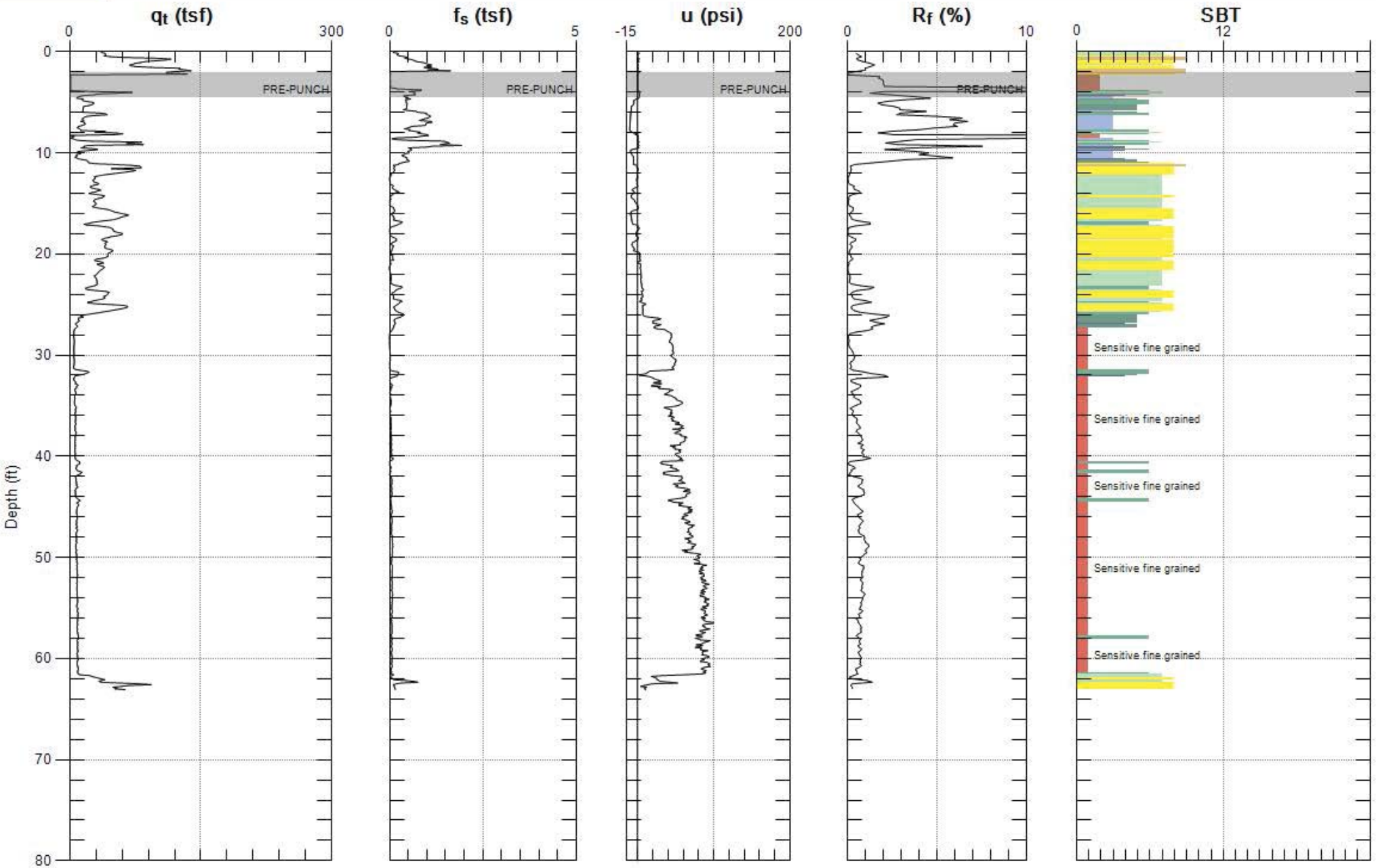
82										
83										
84										

2014-091 HPS PARCEL E.GPJ 11/20/15

ENGINEERING REMEDIATION RES.

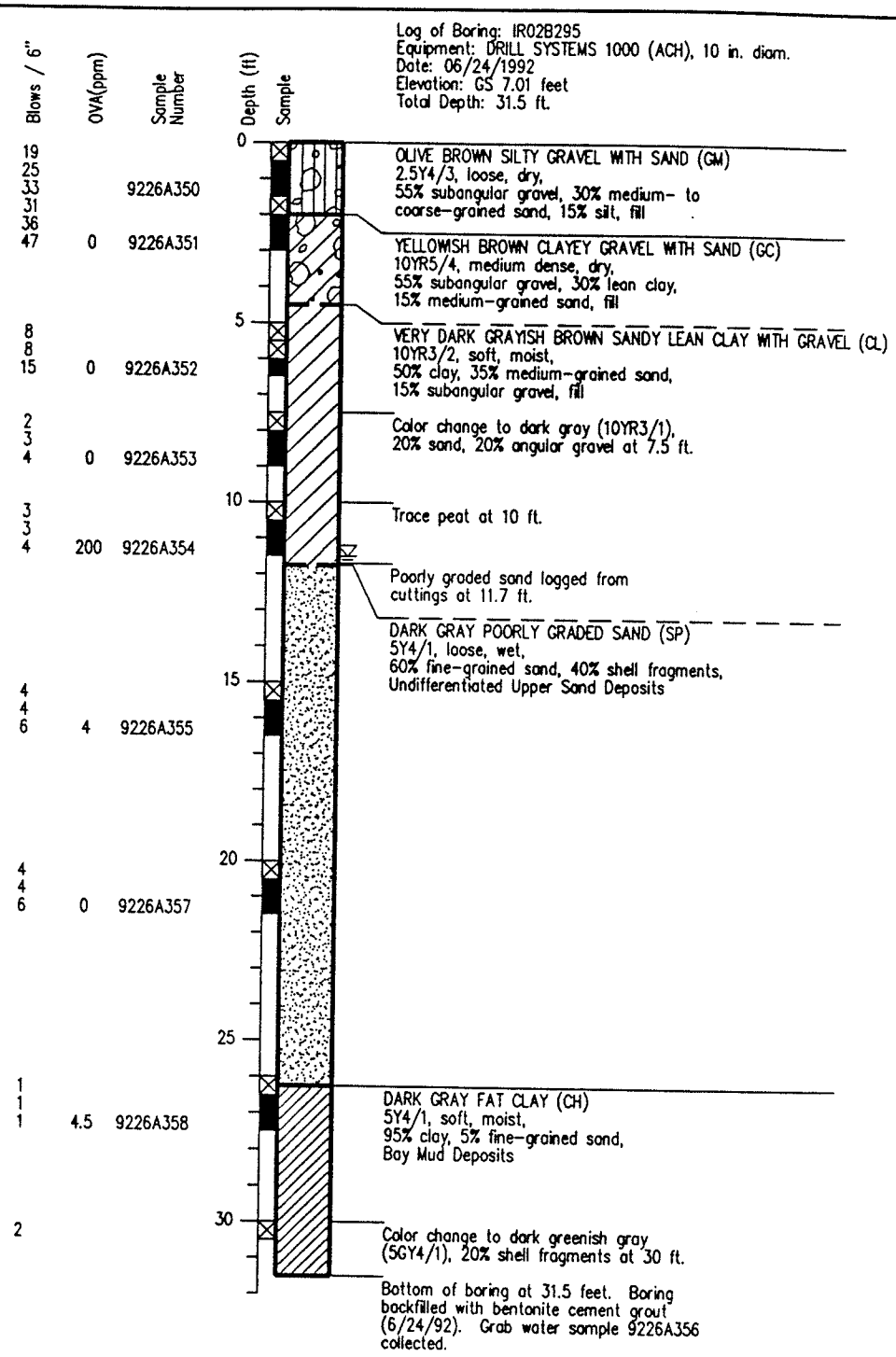
Site: HUNTERS PT PAR.E
Sounding: IRO2CPT68

Engineer: S.LEE
Date: 2/12/2015 01:11



Max. Depth: 63.074 (ft)
Avg. Interval: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)



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Engineering and Environmental Services

Log of Boring IR02B295

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/30/92	

DRILL RIG: Continuous Flight Auger | SURFACE ELEVATION: 10'± | LOGGED BY: L.M.L.
DEPTH TO GROUNDWATER: 0 feet | BORING DIAMETER: 6 Inches | DATE DRILLED: 4/7/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (feet)
CLAY, sandy to gravelly	grey-brown / grey	stiff	CL	
FILL				
CLAY, silty (Bay Mud)	grey	soft	CH	
SAND, silty, fine grained	grey	dense	SM	
Bottom of boring = 91 feet				

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO.	DATE	SHEET NO.	BORING NO.
168-4	April 1972		44

DRILL RIG: Continuous Flight Auger | SURFACE ELEVATION: 111.0 | LOGGED BY: L.M.L.
DEPTH TO GROUNDWATER: 4 feet | BORING DIAMETER: 6 Inches | DATE DRILLED: 4/7/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (feet)
CLAY, silty with some gravel	medium brown	stiff	CL	
FILL				
CLAY, silty (Bay Mud)	grey	soft	CH	
SAND, silty, fine grained	grey	dense	SM	
Bottom of boring = 56.5 feet				

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO.	DATE	SHEET NO.	BORING NO.
168-4	April 1972		45

DRILL RIG: Continuous Flight Auger | SURFACE ELEVATION: 111.0 | LOGGED BY: L.M.L.
DEPTH TO GROUNDWATER: 4 feet | BORING DIAMETER: 6 Inches | DATE DRILLED: 4/7/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (feet)
Asphalt and base rock				
CLAY, silty to sandy	tan	stiff	CL	
CLAY, sandy with some gravel	medium brown	firm to stiff	CL	
GRAVEL, sandy, coarse grained	grey-brown	dense	GP	
SAND, silty to clayey, fine grained	light grey	loose to medium dense	SM-SC	
FILL				
CLAY, silty (Bay Mud)	grey	soft	CH	
Bottom of boring = 64 feet (Bottom of Bay Mud by probing)				

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO.	DATE	SHEET NO.	BORING NO.
168-4	April 1972		46

DRILL RIG: Hollow Stem Auger | SURFACE ELEVATION: 111.0± | LOGGED BY: B.M.L.
DEPTH TO GROUNDWATER: 7 feet | BORING DIAMETER: 6.5 Inches | DATE DRILLED: 4/20/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (feet)	PENETRATION RESISTANCE (BLOWS/FOOT)
GRAVEL, silty to sandy, coarse grained	grey-brown	dense	GM-GP		
SAND, silty, fine grained, with some gravel	dark grey	medium dense	SM-SP	5	22
CLAY, silty with some sand	grey-brown	stiff	CL		
SAND, silty, fine to medium grained with some gravel	black / grey	loose	SW / SP	10	6
SAND, silty, medium to coarse grained with some gravel	grey & black	medium dense	SM-SP	15	5
FILL				20	6
CLAY, silty with some sand lenses and shells (Bay Mud)	dark grey	soft	CH	25	16
				30	3
				35	
				40	4
				45	
				50	2
SAND, clayey with some silt, fine grained	dark grey	medium dense	SC	55	10
SAND, fine grained with thin layers of clay	grey	medium dense	SP	60	
				65	22
CLAY, silty with shells	light brown	very stiff	CH	70	
				75	
CLAY, silty, with shells, occasional sand lenses	grey / tan	stiff to very stiff	CH	80	21
				85	
				90	
				95	
				100	
SAND, clayey, fine to medium grained	light brown	dense / very dense	SC-SP	105	34
				110	
				115	
				120	65
				125	
				130	
CLAY, silty	grey	very stiff	CH	135	21
Bottom of Boring = 133.5 feet					

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO.	DATE	SHEET NO.	BORING NO.
168-4	April 1972		47

DRILL RIG: Hollow Stem Auger | SURFACE ELEVATION: 111.0± | LOGGED BY: B.M.L.
DEPTH TO GROUNDWATER: 6.5 feet | BORING DIAMETER: 6.5 inches | DATE DRILLED: 4/27/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (feet)	PENETRATION RESISTANCE (BLOWS/FOOT)
CLAY, sandy with some gravel	grey-brown	very stiff	CL		
CLAY, sandy with some gravel	grey	very stiff	CL	5	23
CLAY, silty with some sand and gravel	dark grey	firm	CH	10	4
SAND, silty, fine to medium grained with some shells	grey	loose / medium dense	SM-SP	15	6
				20	
				25	22
SAND, clayey, fine grained	grey	medium dense	SC-SP	30	14
FILL					
CLAY, silty with several shells (Bay Mud)	grey	firm / firm	CH	35	3
				40	
				45	
				50	
				55	
				60	5
CLAY, silty	green-grey	very stiff	CH	65	
SAND, silty, fine grained	grey	very dense / dense / medium dense	SM-SP	70	75
				75	
				80	
CLAY, silty with some shells, occasional sand lenses	light brown	stiff to very stiff	CL	85	15
CLAY, silty	green-grey	very stiff	CH	90	
SAND, silty to clayey, fine grained	light brown	very dense	SM-SC	95	14
				100	
				105	87
CLAY, silty to sandy with lenses of clayey sand	grey & brown mottled	hard	CL-CH	110	
				115	69
CLAY, silty with some gravel (weathered bedrock)	light grey-brown	hard	CL	120	
				125	
				130	130/9"
Bottom of Boring = 129.25 feet					

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO.	DATE	SHEET NO.	BORING NO.
168-4	April 1972		48

NOTE

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IF SHEET IS LESS THAN 28" X 40"
IT IS A REDUCED PRINT —
SCALE REDUCED ACCORDINGLY

WESTDIV, DWG. NO.

A-E NO 62474-72-C-0060
CONSOER, TOWNSEND & ASSOCIATES
CONSULTING ENGINEERS

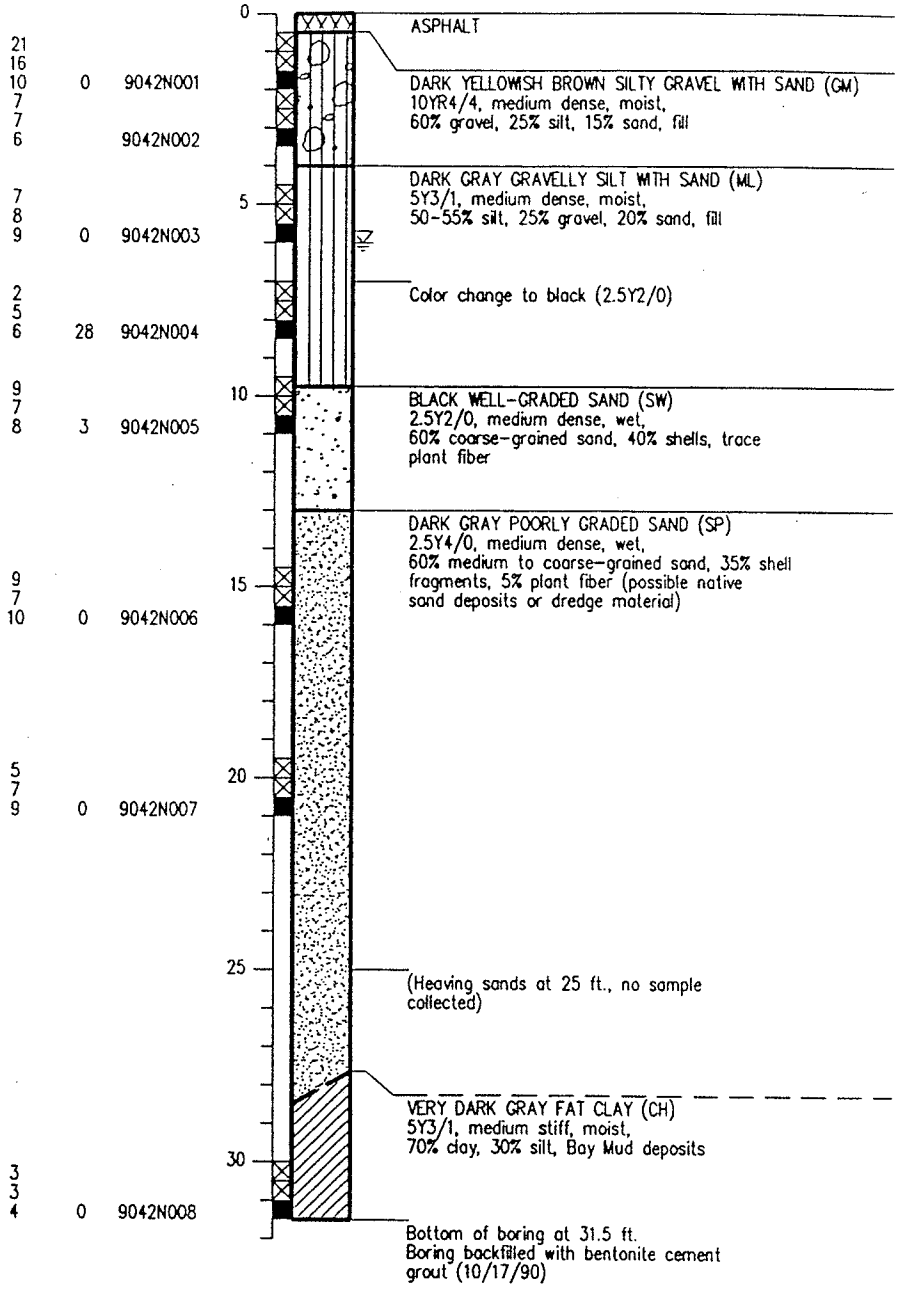
ORIGN.	DR.	CHK.
SUPV.		CH. ENGR.

SUBMITTED BY
FIRM MEMBER TITLE: DATE:
E.I.C. FIRE PROT.
BR. HD. DIR.
SATISFACTORY TO
TITLE: DATE:
APPROVED DATE:
EFD FOR COMMANDER NAVFAC

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION
SAN BRUNO, CALIFORNIA
HUNTERS POINT NAVAL SHIPYARD — SAN FRANCISCO, CALIFORNIA
WATER POLLUTION ABATEMENT
SOIL BORING LOG
BORING NO. 44 TO NO. 48

SIZE	CODE IDENT. NO.	NAVFAC DRAWING NO.
F	80091	6020031
		CONST. CONTR. NO. N62474--72--C--0061
SCALE		SPEC. 12-72-0061 SHEET 67 OF

Log of Boring: IR02B187
Equipment: CME 55 (HSA), 8.0 in. diam.
Date: 10/17/1990
Elevation: GS 6.91 feet
Total Depth: 31.5 ft.



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring: IR02B187
Primary Phase Remedial Investigation
Naval Station, Treasure Island, Hunters Point Annex
San Francisco, California

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
GDT	18639,160.02		5/91	

REVISIONS				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED

NOTE

SOIL BORING LOGS FROM SOIL REPORT ARE INCLUDED HEREIN ONLY FOR THE INFORMATION OF THE CONTRACTOR. NO WARRANTY IS MADE OR IMPLIED AS TO THE ACCURACY OR COMPLETENESS OF THESE BORINGS. OTHER SOIL BORINGS ARE AVAILABLE AT THE HUNTER'S POINT PUBLIC WORKS OFFICE FOR THE CONTRACTOR TO STUDY. NO WARRANTY IS MADE OR IMPLIED AS TO THE ACCURACY OR COMPLETENESS OF THESE OTHER SOIL BORINGS. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO ASCERTAIN EXISTING SOIL CONDITIONS AND IF HE CHOOSES TO BASE HIS DECISIONS ON INFORMATION CONTAINED IN THESE SOIL BORINGS HE SHALL MAKE NO CLAIMS BECAUSE OF PROBLEMS ARISING THEREOF. THESE BORINGS ARE SPECIFICALLY MADE NOT A PORTION OF THIS CONTRACT.

IF SHEET IS LESS THAN
28" X 40"
IT IS A REDUCED PRINT —
SCALE REDUCED ACCORDINGLY

A-E NO. 62474-72-C-0060
CONSOER, TOWNSEND & ASSOCIATES
SAN JOSE, CALIFORNIA
CONSULTING ENGINEERS

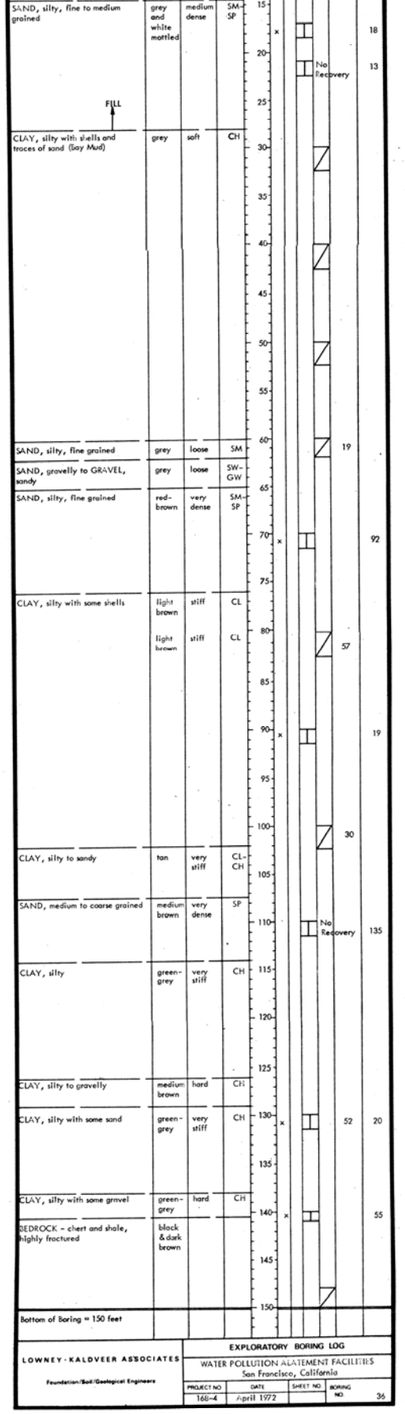
DESIGN | DR. | CHK.
SUPV. | CH. ENGR.
SUBMITTED BY
FIRM MGR/KEY PERSON | DATE
E.I.C. | FIRE PROT.
BR. NO. | DIR.
SATISFACTORY TO
TITLE | DATE
APPROVED | DATE
BY'S FOR COMMANDER NAVFAC

WESTDIV. DWG. NO.

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION
SAN BRUNO, CALIFORNIA
HUNTERS POINT NAVAL SHIPYARD — SAN FRANCISCO, CALIFORNIA
WATER POLLUTION ABATEMENT
SOIL BORING LOGS
BORING NO.1 TO NO. 5

SIZE: F | CODE IDENT. NO.: 80091 | NAVFAC DRAWING NO.: 6020024
CONST. CONTR. NO.: N62474-72-C-0061
SCALE | SPEC.: 12-72-0061 | SHEET 60 OF

B-1



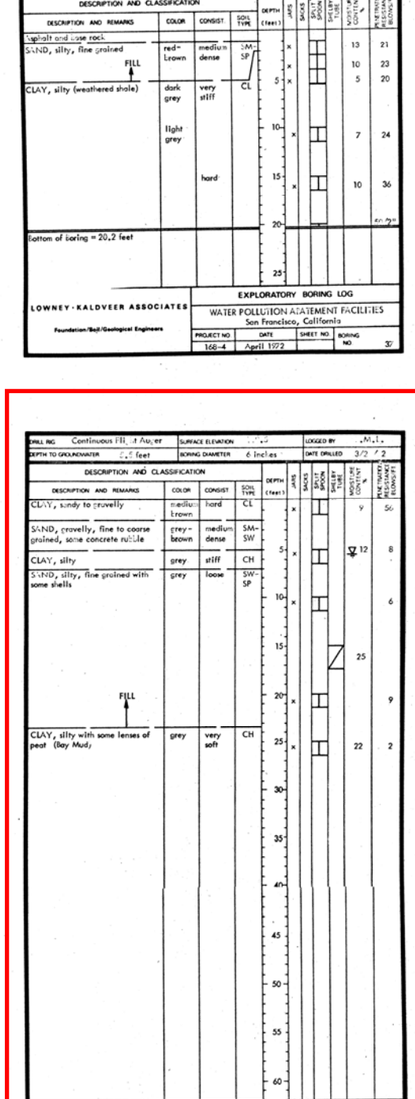
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
SAND, silty, fine to medium grained	grey and white mottled	medium dense	SM-SP
FILL			
CLAY, silty with shells and traces of sand (Bay Mud)	grey	soft	CH
SAND, silty, fine grained	grey	loose	SM
SAND, gravelly to GRAVEL, sandy	grey	loose	SW-GW
SAND, silty, fine grained	red-brown	very dense	SM-SP
CLAY, silty with some shells	light brown	stiff	CL
	light brown	stiff	CL
CLAY, silty to sandy	tan	very stiff	CL-CH
SAND, medium to coarse grained	medium brown	very dense	SP
CLAY, silty	green-grey	very stiff	CH
CLAY, silty to gravelly	medium brown	hard	CH
CLAY, silty with some sand	green-grey	very stiff	CH
CLAY, silty with some gravel	green-grey	hard	CH
BEDROCK - chert and shale, highly fractured	black & dark brown		

Bottom of Boring = 150 feet

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		36



DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
Asphalt and base rock			
SAND, silty, fine grained	red-Brown	medium dense	SM-SP
FILL			
CLAY, silty (weathered shale)	dark grey	very stiff	CL
	light grey	hard	

Bottom of Boring = 20.2 feet

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		37

DRILL RIG: Continuous Flight Auger — SURFACE ELEVATION: [illegible] — LOGGED BY: M.L.
DEPTH TO GROUNDWATER: [illegible] feet — BORING DIAMETER: 6 inches — DATE DRILLED: 3/2/72

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
CLAY, sandy to gravelly	medium brown	hard	CL
SAND, gravelly, fine to coarse grained, some concrete rubble	grey-brown	medium dense	SM-SW
CLAY, silty	grey	stiff	CH
SAND, silty, fine grained with some shells	grey	loose	SW-SP
FILL			
CLAY, silty with some lenses of peat (Bay Mud)	grey	very soft	CH

Bottom of Boring = 62 feet
(Bottom of Bay Mud by probing)

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		38

NOTE

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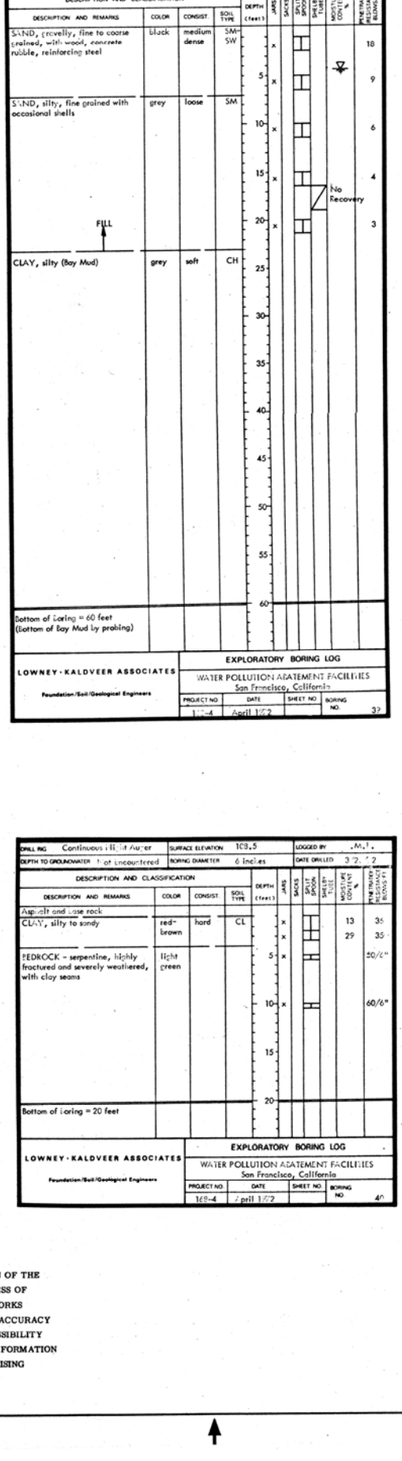


DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
SAND, gravelly, fine to coarse grained, with wood, concrete rubble, reinforcing steel	black	medium dense	SM-SW
SAND, silty, fine grained with occasional shells	grey	loose	SM
FILL			
CLAY, silty (Bay Mud)	grey	soft	CH

Bottom of Boring = 60 feet
(Bottom of Bay Mud by probing)

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		39

DRILL RIG: Continuous Flight Auger — SURFACE ELEVATION: 108.5 — LOGGED BY: M.L.
DEPTH TO GROUNDWATER: Not encountered — BORING DIAMETER: 6 inches — DATE DRILLED: 3/2/72

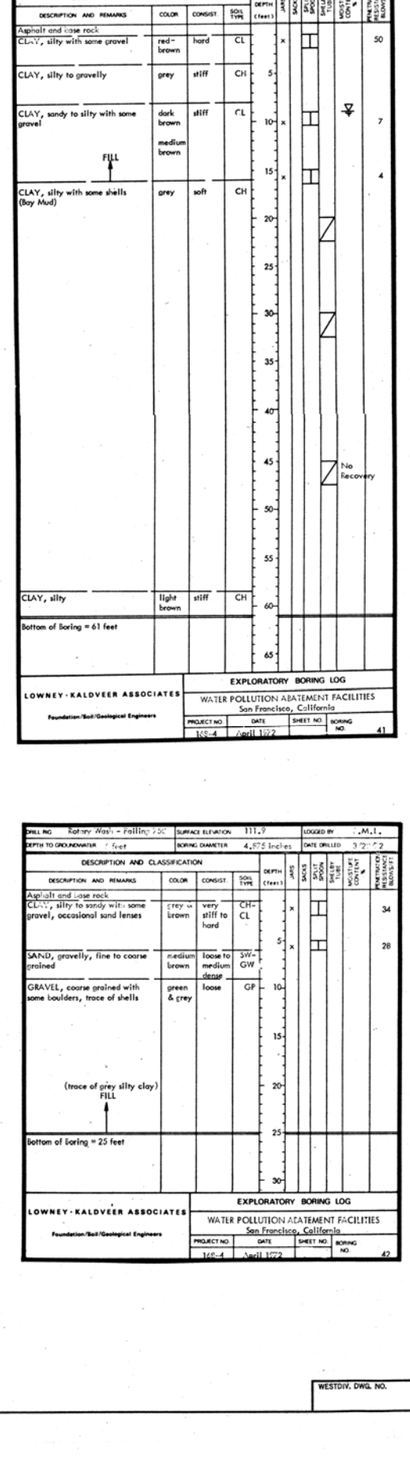
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
Asphalt and base rock			
CLAY, silty to sandy	red-brown	hard	CL
BEDROCK - serpentine, highly fractured and severely weathered, with clay seams	light green		

Bottom of Boring = 20 feet

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		40



DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
Asphalt and base rock			
CLAY, silty with some gravel	red-brown	hard	CL
CLAY, silty to gravelly	grey	stiff	CH
CLAY, sandy to silty with some gravel	dark brown	stiff	CL
FILL	medium brown		
CLAY, silty with some shells (Bay Mud)	grey	soft	CH
CLAY, silty	light brown	stiff	CH

Bottom of Boring = 61 feet

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		41

DRILL RIG: Rotary Wash - Failing 250 — SURFACE ELEVATION: 111.9 — LOGGED BY: M.L.
DEPTH TO GROUNDWATER: [illegible] feet — BORING DIAMETER: 4.875 inches — DATE DRILLED: 3/2/72

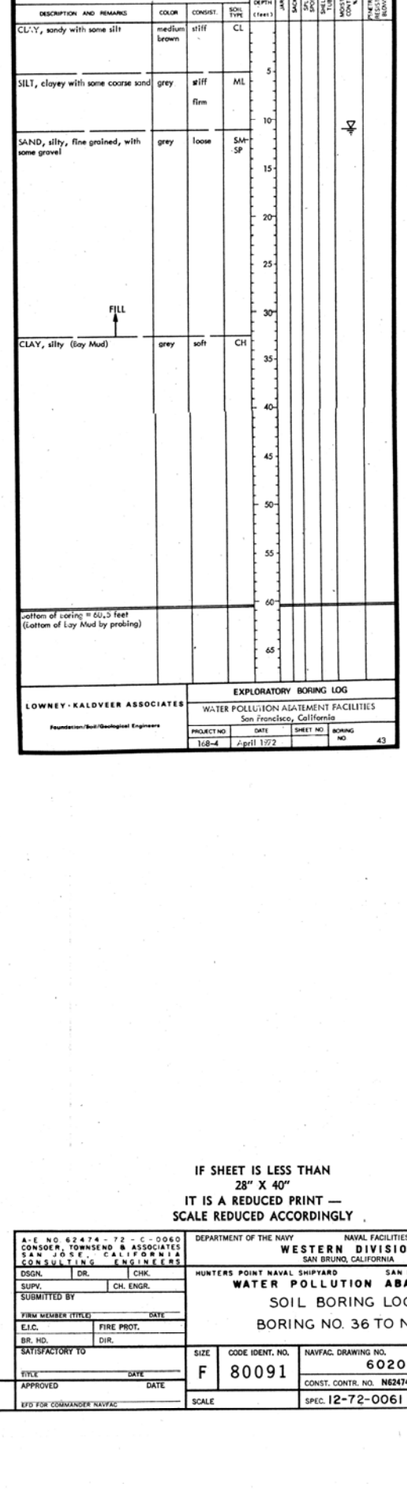
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
Asphalt and base rock			
CLAY, silty to sandy with some gravel, occasional sand lenses	grey to brown	very stiff to hard	CH-CL
SAND, gravelly, fine to coarse grained	medium brown	loose to medium dense	SW-GW
GRAVEL, coarse grained with some boulders, trace of shells	green & grey	loose	GP
(trace of grey silty clay) FILL			

Bottom of Boring = 25 feet

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		42



DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE
CLAY, sandy with some silt	medium brown	stiff	CL
SILT, clayey with some coarse sand	grey	stiff firm	ML
SAND, silty, fine grained, with some gravel	grey	loose	SM-SP
FILL			
CLAY, silty (Bay Mud)	grey	soft	CH

Bottom of Boring = 60.5 feet
(Bottom of Bay Mud by probing)

LOWNEY-KALDVEER ASSOCIATES — Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG
WATER POLLUTION ABATEMENT FACILITIES
San Francisco, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
168-4	April 1972		43

IF SHEET IS LESS THAN
28" X 40"
IT IS A REDUCED PRINT —
SCALE REDUCED ACCORDINGLY

A-E NO 62474-72-C-0060
CONSOER, TOWNSEND & ASSOCIATES
SAN JOSE, CALIFORNIA
CONSULTING ENGINEERS

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION
SAN BRUNO, CALIFORNIA

DSGN. | DR. | CHK.
SUPV. | CH. ENGR.
SUBMITTED BY
FIRM MEMBER (TITLE) | DATE
E.I.C. | FIRE PROT.
BR. HD. | DIR.
SATISFACTORY TO
TITLE | DATE
APPROVED | DATE
EFD FOR COMMANDER NAVFAC

HUNTERS POINT NAVAL SHIPYARD — SAN FRANCISCO, CALIFORNIA
WATER POLLUTION ABATEMENT
SOIL BORING LOGS
BORING NO. 36 TO NO. 43

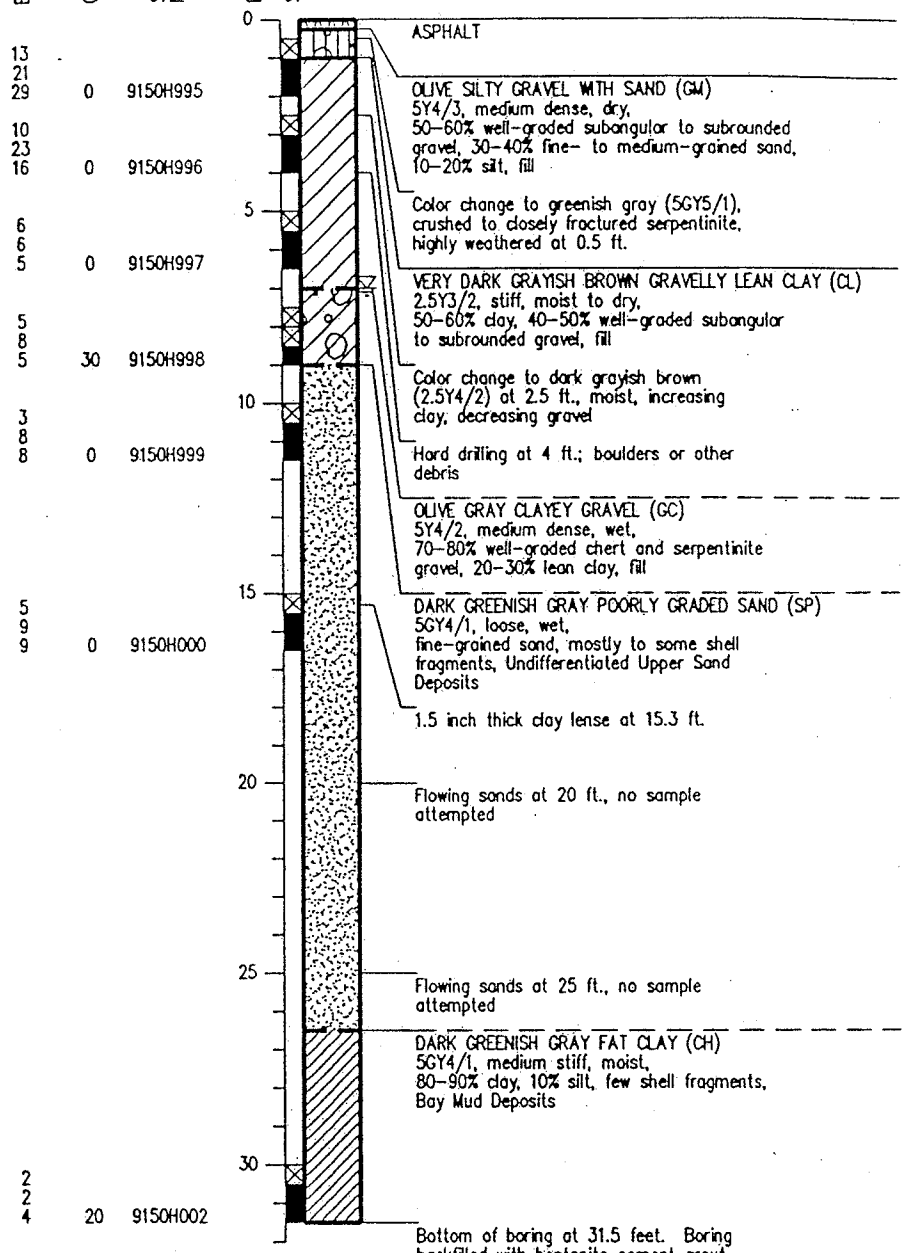
WESTDIV. DWG. NO.

SIZE	CODE IDENT. NO.	NAVFAC. DRAWING NO.
F	80091	6020030

CONST. CONTR. NO. N62474-72-C-0061
SCALE
SPEC. 12-72-0061 | SHEET 66 OF

PRINTED ON DIEPO NO. 10000H CLEARPRINT 1:1

Log of Boring: IR02B186
Equipment: CME 55 (HSA), 8 in. diam.
Date: 12/11/1991
Elevation: GS 6.62 feet
Total Depth: 31.5 ft.



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR02B186

PLATE

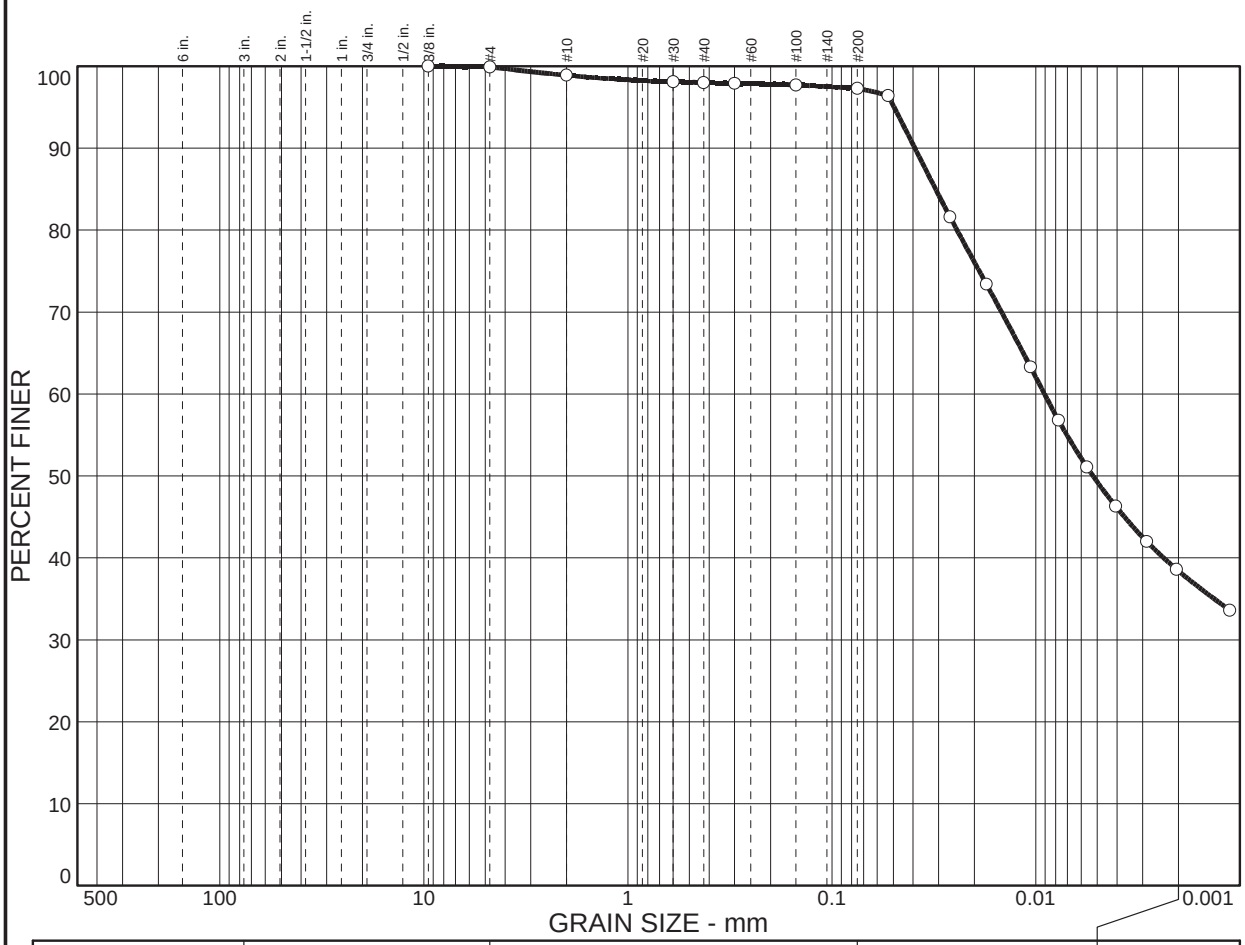
HUNTER'S POINT ANNEX
SAN FRANCISCO, CA

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/09/92	

Attachment F2
Laboratory Test Results

(This attachment is provided on CD only)

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.1	2.6	58.9	38.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.9		
#10	98.9		
#30	98.1		
#40	98.0		
#50	97.9		
#100	97.7		
#200	97.3		
#270	96.4		
0.0264 mm.	81.6		
0.0175 mm.	73.4		
0.0106 mm.	63.3		
0.0078 mm.	56.8		
0.0056 mm.	51.1		
0.0041 mm.	46.3		
0.0029 mm.	42.0		
0.0020 mm.	38.6		
0.0011 mm.	33.6		

* (no specification provided)

Soil Description

Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)

Atterberg Limits

PL= 34 LL= 77 PI= 43

Coefficients

D_{85}= 0.0310 D_{60}= 0.0091 D_{50}= 0.0053
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

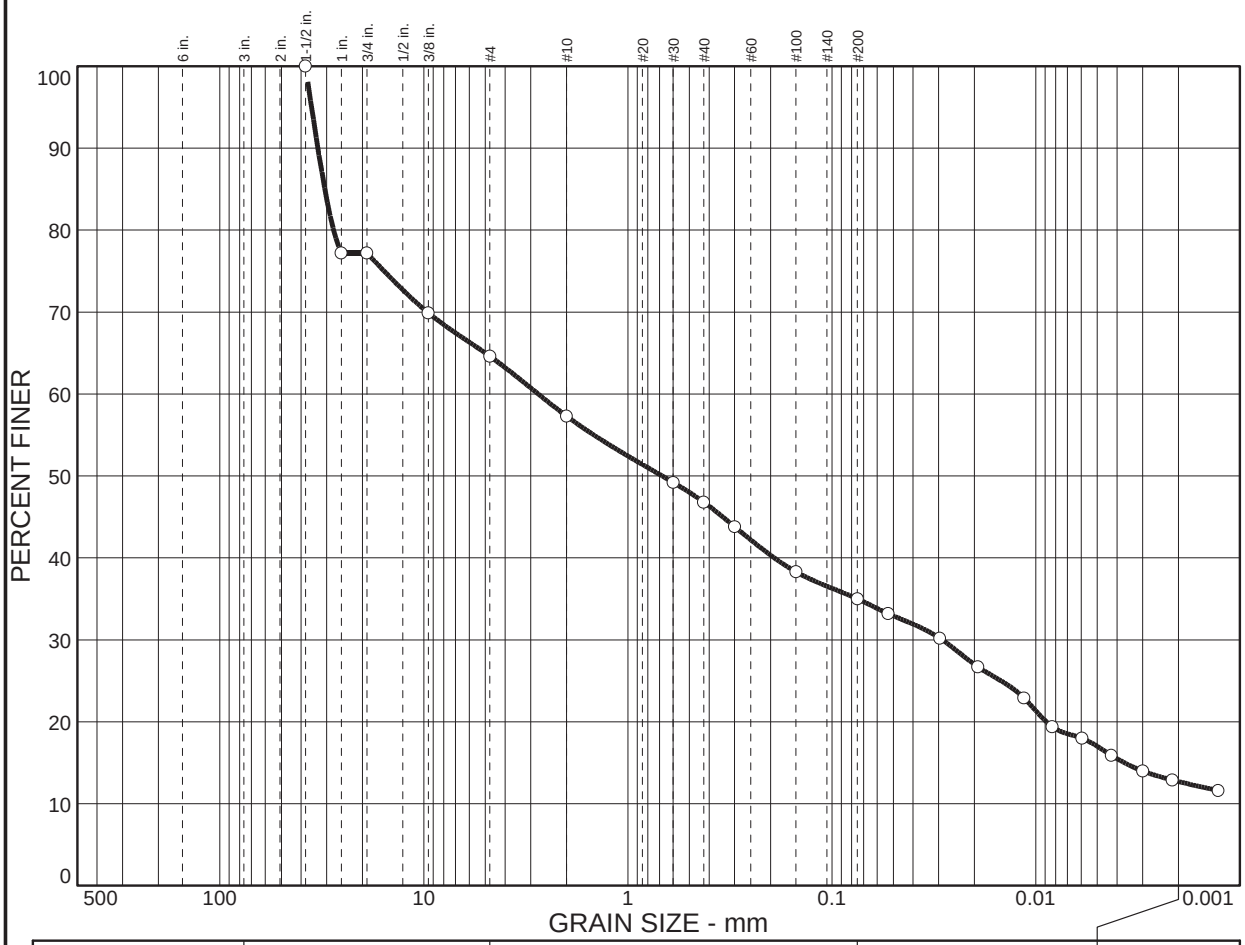
Sample No.: **Source of Sample:** IR02B601 **Date:** 4/14/15
Location: **Elev./Depth:** 9.5-12'

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	35.4	29.6	22.3	12.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	77.2		
3/4 in.	77.2		
3/8 in.	69.9		
#4	64.6		
#10	57.3		
#30	49.2		
#40	46.8		
#50	43.8		
#100	38.3		
#200	35.0		
#270	33.2		
0.0296 mm.	30.2		
0.0193 mm.	26.7		
0.0115 mm.	22.9		
0.0083 mm.	19.4		
0.0060 mm.	18.0		
0.0043 mm.	15.9		
0.0030 mm.	14.0		
0.0021 mm.	12.9		
0.0013 mm.	11.6		

* (no specification provided)

Soil Description

Dark Greenish Gray Fat Clayey GRAVEL w/ Sand & shell fragments (Bay Mud)

Atterberg Limits

PL= 25 LL= 56 PI= 31

Coefficients

D_{85}= 30.6 D_{60}= 2.76 D_{50}= 0.680
D_{30}= 0.0288 D_{15}= 0.0037 D_{10}=
C_u= C_c=

Classification

USCS= GC AASHTO=

Remarks

Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

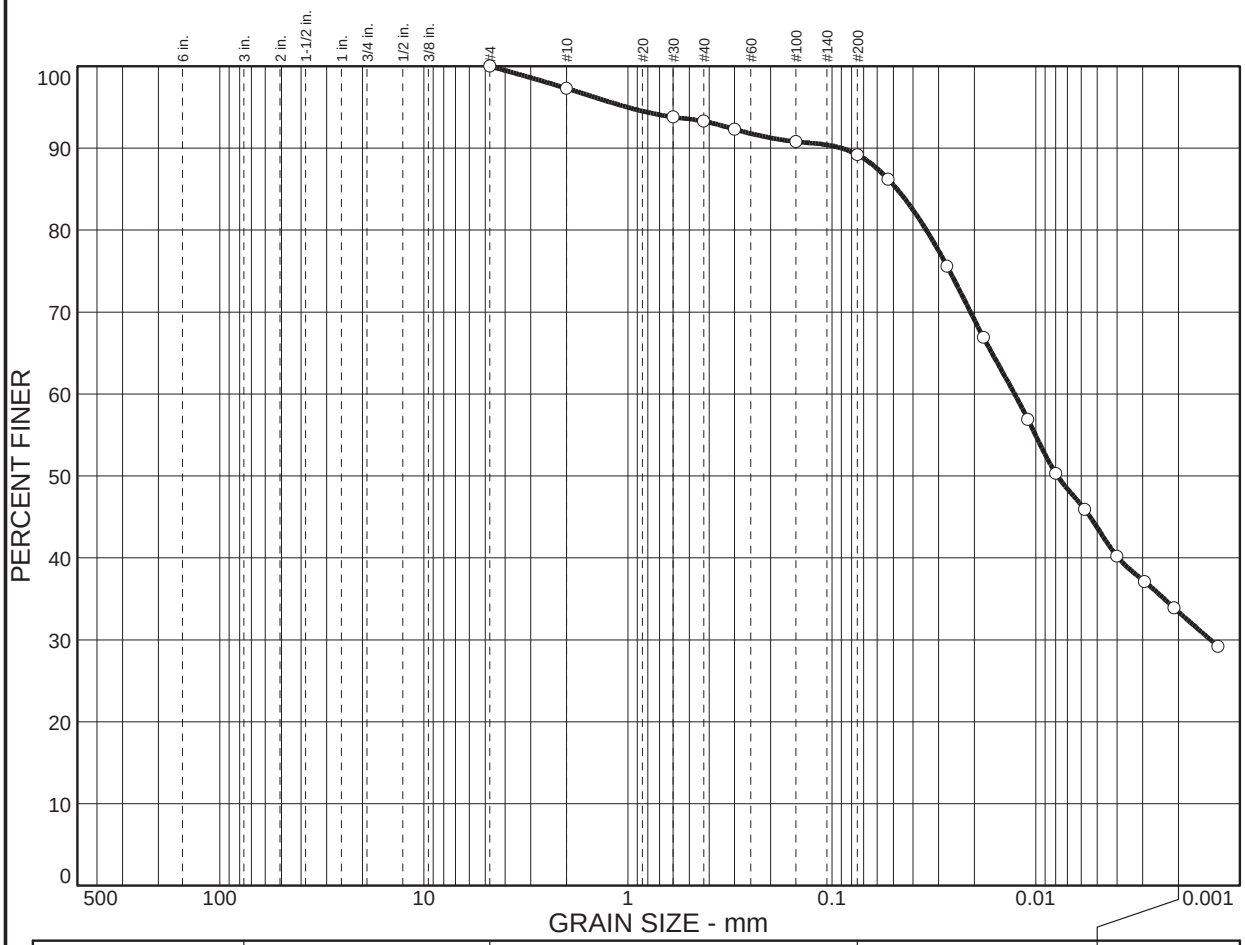
Sample No.: **Source of Sample:** IR02B603 **Date:** 4/27/15
Location: **Elev./Depth:** 1.5-4.0'

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	10.8	55.8	33.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	97.3		
#30	93.8		
#40	93.3		
#50	92.3		
#100	90.8		
#200	89.2		
#270	86.2		
0.0273 mm.	75.6		
0.0181 mm.	66.9		
0.0110 mm.	56.9		
0.0080 mm.	50.3		
0.0058 mm.	45.9		
0.0040 mm.	40.2		
0.0029 mm.	37.1		
0.0021 mm.	33.9		
0.0013 mm.	29.2		

* (no specification provided)

Soil Description

Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)

Atterberg Limits

PL= 31 LL= 67 PI= 36

Coefficients

D_{85}= 0.0480 D_{60}= 0.0127 D_{50}= 0.0078
D_{30}= 0.0014 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

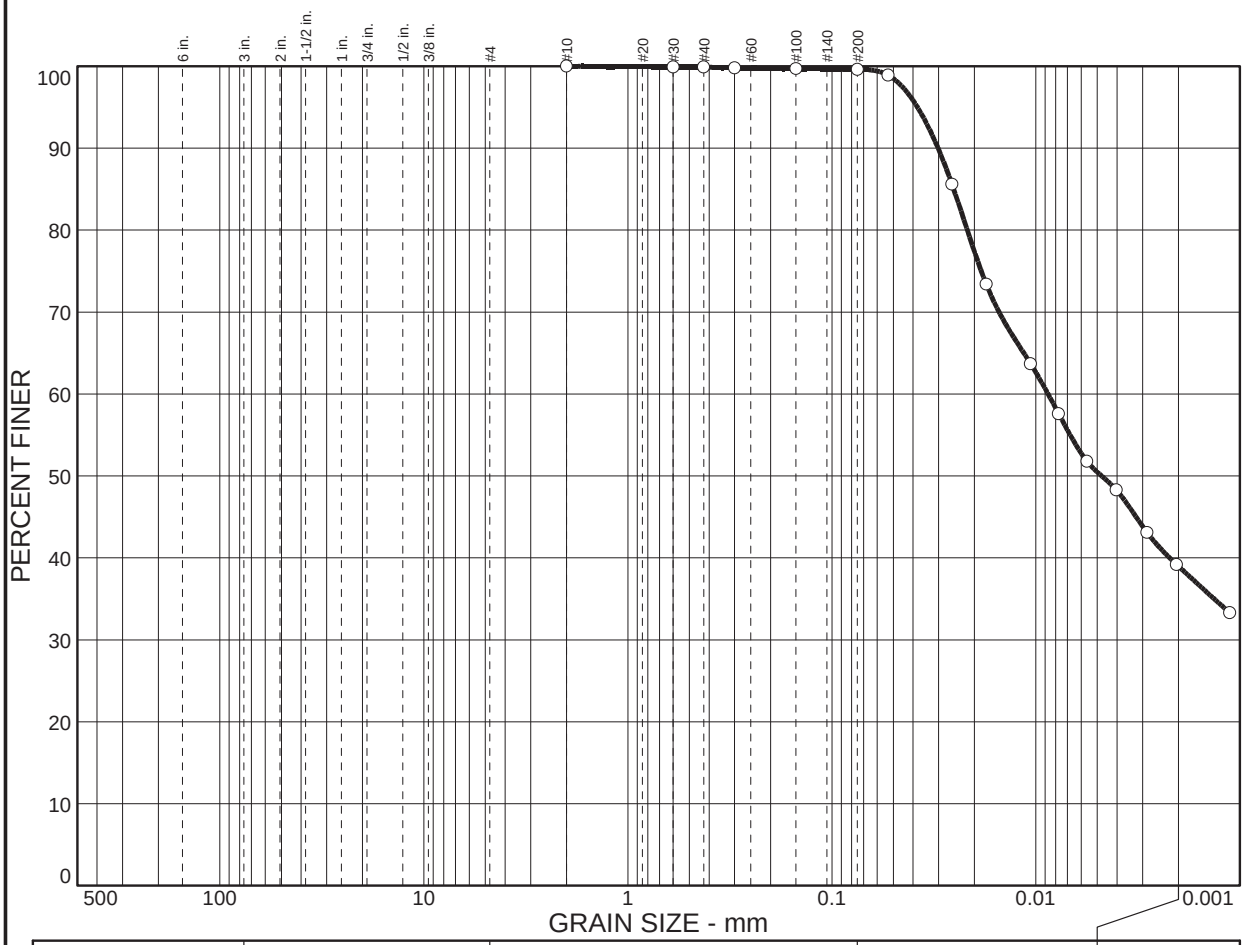
Sample No.: **Source of Sample:** IR02B603 **Date:** 4/3/15
Location: **Elev./Depth:** 19.5-22'

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.4	60.6	39.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.9		
#40	99.9		
#50	99.8		
#100	99.7		
#200	99.6		
#270	98.9		
0.0258 mm.	85.6		
0.0175 mm.	73.4		
0.0106 mm.	63.7		
0.0077 mm.	57.6		
0.0056 mm.	51.8		
0.0040 mm.	48.3		
0.0029 mm.	43.1		
0.0020 mm.	39.2		
0.0011 mm.	33.3		

* (no specification provided)

Soil Description

Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)

Atterberg Limits

PL= 28 LL= 64 PI= 36

Coefficients

D_{85}= 0.0253 D_{60}= 0.0087 D_{50}= 0.0048
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

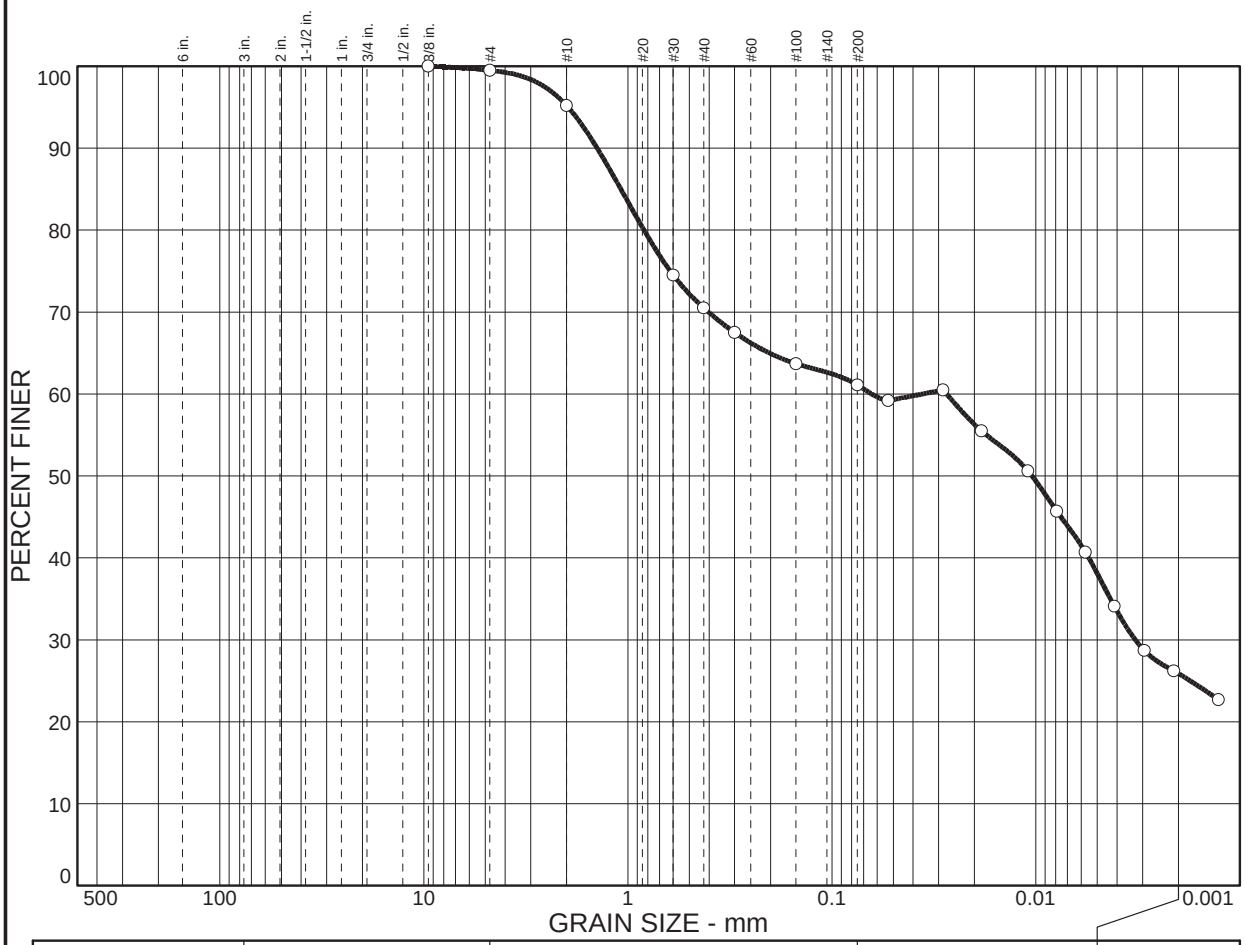
Sample No.: **Source of Sample:** IR02B603 **Date:** 4/14/15
Location: **Elev./Depth:** 28.5-31.0'

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.5	38.4	35.2	25.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.5		
#10	95.2		
#30	74.5		
#40	70.5		
#50	67.5		
#100	63.7		
#200	61.1		
#270	59.2		
0.0285 mm.	60.5		
0.0185 mm.	55.5		
0.0109 mm.	50.6		
0.0079 mm.	45.7		
0.0057 mm.	40.7		
0.0041 mm.	34.1		
0.0029 mm.	28.7		
0.0021 mm.	26.2		
0.0013 mm.	22.7		

* (no specification provided)

Soil Description

Dark Greenish Gray Sandy Fat CLAY w/ shells (Bay Mud)

Atterberg Limits

PL= 32 LL= 76 PI= 44

Coefficients

D_{85}= 1.08 D_{60}= 0.0274 D_{50}= 0.0105
D_{30}= 0.0033 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

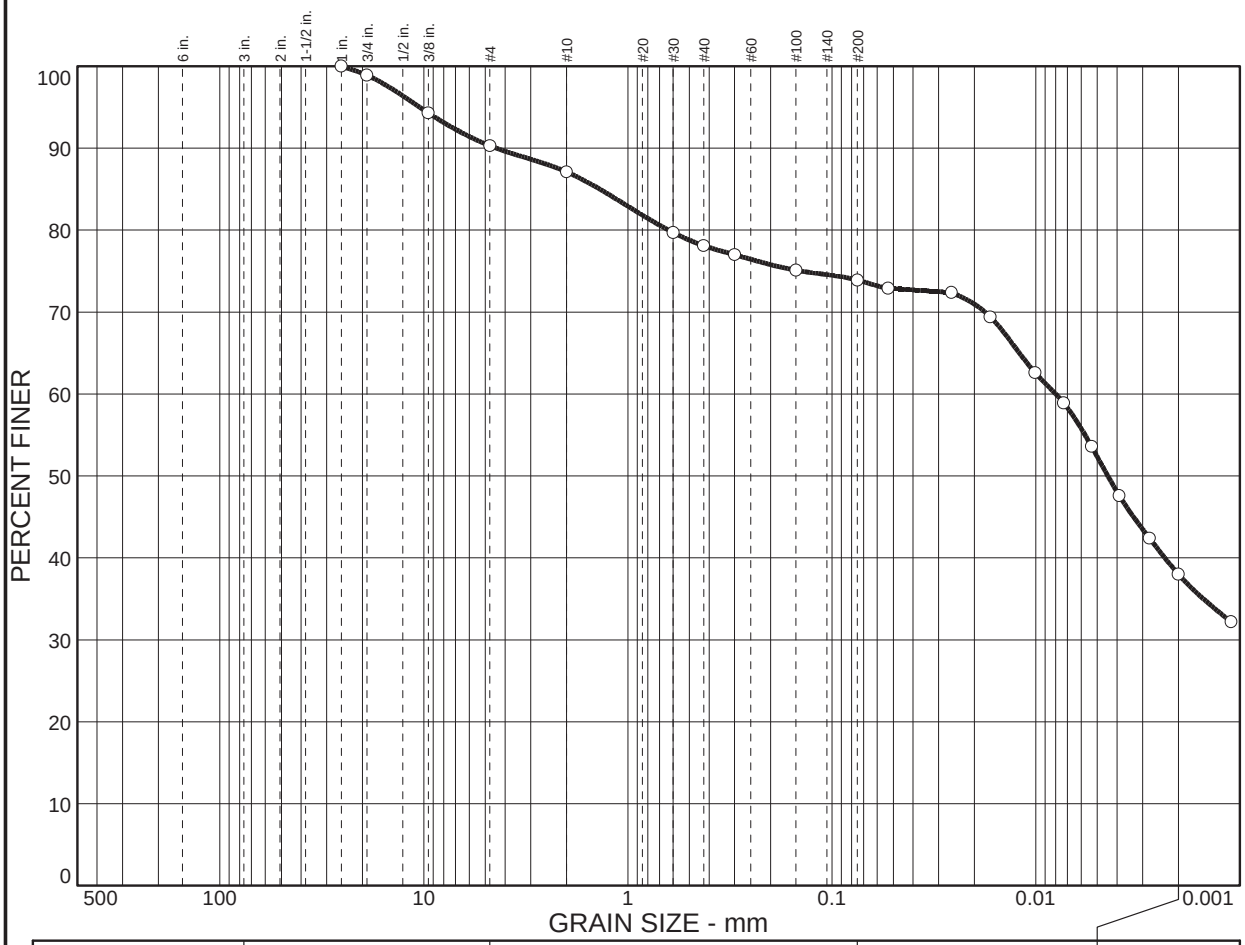
Sample No.: **Source of Sample:** IR02B605 **Date:** 4/29/15
Location: **Elev./Depth:** 31.5-

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	9.7	16.4	35.9	38.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	98.9		
3/8 in.	94.3		
#4	90.3		
#10	87.1		
#30	79.7		
#40	78.1		
#50	77.0		
#100	75.1		
#200	73.9		
#270	72.9		
0.0259 mm.	72.4		
0.0167 mm.	69.4		
0.0101 mm.	62.6		
0.0073 mm.	58.9		
0.0053 mm.	53.6		
0.0039 mm.	47.6		
0.0028 mm.	42.4		
0.0020 mm.	38.0		
0.0011 mm.	32.2		

* (no specification provided)

Soil Description

Dark Greenish Gray Fat CLAY w/ Sand & shells (Bay Mud)

Atterberg Limits

PL= 30 LL= 68 PI= 38

Coefficients

D_{85}= 1.37 D_{60}= 0.0080 D_{50}= 0.0044
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

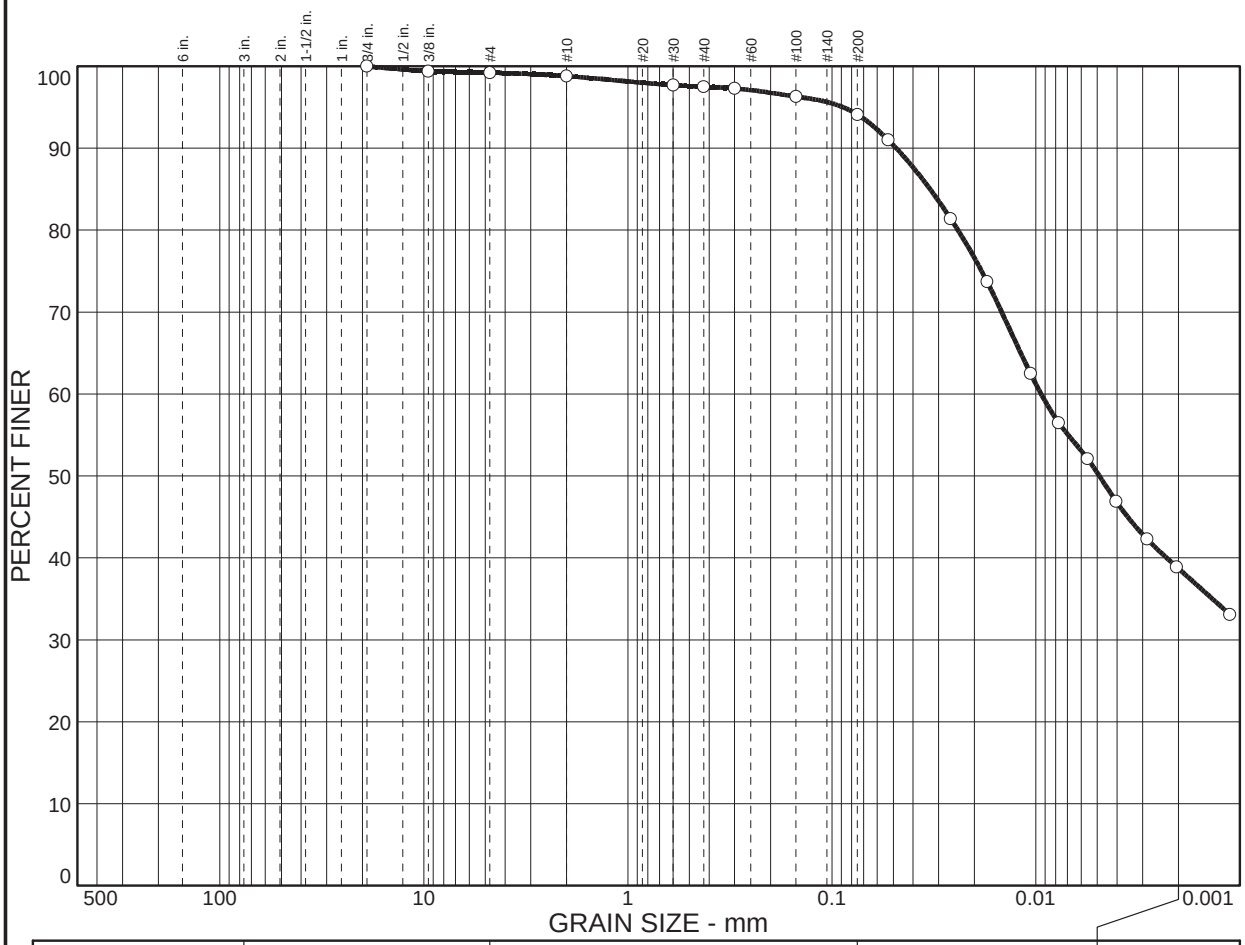
Sample No.: **Source of Sample:** IR02B605 **Date:** 4/14/15
Location: **Elev./Depth:** 51.5-54'

COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.8	5.1	55.4	38.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	99.4		
#4	99.2		
#10	98.8		
#30	97.7		
#40	97.5		
#50	97.3		
#100	96.3		
#200	94.1		
#270	91.0		
0.0262 mm.	81.4		
0.0174 mm.	73.7		
0.0106 mm.	62.5		
0.0077 mm.	56.5		
0.0056 mm.	52.1		
0.0040 mm.	46.9		
0.0029 mm.	42.3		
0.0020 mm.	38.9		
0.0011 mm.	33.1		

* (no specification provided)

Soil Description

Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)

Atterberg Limits

PL= 32 LL= 67 PI= 35

Coefficients

D_{85}= 0.0331 D_{60}= 0.0094 D_{50}= 0.0049
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

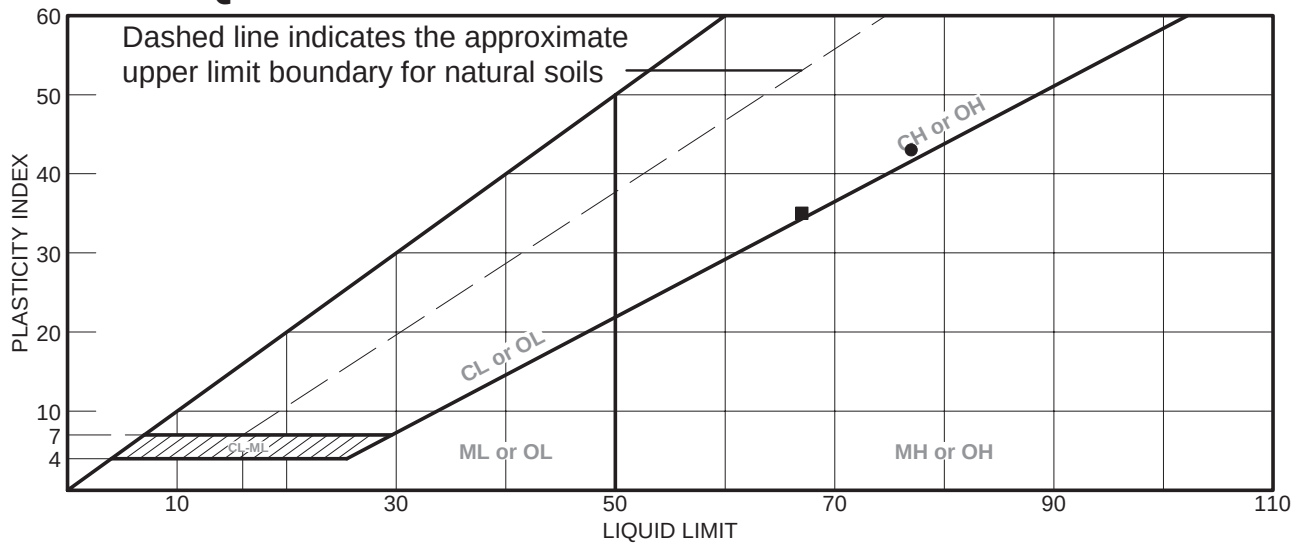
Sample No.: **Source of Sample:** IR03B607 **Date:** 4/14/15
Location: **Elev./Depth:** 21.5-24.0'

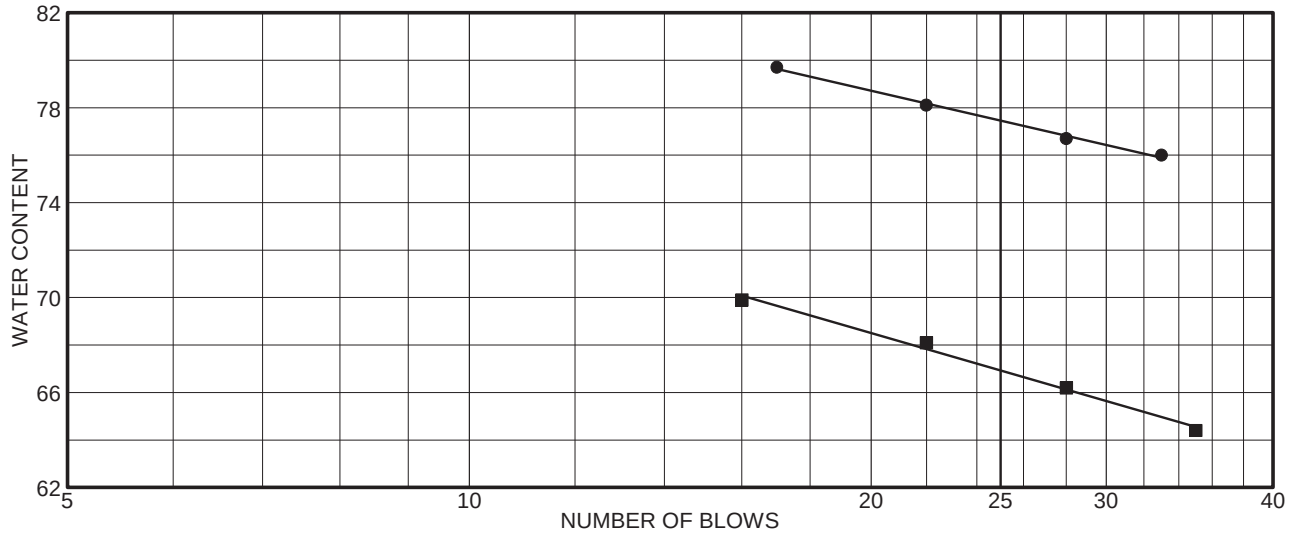
COOPER TESTING LABORATORY

Client: ERRG, Inc.
Project: Parcel E Pre-Design Investigation - 2014-091

Project No: 319-070 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)	77	34	43	98.0	97.3	CH
■	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)	67	32	35	97.5	94.1	CH

Project No. 319-070 **Client:** ERRG, Inc.

Project: Parcel E Pre-Design Investigation - 2014-091

● **Source:** IR02B601 **Elev./Depth:** 9.5-12'

■ **Source:** IR03B607 **Elev./Depth:** 21.5-24.0'

Remarks:

● Sample was prepared using the wet prep method.

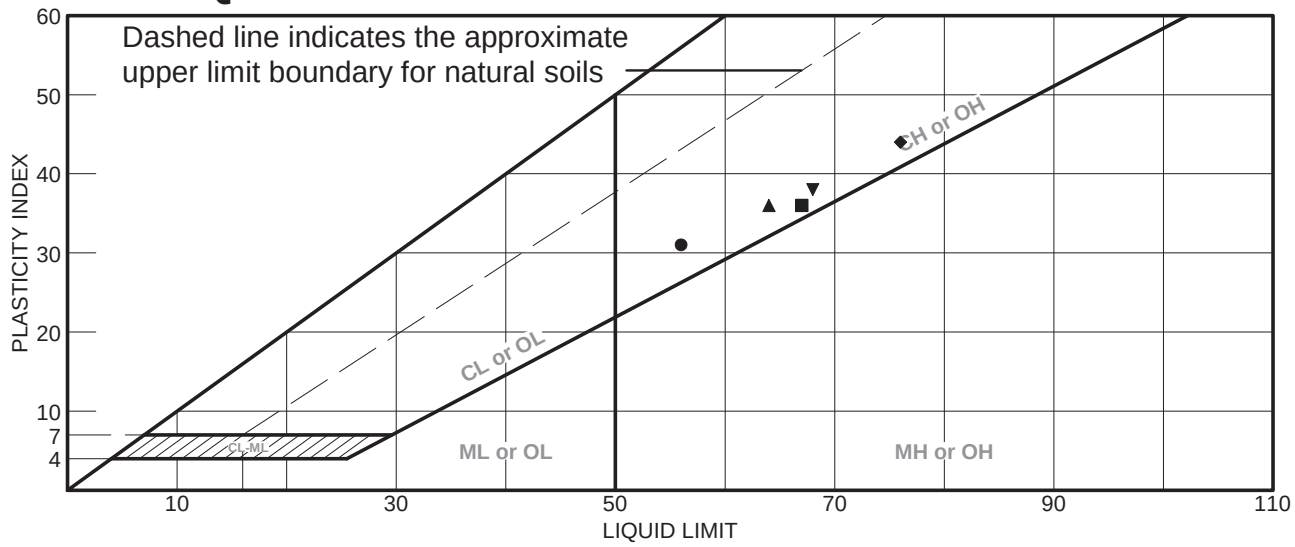
■

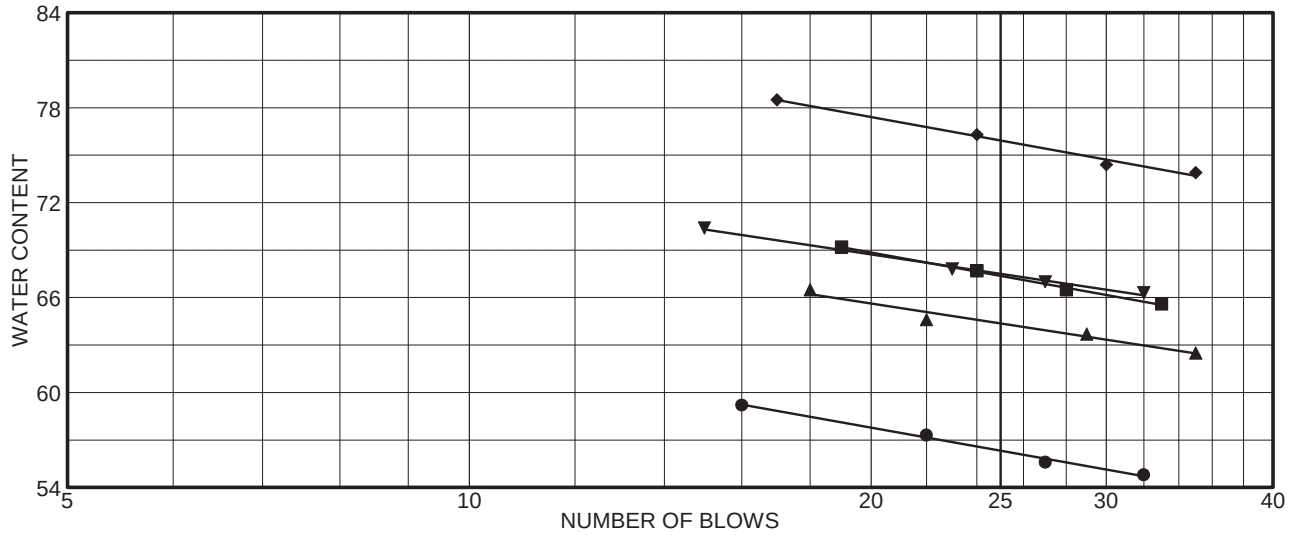
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Greenish Gray Fat Clayey GRAVEL w/ Sand & shell fragments (Bay Mud)	56	25	31	46.8	35.0	GC
■	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)	67	31	36	93.3	89.2	CH
▲	Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)	64	28	36	99.9	99.6	CH
◆	Dark Greenish Gray Sandy Fat CLAY w/ shells (Bay Mud)	76	32	44	70.5	61.1	CH
▼	Dark Greenish Gray Fat CLAY w/ Sand & shells (Bay Mud)	68	30	38	78.1	73.9	CH

Project No. 319-070 **Client:** ERRG, Inc.

Project: Parcel E Pre-Design Investigation - 2014-091

● **Source:** IR02B603 **Elev./Depth:** 1.5-4.0'
■ **Source:** IR02B603 **Elev./Depth:** 19.5-22'
▲ **Source:** IR02B603 **Elev./Depth:** 28.5-31.0'
◆ **Source:** IR02B605 **Elev./Depth:** 31.5-34(Tip-
▼ **Source:** IR02B605 **Elev./Depth:** 51.5-54'

LIQUID AND PLASTIC LIMITS TEST REPORT

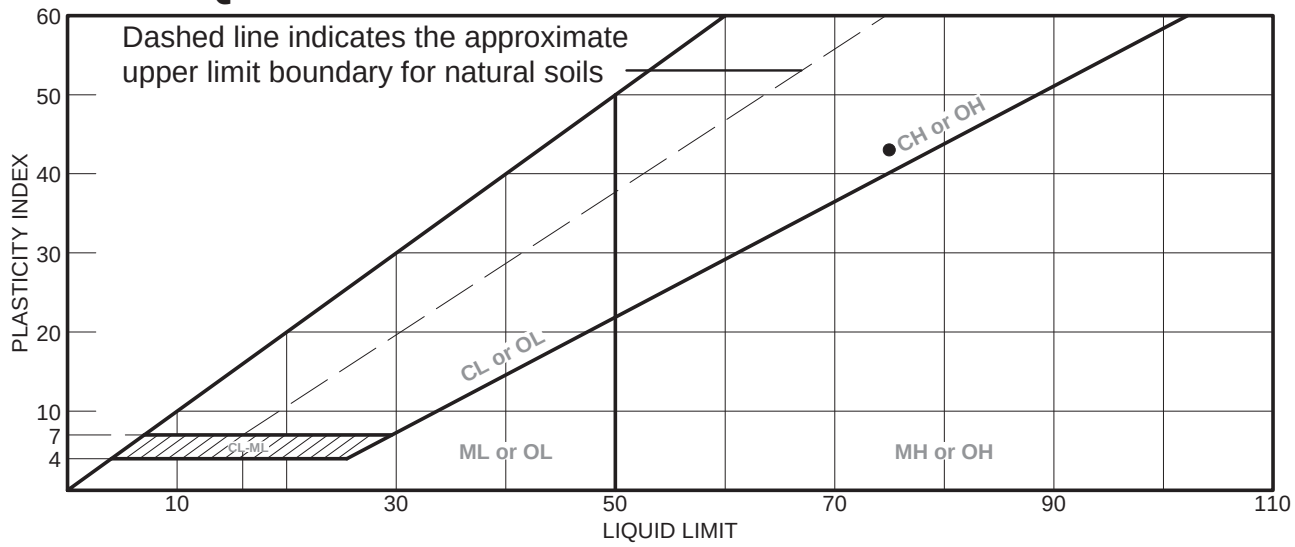
COOPER TESTING LABORATORY

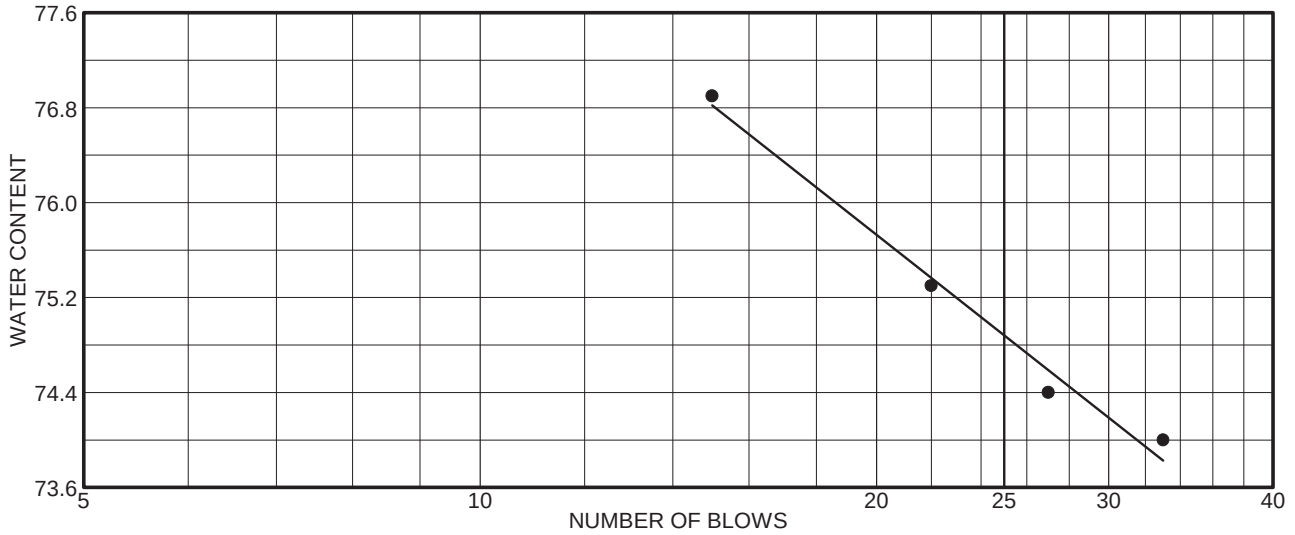
Remarks:

● Sample was prepared using the wet prep method.
■ Sample was prepared using the wet prep method.
▲ Sample was prepared using the wet prep.
◆ Sample was prepared using the wet prep method.
▼ Sample was prepared using the wet prep method.

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Greenish Gray Fat CLAY (Bay Mud)	75	32	43			

Project No. 319-071 **Client:** ERRG

Project: Parcel E Pre-Design Investigation - 2014-091

● **Source:** IR02B603 **Elev./Depth:** 33.5-36'

Remarks:

● Sample was prepared using the wet prep method.

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	319-070	**Project No.:**	2014-091	**Run By:**	MD
Client:	ERRG	**Date:**	5/5/2015	**Checked By:**	DC
Project:	Parcel E Pre-Design Investigation				

Boring:	IR02B600							
Sample:								
Depth, ft.:	5.0							
Soil Type:	Dark Grayish Brown Clayey SAND w/ Gravel							
Wt of Dish & Dry Soil, gm	501.4							
Weight of Dish, gm	173.2							
Weight of Dry Soil, gm	328.2							
Wt. Ret. on #4 Sieve, gm	120.5							
Wt. Ret. on #200 Sieve, gm	267.2							
% Gravel	**36.7**							
% Sand	**44.7**							
% Silt & Clay	**18.6**							

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

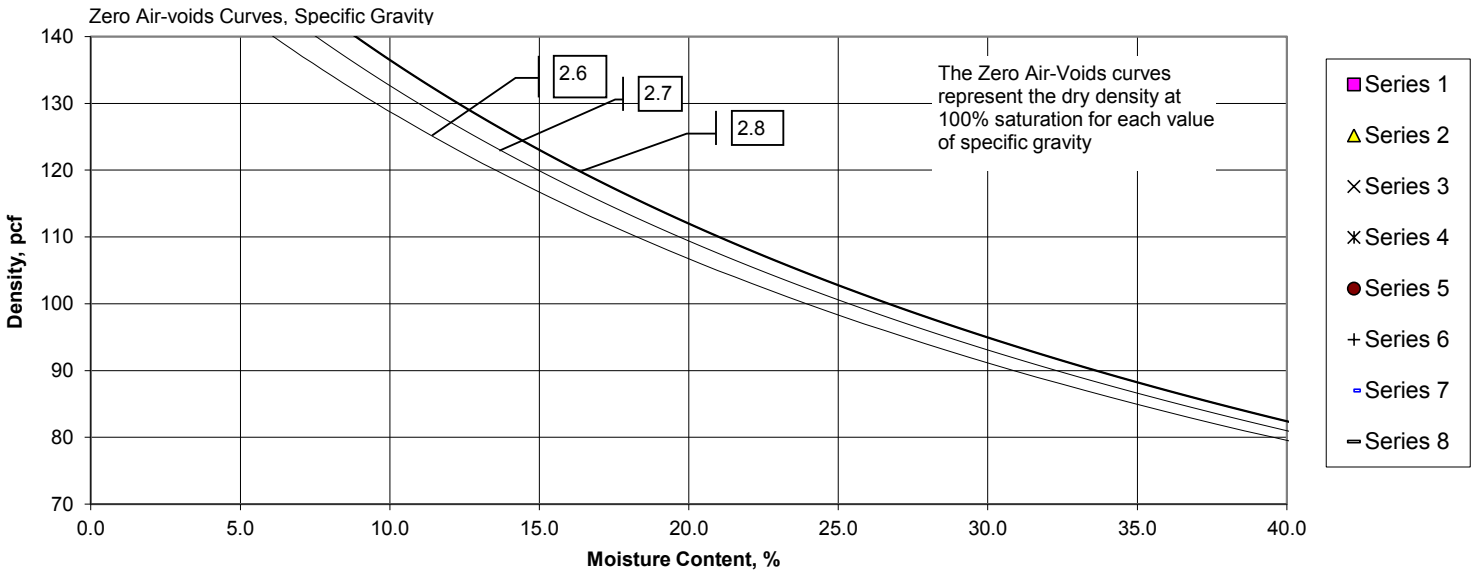
Moisture-Density-Porosity Report
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	319-070	**Project No.**	2014-091	**By:**	RU
Client:	ERRG	**Date:**	05/05/15		
Project Name:	Parcel E Pre-Design Investigation	**Remarks:**			

Boring:	IR02B600	IR02B603						
Sample:								
Depth, ft:	5.0	1.5-4.0						
Visual Description:	Dark Grayish Brown Clayey SAND w/ Gravel	Dark Greenish Gray Fat Clayey GRAVEL w/ Sand & shell fragments (Bay Mud)						
Actual G_s								
Assumed G_s								
Moisture, %	13.3	41.9						
Wet Unit wt, pcf								
Dry Unit wt, pcf								
Dry Bulk Dens.ρb, (g/cc)								
Saturation, %								
Total Porosity, %								
Volumetric Water Cont,Θw,%								
Volumetric Air Cont., Θa,%								
Void Ratio								
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

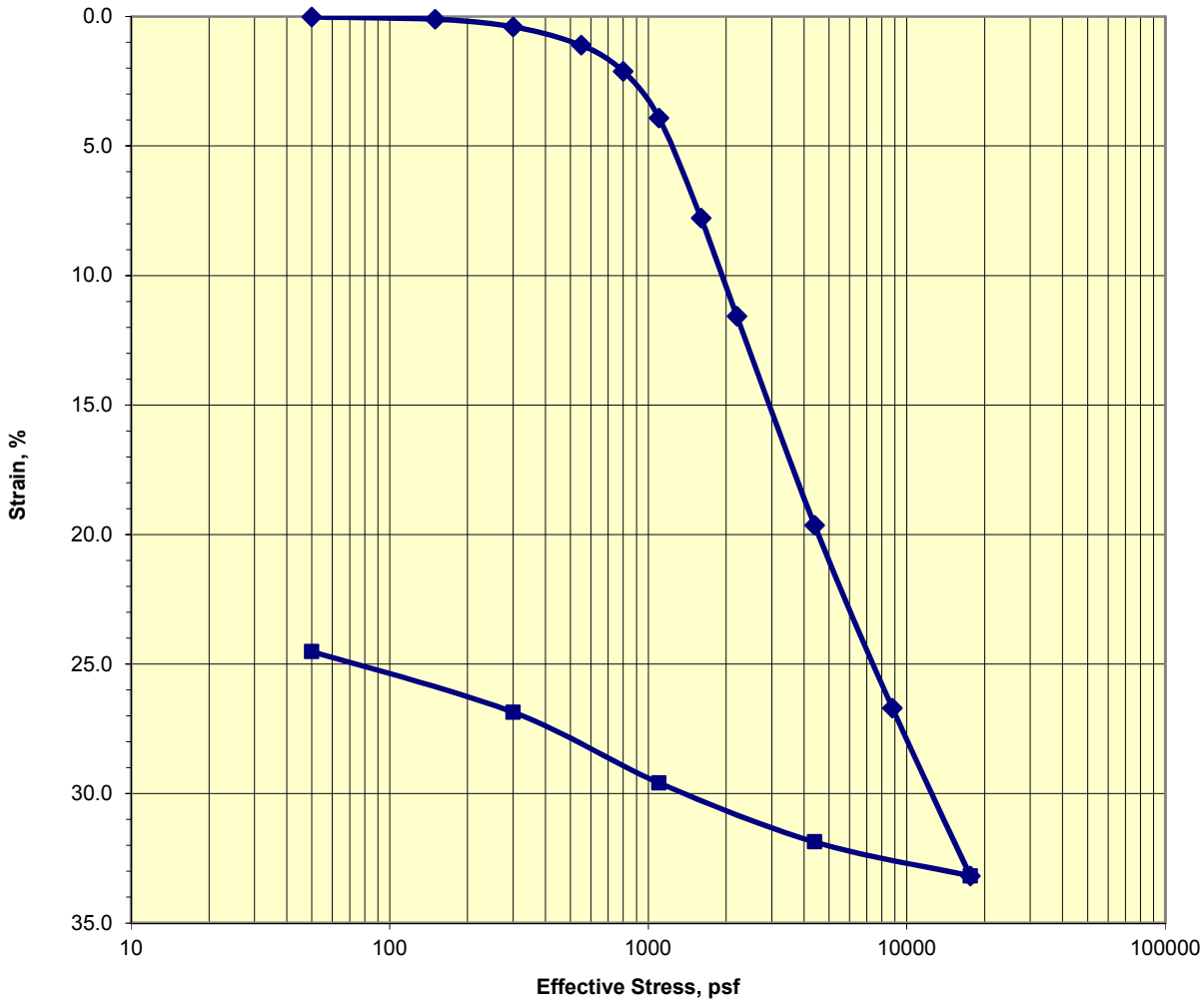
Moisture-Density



Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IR02B601	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	9.5-12(Tip-15")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)			**Date:**	4/23/2015

Strain-Log-P Curve



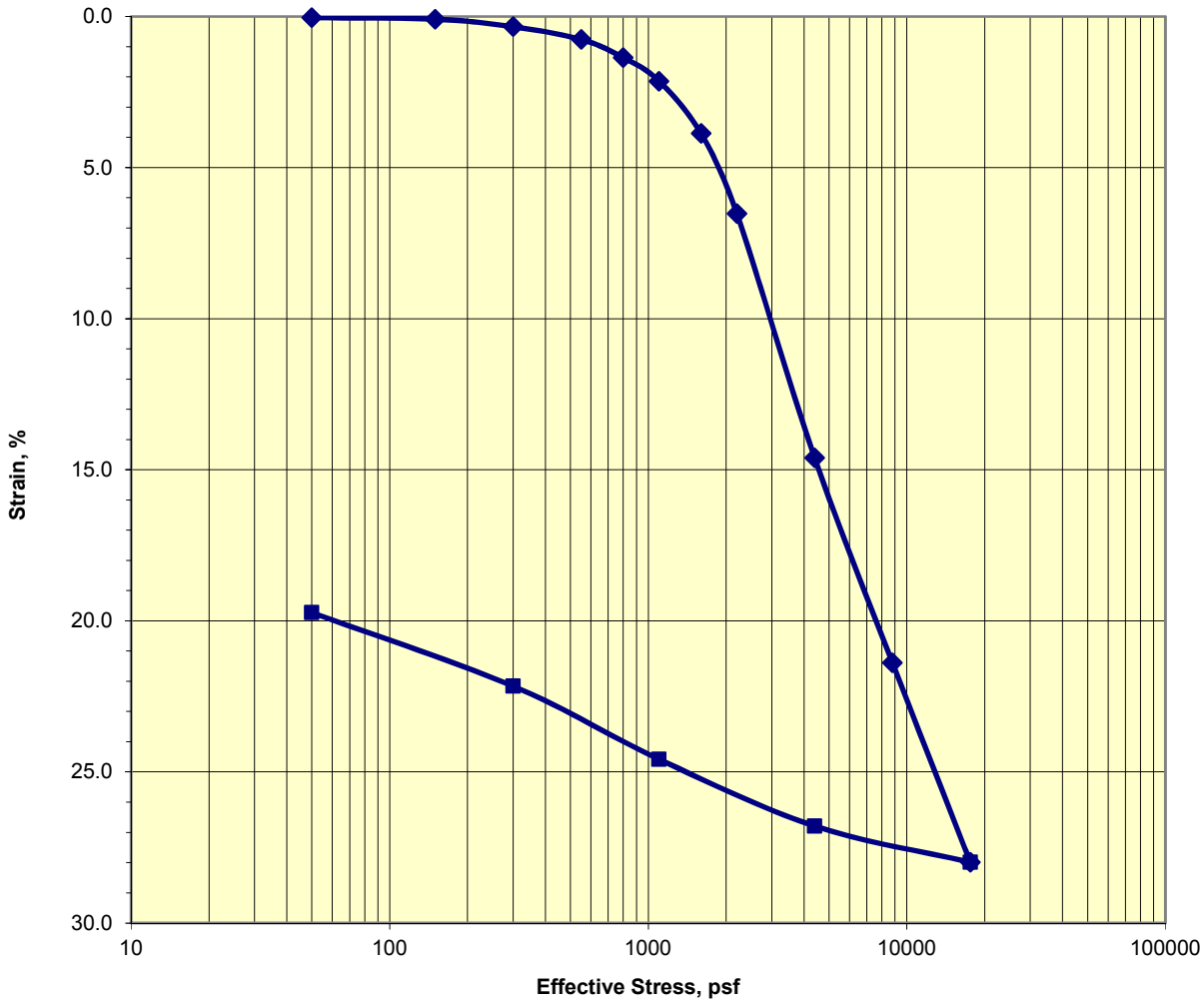
Assumed Gs 2.65	Initial	Final
Moisture %:	74.1	47.4
Dry Density, pcf:	55.4	73.3
Void Ratio:	1.986	1.256
% Saturation:	98.9	100.0

Remarks:

Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IR02B603	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	19.5-22.0(Tip-4")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)			**Date:**	4/9/2015

Strain-Log-P Curve

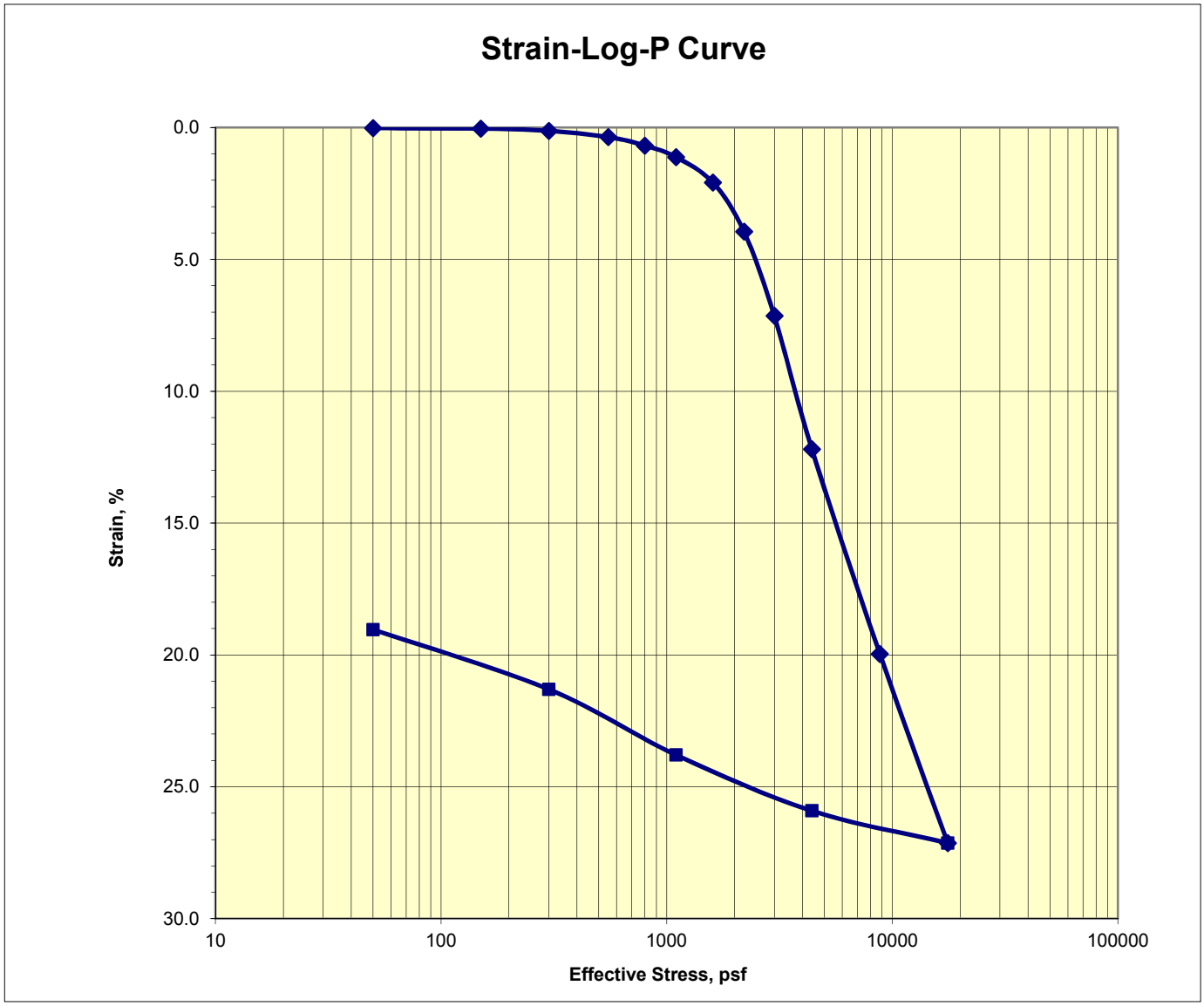


Assumed Gs 2.7	Initial	Final
Moisture %:	65.5	45.8
Dry Density, pcf:	60.3	75.4
Void Ratio:	1.795	1.236
% Saturation:	98.5	100.0

Remarks:

Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IR02B603	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	28.5-31.0(Tip-7")	**Checked:**	PJ/DC
Soil Type:	Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)			**Date:**	4/23/2015



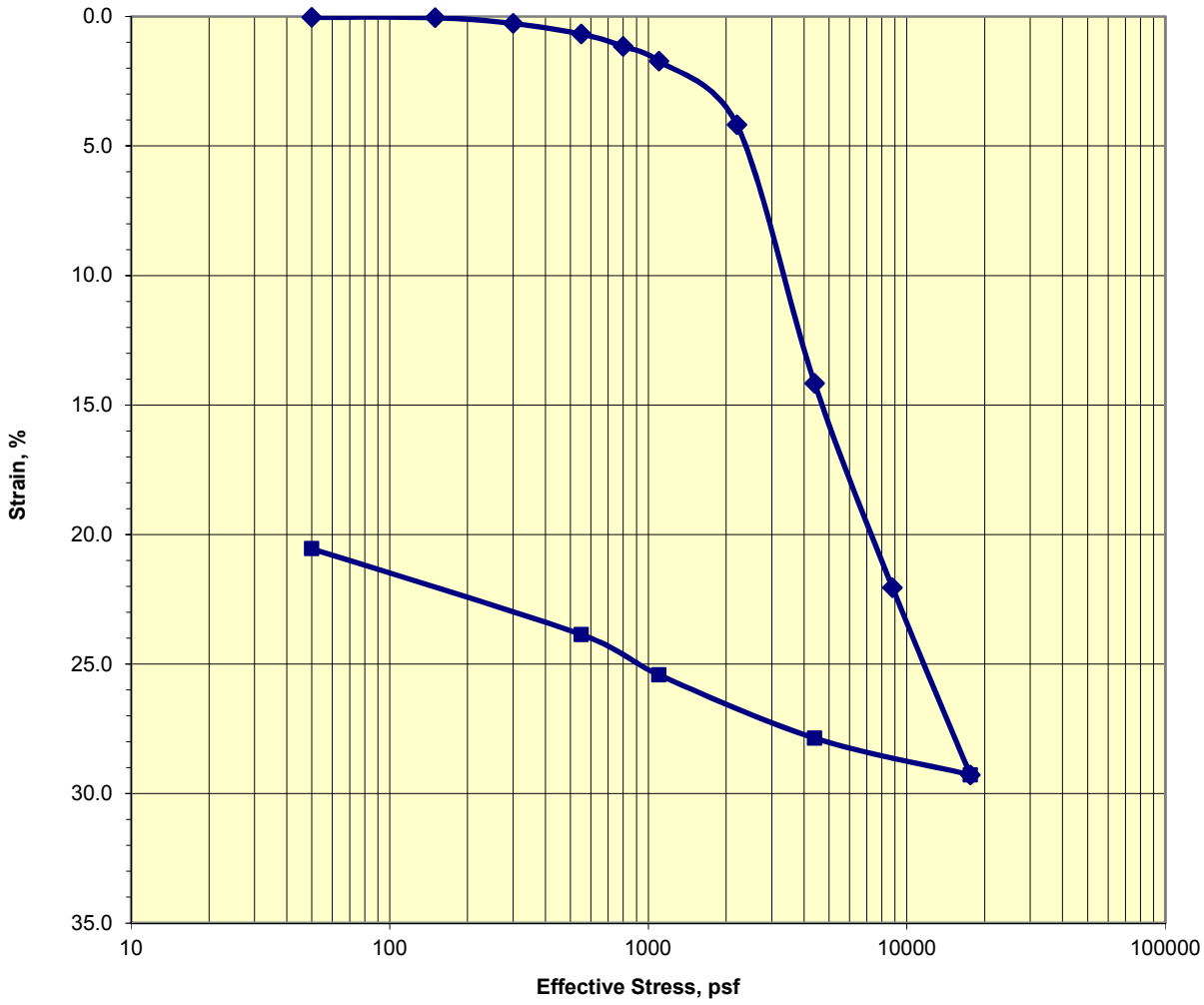
Assumed Gs 2.7	Initial	Final
Moisture %:	62.9	44.8
Dry Density, pcf:	61.5	76.3
Void Ratio:	1.739	1.210
% Saturation:	97.6	100.0

Remarks:

Consolidation Test
ASTM D2435

Job No.:	319-071	**Boring:**	IR02B603	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	33.5-36(Tip-24")	**Checked:**	PJ/DC
Soil Type:	Greenish Gray CLAY (Bay Mud)			**Date:**	6/3/2015

Strain-Log-P Curve



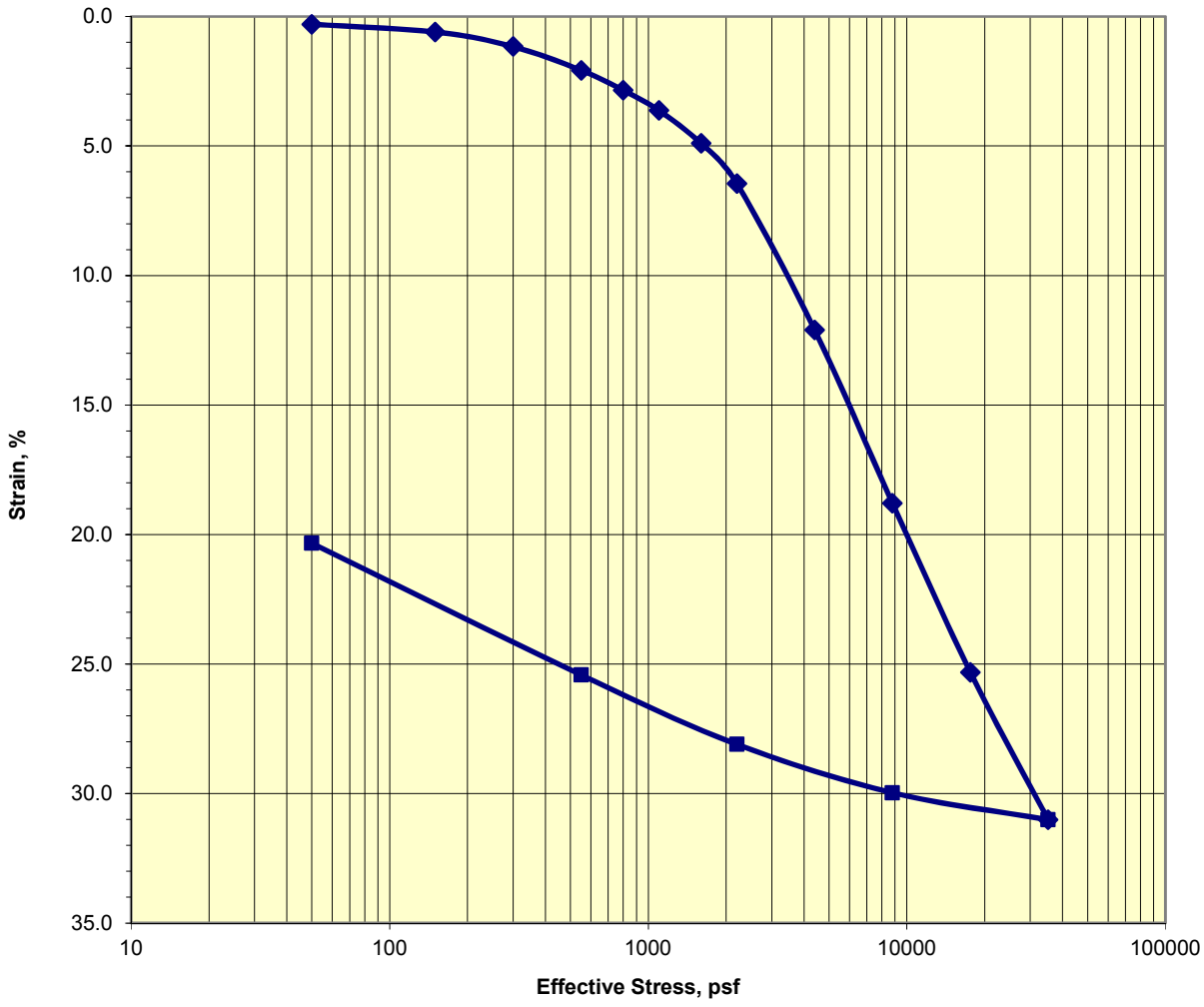
Assumed Gs 2.7	Initial	Final
Moisture %:	72.2	51.1
Dry Density, pcf:	56.2	70.8
Void Ratio:	1.997	1.380
% Saturation:	97.6	100.0

Remarks:

Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IR02B605	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	31.5-34.0(Tip-17")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray Sandy Fat CLAY w/shells (Bay Mud)			**Date:**	5/12/2015

Strain-Log-P Curve



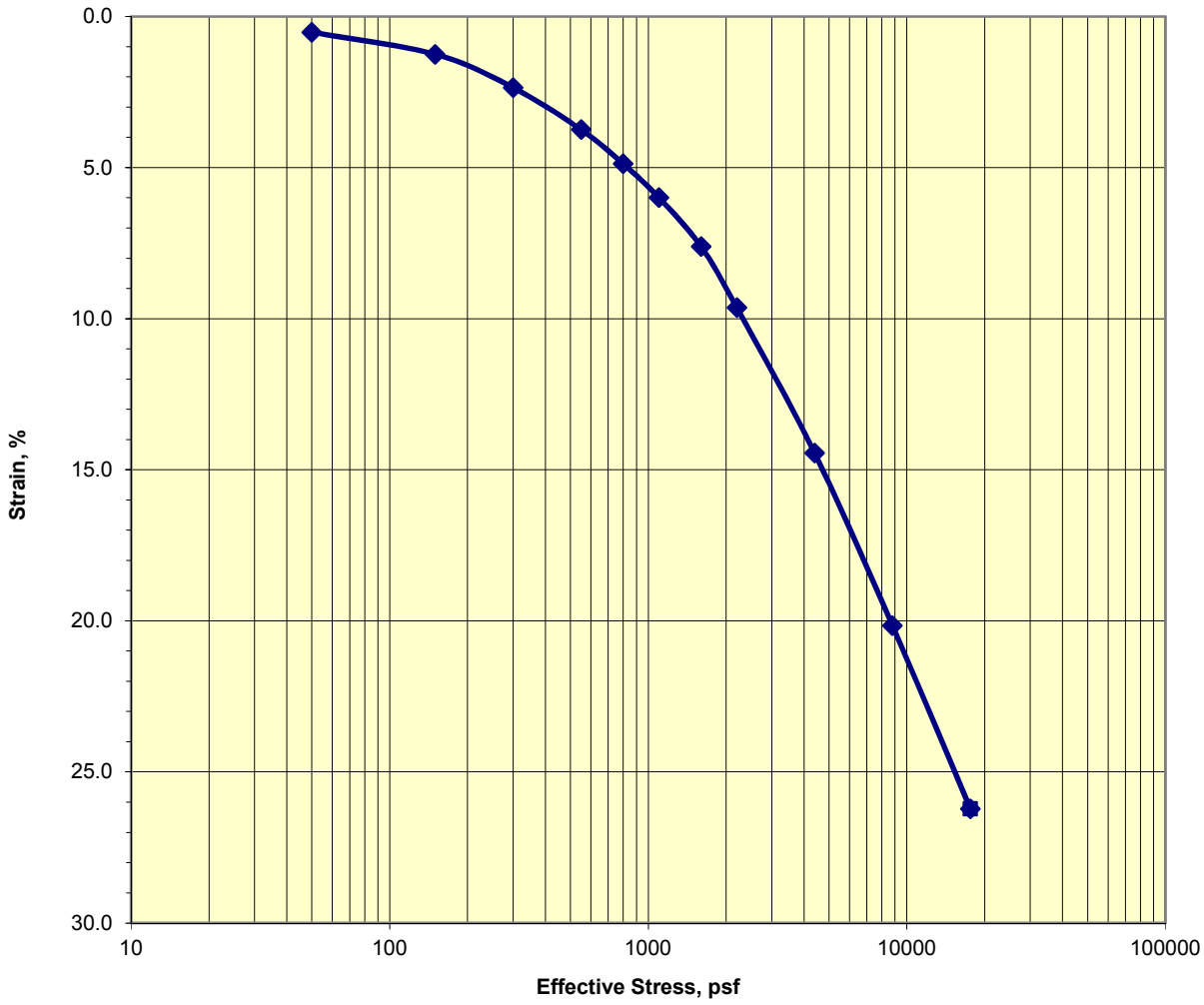
Assumed Gs 2.7	Initial	Final
Moisture %:	56.2	39.4
Dry Density, pcf:	66.6	81.6
Void Ratio:	1.531	1.065
% Saturation:	99.1	100.0

Remarks:

Consolidation Test
ASTM D2435

Job No.:	319-071	**Boring:**	IR02B605	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	43.5-45.5	**Checked:**	PJ/DC
Soil Type:	Gray CLAY w/ shells (Bay Mud)			**Date:**	6/12/2015

Strain-Log-P Curve



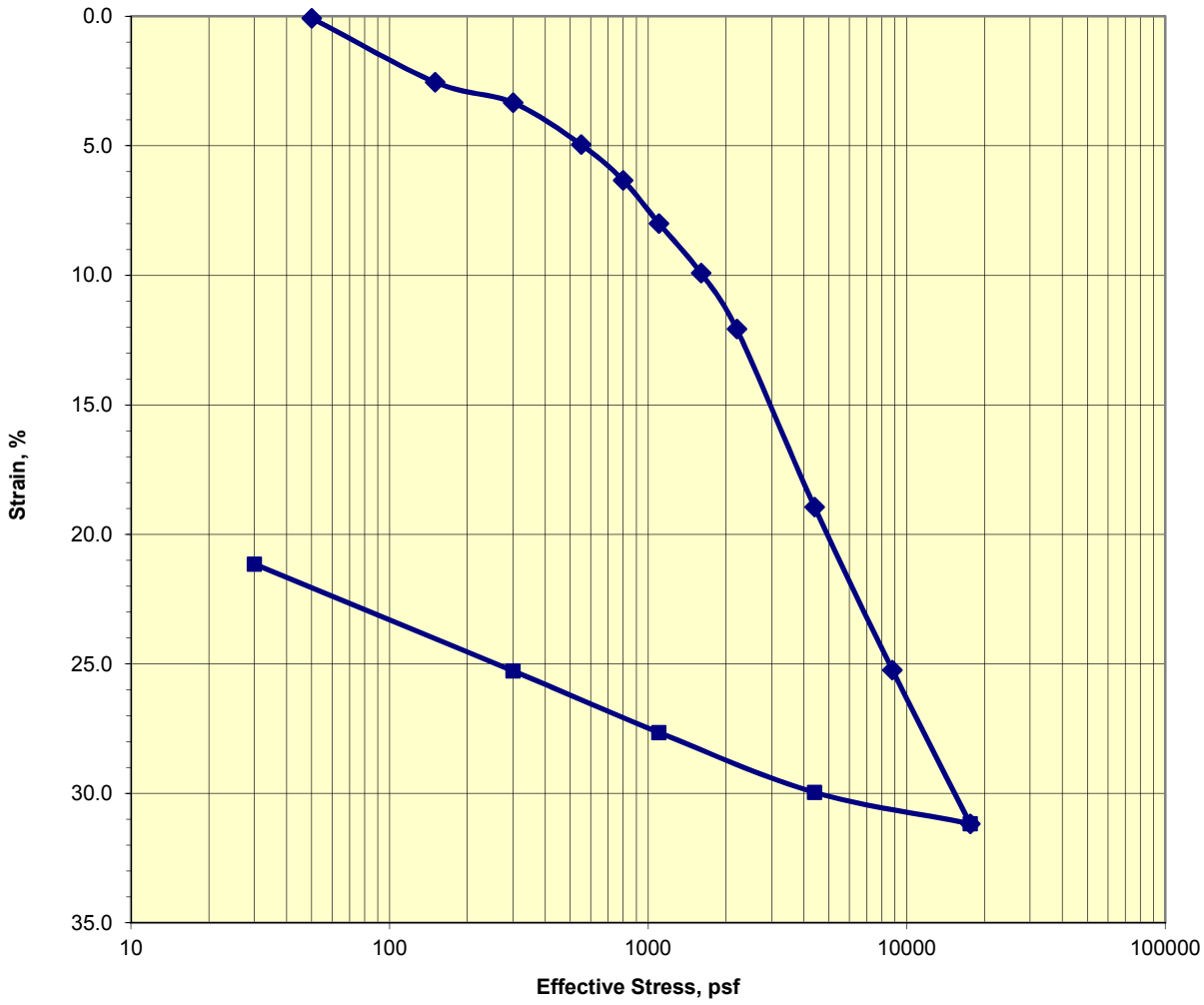
Assumed Gs 2.75	Initial	Final
Moisture %:	48.9	23.9
Dry Density, pcf:	71.6	103.5
Void Ratio:	1.398	0.658
% Saturation:	96.3	100.0

Remarks: *Moderate patching required due to shells. **While attempting to apply the last load increment the sample was accidentaly overstressed. The test had to be discontinued and no rebound is reported. The virgin slope is well defined but the preconsolidation (maximum past pressure) is not well defined, indicating sample disturbance.

Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IRO2B605	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	51.5-54(Tip-11")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray Fat CLAY w/ Sand & shells (Bay Mud)			**Date:**	4/23/2015

Strain-Log-P Curve



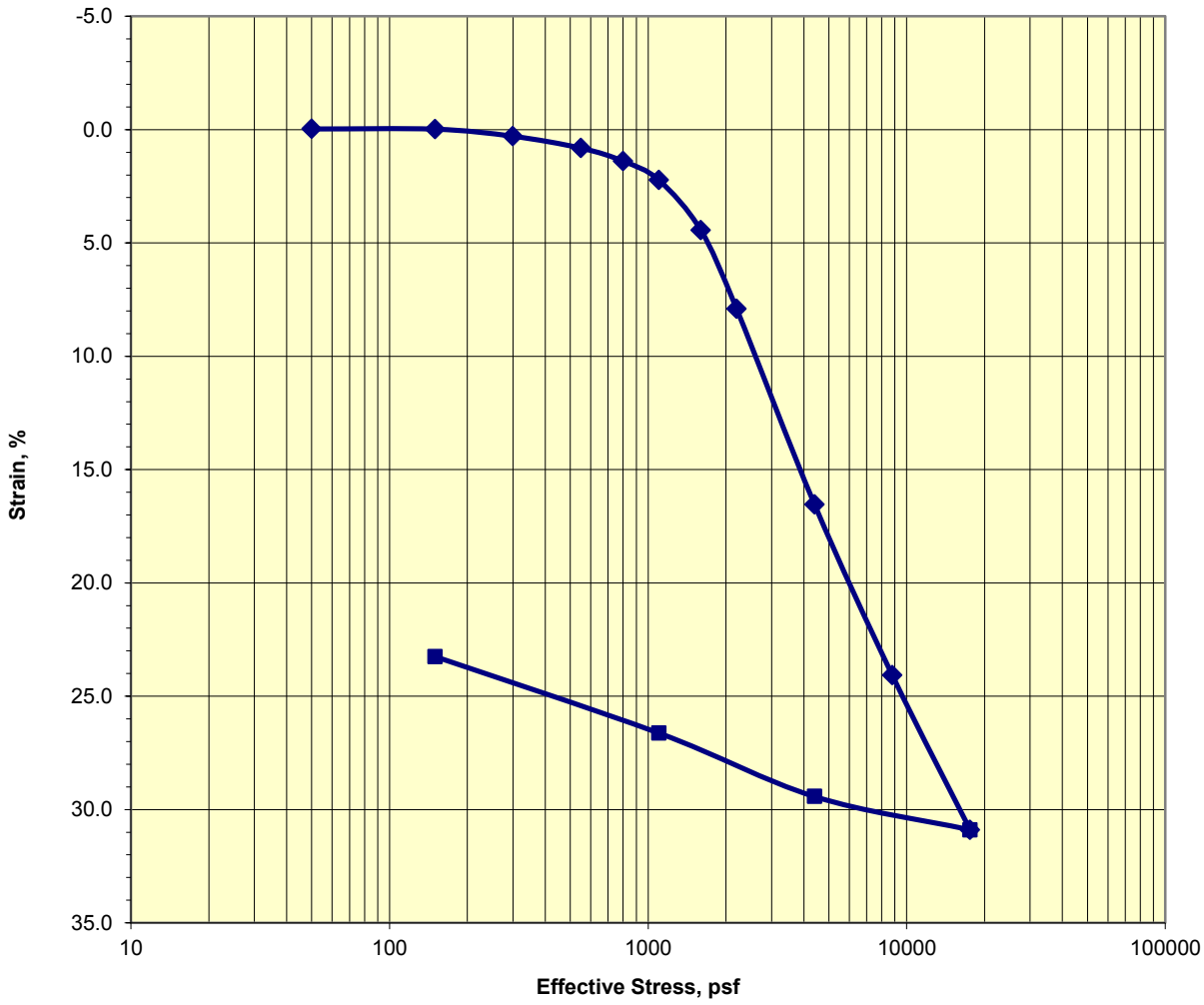
Assumed Gs 2.7	Initial	Final
Moisture %:	61.0	43.5
Dry Density, pcf:	61.1	77.5
Void Ratio:	1.758	1.176
% Saturation:	93.7	100.0

Remarks: Significant patching required due to shells. This sample was not trimmed down to 2.5" due to shells. It is likely that this shelly condition is responsible for the significant consolidation observed during the 150 psf point.

Consolidation Test
ASTM D2435

Job No.:	319-070	**Boring:**	IR03B607	**Run By:**	MD
Client:	ERRG	**Sample:**		**Reduced:**	PJ
Project:	2014-091	**Depth, ft.:**	21.5-24.0(Tip-3")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)			**Date:**	4/23/2015

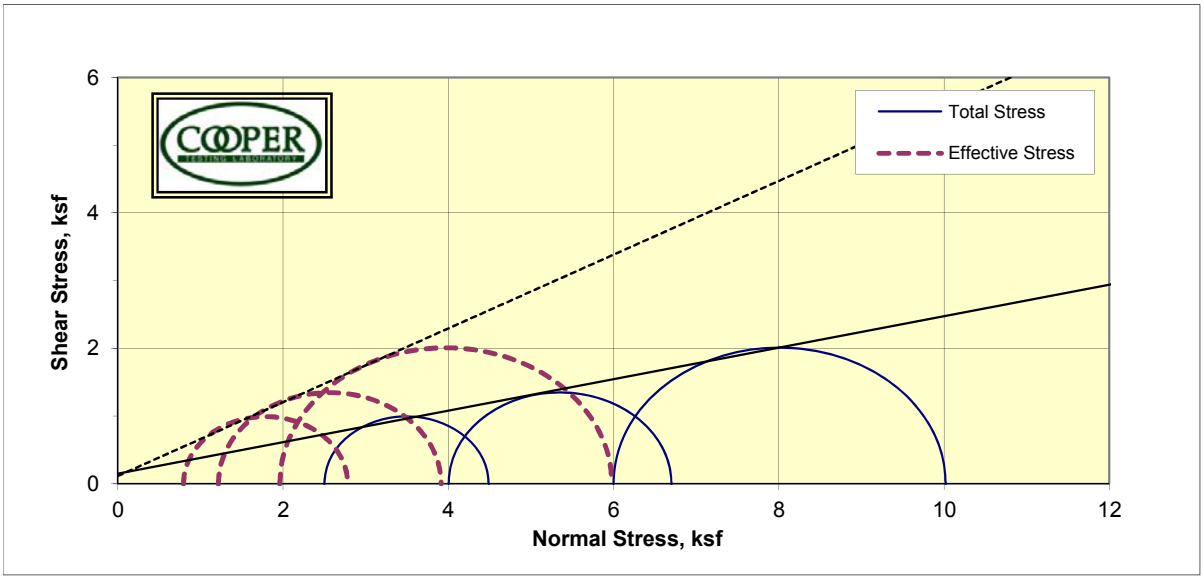
Strain-Log-P Curve

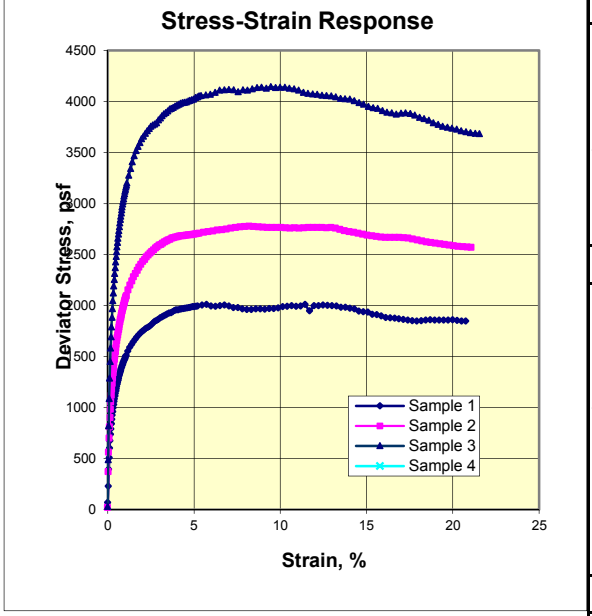


Assumed Gs 2.7	Initial	Final
Moisture %:	69.1	45.8
Dry Density, pcf:	58.2	75.3
Void Ratio:	1.895	1.238
% Saturation:	98.4	100.0

Remarks:

Triaxial Consolidated Undrained with Pore Pressure
ASTM D4767





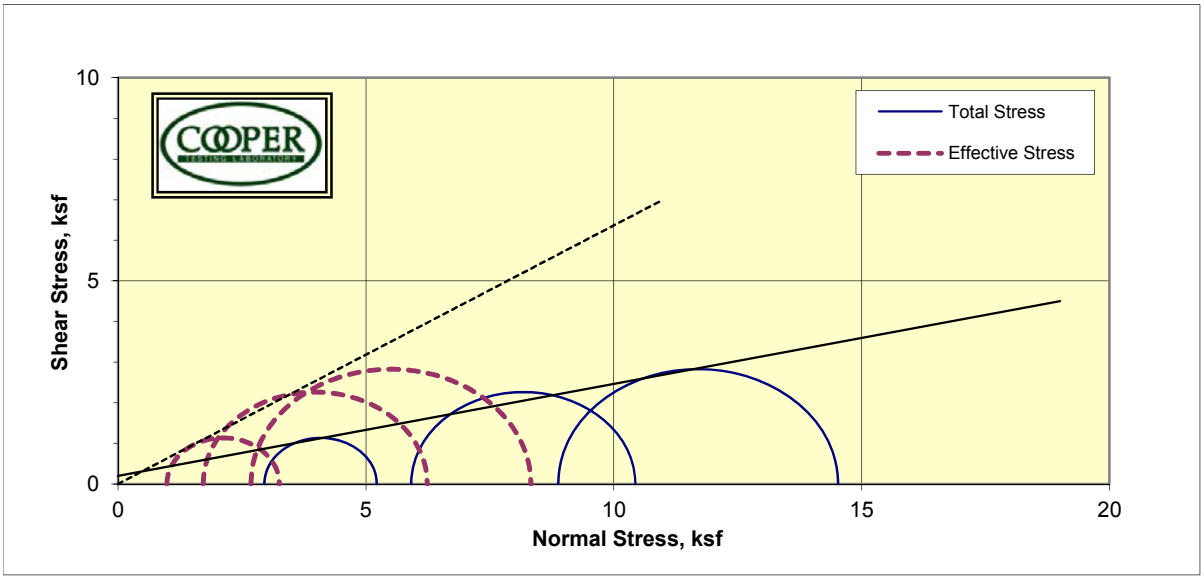
Job No.:	319-072	**Date:**	6/9/2015	
Client:	ERRG		BY:DC	
Project:	2014-091			
Sample 1)	IR02B603 @ 19.5-22(Tip-16.75")	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)		
Sample 2)	IR02B603 @ 19.5-22(Tip-10.5")	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)		
Sample 3)	IR02B603 @ 19.5-22(Tip-4.5")	Dark Greenish Gray Fat CLAY w/ shells (Bay Mud)		
Sample 4)				

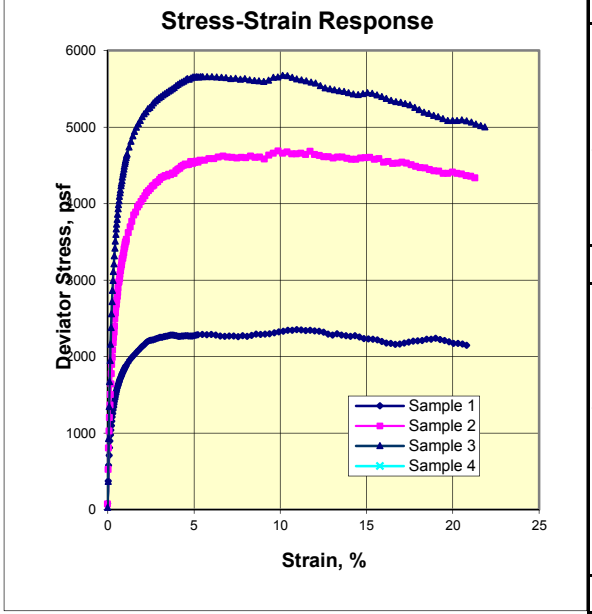
Sample:	**1**	**2**	**3**	**4**
MC, %	66.3	65.4	68.7	
DD, pcf	60.8	61.5	59.4	
Sat. %	99.0	99.5	99.1	
Void Ratio	1.874	1.840	1.941	
Diameter in	2.87	2.87	2.87	
Height, in	6.09	5.85	5.85	
	Final			
MC, %	54.7	50.4	47.7	
DD, pcf	69.0	72.5	74.8	
Sat. %	100.0	100.0	100.0	
Void Ratio	1.531	1.411	1.336	
Diameter, in	2.75	2.72	2.66	
Height, in	5.87	5.55	5.43	
Cell, psi	77.7	87.7	101.3	
BP, psi	60.3	59.9	59.7	
	Effective Stresses At:			
Strain, %	5.0	5.0	5.0	
Deviator ksf	1.989	2.698	4.022	
Excess PP	1.707	2.789	4.041	
Sigma 1	2.781	3.912	5.979	
Sigma 3	0.792	1.214	1.957	
P, ksf	1.786	2.563	3.968	
Q, ksf	0.994	1.349	2.011	
Stress Ratio	3.512	3.223	3.055	
Rate in/min	0.0005	0.0005	0.0005	

Total C	**0.2**	**ksf**
Total phi	**13.1**	**degrees**
Eff. C	**0.1**	**ksf**
Eff. Phi	**28.6**	**degrees**

©

Triaxial Consolidated Undrained with Pore Pressure
ASTM D4767





Sample:	**1**	**2**	**3**	**4**
MC, %	60.7	58.4	63.9	
DD, pcf	63.5	65.3	61.7	
Sat. %	99.2	100.0	99.8	
Void Ratio	1.652	1.578	1.729	
Diameter in	2.88	2.88	2.88	
Height, in	6.08	5.85	5.88	
	Final			
MC, %	49.7	42.8	41.6	
DD, pcf	71.9	78.2	79.4	
Sat. %	100.0	100.0	100.0	
Void Ratio	1.342	1.155	1.123	
Diameter, in	2.76	2.72	2.67	
Height, in	5.85	5.49	5.33	
Cell, psi	100.4	121.8	142.5	
BP, psi	79.9	80.7	80.8	
	Effective Stresses At:			
Strain, %	5.0	5.0	5.0	
Deviator ksf	2.269	4.523	5.650	
Excess PP	1.965	4.197	6.198	
Sigma 1	3.256	6.240	8.330	
Sigma 3	0.987	1.717	2.680	
P, ksf	2.121	3.979	5.505	
Q, ksf	1.134	2.262	2.825	
Stress Ratio	3.300	3.634	3.108	
Rate in/min	0.0002	0.0002	0.0002	

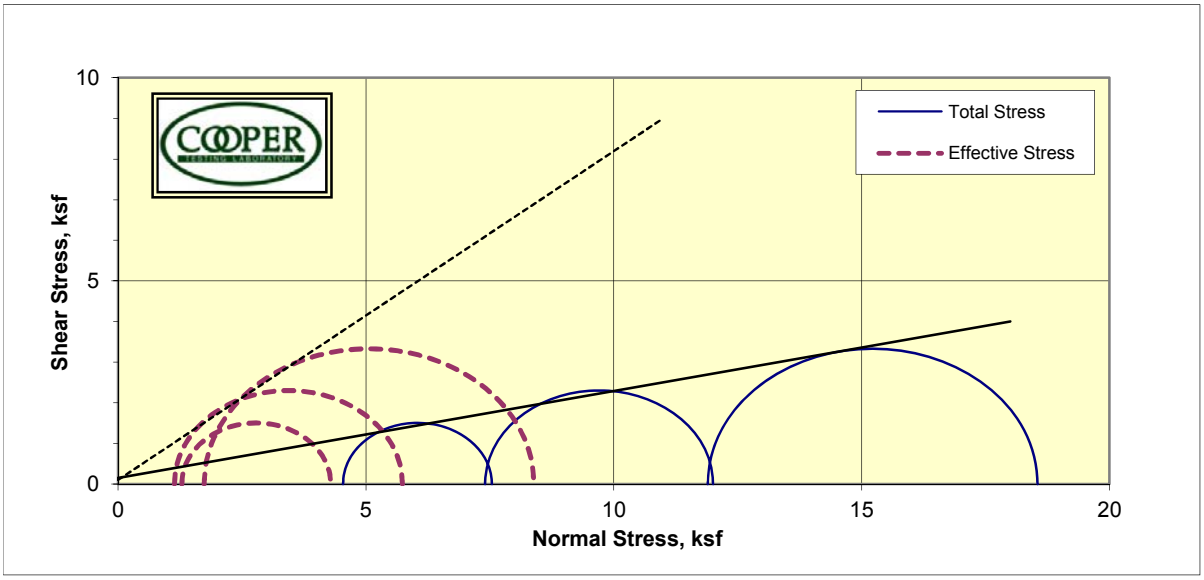
Total C	**0.2**	**ksf**
Total phi	**12.8**	**degrees**
Eff. C	**0.0**	**ksf**
Eff. Phi	**32.5**	**degrees**

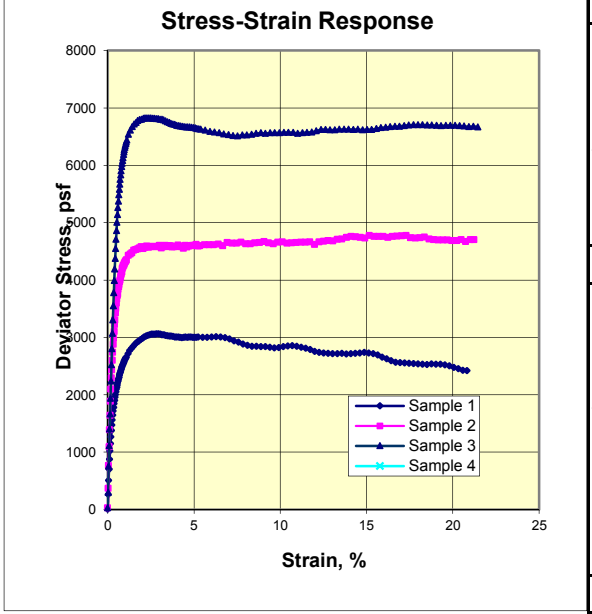
©

Job No.:	319-073	**Date:**	7/7/2015
Client:	ERRG		BY:DC
Project:	2014-091		
Sample 1)	IR02B603 @ 28.5(Tip-19.5")	Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)	
Sample 2)	IR02B603 @ 28.5(Tip-13.5")	Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)	
Sample 3)	IR02B603 @ 28.5(Tip-7.5")	Greenish Gray Fat CLAY w/ shell fragments (Bay Mud)	
Sample 4)			

It appears that the shell fragments may have impacted the sample behavior during testing.

Triaxial Consolidated Undrained with Pore Pressure
ASTM D4767





Sample:	1	2	3	4
MC, %	52.9	35.2	38.0	
DD, pcf	67.5	80.9	79.6	
Sat. %	94.3	86.4	90.3	
Void Ratio	1.543	1.120	1.156	
Diameter in	2.88	2.88	2.88	
Height, in	6.08	5.86	5.85	
	Final			
MC, %	44.9	29.4	26.2	
DD, pcf	76.8	94.9	99.7	
Sat. %	100.0	100.0	100.0	
Void Ratio	1.234	0.809	0.721	
Diameter, in	2.75	2.74	2.66	
Height, in	5.84	5.52	5.46	
Cell, psi	101.3	122.2	152.3	
BP, psi	69.8	70.8	69.7	
	Effective Stresses At:			
Strain, %	5.0	5.0	5.0	
Deviator ksf	3.004	4.600	6.655	
Excess PP	3.252	6.266	10.160	
Sigma 1	4.291	5.738	8.391	
Sigma 3	1.287	1.138	1.736	
P, ksf	2.789	3.438	5.064	
Q, ksf	1.502	2.300	3.327	
Stress Ratio	3.335	5.043	4.833	
Rate in/min	0.0005	0.0005	0.0005	

Total C	0.2	ksf
Total phi	12.1	degrees
Eff. C	0.1	ksf
Eff. Phi	39.0	degrees

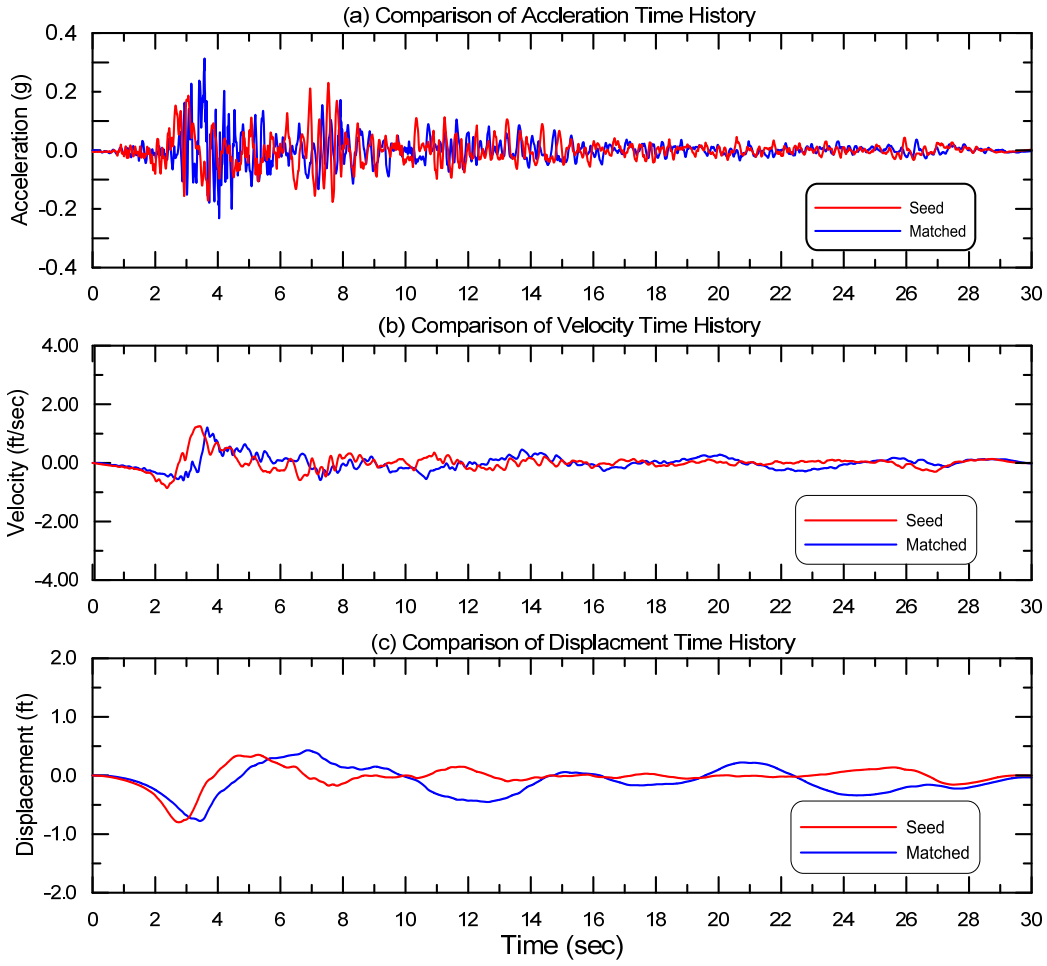
©

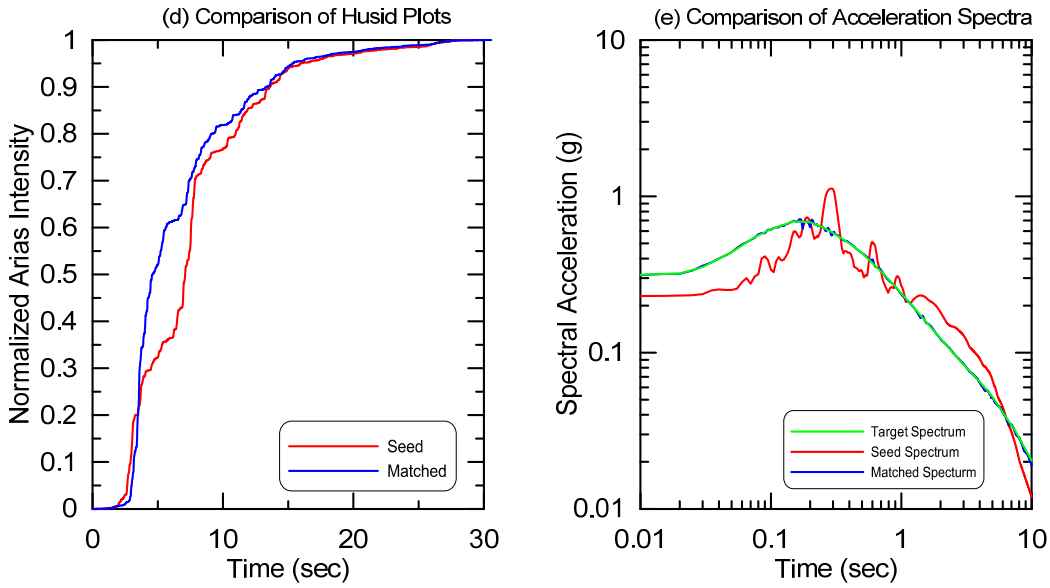
Job No.:	319-073	Date: 7/7/2015
Client:	ERRG	BY:DC
Project:	2014-091	
Sample 1)	IR02B605 @ 43.5(Tip-22")	Greenish Gray CLAY w/ shells (Bay Mud)
Sample 2)	IR02B605 @ 43.5(Tip-16")	Greenish Gray CLAY w/ shells (Bay Mud)
Sample 3)	IR02B605 @ 43.5(Tip-10")	Greenish Gray CLAY w/ shells (Bay Mud)
Sample 4)		

It appears that differences in initial denisty and the amount of shells in each speciment may have impacted the sample behavior during testing.

Attachment F3
Results of Spectral Matching of Acceleration Time Histories

(This attachment is provided on CD only)



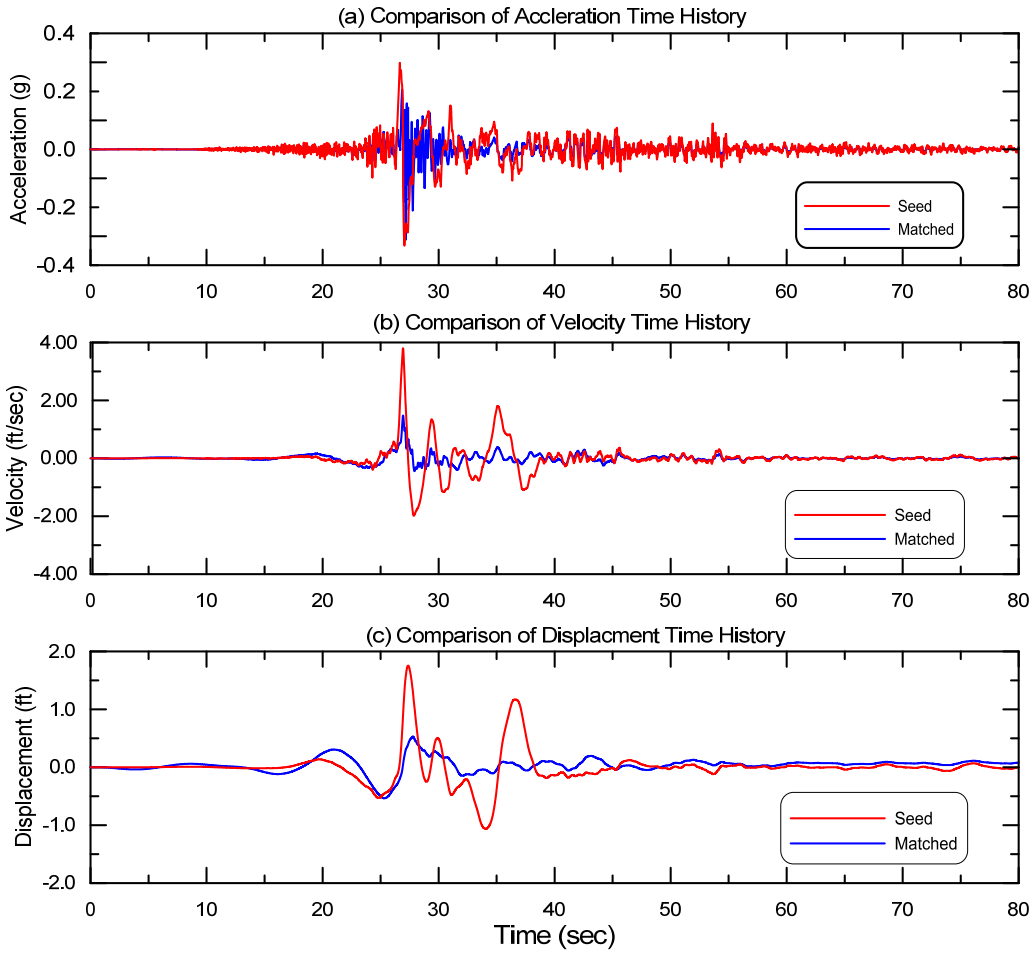


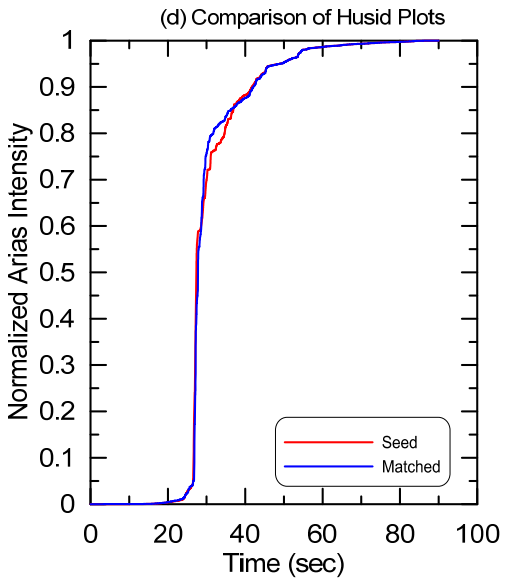
Golder Associates

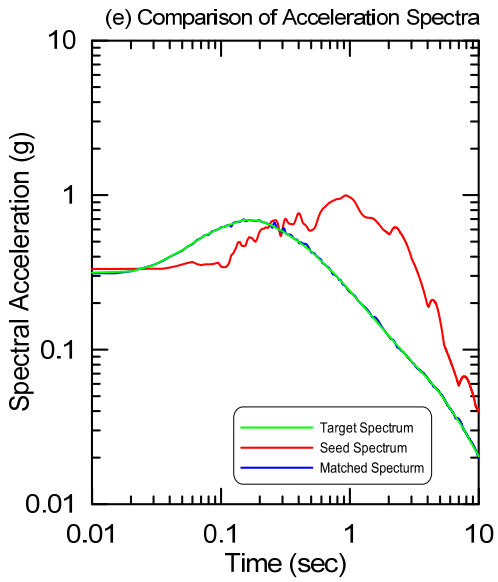
Hunters Point Naval Shipyard
Parcel E Remedial Design

Results of Spectral Matching of Acceleration Time History for Kocaeli Izmit Record

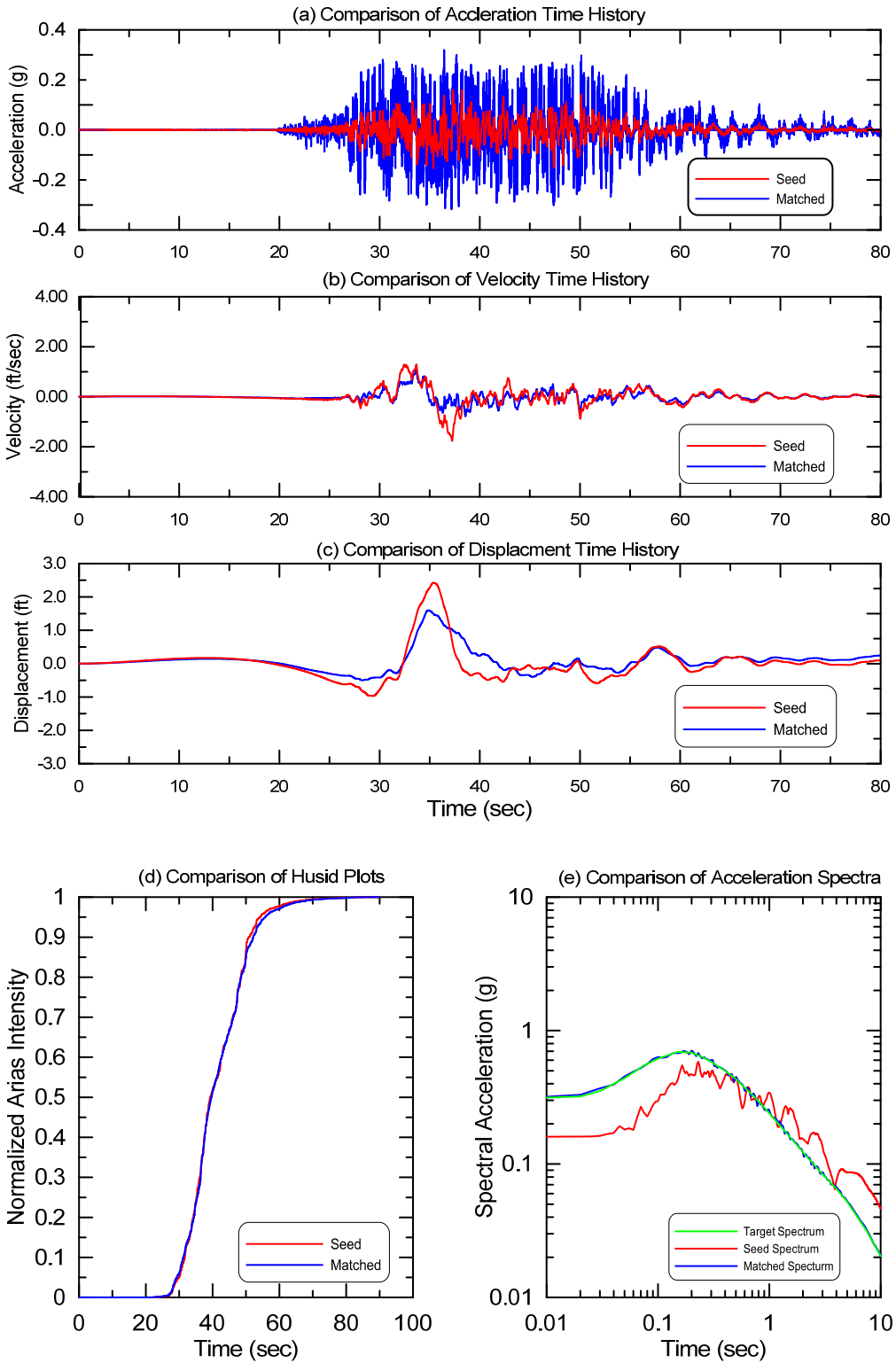
Project No.: **1402317**	Date: **November 2015**	Figure: **F3.1**



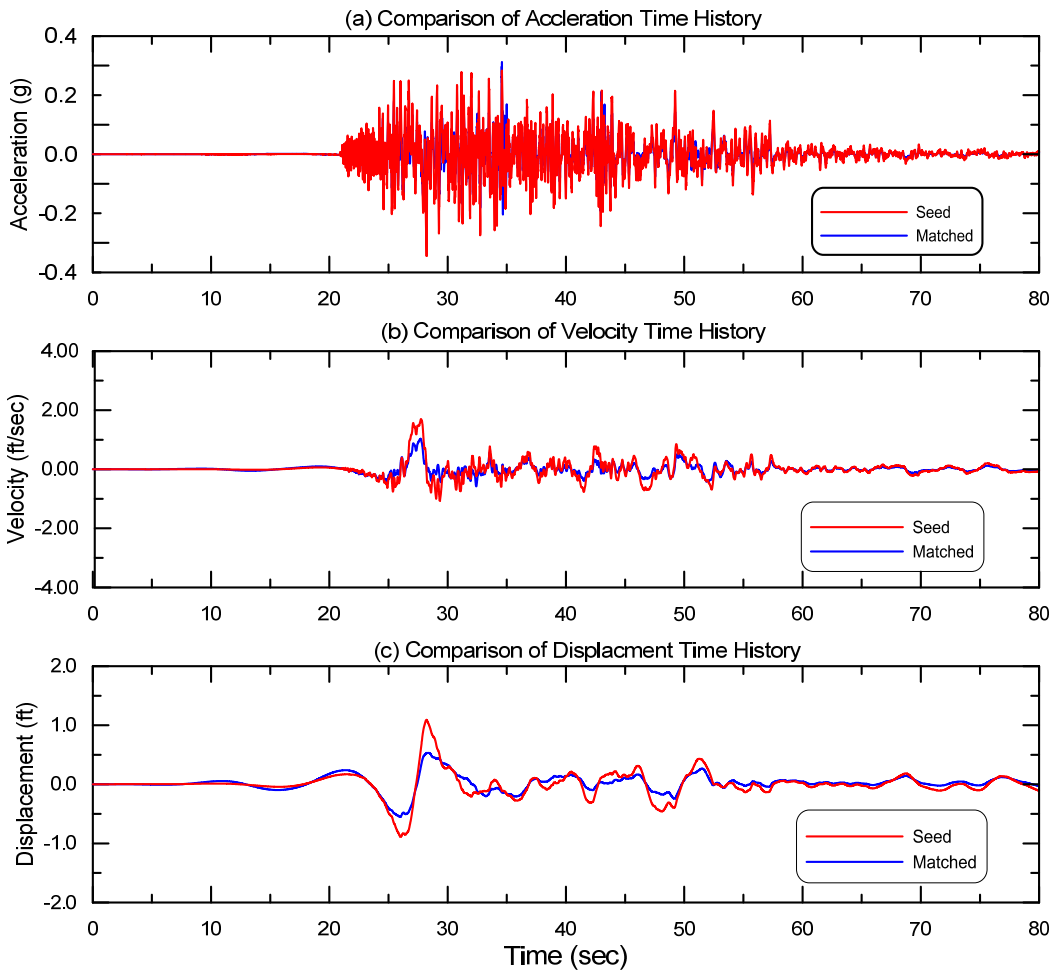


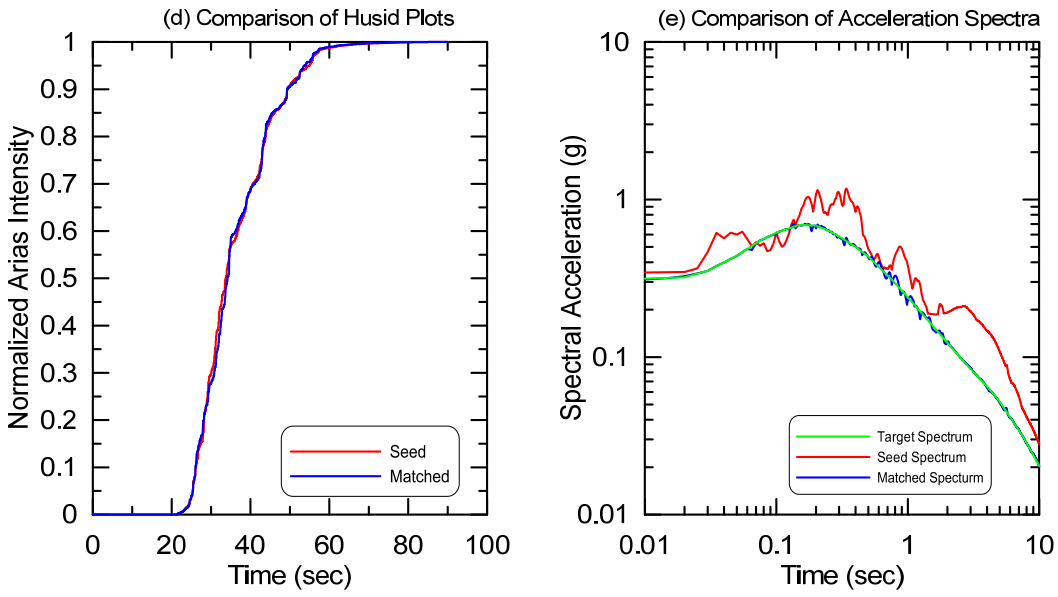


Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Results of Spectral Matching of Acceleration Time History for Denali PS10 Record**	
Project No.: **1402317**	Date: **November 2015**	Figure: **A3.2**



Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Results of Spectral Matching of Acceleration Time History for Chi Chi TCU051 Record**	
Project No.: **1402317**	Date: **November 2015**	Figure: **A3.3**





Golder Associates	Hunters Point Naval Shipyard Parcel E Remedial Design **Results of Spectral Matching of Acceleration Time History for Chi Chi TCU076 Record**	
Project No.: **1402317**	Date: **November 2015**	Figure: **A3.4**

Attachment F4
Analysis of Liquefaction Potential Using CPT Data

(This attachment is provided on CD only)

Table F4.1 Approximate Ground Surface and Water Table Elevations Assumed in the Liquefaction Analyses

CPT Number	Ground Elevation (ft.)	Water Table elevation (ft.)		Soil Boring Number	Ground Elevation (ft.)	Water Table elevation (ft.)
2015 CPTs and Soil Borings:						
IR02CPT-52	14	3		IR02B-600	14	3
IR02CPT-53	6	0		IR02B-601	6	0
IR02CPT-55	14	3				
IR02CPT-56	14.5	3				
IR02CPT-57	13	3		IR02B-602	13	3
IR02CPT-58	4	1		IR02B-603	4	1
IR02CPT-60	11	3				
IR02CPT-61	9	2				
IR02CPT-62	10	3				
IR02CPT-63	7	2				
IR02CPT-65	12	3		IR02B-604	12	3
IR02CPT-66	11	4				
IR02CPT-67	7	0				
IR02CPT-68	6	0		IR02B-605	6	0
IR02CPT-69	9	0				
IR03CPT-70	9	0.5		IR03B-606	9	1
IR03CPT-71	1	0		IR03B-607	2.5	2
IR03CPT-72	9	0				
IR03CPT-73	0	0				

ITSI (2011) CPTs:

IR03CPT-387	9	0
IR03CPT-388	8.5	0
IR03CPT-390	9	0
IR03CPT-391	8.5	0
IR03CPT-392	8.7	0
IR03CPT-393	8.7	0
IR03CPT-394	8.8	0
IR03CPT-395	8.5	0
IR03CPT-396	9	0
IR03CPT-397	7.7	0
IR03CPT-398	7.3	0
IR03CPT-399	7.5	0
IR03CPT-400	7	0
IR03CPT-401	8.8	0
IR03CPT-402	6.6	0
IR03CPT-403	7.2	0
IR03CPT-404	6.3	0
IR03CPT-405	6	0

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IRO2CPT-52c**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		14 ft	4.27 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		11 ft	3.35 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_c Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	4408	24	2.7	2.7	266	0.55	1.4	Unsaturated	7			4408	1.70	74.2	75.1	1.00	0.204	1.1	0.112	1.16	0.975	0.120	**N/A**
0.45	1.48	2728	28	8.1	8.1	95	1.03	1.9	Unsaturated	15			2728	1.70	45.9	72.5	1.00	0.204	1.1	0.109	1.16	0.976	0.117	**N/A**
0.75	2.46	4758	63	13.6	13.6	128	1.33	1.9	Unsaturated	15			4758	1.70	80.0	113.4	1.00	0.204	1.1	0.158	1.34	0.947	0.165	**N/A**
1.05	3.44	9006	140	19.0	19.0	205	1.56	1.8	Unsaturated	13			9006	1.55	138.6	173.3	1.00	0.204	1.1	0.564	1.98	0.847	0.526	**N/A**
1.35	4.43	6651	102	24.4	24.4	133	1.54	1.9	Unsaturated	15			6651	1.45	95.8	132.4	1.00	0.204	1.1	0.205	1.49	0.924	0.208	**N/A**
1.65	5.41	5166	106	29.8	29.8	93	2.06	2.1	Unsaturated	19			5166	1.38	70.6	113.2	1.00	0.204	1.1	0.158	1.34	0.947	0.164	**N/A**
1.95	6.40	9046	162	35.3	35.3	151	1.80	2.0	Unsaturated	17			9046	1.32	118.2	167.4	1.00	0.203	1.1	0.463	1.89	0.861	0.438	**N/A**
2.25	7.38	6125	122	40.7	40.7	95	2.01	2.1	Unsaturated	19			6125	1.27	77.1	121.5	0.99	0.203	1.1	0.175	1.40	0.938	0.180	**N/A**
2.55	8.36	2836	70	46.1	46.1	41	2.50	2.5	Unsaturated	30			2836	1.23	34.5	75.2	0.99	0.203	1.1	0.112	1.16	0.975	0.116	**N/A**
2.85	9.35	2352	63	51.5	51.5	32	2.74	2.6	Unsaturated	34			2352	1.19	27.8	66.9	0.99	0.202	1.1	0.105	1.14	0.978	0.108	**N/A**
3.15	10.33	6271	83	56.9	56.9	82	1.34	2.1	Unsaturated	19			6271	1.16	72.2	115.3	0.99	0.202	1.1	0.162	1.35	0.945	0.163	**N/A**
3.45	11.32	2922	52	62.4	61.5	36	1.81	2.4		27			2922	1.14	33.0	72.0	0.99	0.204	1.0	0.109	1.15	0.976	0.111	**0.54**
3.75	12.30	6788	64	68.1	64.2	83	0.95	2.0		17			6788	1.13	75.7	114.7	0.98	0.213	1.1	0.160	1.35	0.946	0.160	**0.75**
4.05	13.28	4753	51	73.8	66.9	57	1.09	2.1		19			4753	1.11	52.5	90.2	0.98	0.221	1.0	0.126	1.22	0.966	0.126	**0.57**
4.35	14.27	3957	25	79.4	69.6	46	0.63	2.1		19			3957	1.10	43.2	78.4	0.98	0.228	1.0	0.114	1.17	0.973	0.115	**0.50**
4.65	15.25	4976	33	85.1	72.4	57	0.67	2.0		17			4976	1.09	53.8	87.5	0.98	0.235	1.0	0.123	1.20	0.968	0.123	**0.52**
4.95	16.24	2626	48	90.7	75.1	29	1.88	2.5		30			2626	1.08	28.1	66.6	0.98	0.241	1.0	0.105	1.14	0.978	0.105	**0.44**
5.25	17.22	852	13	96.4	77.8	9	1.70	2.9	Clay-Like	45			852	1.07	9.0	42.5	0.97	0.246	1.0	0.087	1.10	0.984	0.087	**N/L**
5.55	18.20	634	8	102.1	80.5	6	1.45	3.0	Clay-Like	49			634	1.06	6.7	39.3	0.97	0.251	1.0	0.085	1.10	0.984	0.085	**N/L**
5.85	19.19	2458	65	107.7	83.2	26	2.76	2.6	Clay-Like	34			2458	1.05	25.6	63.9	0.97	0.256	1.0	0.103	1.13	0.979	0.102	**N/L**
6.15	20.17	5751	68	113.4	85.9	60	1.20	2.1		19			5751	1.04	59.4	99.1	0.97	0.260	1.0	0.136	1.26	0.960	0.133	**0.51**
6.45	21.16	1995	31	119.0	88.7	20	1.65	2.6	Clay-Like	34			1995	1.03	20.4	57.0	0.96	0.264	1.0	0.097	1.12	0.981	0.096	**N/L**
6.75	22.14	3949	76	124.7	91.4	40	1.98	2.4		27			3949	1.03	40.1	81.5	0.96	0.268	1.0	0.117	1.18	0.972	0.115	**0.43**
7.05	23.12	2951	94	130.4	94.1	29	3.33	2.7	Clay-Like	37			2951	1.02	29.8	70.0	0.96	0.271	1.0	0.107	1.15	0.977	0.105	**N/L**
7.35	24.11	813	19	136.0	96.8	7	2.81	3.1	Clay-Like	53			813	1.01	8.1	41.3	0.96	0.274	1.0	0.086	1.10	0.984	0.085	**N/L**
7.65	25.09	758	14	141.7	99.5	6	2.29	3.1	Clay-Like	53			758	1.00	7.5	40.5	0.95	0.277	1.0	0.086	1.10	0.984	0.084	**N/L**
7.95	26.08	735	14	147.3	102.2	6	2.36	3.1	Clay-Like	53			735	1.00	7.3	40.1	0.95	0.280	1.0	0.085	1.10	0.984	0.084	**N/L**
8.25	27.06	730	13	153.0	105.0	6	2.31	3.1	Clay-Like	53			730	0.99	7.2	40.0	0.95	0.282	1.0	0.085	1.10	0.984	0.084	**N/L**
8.55	28.04	715	12	158.7	107.7	5	2.19	3.2	Clay-Like	58			715	0.98	7.0	39.7	0.95	0.284	1.0	0.085	1.10	0.984	0.083	**N/L**
8.85	29.03	716	12	164.3	110.4	5	2.19	3.2	Clay-Like	58			716	0.98	6.9	39.6	0.94	0.286	1.0	0.085	1.10	0.984	0.083	**N/L**
9.15	30.01	751	12	170.0	113.1	5	2.02	3.1	Clay-Like	53			751	0.97	7.2	40.1	0.94	0.288	1.0	0.085	1.10	0.984	0.083	**N/L**
9.45	31.00	748	11	175.6	115.8	5	2.00	3.1	Clay-Like	53			748	0.96	7.1	40.0	0.94	0.290	1.0	0.085	1.10	0.984	0.083	**N/L**
9.75	31.98	761	11	181.3	118.5	5	1.90	3.1	Clay-Like	53			761	0.96	7.2	40.1	0.93	0.291	1.0	0.085	1.10	0.984	0.083	**N/L**
10.05	32.96	771	11	186.9	121.3	5	1.83	3.1	Clay-Like	53			771	0.95	7.3	40.1	0.93	0.293	1.0	0.085	1.10	0.984	0.083	**N/L**
10.35	33.95	786	11	192.6	124.0	5	1.81	3.1	Clay-Like	53			786	0.95	7.4	40.3	0.93	0.294	1.0	0.086	1.10	0.984	0.083	**N/L**
10.65	34.93	771	9	198.3	126.7	5	1.63	3.1	Clay-Like	53			771	0.94	7.2	40.0	0.92	0.295	1.0	0.085	1.10	0.984	0.083	**N/L**
10.95	35.92	776	9	203.9	129.4	5	1.54	3.1	Clay-Like	53			776	0.94	7.2	40.0	0.92	0.296	1.0	0.085	1.10	0.984	0.083	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
11.25	36.90	776	9	209.6	132.1	5	1.52	3.1	Clay-Like	53			776	0.93	7.2	40.0	0.92	0.297	1.0	0.085	1.10	0.984	0.083	**N/L**
11.55	37.88	805	9	215.2	134.8	5	1.52	3.1	Clay-Like	53			805	0.93	7.4	40.3	0.91	0.298	1.0	0.086	1.10	0.984	0.083	**N/L**
11.85	38.87	788	8	220.9	137.6	5	1.46	3.1	Clay-Like	53			788	0.92	7.2	40.0	0.91	0.299	1.0	0.085	1.10	0.984	0.082	**N/L**
12.15	39.85	825	8	226.6	140.3	5	1.29	3.1	Clay-Like	53			825	0.92	7.5	40.4	0.91	0.300	1.0	0.086	1.10	0.984	0.083	**N/L**
12.45	40.84	836	8	232.2	143.0	5	1.32	3.1	Clay-Like	53			836	0.91	7.6	40.5	0.91	0.300	1.0	0.086	1.10	0.984	0.082	**N/L**
12.75	41.82	837	7	237.9	145.7	5	1.13	3.1	Clay-Like	53			837	0.91	7.5	40.5	0.90	0.301	1.0	0.086	1.10	0.984	0.082	**N/L**
13.05	42.80	845	7	243.5	148.4	5	1.24	3.1	Clay-Like	53			845	0.90	7.6	40.5	0.90	0.301	1.0	0.086	1.10	0.984	0.082	**N/L**
13.35	43.79	878	9	249.2	151.1	5	1.38	3.1	Clay-Like	53			878	0.90	7.8	40.9	0.90	0.301	1.0	0.086	1.10	0.984	0.082	**N/L**
13.65	44.77	887	8	254.9	153.9	5	1.28	3.1	Clay-Like	53			887	0.89	7.9	40.9	0.89	0.302	1.0	0.086	1.10	0.984	0.082	**N/L**
13.95	45.76	973	8	260.5	156.6	6	1.17	3.0	Clay-Like	49			973	0.89	8.6	41.9	0.89	0.302	1.0	0.087	1.10	0.984	0.083	**N/L**
14.25	46.74	1073	8	266.2	159.3	6	0.94	2.9	Clay-Like	45			1073	0.89	9.4	43.0	0.89	0.302	1.0	0.087	1.10	0.984	0.083	**N/L**
14.55	47.72	1017	7	271.8	162.0	6	0.93	3.0	Clay-Like	49			1017	0.88	8.9	42.3	0.88	0.302	1.0	0.087	1.10	0.984	0.083	**N/L**
14.85	48.71	1009	7	277.5	164.7	6	0.92	3.0	Clay-Like	49			1009	0.88	8.8	42.2	0.88	0.302	1.0	0.087	1.10	0.984	0.083	**N/L**
15.15	49.69	986	9	283.2	167.4	5	1.28	3.0	Clay-Like	49			986	0.88	8.5	41.9	0.88	0.302	1.0	0.087	1.10	0.984	0.082	**N/L**
15.45	50.68	1366	8	288.8	170.1	8	0.78	2.8	Clay-Like	41			1366	0.87	11.8	46.0	0.87	0.302	1.0	0.090	1.11	0.983	0.085	**N/L**
15.75	51.66	1187	4	294.5	172.9	7	0.48	2.8	Clay-Like	41			1187	0.87	10.2	43.9	0.87	0.302	1.0	0.088	1.10	0.984	0.083	**N/L**
16.05	52.64	1100	5	300.1	175.6	6	0.62	2.9	Clay-Like	45			1100	0.86	9.4	43.0	0.86	0.302	1.0	0.087	1.10	0.984	0.083	**N/L**
16.35	53.63	3455	9	305.8	178.3	23	0.27	2.2		22			3455	0.86	29.4	63.7	0.86	0.302	1.0	0.102	1.13	0.979	0.096	**0.32**
16.65	54.61	2665	6	311.4	181.0	17	0.27	2.3		24			2665	0.86	22.6	56.8	0.86	0.301	1.0	0.097	1.12	0.981	0.091	**0.30**
16.95	55.60	2131	32	317.1	183.7	13	1.77	2.8	Clay-Like	41			2131	0.85	18.0	54.5	0.85	0.301	1.0	0.095	1.12	0.982	0.090	**N/L**
17.25	56.58	3670	88	322.8	186.4	24	2.63	2.7	Clay-Like	37			3670	0.85	30.9	71.5	0.85	0.301	0.9	0.109	1.15	0.976	0.100	**N/L**
17.55	57.56	3822	107	328.4	189.2	25	3.06	2.7	Clay-Like	37			3822	0.85	32.1	73.1	0.85	0.300	0.9	0.110	1.16	0.976	0.101	**N/L**
17.85	58.55	4907	128	334.1	191.9	33	2.81	2.6	Clay-Like	34			4907	0.84	41.0	84.6	0.84	0.300	0.9	0.120	1.19	0.970	0.109	**N/L**
18.15	59.53	5803	141	339.7	194.6	39	2.58	2.5		30			5803	0.84	48.3	93.6	0.84	0.299	0.9	0.130	1.23	0.964	0.117	**0.39**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-53**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		6 ft	1.83 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		6 ft	1.83 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	5466	10	2.7	2.7	330	0.17	1.1	Unsaturated	4			5466	1.70	92.0	92.0	1.00	0.204	1.1	0.128	1.22	0.965	0.136	**N/A**
0.45	1.48	2939	5	8.1	8.1	102	0.18	1.5	Unsaturated	8			2939	1.70	49.5	52.7	1.00	0.204	1.1	0.094	1.12	0.982	0.102	**N/A**
0.75	2.46	1542	3	13.6	13.6	41	0.23	1.9	Unsaturated	15			1542	1.70	25.9	48.5	1.00	0.204	1.1	0.091	1.11	0.983	0.099	**N/A**
1.05	3.44	2275	7	19.0	19.0	51	0.33	1.9	Unsaturated	15			2275	1.55	35.0	59.4	1.00	0.204	1.1	0.099	1.13	0.980	0.107	**N/A**
1.35	4.43	2493	18	24.4	24.4	50	0.71	2.1	Unsaturated	19			2493	1.45	35.9	69.2	1.00	0.204	1.1	0.107	1.15	0.977	0.115	**N/A**
1.65	5.41	270	14	29.8	29.8	4	5.88	3.5	Unsaturated	73			270	1.38	3.7	35.0	1.00	0.204	1.1	0.082	1.10	0.985	0.087	**N/A**
1.95	6.40	126	7	35.3	34.2	2	7.54	3.9	Clay-Like	96			126	1.62	2.0	32.4	1.00	0.210	1.1	0.080	1.10	0.985	0.084	**N/L**
2.25	7.38	267	8	41.0	36.9	4	3.58	3.4	Clay-Like	67			267	1.30	3.5	34.8	0.99	0.226	1.1	0.082	1.10	0.985	0.086	**N/L**
2.55	8.36	463	10	46.7	39.6	7	2.29	3.1	Clay-Like	53			463	1.28	5.9	38.2	0.99	0.239	1.1	0.084	1.10	0.984	0.088	**N/L**
2.85	9.35	350	9	52.3	42.3	5	2.90	3.3	Clay-Like	62			350	1.26	4.4	36.1	0.99	0.250	1.1	0.083	1.10	0.985	0.086	**N/L**
3.15	10.33	261	8	58.0	45.0	3	4.16	3.5	Clay-Like	73			261	1.24	3.2	34.4	0.99	0.260	1.0	0.082	1.10	0.985	0.084	**N/L**
3.45	11.32	223	8	63.6	47.7	2	5.04	3.7	Clay-Like	84			223	1.25	2.8	33.6	0.99	0.268	1.0	0.081	1.10	0.985	0.084	**N/L**
3.75	12.30	356	8	69.3	50.5	4	2.62	3.3	Clay-Like	62			356	1.20	4.2	35.9	0.98	0.276	1.0	0.083	1.10	0.985	0.085	**N/L**
4.05	13.28	380	8	75.0	53.2	4	2.74	3.3	Clay-Like	62			380	1.18	4.5	36.2	0.98	0.283	1.0	0.083	1.10	0.985	0.085	**N/L**
4.35	14.27	390	8	80.6	55.9	4	2.64	3.3	Clay-Like	62			390	1.17	4.5	36.3	0.98	0.289	1.0	0.083	1.10	0.985	0.085	**N/L**
4.65	15.25	429	9	86.3	58.6	4	2.55	3.3	Clay-Like	62			429	1.15	4.9	36.8	0.98	0.294	1.0	0.083	1.10	0.985	0.085	**N/L**
4.95	16.24	427	8	91.9	61.3	4	2.52	3.3	Clay-Like	62			427	1.14	4.8	36.7	0.98	0.299	1.0	0.083	1.10	0.985	0.084	**N/L**
5.25	17.22	440	8	97.6	64.0	4	2.44	3.3	Clay-Like	62			440	1.13	4.9	36.8	0.97	0.303	1.0	0.083	1.10	0.985	0.084	**N/L**
5.55	18.20	463	9	103.3	66.8	4	2.52	3.3	Clay-Like	62			463	1.12	5.1	37.1	0.97	0.307	1.0	0.083	1.10	0.985	0.084	**N/L**
5.85	19.19	475	9	108.9	69.5	4	2.55	3.3	Clay-Like	62			475	1.10	5.2	37.2	0.97	0.310	1.0	0.084	1.10	0.985	0.084	**N/L**
6.15	20.17	474	9	114.6	72.2	4	2.54	3.3	Clay-Like	62			474	1.09	5.1	37.1	0.97	0.313	1.0	0.083	1.10	0.985	0.084	**N/L**
6.45	21.16	528	9	120.2	74.9	5	2.25	3.2	Clay-Like	58			528	1.08	5.7	37.9	0.96	0.316	1.0	0.084	1.10	0.985	0.084	**N/L**
6.75	22.14	519	10	125.9	77.6	4	2.52	3.3	Clay-Like	62			519	1.07	5.5	37.7	0.96	0.318	1.0	0.084	1.10	0.985	0.084	**N/L**
7.05	23.12	514	9	131.6	80.3	4	2.32	3.3	Clay-Like	62			514	1.06	5.4	37.5	0.96	0.320	1.0	0.084	1.10	0.985	0.084	**N/L**
7.35	24.11	526	9	137.2	83.1	4	2.19	3.2	Clay-Like	58			526	1.05	5.5	37.7	0.96	0.322	1.0	0.084	1.10	0.985	0.084	**N/L**
7.65	25.09	539	9	142.9	85.8	4	2.29	3.3	Clay-Like	62			539	1.04	5.6	37.7	0.95	0.324	1.0	0.084	1.10	0.985	0.083	**N/L**
7.95	26.08	525	9	148.5	88.5	4	2.27	3.3	Clay-Like	62			525	1.04	5.4	37.5	0.95	0.326	1.0	0.084	1.10	0.985	0.083	**N/L**
8.25	27.06	555	9	154.2	91.2	4	2.21	3.3	Clay-Like	62			555	1.03	5.6	37.8	0.95	0.327	1.0	0.084	1.10	0.985	0.083	**N/L**
8.55	28.04	575	10	159.8	93.9	4	2.29	3.3	Clay-Like	62			575	1.02	5.8	38.1	0.95	0.328	1.0	0.084	1.10	0.985	0.083	**N/L**
8.85	29.03	592	9	165.5	96.6	4	2.15	3.2	Clay-Like	58			592	1.01	5.9	38.3	0.94	0.329	1.0	0.084	1.10	0.984	0.083	**N/L**
9.15	30.01	609	10	171.2	99.4	4	2.19	3.2	Clay-Like	58			609	1.00	6.1	38.5	0.94	0.330	1.0	0.084	1.10	0.984	0.083	**N/L**
9.45	31.00	623	10	176.8	102.1	4	2.35	3.2	Clay-Like	58			623	1.00	6.1	38.6	0.94	0.331	1.0	0.084	1.10	0.984	0.083	**N/L**
9.75	31.98	627	10	182.5	104.8	4	2.34	3.3	Clay-Like	62			627	0.99	6.1	38.5	0.93	0.332	1.0	0.084	1.10	0.984	0.083	**N/L**
10.05	32.96	661	10	188.1	107.5	5	2.01	3.2	Clay-Like	58			661	0.98	6.4	39.0	0.93	0.332	1.0	0.085	1.10	0.984	0.083	**N/L**
10.35	33.95	747	8	193.8	110.2	5	1.52	3.1	Clay-Like	53			747	0.98	7.2	40.1	0.93	0.333	1.0	0.085	1.10	0.984	0.084	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	769	8	199.5	112.9	5	1.40	3.1	Clay-Like	53			769	0.97	7.4	40.3	0.92	0.333	1.0	0.086	1.10	0.984	0.084	**N/L**
10.95	35.92	705	9	205.1	115.6	5	1.78	3.2	Clay-Like	58			705	0.96	6.7	39.4	0.92	0.333	1.0	0.085	1.10	0.984	0.083	**N/L**
11.25	36.90	697	10	210.8	118.4	4	2.08	3.2	Clay-Like	58			697	0.96	6.6	39.2	0.92	0.334	1.0	0.085	1.10	0.984	0.083	**N/L**
11.55	37.88	751	10	216.4	121.1	5	1.93	3.2	Clay-Like	58			751	0.95	7.1	39.9	0.91	0.334	1.0	0.085	1.10	0.984	0.083	**N/L**
11.85	38.87	1095	8	222.1	123.8	8	0.88	2.8	Clay-Like	41			1095	0.95	10.3	44.0	0.91	0.334	1.0	0.088	1.10	0.984	0.085	**N/L**
12.15	39.85	1642	9	227.8	126.5	12	0.64	2.6	Clay-Like	34			1642	0.94	15.3	50.1	0.91	0.334	1.0	0.092	1.11	0.983	0.089	**N/L**
12.45	40.84	914	10	233.4	129.2	6	1.43	3.0	Clay-Like	49			914	0.94	8.5	41.8	0.91	0.334	1.0	0.087	1.10	0.984	0.084	**N/L**
12.75	41.82	1371	9	239.1	131.9	10	0.83	2.7	Clay-Like	37			1371	0.93	12.6	47.0	0.90	0.334	1.0	0.090	1.11	0.983	0.087	**N/L**
13.05	42.80	1548	35	244.7	134.7	11	2.72	2.9	Clay-Like	45			1548	0.93	14.2	49.5	0.90	0.333	1.0	0.092	1.11	0.983	0.088	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-55**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		14 ft	4.27 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		11 ft	3.35 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	9437	43	2.7	2.7	569	0.46	1.1	Unsaturated	4			9437	1.70	158.8	158.8	1.00	0.204	1.1	0.360	1.78	0.879	0.348	**N/A**
0.45	1.48	9846	70	8.1	8.1	343	0.71	1.4	Unsaturated	7			9846	1.70	165.7	167.2	1.00	0.204	1.1	0.460	1.89	0.861	0.435	**N/A**
0.75	2.46	5519	46	13.6	13.6	149	0.83	1.7	Unsaturated	11			5519	1.70	92.8	111.5	1.00	0.204	1.1	0.155	1.33	0.949	0.161	**N/A**
1.05	3.44	4055	78	19.0	19.0	92	1.94	2.1	Unsaturated	19			4055	1.55	62.4	102.9	1.00	0.204	1.1	0.141	1.28	0.957	0.149	**N/A**
1.35	4.43	8593	109	24.4	24.4	172	1.27	1.8	Unsaturated	13			8593	1.45	123.7	156.2	1.00	0.204	1.1	0.335	1.74	0.884	0.326	**N/A**
1.65	5.41	4545	56	29.8	29.8	82	1.23	2.0	Unsaturated	17			4545	1.38	62.1	97.8	1.00	0.204	1.1	0.134	1.25	0.961	0.142	**N/A**
1.95	6.40	3894	72	35.3	35.3	65	1.87	2.2	Unsaturated	22			3894	1.32	50.9	91.5	1.00	0.203	1.1	0.127	1.22	0.966	0.135	**N/A**
2.25	7.38	9650	91	40.7	40.7	150	0.95	1.8	Unsaturated	13			9650	1.27	121.5	153.5	0.99	0.203	1.1	0.314	1.71	0.889	0.307	**N/A**
2.55	8.36	6340	114	46.1	46.1	92	1.82	2.1	Unsaturated	19			6340	1.23	77.2	121.7	0.99	0.203	1.1	0.175	1.40	0.938	0.180	**N/A**
2.85	9.35	4754	107	51.5	51.5	65	2.28	2.3	Unsaturated	24			4754	1.19	56.2	101.0	0.99	0.202	1.1	0.139	1.27	0.958	0.142	**N/A**
3.15	10.33	5102	104	56.9	56.9	66	2.07	2.3	Unsaturated	24			5102	1.16	58.8	104.3	0.99	0.202	1.1	0.143	1.28	0.956	0.145	**N/A**
3.45	11.32	2642	26	62.4	61.5	33	1.00	2.3		24			2642	1.14	29.8	66.3	0.99	0.204	1.0	0.104	1.14	0.978	0.106	**0.52**
3.75	12.30	1343	8	68.1	64.2	16	0.64	2.5		30			1343	1.13	15.0	49.0	0.98	0.213	1.0	0.092	1.11	0.983	0.093	**0.44**
4.05	13.28	3368	47	73.8	66.9	40	1.44	2.3		24			3368	1.11	37.2	76.0	0.98	0.221	1.0	0.112	1.17	0.974	0.113	**0.51**
4.35	14.27	2645	11	79.4	69.6	31	0.44	2.2		22			2645	1.10	28.9	63.0	0.98	0.228	1.0	0.102	1.13	0.979	0.103	**0.45**
4.65	15.25	3433	23	85.1	72.4	39	0.68	2.2		22			3433	1.09	37.1	73.7	0.98	0.235	1.0	0.110	1.16	0.975	0.111	**0.47**
4.95	16.24	5024	36	90.7	75.1	57	0.72	2.0		17			5024	1.08	53.8	87.5	0.98	0.241	1.0	0.123	1.20	0.968	0.122	**0.51**
5.25	17.22	4075	42	96.4	77.8	45	1.06	2.2		22			4075	1.07	43.2	81.6	0.97	0.246	1.0	0.117	1.18	0.971	0.117	**0.47**
5.55	18.20	3873	26	102.1	80.5	42	0.69	2.1		19			3873	1.06	40.7	75.3	0.97	0.251	1.0	0.112	1.16	0.975	0.111	**0.44**
5.85	19.19	5550	60	107.7	83.2	59	1.11	2.1		19			5550	1.05	57.8	97.0	0.97	0.256	1.0	0.134	1.25	0.962	0.131	**0.51**
6.15	20.17	7315	72	113.4	85.9	77	1.01	2.0		17			7315	1.04	75.6	114.5	0.97	0.260	1.0	0.160	1.35	0.946	0.154	**0.59**
6.45	21.16	8320	96	119.0	88.7	87	1.18	2.0		17			8320	1.03	85.3	126.5	0.96	0.264	1.0	0.187	1.44	0.932	0.178	**0.67**
6.75	22.14	8693	81	124.7	91.4	89	0.94	1.9		15			8693	1.03	88.4	123.5	0.96	0.268	1.0	0.179	1.41	0.936	0.170	**0.63**
7.05	23.12	3995	29	130.4	94.1	40	0.76	2.2		22			3995	1.02	40.3	77.8	0.96	0.271	1.0	0.114	1.17	0.973	0.112	**0.41**
7.35	24.11	7654	95	136.0	96.8	76	1.26	2.1		19			7654	1.01	76.6	121.0	0.96	0.274	1.0	0.173	1.39	0.939	0.164	**0.60**
7.65	25.09	8197	139	141.7	99.5	80	1.72	2.1		19			8197	1.00	81.5	127.1	0.95	0.277	1.0	0.189	1.44	0.931	0.176	**0.64**
7.95	26.08	12131	53	147.3	102.2	118	0.44	1.6		10			12131	1.00	119.7	131.7	0.95	0.280	1.0	0.203	1.48	0.925	0.187	**0.67**
8.25	27.06	10552	118	153.0	105.0	101	1.14	1.9		15			10552	0.99	103.4	141.5	0.95	0.282	1.0	0.241	1.58	0.910	0.218	**0.77**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-56**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		14.5 ft	4.42 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		11.5 ft	3.51 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	5208	42	2.7	2.7	314	0.80	1.5	Unsaturated	8			5208	1.70	87.7	91.8	1.00	0.204	1.1	0.127	1.22	0.965	0.135	**N/A**
0.45	1.48	14340	108	8.1	8.1	499	0.75	1.3	Unsaturated	6			14340	1.70	241.4	241.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.75	2.46	10949	143	13.6	13.6	295	1.31	1.7	Unsaturated	11			10949	1.70	184.1	212.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.05	3.44	5503	40	19.0	19.0	125	0.73	1.8	Unsaturated	13			5503	1.55	84.7	111.1	1.00	0.204	1.1	0.154	1.33	0.949	0.161	**N/A**
1.35	4.43	8720	125	24.4	24.4	175	1.43	1.8	Unsaturated	13			8720	1.45	125.6	158.3	1.00	0.204	1.1	0.354	1.77	0.880	0.343	**N/A**
1.65	5.41	12991	148	29.8	29.8	236	1.14	1.7	Unsaturated	11			12991	1.38	177.4	205.0	1.00	0.204	1.1	2.535	2.20	0.813	2.000	**N/A**
1.95	6.40	9445	141	35.3	35.3	157	1.50	1.9	Unsaturated	15			9445	1.32	123.4	165.6	1.00	0.203	1.1	0.437	1.87	0.865	0.416	**N/A**
2.25	7.38	11167	101	40.7	40.7	173	0.91	1.7	Unsaturated	11			11167	1.27	140.5	164.2	0.99	0.203	1.1	0.420	1.85	0.868	0.401	**N/A**
2.55	8.36																							
2.85	9.35																							
3.15	10.33	5569	124	56.9	56.9	73	2.25	2.3	Unsaturated	24			5569	1.16	64.1	111.4	0.99	0.202	1.1	0.154	1.33	0.949	0.156	**N/A**
3.45	11.32	4836	110	62.4	62.4	60	2.30	2.3	Unsaturated	24			4836	1.14	54.4	98.6	0.99	0.201	1.1	0.135	1.25	0.960	0.137	**N/A**
3.75	12.30	5771	53	68.0	65.6	70	0.92	2.0		17			5771	1.12	64.0	100.2	0.98	0.208	1.0	0.138	1.26	0.959	0.138	**0.66**
4.05	13.28																							
4.35	14.27																							
4.65	15.25	1430	37	85.0	73.7	16	2.76	2.8	Clay-Like	41			1430	1.09	15.4	50.9	0.98	0.230	1.0	0.093	1.11	0.982	0.093	**N/L**
4.95	16.24	820	32	90.6	76.5	8	4.39	3.2	Clay-Like	58			820	1.08	8.7	42.1	0.98	0.236	1.0	0.087	1.10	0.984	0.087	**N/L**
5.25	17.22	1025	26	96.3	79.2	10	2.81	3.0	Clay-Like	49			1025	1.07	10.8	44.9	0.97	0.242	1.0	0.089	1.11	0.984	0.089	**N/L**
5.55	18.20	1089	25	101.9	81.9	11	2.49	2.9	Clay-Like	45			1089	1.06	11.4	45.6	0.97	0.247	1.0	0.089	1.11	0.983	0.089	**N/L**
5.85	19.19	1031	23	107.6	84.6	10	2.49	3.0	Clay-Like	49			1031	1.05	10.7	44.8	0.97	0.251	1.0	0.089	1.11	0.984	0.088	**N/L**
6.15	20.17	1005	23	113.3	87.3	9	2.54	3.0	Clay-Like	49			1005	1.04	10.3	44.3	0.97	0.256	1.0	0.088	1.10	0.984	0.088	**N/L**
6.45	21.16	1045	22	118.9	90.0	10	2.41	3.0	Clay-Like	49			1045	1.03	10.7	44.7	0.96	0.260	1.0	0.089	1.11	0.984	0.088	**N/L**
6.75	22.14	1055	23	124.6	92.8	10	2.49	3.0	Clay-Like	49			1055	1.02	10.7	44.8	0.96	0.264	1.0	0.089	1.11	0.984	0.088	**N/L**
7.05	23.12	1083	23	130.2	95.5	10	2.44	3.0	Clay-Like	49			1083	1.01	10.9	45.0	0.96	0.267	1.0	0.089	1.11	0.984	0.088	**N/L**
7.35	24.11	1080	22	135.9	98.2	9	2.38	3.0	Clay-Like	49			1080	1.01	10.8	44.9	0.96	0.270	1.0	0.089	1.11	0.984	0.087	**N/L**
7.65	25.09	1083	23	141.6	100.9	9	2.40	3.0	Clay-Like	49			1083	1.00	10.7	44.8	0.95	0.273	1.0	0.089	1.11	0.984	0.087	**N/L**
7.95	26.08	1132	23	147.2	103.6	10	2.39	3.0	Clay-Like	49			1132	0.99	11.1	45.4	0.95	0.276	1.0	0.089	1.11	0.983	0.087	**N/L**
8.25	27.06	1118	23	152.9	106.3	9	2.37	3.0	Clay-Like	49			1118	0.99	10.9	45.1	0.95	0.278	1.0	0.089	1.11	0.984	0.087	**N/L**
8.55	28.04	1109	23	158.5	109.1	9	2.39	3.0	Clay-Like	49			1109	0.98	10.8	44.9	0.95	0.280	1.0	0.089	1.11	0.984	0.087	**N/L**
8.85	29.03	1121	22	164.2	111.8	9	2.34	3.0	Clay-Like	49			1121	0.97	10.8	44.9	0.94	0.283	1.0	0.089	1.11	0.984	0.087	**N/L**
9.15	30.01	1088	22	169.8	114.5	9	2.41	3.0	Clay-Like	49			1088	0.97	10.4	44.4	0.94	0.284	1.0	0.088	1.11	0.984	0.086	**N/L**
9.45	31.00	1046	22	175.5	117.2	8	2.47	3.0	Clay-Like	49			1046	0.96	10.0	43.8	0.94	0.286	1.0	0.088	1.10	0.984	0.086	**N/L**
9.75	31.98	1117	21	181.2	119.9	8	2.28	3.0	Clay-Like	49			1117	0.96	10.6	44.6	0.93	0.288	1.0	0.089	1.11	0.984	0.086	**N/L**
10.05	32.96	1157	21	186.8	122.6	9	2.12	3.0	Clay-Like	49			1157	0.95	10.9	45.0	0.93	0.289	1.0	0.089	1.11	0.984	0.086	**N/L**
10.35	33.95	1136	21	192.5	125.3	8	2.22	3.0	Clay-Like	49			1136	0.94	10.6	44.7	0.93	0.291	1.0	0.089	1.11	0.984	0.086	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	1157	21	198.1	128.1	8	2.17	3.0	Clay-Like	49			1157	0.94	10.8	44.8	0.92	0.292	1.0	0.089	1.11	0.984	0.086	**N/L**
10.95	35.92	1179	20	203.8	130.8	8	2.02	3.0	Clay-Like	49			1179	0.93	10.9	45.0	0.92	0.293	1.0	0.089	1.11	0.984	0.086	**N/L**
11.25	36.90	1184	20	209.5	133.5	8	2.04	3.0	Clay-Like	49			1184	0.93	10.9	45.0	0.92	0.294	1.0	0.089	1.11	0.984	0.086	**N/L**
11.55	37.88	1195	19	215.1	136.2	8	1.97	3.0	Clay-Like	49			1195	0.92	10.9	45.1	0.91	0.295	1.0	0.089	1.11	0.984	0.086	**N/L**
11.85	38.87	1225	19	220.8	138.9	8	1.91	3.0	Clay-Like	49			1225	0.92	11.2	45.4	0.91	0.296	1.0	0.089	1.11	0.983	0.086	**N/L**
12.15	39.85	1216	19	226.4	141.6	8	1.96	3.0	Clay-Like	49			1216	0.91	11.0	45.2	0.91	0.296	1.0	0.089	1.11	0.984	0.085	**N/L**
12.45	40.84	1198	20	232.1	144.4	8	2.05	3.0	Clay-Like	49			1198	0.91	10.8	44.9	0.91	0.297	1.0	0.089	1.11	0.984	0.085	**N/L**
12.75	41.82	1250	20	237.8	147.1	8	1.99	3.0	Clay-Like	49			1250	0.91	11.2	45.5	0.90	0.298	1.0	0.089	1.11	0.983	0.085	**N/L**
13.05	42.80	1265	21	243.4	149.8	8	2.04	3.0	Clay-Like	49			1265	0.90	11.3	45.6	0.90	0.298	1.0	0.089	1.11	0.983	0.085	**N/L**
13.35	43.79	1232	21	249.1	152.5	8	2.13	3.0	Clay-Like	49			1232	0.90	10.9	45.1	0.90	0.298	1.0	0.089	1.11	0.984	0.085	**N/L**
13.65	44.77	1312	21	254.7	155.2	8	2.00	3.0	Clay-Like	49			1312	0.89	11.6	46.0	0.89	0.299	1.0	0.089	1.11	0.983	0.085	**N/L**
13.95	45.76	1325	22	260.4	157.9	8	2.04	3.0	Clay-Like	49			1325	0.89	11.7	46.1	0.89	0.299	1.0	0.090	1.11	0.983	0.085	**N/L**
14.25	46.74	1359	21	266.1	160.7	9	1.90	2.9	Clay-Like	45			1359	0.88	11.9	46.3	0.89	0.299	1.0	0.090	1.11	0.983	0.085	**N/L**
14.55	47.72	1394	20	271.7	163.4	9	1.79	2.9	Clay-Like	45			1394	0.88	12.2	46.7	0.88	0.299	1.0	0.090	1.11	0.983	0.086	**N/L**
14.85	48.71	1422	20	277.4	166.1	9	1.74	2.9	Clay-Like	45			1422	0.88	12.3	46.9	0.88	0.299	1.0	0.090	1.11	0.983	0.086	**N/L**
15.15	49.69	1460	20	283.0	168.8	9	1.68	2.9	Clay-Like	45			1460	0.87	12.6	47.3	0.88	0.299	1.0	0.090	1.11	0.983	0.086	**N/L**
15.45	50.68	1417	20	288.7	171.5	9	1.80	2.9	Clay-Like	45			1417	0.87	12.2	46.7	0.87	0.299	1.0	0.090	1.11	0.983	0.085	**N/L**
15.75	51.66	1528	25	294.4	174.2	9	2.00	2.9	Clay-Like	45			1528	0.87	13.1	47.9	0.87	0.299	1.0	0.091	1.11	0.983	0.086	**N/L**
16.05	52.64	1768	25	300.0	177.0	11	1.73	2.8	Clay-Like	41			1768	0.86	15.1	50.5	0.86	0.299	1.0	0.093	1.11	0.983	0.087	**N/L**
16.35	53.63	4365	73	305.7	179.7	30	1.80	2.5		30			4365	0.86	37.1	78.6	0.86	0.299	0.9	0.115	1.17	0.973	0.106	**0.35**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-57**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		13 ft	3.96 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		10 ft	3.05 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	7894	40	2.7	2.7	476	0.51	1.2	Unsaturated	4			7894	1.70	132.9	132.9	1.00	0.204	1.1	0.207	1.49	0.923	0.210	**N/A**
0.45	1.48	4086	60	8.1	8.1	142	1.47	1.9	Unsaturated	15			4086	1.70	68.8	99.9	1.00	0.204	1.1	0.137	1.26	0.959	0.145	**N/A**
0.75	2.46	2527	40	13.6	13.6	68	1.57	2.2	Unsaturated	22			2527	1.70	42.5	80.6	1.00	0.204	1.1	0.116	1.18	0.972	0.124	**N/A**
1.05	3.44	1481	33	19.0	19.0	33	2.25	2.5	Unsaturated	30			1481	1.55	22.8	59.5	1.00	0.204	1.1	0.099	1.13	0.980	0.107	**N/A**
1.35	4.43	5722	108	24.4	24.4	115	1.89	2.1	Unsaturated	19			5722	1.45	82.4	128.3	1.00	0.204	1.1	0.192	1.45	0.930	0.197	**N/A**
1.65	5.41	10206	124	29.8	29.8	185	1.22	1.8	Unsaturated	13			10206	1.38	139.4	174.2	1.00	0.204	1.1	0.584	2.00	0.845	0.542	**N/A**
1.95	6.40	9331	100	35.3	35.3	156	1.08	1.8	Unsaturated	13			9331	1.32	122.0	154.1	1.00	0.203	1.1	0.318	1.72	0.888	0.311	**N/A**
2.25	7.38	6484	93	40.7	40.7	100	1.44	2.0	Unsaturated	17			6484	1.27	81.6	122.0	0.99	0.203	1.1	0.176	1.40	0.938	0.181	**N/A**
2.55	8.36	2504	43	46.1	46.1	36	1.75	2.4	Unsaturated	27			2504	1.23	30.5	68.7	0.99	0.203	1.1	0.106	1.15	0.977	0.111	**N/A**
2.85	9.35	1395	43	51.5	51.5	19	3.17	2.8	Unsaturated	41			1395	1.19	16.5	52.4	0.99	0.202	1.0	0.094	1.11	0.982	0.097	**N/A**
3.15	10.33	1702	42	57.0	56.0	22	2.56	2.7	Clay-Like	37			1702	1.17	19.7	56.4	0.99	0.205	1.0	0.097	1.12	0.981	0.099	**N/L**
3.45	11.32	1090	17	62.7	58.7	13	1.63	2.7	Clay-Like	37			1090	1.15	12.4	46.7	0.99	0.215	1.0	0.090	1.11	0.983	0.092	**N/L**
3.75	12.30	325	18	68.3	61.5	3	6.89	3.6	Clay-Like	78			325	1.14	3.7	34.9	0.98	0.223	1.0	0.082	1.10	0.985	0.083	**N/L**
4.05	13.28	624	16	74.0	64.2	7	3.00	3.1	Clay-Like	53			624	1.13	7.0	39.7	0.98	0.231	1.0	0.085	1.10	0.984	0.086	**N/L**
4.35	14.27	559	14	79.7	66.9	6	2.90	3.2	Clay-Like	58			559	1.11	6.2	38.6	0.98	0.238	1.0	0.084	1.10	0.984	0.085	**N/L**
4.65	15.25	603	12	85.3	69.6	6	2.28	3.1	Clay-Like	53			603	1.10	6.6	39.2	0.98	0.245	1.0	0.085	1.10	0.984	0.086	**N/L**
4.95	16.24	587	10	91.0	72.3	6	2.09	3.1	Clay-Like	53			587	1.09	6.3	38.9	0.98	0.251	1.0	0.085	1.10	0.984	0.085	**N/L**
5.25	17.22	272	10	96.6	75.0	2	5.74	3.7	Clay-Like	84			272	1.08	2.9	33.8	0.97	0.256	1.0	0.081	1.10	0.985	0.081	**N/L**
5.55	18.20	368	10	102.3	77.8	3	3.84	3.5	Clay-Like	73			368	1.07	3.9	35.3	0.97	0.261	1.0	0.082	1.10	0.985	0.082	**N/L**
5.85	19.19	558	10	108.0	80.5	5	2.14	3.2	Clay-Like	58			558	1.06	5.9	38.2	0.97	0.265	1.0	0.084	1.10	0.984	0.084	**N/L**
6.15	20.17	568	9	113.6	83.2	5	2.09	3.2	Clay-Like	58			568	1.05	5.9	38.3	0.97	0.269	1.0	0.084	1.10	0.984	0.084	**N/L**
6.45	21.16	570	9	119.3	85.9	5	2.01	3.2	Clay-Like	58			570	1.04	5.9	38.2	0.96	0.273	1.0	0.084	1.10	0.984	0.084	**N/L**
6.75	22.14	587	9	124.9	88.6	5	2.01	3.2	Clay-Like	58			587	1.04	6.0	38.4	0.96	0.277	1.0	0.084	1.10	0.984	0.084	**N/L**
7.05	23.12	569	9	130.6	91.3	5	2.07	3.2	Clay-Like	58			569	1.03	5.8	38.1	0.96	0.280	1.0	0.084	1.10	0.985	0.083	**N/L**
7.35	24.11	566	9	136.3	94.1	4	2.04	3.2	Clay-Like	58			566	1.02	5.7	38.0	0.96	0.283	1.0	0.084	1.10	0.985	0.083	**N/L**
7.65	25.09	629	10	141.9	96.8	5	2.02	3.2	Clay-Like	58			629	1.01	6.3	38.8	0.95	0.285	1.0	0.085	1.10	0.984	0.083	**N/L**
7.95	26.08	664	10	147.6	99.5	5	1.96	3.1	Clay-Like	53			664	1.00	6.6	39.2	0.95	0.288	1.0	0.085	1.10	0.984	0.084	**N/L**
8.25	27.06	597	8	153.2	102.2	4	1.81	3.2	Clay-Like	58			597	1.00	5.9	38.2	0.95	0.290	1.0	0.084	1.10	0.984	0.083	**N/L**
8.55	28.04	640	8	158.9	104.9	5	1.77	3.2	Clay-Like	58			640	0.99	6.3	38.7	0.95	0.292	1.0	0.085	1.10	0.984	0.083	**N/L**
8.85	29.03	638	8	164.6	107.6	5	1.75	3.2	Clay-Like	58			638	0.98	6.2	38.7	0.94	0.294	1.0	0.084	1.10	0.984	0.083	**N/L**
9.15	30.01	647	7	170.2	110.4	5	1.46	3.1	Clay-Like	53			647	0.98	6.3	38.8	0.94	0.296	1.0	0.085	1.10	0.984	0.083	**N/L**
9.45	31.00	648	6	175.9	113.1	4	1.28	3.1	Clay-Like	53			648	0.97	6.2	38.7	0.94	0.297	1.0	0.085	1.10	0.984	0.083	**N/L**
9.75	31.98	668	7	181.5	115.8	4	1.39	3.1	Clay-Like	53			668	0.96	6.4	38.9	0.93	0.299	1.0	0.085	1.10	0.984	0.083	**N/L**
10.05	32.96	702	8	187.2	118.5	5	1.50	3.1	Clay-Like	53			702	0.96	6.7	39.3	0.93	0.300	1.0	0.085	1.10	0.984	0.083	**N/L**
10.35	33.95	685	6	192.8	121.2	4	1.24	3.1	Clay-Like	53			685	0.95	6.5	39.1	0.93	0.301	1.0	0.085	1.10	0.984	0.082	**N/L**
10.65	34.93	688	6	198.5	123.9	4	1.20	3.1	Clay-Like	53			688	0.95	6.4	39.0	0.92	0.302	1.0	0.085	1.10	0.984	0.082	**N/L**
10.95	35.92	676	5	204.2	126.7	4	1.16	3.1	Clay-Like	53			676	0.94	6.3	38.8	0.92	0.303	1.0	0.085	1.10	0.984	0.082	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	$q_{c1N\text{-}cs}$	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
11.25	36.90	702	6	209.8	129.4	4	1.15	3.1	Clay-Like	53			702	0.94	6.5	39.1	0.92	0.304	1.0	0.085	1.10	0.984	0.082	**N/L**
11.55	37.88	711	6	215.5	132.1	4	1.18	3.1	Clay-Like	53			711	0.93	6.6	39.2	0.91	0.305	1.0	0.085	1.10	0.984	0.082	**N/L**
11.85	38.87	730	6	221.1	134.8	4	1.13	3.1	Clay-Like	53			730	0.93	6.7	39.4	0.91	0.305	1.0	0.085	1.10	0.984	0.082	**N/L**
12.15	39.85	711	5	226.8	137.5	4	1.07	3.1	Clay-Like	53			711	0.92	6.5	39.1	0.91	0.306	1.0	0.085	1.10	0.984	0.082	**N/L**
12.45	40.84	737	6	232.5	140.2	4	1.15	3.1	Clay-Like	53			737	0.92	6.7	39.4	0.91	0.306	1.0	0.085	1.10	0.984	0.082	**N/L**
12.75	41.82	760	6	238.1	143.0	4	1.14	3.1	Clay-Like	53			760	0.91	6.9	39.6	0.90	0.307	1.0	0.085	1.10	0.984	0.082	**N/L**
13.05	42.80	757	7	243.8	145.7	4	1.27	3.1	Clay-Like	53			757	0.91	6.8	39.5	0.90	0.307	1.0	0.085	1.10	0.984	0.082	**N/L**
13.35	43.79	770	7	249.4	148.4	4	1.33	3.1	Clay-Like	53			770	0.90	6.9	39.6	0.90	0.307	1.0	0.085	1.10	0.984	0.082	**N/L**
13.65	44.77	782	7	255.1	151.1	4	1.25	3.1	Clay-Like	53			782	0.90	7.0	39.7	0.89	0.307	1.0	0.085	1.10	0.984	0.082	**N/L**
13.95	45.76	796	8	260.8	153.8	4	1.41	3.2	Clay-Like	58			796	0.89	7.1	39.8	0.89	0.308	1.0	0.085	1.10	0.984	0.082	**N/L**
14.25	46.74	780	7	266.4	156.5	4	1.33	3.2	Clay-Like	58			780	0.89	6.9	39.6	0.89	0.308	1.0	0.085	1.10	0.984	0.081	**N/L**
14.55	47.72	813	6	272.1	159.2	4	1.17	3.1	Clay-Like	53			813	0.89	7.1	40.0	0.88	0.308	1.0	0.085	1.10	0.984	0.082	**N/L**
14.85	48.71	820	7	277.7	162.0	4	1.21	3.1	Clay-Like	53			820	0.88	7.2	40.0	0.88	0.307	1.0	0.085	1.10	0.984	0.081	**N/L**
15.15	49.69	802	7	283.4	164.7	4	1.26	3.2	Clay-Like	58			802	0.88	7.0	39.7	0.88	0.307	1.0	0.085	1.10	0.984	0.081	**N/L**
15.45	50.68	836	7	289.1	167.4	4	1.36	3.2	Clay-Like	58			836	0.88	7.2	40.1	0.87	0.307	1.0	0.085	1.10	0.984	0.081	**N/L**
15.75	51.66	868	8	294.7	170.1	4	1.37	3.1	Clay-Like	53			868	0.87	7.5	40.4	0.87	0.307	1.0	0.086	1.10	0.984	0.081	**N/L**
16.05	52.64	1130	14	300.4	172.8	6	1.73	3.0	Clay-Like	49			1130	0.87	9.7	43.4	0.86	0.307	1.0	0.088	1.10	0.984	0.083	**N/L**
16.35	53.63	1310	16	306.0	175.5	8	1.57	3.0	Clay-Like	49			1310	0.86	11.2	45.5	0.86	0.306	1.0	0.089	1.11	0.983	0.084	**N/L**
16.65	54.61	5614	92	311.7	178.3	39	1.73	2.4		27			5614	0.86	47.8	91.7	0.86	0.306	0.9	0.127	1.22	0.965	0.116	**0.38**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-58**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		4 ft	1.22 m
Approx. water table elevation		1 ft	0.30 m
Approx. depth to ground water table		3 ft	0.91 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	1198	9	2.7	2.7	72	0.72	1.9	Unsaturated	15			1198	1.70	20.2	41.6	1.00	0.204	1.1	0.086	1.10	0.984	0.094	**N/A**
0.45	1.48	664	11	8.1	8.1	23	1.65	2.6	Unsaturated	34			664	1.70	11.2	44.6	1.00	0.204	1.1	0.089	1.11	0.984	0.096	**N/A**
0.75	2.46	472	14	13.6	13.6	12	2.97	2.9	Unsaturated	45			472	1.70	7.9	41.0	1.00	0.204	1.1	0.086	1.10	0.984	0.093	**N/A**
1.05	3.44	543	18	19.1	17.8	12	3.53	3.0	Clay-Like	49			543	1.58	8.5	41.8	1.00	0.219	1.1	0.087	1.10	0.984	0.094	**N/L**
1.35	4.43	444	15	24.7	20.5	9	3.48	3.1	Clay-Like	53			444	1.52	6.7	39.4	1.00	0.246	1.1	0.085	1.10	0.984	0.092	**N/L**
1.65	5.41	306	9	30.4	23.2	6	3.32	3.2	Clay-Like	58			306	1.47	4.5	36.3	1.00	0.267	1.1	0.083	1.10	0.985	0.089	**N/L**
1.95	6.40	380	6	36.1	25.9	7	1.86	3.0	Clay-Like	49			380	1.43	5.4	37.6	1.00	0.283	1.1	0.084	1.10	0.985	0.090	**N/L**
2.25	7.38	415	5	41.7	28.6	7	1.37	3.0	Clay-Like	49			415	1.39	5.7	38.0	0.99	0.296	1.1	0.084	1.10	0.985	0.089	**N/L**
2.55	8.36	412	5	47.4	31.3	6	1.35	3.0	Clay-Like	49			412	1.36	5.6	37.8	0.99	0.306	1.1	0.084	1.10	0.985	0.089	**N/L**
2.85	9.35	321	4	53.0	34.1	5	1.65	3.2	Clay-Like	58			321	1.33	4.2	36.0	0.99	0.315	1.1	0.083	1.10	0.985	0.087	**N/L**
3.15	10.33	193	4	58.7	36.8	2	3.30	3.6	Clay-Like	78			193	1.41	2.7	33.6	0.99	0.322	1.1	0.081	1.10	0.985	0.085	**N/L**
3.45	11.32	264	5	64.4	39.5	3	2.68	3.4	Clay-Like	67			264	1.28	3.3	34.7	0.99	0.328	1.1	0.082	1.10	0.985	0.085	**N/L**
3.75	12.30	439	5	70.0	42.2	6	1.37	3.0	Clay-Like	49			439	1.26	5.5	37.7	0.98	0.333	1.1	0.084	1.10	0.985	0.087	**N/L**
4.05	13.28	361	6	75.7	44.9	4	2.06	3.2	Clay-Like	58			361	1.24	4.4	36.3	0.98	0.338	1.1	0.083	1.10	0.985	0.086	**N/L**
4.35	14.27	323	7	81.3	47.6	3	2.82	3.4	Clay-Like	67			323	1.22	3.9	35.4	0.98	0.342	1.0	0.082	1.10	0.985	0.085	**N/L**
4.65	15.25	512	7	87.0	50.4	6	1.75	3.1	Clay-Like	53			512	1.20	6.1	38.5	0.98	0.345	1.0	0.084	1.10	0.984	0.087	**N/L**
4.95	16.24	574	7	92.7	53.1	7	1.40	3.0	Clay-Like	49			574	1.19	6.7	39.4	0.98	0.348	1.0	0.085	1.10	0.984	0.087	**N/L**
5.25	17.22	579	7	98.3	55.8	6	1.50	3.0	Clay-Like	49			579	1.17	6.7	39.4	0.97	0.350	1.0	0.085	1.10	0.984	0.087	**N/L**
5.55	18.20	544	7	104.0	58.5	6	1.51	3.1	Clay-Like	53			544	1.15	6.2	38.7	0.97	0.352	1.0	0.085	1.10	0.984	0.086	**N/L**
5.85	19.19	565	6	109.6	61.2	6	1.39	3.0	Clay-Like	49			565	1.14	6.4	38.9	0.97	0.354	1.0	0.085	1.10	0.984	0.086	**N/L**
6.15	20.17	597	7	115.3	63.9	6	1.37	3.0	Clay-Like	49			597	1.13	6.7	39.3	0.97	0.356	1.0	0.085	1.10	0.984	0.086	**N/L**
6.45	21.16	579	6	121.0	66.7	6	1.32	3.0	Clay-Like	49			579	1.12	6.4	39.0	0.96	0.357	1.0	0.085	1.10	0.984	0.086	**N/L**
6.75	22.14	587	6	126.6	69.4	5	1.37	3.0	Clay-Like	49			587	1.10	6.4	39.0	0.96	0.358	1.0	0.085	1.10	0.984	0.085	**N/L**
7.05	23.12	562	6	132.3	72.1	5	1.46	3.1	Clay-Like	53			562	1.09	6.1	38.5	0.96	0.359	1.0	0.084	1.10	0.984	0.085	**N/L**
7.35	24.11	641	6	137.9	74.8	6	1.26	3.0	Clay-Like	49			641	1.08	6.9	39.6	0.96	0.360	1.0	0.085	1.10	0.984	0.085	**N/L**
7.65	25.09	676	6	143.6	77.5	6	1.20	3.0	Clay-Like	49			676	1.07	7.2	40.0	0.95	0.360	1.0	0.085	1.10	0.984	0.085	**N/L**
7.95	26.08	656	6	149.2	80.2	6	1.18	3.0	Clay-Like	49			656	1.06	6.9	39.6	0.95	0.361	1.0	0.085	1.10	0.984	0.085	**N/L**
8.25	27.06	648	6	154.9	82.9	5	1.13	3.0	Clay-Like	49			648	1.05	6.8	39.4	0.95	0.361	1.0	0.085	1.10	0.984	0.085	**N/L**
8.55	28.04	674	5	160.6	85.7	6	0.98	3.0	Clay-Like	49			674	1.04	7.0	39.7	0.95	0.362	1.0	0.085	1.10	0.984	0.085	**N/L**
8.85	29.03	666	5	166.2	88.4	5	1.02	3.0	Clay-Like	49			666	1.04	6.8	39.5	0.94	0.362	1.0	0.085	1.10	0.984	0.084	**N/L**
9.15	30.01	691	5	171.9	91.1	5	1.01	3.0	Clay-Like	49			691	1.03	7.0	39.8	0.94	0.362	1.0	0.085	1.10	0.984	0.084	**N/L**
9.45	31.00	728	6	177.5	93.8	6	1.09	3.0	Clay-Like	49			728	1.02	7.4	40.2	0.94	0.362	1.0	0.086	1.10	0.984	0.085	**N/L**
9.75	31.98	738	7	183.2	96.5	6	1.19	3.0	Clay-Like	49			738	1.01	7.4	40.3	0.93	0.362	1.0	0.086	1.10	0.984	0.084	**N/L**
10.05	32.96	753	7	188.9	99.2	6	1.19	3.0	Clay-Like	49			753	1.00	7.5	40.4	0.93	0.361	1.0	0.086	1.10	0.984	0.084	**N/L**
10.35	33.95	763	7	194.5	102.0	6	1.21	3.0	Clay-Like	49			763	1.00	7.5	40.5	0.93	0.361	1.0	0.086	1.10	0.984	0.084	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	770	7	200.2	104.7	6	1.18	3.0	Clay-Like	49			770	0.99	7.6	40.5	0.92	0.361	1.0	0.086	1.10	0.984	0.084	**N/L**
10.95	35.92	792	7	205.8	107.4	6	1.22	3.0	Clay-Like	49			792	0.98	7.7	40.7	0.92	0.360	1.0	0.086	1.10	0.984	0.084	**N/L**
11.25	36.90	787	7	211.5	110.1	5	1.17	3.0	Clay-Like	49			787	0.98	7.6	40.6	0.92	0.360	1.0	0.086	1.10	0.984	0.084	**N/L**
11.55	37.88	795	7	217.2	112.8	5	1.20	3.0	Clay-Like	49			795	0.97	7.6	40.6	0.91	0.359	1.0	0.086	1.10	0.984	0.084	**N/L**
11.85	38.87	803	7	222.8	115.5	5	1.20	3.0	Clay-Like	49			803	0.97	7.7	40.7	0.91	0.359	1.0	0.086	1.10	0.984	0.084	**N/L**
12.15	39.85	816	7	228.5	118.3	5	1.27	3.0	Clay-Like	49			816	0.96	7.7	40.8	0.91	0.358	1.0	0.086	1.10	0.984	0.084	**N/L**
12.45	40.84	838	8	234.1	121.0	5	1.34	3.0	Clay-Like	49			838	0.95	7.9	41.0	0.91	0.358	1.0	0.086	1.10	0.984	0.084	**N/L**
12.75	41.82	858	9	239.8	123.7	6	1.40	3.1	Clay-Like	53			858	0.95	8.1	41.2	0.90	0.357	1.0	0.086	1.10	0.984	0.084	**N/L**
13.05	42.80	924	10	245.5	126.4	6	1.52	3.0	Clay-Like	49			924	0.94	8.6	42.0	0.90	0.356	1.0	0.087	1.10	0.984	0.084	**N/L**
13.35	43.79	2091	31	251.1	129.1	16	1.67	2.7	Clay-Like	37			2091	0.94	19.4	56.0	0.90	0.355	1.0	0.097	1.12	0.981	0.093	**N/L**
13.65	44.77	7156	74	256.8	131.8	60	1.07	2.1		19			7156	0.93	66.0	107.5	0.89	0.355	1.0	0.148	1.30	0.953	0.137	**0.39**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-60**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		11 ft	3.35 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		8 ft	2.44 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	462	4	2.7	2.7	28	0.94	2.4	Unsaturated	27			462	1.70	7.8	38.6	1.00	0.204	1.1	0.084	1.10	0.984	0.091	**N/A**
0.45	1.48	1259	13	8.1	8.1	44	1.02	2.2	Unsaturated	22			1259	1.70	21.2	53.0	1.00	0.204	1.1	0.094	1.12	0.982	0.102	**N/A**
0.75	2.46	3184	23	13.6	13.6	86	0.73	1.9	Unsaturated	15			3184	1.70	53.5	81.7	1.00	0.204	1.1	0.117	1.18	0.971	0.125	**N/A**
1.05	3.44	3527	50	19.0	19.0	80	1.43	2.1	Unsaturated	19			3527	1.55	54.3	92.5	1.00	0.204	1.1	0.128	1.23	0.965	0.136	**N/A**
1.35	4.43	4674	62	24.4	24.4	94	1.33	2.0	Unsaturated	17			4674	1.45	67.3	104.3	1.00	0.204	1.1	0.143	1.28	0.956	0.150	**N/A**
1.65	5.41	3362	69	29.8	29.8	61	2.08	2.3	Unsaturated	24			3362	1.38	45.9	87.5	1.00	0.204	1.1	0.123	1.20	0.968	0.131	**N/A**
1.95	6.40	1553	24	35.3	35.3	25	1.58	2.5	Unsaturated	30			1553	1.32	20.3	56.1	1.00	0.203	1.1	0.097	1.12	0.981	0.102	**N/A**
2.25	7.38	2054	40	40.7	40.7	31	1.98	2.5	Unsaturated	30			2054	1.27	25.9	63.6	0.99	0.203	1.1	0.102	1.13	0.979	0.107	**N/A**
2.55	8.36	1439	30	46.2	45.1	21	2.15	2.7	Clay-Like	37			1439	1.24	17.6	53.6	0.99	0.207	1.1	0.095	1.12	0.982	0.099	**N/L**
2.85	9.35	1958	29	51.8	47.8	27	1.50	2.5		30			1958	1.22	23.6	60.6	0.99	0.219	1.1	0.100	1.13	0.980	0.104	**0.47**
3.15	10.33	3551	73	57.5	50.5	49	2.09	2.4		27			3551	1.20	42.2	84.3	0.99	0.230	1.1	0.120	1.19	0.970	0.124	**0.54**
3.45	11.32	2755	57	63.2	53.2	37	2.12	2.5		30			2755	1.18	32.3	72.2	0.99	0.239	1.1	0.109	1.15	0.976	0.112	**0.47**
3.75	12.30	531	12	68.8	56.0	6	2.57	3.1	Clay-Like	53			531	1.17	6.1	38.6	0.98	0.247	1.0	0.084	1.10	0.984	0.086	**N/L**
4.05	13.28	503	12	74.5	58.7	6	2.77	3.2	Clay-Like	58			503	1.15	5.8	38.0	0.98	0.255	1.0	0.084	1.10	0.985	0.086	**N/L**
4.35	14.27	799	14	80.1	61.4	9	1.98	2.9	Clay-Like	45			799	1.14	9.0	42.4	0.98	0.261	1.0	0.087	1.10	0.984	0.088	**N/L**
4.65	15.25	337	19	85.8	64.1	3	7.38	3.6	Clay-Like	78			337	1.13	3.8	35.0	0.98	0.267	1.0	0.082	1.10	0.985	0.083	**N/L**
4.95	16.24	172	23	91.5	66.8	1	27.91	4.4	Clay-Like	132			172	1.16	2.0	31.9	0.98	0.273	1.0	0.080	1.10	0.985	0.081	**N/L**
5.25	17.22	142	24	97.1	69.5	1	53.74	4.6	Clay-Like	148			142	1.17	1.6	31.3	0.97	0.277	1.0	0.080	1.10	0.985	0.080	**N/L**
5.55	18.20	169	23	102.8	72.3	1	34.59	4.4	Clay-Like	132			169	1.13	1.9	31.8	0.97	0.282	1.0	0.080	1.10	0.985	0.080	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-62**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		2 ft	0.61 m
Approx. depth to ground water table		7 ft	2.13 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	2412	6	2.7	2.7	145	0.23	1.4	Unsaturated	7			2412	1.70	40.6	41.3	1.00	0.204	1.1	0.086	1.10	0.984	0.093	**N/A**
0.45	1.48	1360	16	8.1	8.1	47	1.18	2.2	Unsaturated	22			1360	1.70	22.9	55.2	1.00	0.204	1.1	0.096	1.12	0.981	0.104	**N/A**
0.75	2.46	8981	125	13.6	13.6	242	1.40	1.7	Unsaturated	11			8981	1.70	151.0	175.8	1.00	0.204	1.1	0.618	2.02	0.841	0.572	**N/A**
1.05	3.44	5085	52	19.0	19.0	116	1.03	1.9	Unsaturated	15			5085	1.55	78.2	111.3	1.00	0.204	1.1	0.154	1.33	0.949	0.161	**N/A**
1.35	4.43	3539	25	24.4	24.4	71	0.71	1.9	Unsaturated	15			3539	1.45	51.0	78.5	1.00	0.204	1.1	0.114	1.17	0.973	0.123	**N/A**
1.65	5.41	2979	23	29.8	29.8	54	0.78	2.1	Unsaturated	19			2979	1.38	40.7	75.2	1.00	0.204	1.1	0.112	1.16	0.975	0.120	**N/A**
1.95	6.40	1910	28	35.3	35.3	31	1.50	2.4	Unsaturated	27			1910	1.32	25.0	61.4	1.00	0.203	1.1	0.101	1.13	0.980	0.107	**N/A**
2.25	7.38	7123	177	40.8	39.6	112	2.50	2.2		22			7123	1.28	90.3	142.6	0.99	0.209	1.1	0.246	1.59	0.909	0.246	**1.18**
2.55	8.36	5540	127	46.4	42.3	84	2.30	2.2		22			5540	1.26	69.0	115.0	0.99	0.222	1.1	0.161	1.35	0.945	0.167	**0.75**
2.85	9.35																							
3.15	10.33																							
3.45	11.32	4466	88	63.4	50.5	62	2.00	2.3		24			4466	1.20	53.1	96.9	0.99	0.253	1.1	0.133	1.25	0.962	0.137	**0.54**
3.75	12.30	1757	33	69.1	53.2	23	1.96	2.6	Clay-Like	34			1757	1.18	20.6	57.2	0.98	0.261	1.0	0.097	1.12	0.981	0.100	**N/L**
4.05	13.28	1183	7	74.7	55.9	15	0.65	2.5		30			1183	1.17	13.7	47.3	0.98	0.268	1.0	0.090	1.11	0.983	0.093	**0.35**
4.35	14.27	760	6	80.4	58.6	9	0.88	2.8	Clay-Like	41			760	1.15	8.7	41.9	0.98	0.274	1.0	0.087	1.10	0.984	0.088	**N/L**
4.65	15.25	542	9	86.0	61.4	6	1.90	3.1	Clay-Like	53			542	1.14	6.1	38.6	0.98	0.280	1.0	0.084	1.10	0.984	0.086	**N/L**
4.95	16.24	435	11	91.7	64.1	4	3.27	3.3	Clay-Like	62			435	1.13	4.9	36.8	0.98	0.285	1.0	0.083	1.10	0.985	0.084	**N/L**
5.25	17.22	592	11	97.4	66.8	6	2.32	3.1	Clay-Like	53			592	1.12	6.5	39.1	0.97	0.290	1.0	0.085	1.10	0.984	0.086	**N/L**
5.55	18.20	628	13	103.0	69.5	6	2.54	3.1	Clay-Like	53			628	1.10	6.9	39.6	0.97	0.294	1.0	0.085	1.10	0.984	0.086	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-62**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		10 ft	3.05 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		7 ft	2.13 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	1192	8	2.7	2.7	72	0.69	1.9	Unsaturated	15			1192	1.70	20.1	41.4	1.00	0.204	1.1	0.086	1.10	0.984	0.093	**N/A**
0.45	1.48	3751	28	8.1	8.1	130	0.74	1.7	Unsaturated	11			3751	1.70	63.1	78.7	1.00	0.204	1.1	0.115	1.17	0.973	0.123	**N/A**
0.75	2.46	2655	18	13.6	13.6	71	0.69	1.9	Unsaturated	15			2655	1.70	44.7	71.0	1.00	0.204	1.1	0.108	1.15	0.976	0.116	**N/A**
1.05	3.44	1939	22	19.0	19.0	44	1.15	2.2	Unsaturated	22			1939	1.55	29.8	64.2	1.00	0.204	1.1	0.103	1.14	0.979	0.111	**N/A**
1.35	4.43	3018	36	24.4	24.4	60	1.21	2.1	Unsaturated	19			3018	1.45	43.5	78.8	1.00	0.204	1.1	0.115	1.17	0.973	0.123	**N/A**
1.65	5.41	3166	53	29.8	29.8	57	1.70	2.2	Unsaturated	22			3166	1.38	43.2	81.6	1.00	0.204	1.1	0.117	1.18	0.971	0.125	**N/A**
1.95	6.40	2769	8	35.3	35.3	46	0.29	1.9	Unsaturated	15			2769	1.32	36.2	60.8	1.00	0.203	1.1	0.100	1.13	0.980	0.106	**N/A**
2.25	7.38																							
2.55	8.36																							
2.85	9.35	1052	29	52.1	45.1	15	2.95	2.9	Clay-Like	45			1052	1.24	12.9	47.7	0.99	0.234	1.1	0.091	1.11	0.983	0.094	**N/L**
3.15	10.33	3961	64	57.7	47.8	56	1.64	2.2		22			3961	1.22	47.8	87.5	0.99	0.244	1.1	0.123	1.20	0.968	0.128	**0.52**
3.45	11.32	3663	82	63.4	50.5	50	2.28	2.4		27			3663	1.20	43.5	86.0	0.99	0.253	1.1	0.121	1.20	0.969	0.126	**0.50**
3.75	12.30	1469	42	69.1	53.2	19	2.98	2.8	Clay-Like	41			1469	1.18	17.2	53.4	0.98	0.261	1.0	0.095	1.12	0.982	0.097	**N/L**
4.05	13.28	2557	57	74.7	55.9	33	2.30	2.5		30			2557	1.17	29.6	68.6	0.98	0.268	1.0	0.106	1.15	0.977	0.109	**0.41**
4.35	14.27	3342	70	80.4	58.6	42	2.15	2.4		27			3342	1.15	38.2	78.9	0.98	0.274	1.0	0.115	1.17	0.973	0.117	**0.43**
4.65	15.25	970	28	86.0	61.4	11	3.20	3.0	Clay-Like	49			970	1.14	10.9	45.1	0.98	0.280	1.0	0.089	1.11	0.984	0.090	**N/L**
4.95	16.24	745	22	91.7	64.1	8	3.41	3.1	Clay-Like	53			745	1.13	8.3	41.5	0.98	0.285	1.0	0.086	1.10	0.984	0.088	**N/L**
5.25	17.22	703	19	97.4	66.8	7	3.21	3.1	Clay-Like	53			703	1.12	7.8	40.8	0.97	0.290	1.0	0.086	1.10	0.984	0.087	**N/L**
5.55	18.20	776	20	103.0	69.5	8	2.92	3.1	Clay-Like	53			776	1.10	8.5	41.8	0.97	0.294	1.0	0.087	1.10	0.984	0.087	**N/L**
5.85	19.19	815	21	108.7	72.2	8	2.94	3.1	Clay-Like	53			815	1.09	8.8	42.2	0.97	0.298	1.0	0.087	1.10	0.984	0.087	**N/L**
6.15	20.17	815	19	114.3	74.9	8	2.76	3.1	Clay-Like	53			815	1.08	8.7	42.1	0.97	0.301	1.0	0.087	1.10	0.984	0.087	**N/L**
6.45	21.16	812	19	120.0	77.7	8	2.81	3.1	Clay-Like	53			812	1.07	8.6	42.0	0.96	0.304	1.0	0.087	1.10	0.984	0.087	**N/L**
6.75	22.14	797	21	125.7	80.4	7	3.09	3.1	Clay-Like	53			797	1.06	8.4	41.6	0.96	0.307	1.0	0.087	1.10	0.984	0.086	**N/L**
7.05	23.12	773	20	131.3	83.1	7	3.11	3.1	Clay-Like	53			773	1.05	8.1	41.2	0.96	0.309	1.0	0.086	1.10	0.984	0.086	**N/L**
7.35	24.11	788	19	137.0	85.8	7	2.92	3.1	Clay-Like	53			788	1.04	8.1	41.3	0.96	0.311	1.0	0.086	1.10	0.984	0.086	**N/L**
7.65	25.09	849	19	142.6	88.5	7	2.69	3.1	Clay-Like	53			849	1.04	8.7	42.1	0.95	0.314	1.0	0.087	1.10	0.984	0.086	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-63**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		7 ft	2.13 m
Approx. water table elevation		2 ft	0.61 m
Approx. depth to ground water table		5 ft	1.52 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49																							
0.45	1.48																							
0.75	2.46																							
1.05	3.44																							
1.35	4.43	831	33	24.4	24.4	16	4.12	2.9	Unsaturated	45			831	1.45	12.0	46.4	1.00	0.204	1.1	0.090	1.11	0.983	0.097	**N/A**
1.65	5.41	3020	57	29.9	28.7	55	1.92	2.3		24			3020	1.39	41.7	81.9	1.00	0.212	1.1	0.118	1.18	0.971	0.126	**0.59**
1.95	6.40	2508	55	35.6	31.4	44	2.21	2.4		27			2508	1.36	33.8	73.1	1.00	0.230	1.1	0.110	1.16	0.976	0.118	**0.51**
2.25	7.38	4532	56	41.2	34.1	76	1.25	2.1		19			4532	1.33	59.7	99.5	0.99	0.245	1.1	0.137	1.26	0.960	0.144	**0.59**
2.55	8.36	1941	26	46.9	36.8	31	1.36	2.4		27			1941	1.30	25.1	61.5	0.99	0.258	1.1	0.101	1.13	0.980	0.106	**0.41**
2.85	9.35	701	17	52.6	39.6	10	2.57	3.0	Clay-Like	49			701	1.28	8.9	42.3	0.99	0.269	1.1	0.087	1.10	0.984	0.091	**N/L**
3.15	10.33	1932	55	58.2	42.3	29	2.94	2.6	Clay-Like	34			1932	1.26	24.1	61.9	0.99	0.278	1.1	0.101	1.13	0.980	0.106	**N/L**
3.45	11.32	2579	50	63.9	45.0	37	1.97	2.4		27			2579	1.24	31.6	70.2	0.99	0.286	1.1	0.107	1.15	0.977	0.112	**0.39**
3.75	12.30	2563	67	69.5	47.7	36	2.67	2.5		30			2563	1.22	30.9	70.4	0.98	0.293	1.1	0.108	1.15	0.977	0.112	**0.38**
4.05	13.28	2039	47	75.2	50.4	27	2.39	2.6	Clay-Like	34			2039	1.20	24.2	62.1	0.98	0.299	1.1	0.101	1.13	0.980	0.104	**N/L**
4.35	14.27	1398	27	80.9	53.1	18	2.05	2.7	Clay-Like	37			1398	1.18	16.4	52.0	0.98	0.304	1.0	0.094	1.11	0.982	0.096	**N/L**
4.65	15.25	1199	29	86.5	55.9	15	2.59	2.8	Clay-Like	41			1199	1.17	13.9	48.9	0.98	0.309	1.0	0.091	1.11	0.983	0.094	**N/L**
4.95	16.24	556	12	92.2	58.6	6	2.68	3.2	Clay-Like	58			556	1.15	6.4	38.9	0.98	0.313	1.0	0.085	1.10	0.984	0.086	**N/L**
5.25	17.22	482	11	97.8	61.3	5	2.83	3.2	Clay-Like	58			482	1.14	5.4	37.6	0.97	0.317	1.0	0.084	1.10	0.985	0.085	**N/L**
5.55	18.20	512	11	103.5	64.0	5	2.70	3.2	Clay-Like	58			512	1.13	5.7	38.0	0.97	0.321	1.0	0.084	1.10	0.985	0.085	**N/L**
5.85	19.19	513	11	109.2	66.7	5	2.64	3.2	Clay-Like	58			513	1.12	5.7	37.9	0.97	0.323	1.0	0.084	1.10	0.985	0.085	**N/L**
6.15	20.17	513	10	114.8	69.4	5	2.63	3.2	Clay-Like	58			513	1.10	5.6	37.9	0.97	0.326	1.0	0.084	1.10	0.985	0.085	**N/L**
6.45	21.16	503	10	120.5	72.2	4	2.61	3.3	Clay-Like	62			503	1.09	5.4	37.6	0.96	0.328	1.0	0.084	1.10	0.985	0.084	**N/L**
6.75	22.14	517	10	126.1	74.9	4	2.68	3.3	Clay-Like	62			517	1.08	5.5	37.7	0.96	0.331	1.0	0.084	1.10	0.985	0.084	**N/L**
7.05	23.12	512	10	131.8	77.6	4	2.58	3.3	Clay-Like	62			512	1.07	5.4	37.6	0.96	0.332	1.0	0.084	1.10	0.985	0.084	**N/L**
7.35	24.11	500	10	137.5	80.3	4	2.73	3.3	Clay-Like	62			500	1.06	5.3	37.3	0.96	0.334	1.0	0.084	1.10	0.985	0.084	**N/L**
7.65	25.09	534	10	143.1	83.0	4	2.57	3.3	Clay-Like	62			534	1.05	5.6	37.7	0.95	0.335	1.0	0.084	1.10	0.985	0.084	**N/L**
7.95	26.08	536	9	148.8	85.7	4	2.42	3.3	Clay-Like	62			536	1.04	5.5	37.7	0.95	0.337	1.0	0.084	1.10	0.985	0.083	**N/L**
8.25	27.06	559	9	154.4	88.5	4	2.23	3.2	Clay-Like	58			559	1.04	5.7	38.0	0.95	0.338	1.0	0.084	1.10	0.985	0.083	**N/L**
8.55	28.04	524	9	160.1	91.2	4	2.37	3.3	Clay-Like	62			524	1.03	5.3	37.4	0.95	0.339	1.0	0.084	1.10	0.985	0.083	**N/L**
8.85	29.03	549	9	165.7	93.9	4	2.23	3.3	Clay-Like	62			549	1.02	5.5	37.7	0.94	0.340	1.0	0.084	1.10	0.985	0.083	**N/L**
9.15	30.01	542	9	171.4	96.6	4	2.32	3.3	Clay-Like	62			542	1.01	5.4	37.6	0.94	0.340	1.0	0.084	1.10	0.985	0.083	**N/L**
9.45	31.00	575	9	177.1	99.3	4	2.26	3.3	Clay-Like	62			575	1.00	5.7	37.9	0.94	0.341	1.0	0.084	1.10	0.985	0.083	**N/L**
9.75	31.98	568	9	182.7	102.0	4	2.23	3.3	Clay-Like	62			568	1.00	5.6	37.8	0.93	0.341	1.0	0.084	1.10	0.985	0.083	**N/L**
10.05	32.96	577	9	188.4	104.7	4	2.22	3.3	Clay-Like	62			577	0.99	5.7	37.9	0.93	0.342	1.0	0.084	1.10	0.985	0.082	**N/L**
10.35	33.95	590	9	194.0	107.5	4	2.23	3.3	Clay-Like	62			590	0.98	5.7	38.0	0.93	0.342	1.0	0.084	1.10	0.985	0.082	**N/L**
10.65	34.93	598	8	199.7	110.2	4	2.09	3.3	Clay-Like	62			598	0.98	5.8	38.0	0.92	0.342	1.0	0.084	1.10	0.985	0.082	**N/L**
10.95	35.92	607	8	205.4	112.9	4	2.03	3.3	Clay-Like	62			607	0.97	5.8	38.1	0.92	0.342	1.0	0.084	1.10	0.985	0.082	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
11.25	36.90	617	9	211.0	115.6	4	2.14	3.3	Clay-Like	62			617	0.96	5.9	38.2	0.92	0.342	1.0	0.084	1.10	0.985	0.082	**N/L**
11.55	37.88	626	8	216.7	118.3	4	2.04	3.3	Clay-Like	62			626	0.96	5.9	38.2	0.91	0.342	1.0	0.084	1.10	0.984	0.082	**N/L**
11.85	38.87	637	8	222.3	121.0	4	2.03	3.3	Clay-Like	62			637	0.95	6.0	38.3	0.91	0.342	1.0	0.084	1.10	0.984	0.082	**N/L**
12.15	39.85	650	9	228.0	123.8	4	2.16	3.3	Clay-Like	62			650	0.95	6.1	38.4	0.91	0.342	1.0	0.084	1.10	0.984	0.082	**N/L**
12.45	40.84	662	10	233.7	126.5	4	2.39	3.3	Clay-Like	62			662	0.94	6.2	38.6	0.91	0.341	1.0	0.084	1.10	0.984	0.082	**N/L**
12.75	41.82	668	9	239.3	129.2	4	2.21	3.3	Clay-Like	62			668	0.94	6.2	38.6	0.90	0.341	1.0	0.084	1.10	0.984	0.082	**N/L**
13.05	42.80	677	9	245.0	131.9	4	2.15	3.3	Clay-Like	62			677	0.93	6.2	38.7	0.90	0.341	1.0	0.084	1.10	0.984	0.082	**N/L**
13.35	43.79	685	9	250.6	134.6	4	2.13	3.3	Clay-Like	62			685	0.93	6.3	38.7	0.90	0.340	1.0	0.085	1.10	0.984	0.082	**N/L**
13.65	44.77	704	9	256.3	137.3	4	1.99	3.3	Clay-Like	62			704	0.92	6.4	38.9	0.89	0.340	1.0	0.085	1.10	0.984	0.082	**N/L**
13.95	45.76	762	7	262.0	140.1	4	1.49	3.2	Clay-Like	58			762	0.92	6.9	39.6	0.89	0.339	1.0	0.085	1.10	0.984	0.082	**N/L**
14.25	46.74	780	8	267.6	142.8	4	1.64	3.2	Clay-Like	58			780	0.91	7.1	39.8	0.89	0.339	1.0	0.085	1.10	0.984	0.082	**N/L**
14.55	47.72	752	9	273.3	145.5	4	1.80	3.2	Clay-Like	58			752	0.91	6.8	39.4	0.88	0.338	1.0	0.085	1.10	0.984	0.082	**N/L**
14.85	48.71	736	10	278.9	148.2	4	2.09	3.3	Clay-Like	62			736	0.90	6.6	39.1	0.88	0.337	1.0	0.085	1.10	0.984	0.081	**N/L**
15.15	49.69	743	10	284.6	150.9	4	2.19	3.3	Clay-Like	62			743	0.90	6.6	39.2	0.88	0.337	1.0	0.085	1.10	0.984	0.081	**N/L**
15.45	50.68	760	10	290.3	153.6	4	2.16	3.3	Clay-Like	62			760	0.90	6.7	39.3	0.87	0.336	1.0	0.085	1.10	0.984	0.081	**N/L**
15.75	51.66	765	10	295.9	156.4	4	2.19	3.3	Clay-Like	62			765	0.89	6.8	39.3	0.87	0.335	1.0	0.085	1.10	0.984	0.081	**N/L**
16.05	52.64	795	11	301.6	159.1	4	2.25	3.3	Clay-Like	62			795	0.89	7.0	39.6	0.86	0.335	1.0	0.085	1.10	0.984	0.081	**N/L**
16.35	53.63	808	12	307.2	161.8	4	2.38	3.3	Clay-Like	62			808	0.88	7.1	39.8	0.86	0.334	1.0	0.085	1.10	0.984	0.081	**N/L**
16.65	54.61	819	11	312.9	164.5	4	2.20	3.3	Clay-Like	62			819	0.88	7.1	39.8	0.86	0.333	1.0	0.085	1.10	0.984	0.081	**N/L**
16.95	55.60	1685	10	318.5	167.2	11	0.74	2.7	Clay-Like	37			1685	0.88	14.6	49.6	0.85	0.332	1.0	0.092	1.11	0.983	0.087	**N/L**
17.25	56.58	974	9	324.2	169.9	5	1.44	3.1	Clay-Like	53			974	0.87	8.4	41.7	0.85	0.331	1.0	0.087	1.10	0.984	0.082	**N/L**
17.55	57.56	859	10	329.9	172.7	4	1.92	3.2	Clay-Like	58			859	0.87	7.4	40.3	0.85	0.330	1.0	0.086	1.10	0.984	0.081	**N/L**
17.85	58.55	1378	39	335.5	175.4	8	3.74	3.1	Clay-Like	53			1378	0.86	11.8	46.3	0.84	0.330	1.0	0.090	1.11	0.983	0.085	**N/L**
18.15	59.53	1720	71	341.2	178.1	10	5.18	3.1	Clay-Like	53			1720	0.86	14.7	50.1	0.84	0.329	1.0	0.092	1.11	0.983	0.087	**N/L**
18.45	60.52	1854	84	346.8	180.8	11	5.61	3.1	Clay-Like	53			1854	0.86	15.7	51.6	0.84	0.328	1.0	0.093	1.11	0.982	0.088	**N/L**
18.75	61.50	2120	96	352.5	183.5	13	5.41	3.1	Clay-Like	53			2120	0.85	17.9	54.5	0.83	0.327	1.0	0.096	1.12	0.982	0.090	**N/L**
19.05	62.48	3819	172	358.2	186.2	25	4.98	2.8	Clay-Like	41			3819	0.85	32.2	73.5	0.83	0.326	0.9	0.110	1.16	0.975	0.102	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-65**

Test Boring Information:

Approx. ground elevation		12 ft	3.66 m
Approx. water table elevation		3 ft	0.91 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	6343	59	2.7	2.7	383	0.93	1.5	Unsaturated	8			6343	1.70	106.8	111.3	1.00	0.204	1.1	0.154	1.33	0.949	0.161	**N/A**
0.45	1.48	6238	21	8.1	8.1	217	0.34	1.4	Unsaturated	7			6238	1.70	105.0	106.1	1.00	0.204	1.1	0.146	1.29	0.954	0.153	**N/A**
0.75	2.46	2829	20	13.6	13.6	76	0.70	1.9	Unsaturated	15			2829	1.70	47.6	74.5	1.00	0.204	1.1	0.111	1.16	0.975	0.119	**N/A**
1.05	3.44	2514	58	19.0	19.0	57	2.31	2.3	Unsaturated	24			2514	1.55	38.7	78.0	1.00	0.204	1.1	0.114	1.17	0.973	0.122	**N/A**
1.35	4.43	6050	107	24.4	24.4	121	1.78	2.0	Unsaturated	17			6050	1.45	87.1	128.8	1.00	0.204	1.1	0.194	1.46	0.929	0.198	**N/A**
1.65	5.41	7282	172	29.8	29.8	132	2.37	2.1	Unsaturated	19			7282	1.38	99.5	150.0	1.00	0.204	1.1	0.288	1.67	0.896	0.284	**N/A**
1.95	6.40	7677	191	35.3	35.3	128	2.49	2.1	Unsaturated	19			7677	1.32	100.3	151.1	1.00	0.203	1.1	0.296	1.68	0.894	0.291	**N/A**
2.25	7.38	959	32	40.7	40.7	14	3.50	2.9	Unsaturated	45			959	1.27	12.1	46.6	0.99	0.203	1.1	0.090	1.11	0.983	0.094	**N/A**
2.55	8.36	436	11	46.1	46.1	6	2.88	3.2	Unsaturated	58			436	1.23	5.3	37.5	0.99	0.203	1.0	0.084	1.10	0.985	0.086	**N/A**
2.85	9.35	316	7	51.6	50.6	4	2.70	3.3	Clay-Like	62			316	1.20	3.8	35.3	0.99	0.206	1.0	0.082	1.10	0.985	0.084	**N/L**
3.15	10.33	294	7	57.3	53.3	3	2.82	3.4	Clay-Like	67			294	1.18	3.4	34.8	0.99	0.217	1.0	0.082	1.10	0.985	0.084	**N/L**
3.45	11.32	344	6	62.9	56.0	4	1.99	3.3	Clay-Like	62			344	1.17	4.0	35.6	0.99	0.226	1.0	0.082	1.10	0.985	0.084	**N/L**
3.75	12.30	330	5	68.6	58.7	3	2.03	3.3	Clay-Like	62			330	1.15	3.8	35.3	0.98	0.235	1.0	0.082	1.10	0.985	0.084	**N/L**
4.05	13.28	332	6	74.2	61.4	3	2.22	3.3	Clay-Like	62			332	1.14	3.7	35.3	0.98	0.242	1.0	0.082	1.10	0.985	0.083	**N/L**
4.35	14.27	333	5	79.9	64.1	3	1.89	3.3	Clay-Like	62			333	1.13	3.7	35.2	0.98	0.249	1.0	0.082	1.10	0.985	0.083	**N/L**
4.65	15.25	310	4	85.6	66.9	3	1.85	3.4	Clay-Like	67			310	1.11	3.4	34.8	0.98	0.255	1.0	0.082	1.10	0.985	0.083	**N/L**
4.95	16.24	301	4	91.2	69.6	2	2.07	3.4	Clay-Like	67			301	1.10	3.3	34.6	0.98	0.261	1.0	0.082	1.10	0.985	0.082	**N/L**
5.25	17.22	298	4	96.9	72.3	2	1.97	3.4	Clay-Like	67			298	1.09	3.2	34.5	0.97	0.266	1.0	0.082	1.10	0.985	0.082	**N/L**
5.55	18.20	291	5	102.5	75.0	2	2.40	3.5	Clay-Like	73			291	1.08	3.1	34.3	0.97	0.271	1.0	0.082	1.10	0.985	0.082	**N/L**
5.85	19.19	315	4	108.2	77.7	2	2.10	3.5	Clay-Like	73			315	1.07	3.3	34.6	0.97	0.275	1.0	0.082	1.10	0.985	0.082	**N/L**
6.15	20.17	382	5	113.9	80.4	3	1.96	3.4	Clay-Like	67			382	1.06	4.0	35.6	0.97	0.279	1.0	0.082	1.10	0.985	0.082	**N/L**
6.45	21.16	385	5	119.5	83.2	3	1.82	3.4	Clay-Like	67			385	1.05	4.0	35.6	0.96	0.283	1.0	0.082	1.10	0.985	0.082	**N/L**
6.75	22.14	430	5	125.2	85.9	3	1.68	3.3	Clay-Like	62			430	1.04	4.4	36.2	0.96	0.286	1.0	0.083	1.10	0.985	0.082	**N/L**
7.05	23.12	431	5	130.8	88.6	3	1.53	3.3	Clay-Like	62			431	1.04	4.4	36.2	0.96	0.289	1.0	0.083	1.10	0.985	0.082	**N/L**
7.35	24.11	433	5	136.5	91.3	3	1.74	3.3	Clay-Like	62			433	1.03	4.4	36.2	0.96	0.292	1.0	0.083	1.10	0.985	0.082	**N/L**
7.65	25.09	440	5	142.2	94.0	3	1.68	3.3	Clay-Like	62			440	1.02	4.4	36.2	0.95	0.294	1.0	0.083	1.10	0.985	0.082	**N/L**
7.95	26.08	447	4	147.8	96.7	3	1.36	3.3	Clay-Like	62			447	1.01	4.5	36.3	0.95	0.296	1.0	0.083	1.10	0.985	0.082	**N/L**
8.25	27.06	450	4	153.5	99.5	3	1.31	3.3	Clay-Like	62			450	1.00	4.5	36.3	0.95	0.299	1.0	0.083	1.10	0.985	0.082	**N/L**
8.55	28.04	468	4	159.1	102.2	3	1.24	3.3	Clay-Like	62			468	1.00	4.6	36.5	0.95	0.300	1.0	0.083	1.10	0.985	0.082	**N/L**
8.85	29.03	484	3	164.8	104.9	3	1.07	3.2	Clay-Like	58			484	0.99	4.7	36.7	0.94	0.302	1.0	0.083	1.10	0.985	0.082	**N/L**
9.15	30.01	514	4	170.4	107.6	3	1.21	3.2	Clay-Like	58			514	0.98	5.0	37.0	0.94	0.304	1.0	0.083	1.10	0.985	0.082	**N/L**
9.45	31.00	513	4	176.1	110.3	3	1.12	3.2	Clay-Like	58			513	0.98	5.0	37.0	0.94	0.305	1.0	0.083	1.10	0.985	0.082	**N/L**
9.75	31.98	528	3	181.8	113.0	3	0.88	3.2	Clay-Like	58			528	0.97	5.1	37.1	0.93	0.306	1.0	0.083	1.10	0.985	0.082	**N/L**
10.05	32.96	538	3	187.4	115.8	3	0.85	3.2	Clay-Like	58			538	0.96	5.1	37.2	0.93	0.307	1.0	0.084	1.10	0.985	0.082	**N/L**
10.35	33.95	545	3	193.1	118.5	3	0.97	3.2	Clay-Like	58			545	0.96	5.2	37.3	0.93	0.308	1.0	0.084	1.10	0.985	0.081	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	565	3	198.7	121.2	3	0.85	3.2	Clay-Like	58			565	0.95	5.3	37.5	0.92	0.309	1.0	0.084	1.10	0.985	0.081	**N/L**
10.95	35.92	568	3	204.4	123.9	3	0.83	3.2	Clay-Like	58			568	0.95	5.3	37.5	0.92	0.310	1.0	0.084	1.10	0.985	0.081	**N/L**
11.25	36.90	583	3	210.1	126.6	3	0.90	3.2	Clay-Like	58			583	0.94	5.4	37.6	0.92	0.311	1.0	0.084	1.10	0.985	0.081	**N/L**
11.55	37.88	602	3	215.7	129.3	3	0.77	3.1	Clay-Like	53			602	0.94	5.6	37.9	0.91	0.311	1.0	0.084	1.10	0.985	0.081	**N/L**
11.85	38.87	613	3	221.4	132.1	3	0.88	3.2	Clay-Like	58			613	0.93	5.7	37.9	0.91	0.312	1.0	0.084	1.10	0.985	0.081	**N/L**
12.15	39.85	637	4	227.0	134.8	4	0.99	3.2	Clay-Like	58			637	0.93	5.8	38.2	0.91	0.312	1.0	0.084	1.10	0.985	0.081	**N/L**
12.45	40.84	665	4	232.7	137.5	4	0.99	3.2	Clay-Like	58			665	0.92	6.1	38.5	0.91	0.313	1.0	0.084	1.10	0.984	0.081	**N/L**
12.75	41.82	683	5	238.4	140.2	4	1.13	3.2	Clay-Like	58			683	0.92	6.2	38.7	0.90	0.313	1.0	0.084	1.10	0.984	0.081	**N/L**
13.05	42.80	685	5	244.0	142.9	4	1.14	3.2	Clay-Like	58			685	0.91	6.2	38.6	0.90	0.313	1.0	0.084	1.10	0.984	0.081	**N/L**
13.35	43.79	705	5	249.7	145.6	4	1.04	3.1	Clay-Like	53			705	0.91	6.3	38.9	0.90	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
13.65	44.77	718	5	255.3	148.3	4	1.16	3.2	Clay-Like	58			718	0.90	6.4	39.0	0.89	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
13.95	45.76	730	5	261.0	151.1	4	1.13	3.2	Clay-Like	58			730	0.90	6.5	39.1	0.89	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
14.25	46.74	749	5	266.7	153.8	4	1.08	3.1	Clay-Like	53			749	0.90	6.6	39.3	0.89	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
14.55	47.72	767	5	272.3	156.5	4	1.06	3.1	Clay-Like	53			767	0.89	6.8	39.5	0.88	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
14.85	48.71	788	6	278.0	159.2	4	1.12	3.1	Clay-Like	53			788	0.89	6.9	39.7	0.88	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
15.15	49.69	912	6	283.6	161.9	5	0.98	3.0	Clay-Like	49			912	0.88	8.0	41.1	0.88	0.313	1.0	0.086	1.10	0.984	0.082	**N/L**
15.45	50.68	2520	10	289.3	164.6	17	0.46	2.4		27			2520	0.88	21.9	57.3	0.87	0.313	1.0	0.098	1.12	0.981	0.092	**0.29**
15.75	51.66	9559	21	295.0	167.4	71	0.23	1.7		11			9559	0.88	82.8	100.5	0.87	0.312	0.9	0.138	1.26	0.959	0.125	**0.40**
16.05	52.64	9024	27	300.6	170.1	66	0.31	1.8		13			9024	0.87	77.9	103.2	0.86	0.312	0.9	0.142	1.28	0.957	0.128	**0.41**
16.35	53.63	7024	12	306.3	172.8	51	0.18	1.8		13			7024	0.87	60.4	83.0	0.86	0.312	1.0	0.119	1.19	0.971	0.109	**0.35**
16.65	54.61	1394	10	311.9	175.5	8	0.88	2.8	Clay-Like	41			1394	0.86	11.9	46.2	0.86	0.311	1.0	0.090	1.11	0.983	0.085	**N/L**
16.95	55.60	934	9	317.6	178.2	5	1.40	3.1	Clay-Like	53			934	0.86	8.0	41.1	0.85	0.311	1.0	0.086	1.10	0.984	0.082	**N/L**
17.25	56.58	960	8	323.2	180.9	5	1.27	3.1	Clay-Like	53			960	0.86	8.2	41.3	0.85	0.310	1.0	0.086	1.10	0.984	0.082	**N/L**
17.55	57.56	2260	9	328.9	183.7	14	0.46	2.5		30			2260	0.85	19.1	54.6	0.85	0.310	1.0	0.096	1.12	0.982	0.090	**0.29**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-66b**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		11 ft	3.35 m
Approx. water table elevation		4 ft	1.22 m
Approx. depth to ground water table		7 ft	2.13 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	3015	39	2.7	2.7	182	1.29	1.8	Unsaturated	13			3015	1.70	50.7	71.9	1.00	0.204	1.1	0.109	1.15	0.976	0.117	**N/A**
0.475	1.56	2752	74	8.6	8.6	93	2.68	2.2	Unsaturated	22			2752	1.70	46.3	85.6	1.00	0.204	1.1	0.121	1.20	0.969	0.129	**N/A**
0.775	2.54	5741	64	14.0	14.0	152	1.12	1.8	Unsaturated	13			5741	1.68	95.7	123.8	1.00	0.204	1.1	0.180	1.42	0.935	0.185	**N/A**
1.075	3.53	7271	5																					
1.375	4.51																							
1.675	5.49																							
1.975	6.48																							
2.275	7.46																							
2.575	8.45																							
2.875	9.43																							
3.175	10.41																							
3.475	11.40																							
3.775	12.38	414	15	69.5	53.4	5	4.40	3.4	Clay-Like	67			414	1.18	4.8	36.7	0.98	0.261	1.0	0.083	1.10	0.985	0.085	**N/L**
4.075	13.37	489	17	75.2	56.2	5	4.19	3.3	Clay-Like	62			489	1.17	5.7	37.9	0.98	0.268	1.0	0.084	1.10	0.985	0.086	**N/L**
4.375	14.35	523	17	80.9	58.9	6	3.91	3.3	Clay-Like	62			523	1.15	6.0	38.3	0.98	0.275	1.0	0.084	1.10	0.984	0.086	**N/L**
4.675	15.33	465	17	86.5	61.6	5	4.42	3.4	Clay-Like	67			465	1.14	5.2	37.2	0.98	0.280	1.0	0.084	1.10	0.985	0.085	**N/L**
4.975	16.32	491	16	92.2	64.3	5	4.13	3.3	Clay-Like	62			491	1.13	5.5	37.6	0.98	0.285	1.0	0.084	1.10	0.985	0.085	**N/L**
5.275	17.30	516	17	97.8	67.0	5	4.05	3.3	Clay-Like	62			516	1.11	5.7	37.9	0.97	0.290	1.0	0.084	1.10	0.985	0.085	**N/L**
5.575	18.29	528	17	103.5	69.7	5	3.94	3.3	Clay-Like	62			528	1.10	5.8	38.0	0.97	0.294	1.0	0.084	1.10	0.985	0.085	**N/L**
5.875	19.27	543	17	109.1	72.5	5	3.90	3.3	Clay-Like	62			543	1.09	5.9	38.1	0.97	0.298	1.0	0.084	1.10	0.985	0.085	**N/L**
6.175	20.25	551	17	114.8	75.2	5	3.99	3.3	Clay-Like	62			551	1.08	5.9	38.2	0.97	0.301	1.0	0.084	1.10	0.984	0.084	**N/L**
6.475	21.24	562	18	120.5	77.9	5	4.00	3.3	Clay-Like	62			562	1.07	6.0	38.3	0.96	0.304	1.0	0.084	1.10	0.984	0.084	**N/L**
6.775	22.22	576	17	126.1	80.6	5	3.82	3.3	Clay-Like	62			576	1.06	6.1	38.4	0.96	0.307	1.0	0.084	1.10	0.984	0.084	**N/L**
7.075	23.21	580	17	131.8	83.3	5	3.85	3.3	Clay-Like	62			580	1.05	6.0	38.4	0.96	0.309	1.0	0.084	1.10	0.984	0.084	**N/L**
7.375	24.19	584	18	137.4	86.0	5	3.94	3.3	Clay-Like	62			584	1.04	6.0	38.4	0.96	0.312	1.0	0.084	1.10	0.984	0.084	**N/L**
7.675	25.17	599	17	143.1	88.7	5	3.80	3.3	Clay-Like	62			599	1.03	6.1	38.5	0.95	0.314	1.0	0.084	1.10	0.984	0.084	**N/L**
7.975	26.16	604	17	148.8	91.5	5	3.78	3.3	Clay-Like	62			604	1.03	6.1	38.5	0.95	0.316	1.0	0.084	1.10	0.984	0.084	**N/L**
8.275	27.14	612	18	154.4	94.2	5	3.85	3.3	Clay-Like	62			612	1.02	6.2	38.6	0.95	0.317	1.0	0.084	1.10	0.984	0.083	**N/L**
8.575	28.13	608	17	160.1	96.9	5	3.82	3.3	Clay-Like	62			608	1.01	6.1	38.4	0.94	0.319	1.0	0.084	1.10	0.984	0.083	**N/L**
8.875	29.11	645	17	165.7	99.6	5	3.62	3.3	Clay-Like	62			645	1.00	6.4	38.9	0.94	0.320	1.0	0.085	1.10	0.984	0.083	**N/L**
9.175	30.09	661	17	171.4	102.3	5	3.53	3.3	Clay-Like	62			661	1.00	6.5	39.0	0.94	0.321	1.0	0.085	1.10	0.984	0.083	**N/L**
9.475	31.08	660	17	177.1	105.0	5	3.46	3.3	Clay-Like	62			660	0.99	6.5	39.0	0.94	0.322	1.0	0.085	1.10	0.984	0.083	**N/L**
9.775	32.06	684	17	182.7	107.8	5	3.38	3.3	Clay-Like	62			684	0.98	6.7	39.2	0.93	0.323	1.0	0.085	1.10	0.984	0.083	**N/L**
10.075	33.05	711	18	188.4	110.5	5	3.37	3.3	Clay-Like	62			711	0.98	6.9	39.5	0.93	0.324	1.0	0.085	1.10	0.984	0.083	**N/L**
10.375	34.03	693	16	194.0	113.2	5	3.28	3.3	Clay-Like	62			693	0.97	6.7	39.2	0.93	0.324	1.0	0.085	1.10	0.984	0.083	**N/L**
10.675	35.01	715	17	199.7	115.9	5	3.25	3.3	Clay-Like	62			715	0.96	6.8	39.4	0.92	0.325	1.0	0.085	1.10	0.984	0.083	**N/L**
10.975	36.00	731	17	205.4	118.6	5	3.23	3.3	Clay-Like	62			731	0.96	6.9	39.6	0.92	0.325	1.0	0.085	1.10	0.984	0.083	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	$q_{c1N\text{-}cs}$	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
11.275	36.98	747	17	211.0	121.3	5	3.15	3.3	Clay-Like	62			747	0.95	7.0	39.7	0.92	0.326	1.0	0.085	1.10	0.984	0.083	**N/L**
11.575	37.97	761	17	216.7	124.1	5	3.17	3.3	Clay-Like	62			761	0.95	7.1	39.9	0.91	0.326	1.0	0.085	1.10	0.984	0.083	**N/L**
11.875	38.95	759	17	222.3	126.8	5	3.25	3.3	Clay-Like	62			759	0.94	7.1	39.8	0.91	0.326	1.0	0.085	1.10	0.984	0.083	**N/L**
12.175	39.93	789	17	228.0	129.5	5	3.09	3.3	Clay-Like	62			789	0.94	7.3	40.1	0.91	0.326	1.0	0.085	1.10	0.984	0.083	**N/L**
12.475	40.92	802	18	233.7	132.2	5	3.10	3.3	Clay-Like	62			802	0.93	7.4	40.2	0.91	0.326	1.0	0.086	1.10	0.984	0.083	**N/L**
12.775	41.90	815	18	239.3	134.9	5	3.20	3.3	Clay-Like	62			815	0.93	7.5	40.3	0.90	0.326	1.0	0.086	1.10	0.984	0.083	**N/L**
13.075	42.89	823	18	245.0	137.6	5	3.13	3.3	Clay-Like	62			823	0.92	7.5	40.4	0.90	0.326	1.0	0.086	1.10	0.984	0.083	**N/L**
13.375	43.87	831	18	250.6	140.4	5	3.16	3.3	Clay-Like	62			831	0.92	7.5	40.4	0.90	0.326	1.0	0.086	1.10	0.984	0.083	**N/L**
13.675	44.85	837	17	256.3	143.1	5	2.99	3.3	Clay-Like	62			837	0.91	7.6	40.4	0.89	0.326	1.0	0.086	1.10	0.984	0.082	**N/L**
13.975	45.84	986	16	261.9	145.8	6	2.23	3.1	Clay-Like	53			986	0.91	8.9	42.3	0.89	0.326	1.0	0.087	1.10	0.984	0.083	**N/L**
14.275	46.82	1066	17	267.6	148.5	7	2.19	3.1	Clay-Like	53			1066	0.90	9.5	43.2	0.89	0.326	1.0	0.088	1.10	0.984	0.084	**N/L**
14.575	47.81	950	18	273.3	151.2	5	2.71	3.2	Clay-Like	58			950	0.90	8.5	41.7	0.88	0.325	1.0	0.087	1.10	0.984	0.083	**N/L**
14.875	48.79	921	19	278.9	153.9	5	2.98	3.2	Clay-Like	58			921	0.89	8.2	41.3	0.88	0.325	1.0	0.086	1.10	0.984	0.083	**N/L**
15.175	49.77	1086	18	284.6	156.7	6	2.30	3.1	Clay-Like	53			1086	0.89	9.6	43.3	0.87	0.324	1.0	0.088	1.10	0.984	0.084	**N/L**
15.475	50.76	6962	27	290.2	159.4	53	0.41	1.9		15			6962	0.89	61.1	90.7	0.87	0.324	1.0	0.126	1.22	0.966	0.117	**0.36**
15.775	51.74	5822	32	295.9	162.1	43	0.58	2.1		19			5822	0.88	50.9	88.2	0.87	0.323	1.0	0.124	1.21	0.968	0.114	**0.35**
16.075	52.73	1648	17	301.6	164.8	10	1.28	2.8	Clay-Like	41			1648	0.88	14.3	49.5	0.86	0.323	1.0	0.092	1.11	0.983	0.087	**N/L**
16.375	53.71	2654	23	307.2	167.5	18	0.96	2.5		30			2654	0.88	23.0	59.7	0.86	0.322	1.0	0.099	1.13	0.980	0.094	**0.29**
16.675	54.69	1489	20	312.9	170.2	9	1.67	2.9	Clay-Like	45			1489	0.87	12.8	47.6	0.86	0.322	1.0	0.091	1.11	0.983	0.086	**N/L**
16.975	55.68	2881	18	318.5	173.0	19	0.71	2.4		27			2881	0.87	24.8	61.1	0.85	0.321	1.0	0.100	1.13	0.980	0.094	**0.29**
17.275	56.66	2439	19	324.2	175.7	16	0.89	2.6	Clay-Like	34			2439	0.86	20.9	57.6	0.85	0.320	1.0	0.098	1.12	0.981	0.092	**N/L**
17.575	57.65	1109	19	329.9	178.4	6	2.43	3.1	Clay-Like	53			1109	0.86	9.5	43.1	0.85	0.320	1.0	0.087	1.10	0.984	0.083	**N/L**
17.875	58.63	1093	21	335.5	181.1	6	2.75	3.2	Clay-Like	58			1093	0.86	9.3	42.8	0.84	0.319	1.0	0.087	1.10	0.984	0.083	**N/L**
18.175	59.61	1107	22	341.2	183.8	6	2.82	3.2	Clay-Like	58			1107	0.85	9.4	42.9	0.84	0.318	1.0	0.087	1.10	0.984	0.083	**N/L**
18.475	60.60	1165	27	346.8	186.5	6	3.35	3.2	Clay-Like	58			1165	0.85	9.8	43.5	0.84	0.318	1.0	0.088	1.10	0.984	0.083	**N/L**
18.775	61.58	1178	26	352.5	189.2	6	3.18	3.2	Clay-Like	58			1178	0.85	9.9	43.6	0.83	0.317	1.0	0.088	1.10	0.984	0.083	**N/L**
19.075	62.57	1179	25	358.2	192.0	6	3.10	3.2	Clay-Like	58			1179	0.84	9.9	43.6	0.83	0.316	1.0	0.088	1.10	0.984	0.083	**N/L**
19.375	63.55	1208	28	363.8	194.7	6	3.27	3.2	Clay-Like	58			1208	0.84	10.1	43.9	0.83	0.315	1.0	0.088	1.10	0.984	0.083	**N/L**
19.675	64.53	1196	26	369.5	197.4	6	3.10	3.2	Clay-Like	58			1196	0.84	9.9	43.7	0.82	0.314	1.0	0.088	1.10	0.984	0.083	**N/L**
19.975	65.52	1272	25	375.1	200.1	6	2.84	3.2	Clay-Like	58			1272	0.83	10.5	44.5	0.82	0.313	1.0	0.088	1.11	0.984	0.083	**N/L**
20.275	66.50	1388	30	380.8	202.8	7	2.95	3.1	Clay-Like	53			1388	0.83	11.4	45.8	0.82	0.313	1.0	0.089	1.11	0.983	0.084	**N/L**
20.575	67.49	1428	34	386.4	205.5	7	3.27	3.1	Clay-Like	53			1428	0.83	11.7	46.1	0.81	0.312	1.0	0.090	1.11	0.983	0.084	**N/L**
20.875	68.47	1624	36	392.1	208.3	8	2.89	3.0	Clay-Like	49			1624	0.83	13.3	48.3	0.81	0.311	0.9	0.091	1.11	0.983	0.085	**N/L**
21.175	69.45	2721	66	397.8	211.0	16	2.85	2.8	Clay-Like	41			2721	0.82	22.2	60.1	0.81	0.310	0.9	0.100	1.13	0.980	0.092	**N/L**
21.475	70.44	2485	74	403.4	213.7	14	3.56	2.9	Clay-Like	45			2485	0.82	20.2	57.5	0.80	0.309	0.9	0.098	1.12	0.981	0.090	**N/L**
21.775	71.42	5185	67	409.1	216.4	32	1.40	2.4		27			5185	0.82	42.0	83.9	0.80	0.308	0.9	0.119	1.19	0.970	0.108	**0.35**
22.025	72.24	2520	30	413.8	218.7	14	1.43	2.7	Clay-Like	37			2520	0.82	20.4	57.3	0.80	0.307	0.9	0.098	1.12	0.981	0.090	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-67**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		7 ft	2.13 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7 ft	2.13 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	10741	90	2.7	2.7	648	0.84	1.3	Unsaturated	6			10741	1.70	180.8	181.0	1.00	0.204	1.1	0.755	2.11	0.828	0.687	**N/A**
0.45	1.48	4867	116	8.1	8.1	169	2.40	2.0	Unsaturated	17			4867	1.70	81.9	122.4	1.00	0.204	1.1	0.177	1.40	0.937	0.182	**N/A**
0.75	2.46	1856	75	13.6	13.6	50	4.06	2.5	Unsaturated	30			1856	1.70	31.2	70.7	1.00	0.204	1.1	0.108	1.15	0.977	0.116	**N/A**
1.05	3.44	1315	65	19.0	19.0	30	4.99	2.8	Unsaturated	41			1315	1.55	20.2	57.4	1.00	0.204	1.1	0.098	1.12	0.981	0.105	**N/A**
1.35	4.43	605	22	24.4	24.4	12	3.72	3.0	Unsaturated	49			605	1.45	8.7	42.1	1.00	0.204	1.1	0.087	1.10	0.984	0.093	**N/A**
1.65	5.41	441	9	29.8	29.8	7	2.19	3.0	Unsaturated	49			441	1.38	6.0	38.5	1.00	0.204	1.1	0.084	1.10	0.984	0.090	**N/A**
1.95	6.40																							
2.25	7.38																							
2.55	8.36																							
2.85	9.35																							
3.15	10.33																							
3.45	11.32	6877	16	63.4	50.5	95	0.23	1.6		10			6877	1.20	81.8	91.5	0.99	0.253	1.1	0.127	1.22	0.966	0.131	**0.52**
3.75	12.30	4656	25	69.1	53.2	62	0.56	1.9		15			4656	1.18	54.6	82.9	0.98	0.261	1.1	0.118	1.19	0.971	0.122	**0.47**
4.05	13.28	2941	12	74.7	55.9	38	0.43	2.1		19			2941	1.17	34.0	66.8	0.98	0.268	1.0	0.105	1.14	0.978	0.107	**0.40**
4.35	14.27	4894	16	80.4	58.6	62	0.34	1.8		13			4894	1.15	55.9	77.9	0.98	0.274	1.0	0.114	1.17	0.973	0.116	**0.42**
4.65	15.25	5551	4	86.0	61.4	69	0.10	1.6		10			5551	1.14	62.7	71.3	0.98	0.280	1.0	0.108	1.15	0.976	0.110	**0.39**
4.95	16.24	5501	4	91.7	64.1	67	0.10	1.7		11			5501	1.13	61.4	76.9	0.98	0.285	1.0	0.113	1.17	0.974	0.114	**0.40**
5.25	17.22	5988	22	97.4	66.8	72	0.37	1.8		13			5988	1.12	66.1	89.7	0.97	0.290	1.0	0.125	1.21	0.967	0.126	**0.43**
5.55	18.20	6490	20	103.0	69.5	76	0.32	1.7		11			6490	1.10	70.9	87.3	0.97	0.294	1.0	0.123	1.20	0.968	0.123	**0.42**
5.85	19.19	1983	25	108.7	72.2	22	1.34	2.5		30			1983	1.09	21.4	57.7	0.97	0.298	1.0	0.098	1.12	0.981	0.098	**0.33**
6.15	20.17	3323	20	114.3	74.9	37	0.61	2.2		22			3323	1.08	35.6	71.7	0.97	0.301	1.0	0.109	1.15	0.976	0.109	**0.36**
6.45	21.16	1894	28	120.0	77.7	20	1.58	2.6	Clay-Like	34			1894	1.07	20.1	56.5	0.96	0.304	1.0	0.097	1.12	0.981	0.097	**N/L**
6.75	22.14	1689	27	125.7	80.4	17	1.75	2.7	Clay-Like	37			1689	1.06	17.8	53.8	0.96	0.307	1.0	0.095	1.12	0.982	0.095	**N/L**
7.05	23.12	5420	19	131.3	83.1	58	0.37	1.9		15			5420	1.05	56.5	85.2	0.96	0.309	1.0	0.121	1.20	0.969	0.119	**0.39**
7.35	24.11	4036	32	137.0	85.8	42	0.83	2.2		22			4036	1.04	41.7	79.6	0.96	0.311	1.0	0.115	1.18	0.973	0.114	**0.37**
7.65	25.09	1577	23	142.6	88.5	15	1.62	2.7	Clay-Like	37			1577	1.04	16.2	51.7	0.95	0.314	1.0	0.093	1.11	0.982	0.093	**N/L**
7.95	26.08	1806	20	148.3	91.2	17	1.23	2.6	Clay-Like	34			1806	1.03	18.4	54.2	0.95	0.315	1.0	0.095	1.12	0.982	0.094	**N/L**
8.25	27.06	1535	20	154.0	94.0	14	1.48	2.7	Clay-Like	37			1535	1.02	15.5	50.8	0.95	0.317	1.0	0.093	1.11	0.982	0.092	**N/L**
8.55	28.04	894	11	159.6	96.7	7	1.51	3.0	Clay-Like	49			894	1.01	9.0	42.4	0.95	0.318	1.0	0.087	1.10	0.984	0.086	**N/L**
8.85	29.03	668	4	165.3	99.4	5	0.71	3.0	Clay-Like	49			668	1.00	6.6	39.3	0.94	0.320	1.0	0.085	1.10	0.984	0.084	**N/L**
9.15	30.01	655	1	170.9	102.1	5	0.23	2.9	Clay-Like	45			655	1.00	6.5	39.0	0.94	0.321	1.0	0.085	1.10	0.984	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-68**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		6 ft	1.83 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		6 ft	1.83 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	6723	42	2.7	2.7	405	0.63	1.3	Unsaturated	6			6723	1.70	113.2	113.3	1.00	0.204	1.1	0.158	1.34	0.947	0.164	**N/A**
0.45	1.48	9382	93	8.1	8.1	327	0.99	1.5	Unsaturated	8			9382	1.70	157.9	163.7	1.00	0.204	1.1	0.413	1.84	0.869	0.394	**N/A**
0.75	2.46	11806	53																					
1.05	3.44	1617	63	19.0	19.0	36	3.97	2.6	Unsaturated	34			1617	1.55	24.9	63.0	1.00	0.204	1.1	0.102	1.13	0.979	0.110	**N/A**
1.35	4.43	2300	52	24.4	24.4	46	2.26	2.4	Unsaturated	27			2300	1.45	33.1	72.2	1.00	0.204	1.1	0.109	1.15	0.976	0.117	**N/A**
1.65	5.41	1861	46	29.8	29.8	33	2.53	2.5	Unsaturated	30			1861	1.38	25.4	63.0	1.00	0.204	1.1	0.102	1.13	0.979	0.109	**N/A**
1.95	6.40	2060	90	35.3	34.2	34	4.43	2.7	Clay-Like	37			2060	1.33	27.1	66.5	1.00	0.210	1.1	0.104	1.14	0.978	0.111	**N/L**
2.25	7.38	1500	73	41.0	36.9	24	5.01	2.8	Clay-Like	41			1500	1.30	19.4	56.3	0.99	0.226	1.1	0.097	1.12	0.981	0.102	**N/L**
2.55	8.36	2262	69	46.7	39.6	35	3.13	2.6	Clay-Like	34			2262	1.28	28.7	68.1	0.99	0.239	1.1	0.106	1.14	0.978	0.111	**N/L**
2.85	9.35	3397	103	52.3	42.3	51	3.07	2.5		30			3397	1.26	42.3	85.6	0.99	0.250	1.1	0.121	1.20	0.969	0.127	**0.51**
3.15	10.33	1158	44	58.0	45.0	16	3.97	2.9	Clay-Like	45			1158	1.24	14.2	49.4	0.99	0.260	1.1	0.092	1.11	0.983	0.095	**N/L**
3.45	11.32	5177	21	63.6	47.7	74	0.41	1.8		13			5177	1.22	62.5	85.4	0.99	0.268	1.1	0.121	1.20	0.969	0.126	**0.47**
3.75	12.30	3945	4	69.3	50.5	54	0.10	1.8		13			3945	1.20	46.9	67.5	0.98	0.276	1.1	0.105	1.14	0.978	0.109	**0.39**
4.05	13.28	2809	8	75.0	53.2	37	0.28	2.0		17			2809	1.18	32.9	61.6	0.98	0.283	1.1	0.101	1.13	0.980	0.104	**0.37**
4.35	14.27	3018	8	80.6	55.9	39	0.27	2.0		17			3018	1.17	34.9	64.1	0.98	0.289	1.0	0.103	1.14	0.979	0.105	**0.36**
4.65	15.25	3218	6	86.3	58.6	41	0.19	1.9		15			3218	1.15	36.8	61.5	0.98	0.294	1.0	0.101	1.13	0.980	0.103	**0.35**
4.95	16.24	5193	11	91.9	61.3	65	0.22	1.8		13			5193	1.14	58.7	81.0	0.98	0.299	1.0	0.117	1.18	0.972	0.119	**0.40**
5.25	17.22	3555	13	97.6	64.0	43	0.39	2.0		17			3555	1.13	39.7	70.0	0.97	0.303	1.0	0.107	1.15	0.977	0.109	**0.36**
5.55	18.20	4650	7	103.3	66.8	55	0.16	1.8		13			4650	1.12	51.4	72.6	0.97	0.307	1.0	0.109	1.16	0.976	0.111	**0.36**
5.85	19.19	4070	8	108.9	69.5	47	0.21	1.9		15			4070	1.10	44.5	70.8	0.97	0.310	1.0	0.108	1.15	0.977	0.109	**0.35**
6.15	20.17	3932	6	114.6	72.2	45	0.16	1.9		15			3932	1.09	42.5	68.4	0.97	0.313	1.0	0.106	1.14	0.977	0.106	**0.34**
6.45	21.16	3411	2	120.2	74.9	38	0.10	1.9		15			3411	1.08	36.5	61.2	0.96	0.316	1.0	0.100	1.13	0.980	0.101	**0.32**
6.75	22.14	2995	3	125.9	77.6	32	0.10	2.0		17			2995	1.07	31.8	60.2	0.96	0.318	1.0	0.100	1.13	0.980	0.100	**0.31**
7.05	23.12	2665	14	131.6	80.3	28	0.57	2.2		22			2665	1.06	28.0	61.9	0.96	0.320	1.0	0.101	1.13	0.980	0.101	**0.31**
7.35	24.11	3644	13	137.2	83.1	38	0.38	2.0		17			3644	1.05	38.0	67.9	0.96	0.322	1.0	0.106	1.14	0.978	0.105	**0.33**
7.65	25.09	4343	19	142.9	85.8	45	0.46	2.0		17			4343	1.04	44.9	76.4	0.95	0.324	1.0	0.113	1.17	0.974	0.111	**0.34**
7.95	26.08	2172	23	148.5	88.5	21	1.15	2.5		30			2172	1.04	22.3	58.8	0.95	0.326	1.0	0.099	1.12	0.981	0.098	**0.30**
8.25	27.06	753	11	154.2	91.2	6	1.85	3.1	Clay-Like	53			753	1.03	7.7	40.7	0.95	0.327	1.0	0.086	1.10	0.984	0.085	**N/L**
8.55	28.04	484	1	159.8	93.9	3	0.43	3.1	Clay-Like	53			484	1.02	4.9	36.9	0.95	0.328	1.0	0.083	1.10	0.985	0.082	**N/L**
8.85	29.03	489	1	165.5	96.6	3	0.17	3.0	Clay-Like	49			489	1.01	4.9	36.9	0.94	0.329	1.0	0.083	1.10	0.985	0.082	**N/L**
9.15	30.01	486	2	171.2	99.4	3	0.50	3.1	Clay-Like	53			486	1.00	4.8	36.9	0.94	0.330	1.0	0.083	1.10	0.985	0.082	**N/L**
9.45	31.00	595	1	176.8	102.1	4	0.32	2.9	Clay-Like	45			595	1.00	5.9	38.2	0.94	0.331	1.0	0.084	1.10	0.984	0.083	**N/L**
9.75	31.98	1061	11	182.5	104.8	9	1.31	2.9	Clay-Like	45			1061	0.99	10.4	44.3	0.93	0.332	1.0	0.088	1.10	0.984	0.087	**N/L**
10.05	32.96	672	3	188.1	107.5	5	0.69	3.0	Clay-Like	49			672	0.98	6.5	39.2	0.93	0.332	1.0	0.085	1.10	0.984	0.083	**N/L**
10.35	33.95	592	2	193.8	110.2	4	0.56	3.1	Clay-Like	53			592	0.98	5.7	38.1	0.93	0.333	1.0	0.084	1.10	0.985	0.082	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	594	3	199.5	112.9	4	0.69	3.1	Clay-Like	53			594	0.97	5.7	38.0	0.92	0.333	1.0	0.084	1.10	0.985	0.082	**N/L**
10.95	35.92	640	2	205.1	115.6	4	0.53	3.0	Clay-Like	49			640	0.96	6.1	38.6	0.92	0.333	1.0	0.084	1.10	0.984	0.082	**N/L**
11.25	36.90	624	4	210.8	118.4	4	0.87	3.1	Clay-Like	53			624	0.96	5.9	38.3	0.92	0.334	1.0	0.084	1.10	0.984	0.082	**N/L**
11.55	37.88	634	4	216.4	121.1	4	1.01	3.1	Clay-Like	53			634	0.95	6.0	38.4	0.91	0.334	1.0	0.084	1.10	0.984	0.082	**N/L**
11.85	38.87	600	5	222.1	123.8	3	1.24	3.2	Clay-Like	58			600	0.95	5.6	37.9	0.91	0.334	1.0	0.084	1.10	0.985	0.082	**N/L**
12.15	39.85	618	6	227.8	126.5	3	1.47	3.2	Clay-Like	58			618	0.94	5.8	38.1	0.91	0.334	1.0	0.084	1.10	0.985	0.082	**N/L**
12.45	40.84	856	2	233.4	129.2	5	0.38	2.8	Clay-Like	41			856	0.94	7.9	40.9	0.91	0.334	1.0	0.086	1.10	0.984	0.083	**N/L**
12.75	41.82	886	3	239.1	131.9	6	0.41	2.8	Clay-Like	41			886	0.93	8.2	41.2	0.90	0.334	1.0	0.086	1.10	0.984	0.083	**N/L**
13.05	42.80	744	6	244.7	134.7	4	1.12	3.1	Clay-Like	53			744	0.93	6.8	39.5	0.90	0.333	1.0	0.085	1.10	0.984	0.082	**N/L**
13.35	43.79	709	5	250.4	137.4	4	1.03	3.1	Clay-Like	53			709	0.92	6.5	39.1	0.90	0.333	1.0	0.085	1.10	0.984	0.082	**N/L**
13.65	44.77	906	4	256.1	140.1	5	0.64	2.9	Clay-Like	45			906	0.92	8.2	41.4	0.89	0.333	1.0	0.086	1.10	0.984	0.083	**N/L**
13.95	45.76	798	6	261.7	142.8	4	1.04	3.1	Clay-Like	53			798	0.91	7.2	40.1	0.89	0.332	1.0	0.085	1.10	0.984	0.082	**N/L**
14.25	46.74	780	6	267.4	145.5	4	1.10	3.1	Clay-Like	53			780	0.91	7.0	39.8	0.89	0.332	1.0	0.085	1.10	0.984	0.082	**N/L**
14.55	47.72	765	6	273.0	148.2	4	1.20	3.1	Clay-Like	53			765	0.90	6.8	39.6	0.88	0.332	1.0	0.085	1.10	0.984	0.082	**N/L**
14.85	48.71	720	8	278.7	151.0	4	1.72	3.3	Clay-Like	62			720	0.90	6.4	38.9	0.88	0.331	1.0	0.085	1.10	0.984	0.081	**N/L**
15.15	49.69	753	7	284.4	153.7	4	1.43	3.2	Clay-Like	58			753	0.90	6.7	39.3	0.88	0.331	1.0	0.085	1.10	0.984	0.081	**N/L**
15.45	50.68	806	6	290.0	156.4	4	1.19	3.1	Clay-Like	53			806	0.89	7.1	39.9	0.87	0.330	1.0	0.085	1.10	0.984	0.082	**N/L**
15.75	51.66	828	7	295.7	159.1	4	1.26	3.1	Clay-Like	53			828	0.89	7.3	40.1	0.87	0.329	1.0	0.085	1.10	0.984	0.082	**N/L**
16.05	52.64	811	6	301.3	161.8	4	1.25	3.2	Clay-Like	58			811	0.88	7.1	39.9	0.86	0.329	1.0	0.085	1.10	0.984	0.081	**N/L**
16.35	53.63	829	7	307.0	164.5	4	1.35	3.2	Clay-Like	58			829	0.88	7.2	40.0	0.86	0.328	1.0	0.085	1.10	0.984	0.081	**N/L**
16.65	54.61	848	6	312.6	167.3	4	1.18	3.1	Clay-Like	53			848	0.88	7.4	40.2	0.86	0.327	1.0	0.086	1.10	0.984	0.081	**N/L**
16.95	55.60	879	6	318.3	170.0	4	1.05	3.1	Clay-Like	53			879	0.87	7.6	40.6	0.85	0.327	1.0	0.086	1.10	0.984	0.082	**N/L**
17.25	56.58	851	6	324.0	172.7	4	1.05	3.1	Clay-Like	53			851	0.87	7.3	40.2	0.85	0.326	1.0	0.086	1.10	0.984	0.081	**N/L**
17.55	57.56	892	6	329.6	175.4	4	1.04	3.1	Clay-Like	53			892	0.86	7.6	40.6	0.85	0.325	1.0	0.086	1.10	0.984	0.081	**N/L**
17.85	58.55	868	6	335.3	178.1	4	1.10	3.1	Clay-Like	53			868	0.86	7.4	40.3	0.84	0.324	1.0	0.086	1.10	0.984	0.081	**N/L**
18.15	59.53	876	6	340.9	180.8	4	1.14	3.1	Clay-Like	53			876	0.86	7.4	40.4	0.84	0.323	1.0	0.086	1.10	0.984	0.081	**N/L**
18.45	60.52	878	6	346.6	183.6	4	1.10	3.1	Clay-Like	53			878	0.85	7.4	40.3	0.84	0.323	1.0	0.086	1.10	0.984	0.081	**N/L**
18.75	61.50	1697	5	352.3	186.3	10	0.39	2.6	Clay-Like	34			1697	0.85	14.3	48.8	0.83	0.322	1.0	0.091	1.11	0.983	0.086	**N/L**
19.05	62.48	5139	23	357.9	189.0	35	0.48	2.1		19			5139	0.85	43.1	78.3	0.83	0.321	0.9	0.114	1.17	0.973	0.105	**0.33**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02CPT-69**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49																							
0.45	1.48																							
0.75	2.46																							
1.05	3.44																							
1.35	4.43																							
1.65	5.41																							
1.95	6.40																							
2.25	7.38																							
2.55	8.36																							
2.85	9.35	2425	28	51.6	50.6	33	1.19	2.3		24			2425	1.20	28.8	65.0	0.99	0.206	1.1	0.103	1.14	0.979	0.107	**0.52**
3.15	10.33	2560	57	57.3	53.3	34	2.28	2.5		30			2560	1.18	30.0	69.1	0.99	0.217	1.1	0.107	1.15	0.977	0.110	**0.51**
3.45	11.32	2089	30	62.9	56.0	27	1.47	2.5		30			2089	1.17	24.2	61.3	0.99	0.226	1.0	0.101	1.13	0.980	0.103	**0.46**
3.75	12.30	2538	31	68.6	58.7	32	1.26	2.4		27			2538	1.15	29.0	66.7	0.98	0.235	1.0	0.105	1.14	0.978	0.107	**0.46**
4.05	13.28	2228	34	74.2	61.4	27	1.56	2.5		30			2228	1.14	25.2	62.6	0.98	0.242	1.0	0.102	1.13	0.979	0.103	**0.43**
4.35	14.27	1937	36	79.9	64.1	23	1.93	2.6	Clay-Like	34			1937	1.13	21.6	58.6	0.98	0.249	1.0	0.098	1.12	0.981	0.100	**N/L**
4.65	15.25	1734	36	85.6	66.9	20	2.19	2.7	Clay-Like	37			1734	1.11	19.1	55.7	0.98	0.255	1.0	0.096	1.12	0.981	0.097	**N/L**
4.95	16.24	2406	51	91.2	69.6	28	2.22	2.6	Clay-Like	34			2406	1.10	26.3	64.8	0.98	0.261	1.0	0.103	1.14	0.979	0.104	**N/L**
5.25	17.22	2278	36	96.9	72.3	25	1.66	2.5		30			2278	1.09	24.6	61.9	0.97	0.266	1.0	0.101	1.13	0.980	0.102	**0.38**
5.55	18.20	2935	39	102.5	75.0	32	1.38	2.4		27			2935	1.08	31.4	70.0	0.97	0.271	1.0	0.107	1.15	0.977	0.107	**0.40**
5.85	19.19	2907	39	108.2	77.7	32	1.41	2.4		27			2907	1.07	30.8	69.2	0.97	0.275	1.0	0.107	1.15	0.977	0.106	**0.39**
6.15	20.17	2932	34	113.9	80.4	31	1.21	2.4		27			2932	1.06	30.8	69.1	0.97	0.279	1.0	0.107	1.15	0.977	0.106	**0.38**
6.45	21.16	3877	40	119.5	83.2	41	1.07	2.2		22			3877	1.05	40.4	77.9	0.96	0.283	1.0	0.114	1.17	0.973	0.113	**0.40**
6.75	22.14	3360	51	125.2	85.9	35	1.58	2.4		27			3360	1.04	34.7	74.3	0.96	0.286	1.0	0.111	1.16	0.975	0.110	**0.38**
7.05	23.12	4120	91	130.8	88.6	42	2.28	2.4		27			4120	1.04	42.2	84.3	0.96	0.289	1.0	0.120	1.19	0.970	0.118	**0.41**
7.35	24.11	3295	67	136.5	91.3	33	2.13	2.5		30			3295	1.03	33.5	73.8	0.96	0.292	1.0	0.110	1.16	0.975	0.109	**0.37**
7.65	25.09	3136	41	142.2	94.0	31	1.38	2.4		27			3136	1.02	31.6	70.2	0.95	0.294	1.0	0.107	1.15	0.977	0.106	**0.36**
7.95	26.08	4335	68	147.8	96.7	42	1.63	2.3		24			4335	1.01	43.4	84.2	0.95	0.296	1.0	0.120	1.19	0.970	0.117	**0.39**
8.25	27.06	3778	38	153.5	99.5	36	1.06	2.3		24			3778	1.00	37.6	76.5	0.95	0.299	1.0	0.113	1.17	0.974	0.110	**0.37**
8.55	28.04	4902	55	159.1	102.2	47	1.17	2.2		22			4902	1.00	48.4	88.3	0.95	0.300	1.0	0.124	1.21	0.968	0.120	**0.40**
8.85	29.03	6966	63	164.8	104.9	66	0.92	2.0		17			6966	0.99	68.3	105.5	0.94	0.302	1.0	0.145	1.29	0.955	0.138	**0.46**
9.15	30.01	3371	74	170.4	107.6	31	2.32	2.5		30			3371	0.98	32.8	72.9	0.94	0.304	1.0	0.110	1.16	0.976	0.106	**0.35**
9.45	31.00	3299	61	176.1	110.3	30	1.94	2.5		30			3299	0.98	31.9	71.7	0.94	0.305	1.0	0.109	1.15	0.976	0.105	**0.34**
9.75	31.98	3685	79	181.8	113.0	33	2.26	2.5		30			3685	0.97	35.4	76.3	0.93	0.306	1.0	0.113	1.17	0.974	0.109	**0.35**
10.05	32.96	3489	89	187.4	115.8	30	2.70	2.6	Clay-Like	34			3489	0.96	33.3	74.3	0.93	0.307	1.0	0.111	1.16	0.975	0.107	**N/L**
10.35	33.95	3530	77	193.1	118.5	30	2.30	2.5		30			3530	0.96	33.5	73.8	0.93	0.308	1.0	0.110	1.16	0.975	0.106	**0.34**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	3939	96	198.7	121.2	34	2.55	2.5		30			3939	0.95	37.2	78.7	0.92	0.309	1.0	0.115	1.17	0.973	0.110	**0.35**
10.95	35.92	5548	121	204.4	123.9	48	2.26	2.4		27			5548	0.95	52.1	97.3	0.92	0.310	1.0	0.134	1.25	0.961	0.126	**0.41**
11.25	36.90	5836	176	210.1	126.6	50	3.12	2.5		30			5836	0.94	54.4	101.8	0.92	0.311	1.0	0.140	1.27	0.958	0.130	**0.42**
11.55	37.88	3930	111	215.7	129.3	32	2.98	2.6	Clay-Like	34			3930	0.94	36.5	78.5	0.91	0.311	1.0	0.114	1.17	0.973	0.109	**N/L**
11.85	38.87	2033	79	221.4	132.1	16	4.36	2.9	Clay-Like	45			2033	0.93	18.8	55.6	0.91	0.312	1.0	0.096	1.12	0.981	0.093	**N/L**
12.15	39.85	2287	44	227.0	134.8	18	2.15	2.7	Clay-Like	37			2287	0.93	21.0	58.2	0.91	0.312	1.0	0.098	1.12	0.981	0.094	**N/L**
12.45	40.84	4006	33	232.7	137.5	32	0.86	2.3		24			4006	0.92	36.6	75.2	0.91	0.313	1.0	0.112	1.16	0.975	0.106	**0.34**
12.75	41.82	6852	59	238.4	140.2	55	0.89	2.1		19			6852	0.92	62.2	102.6	0.90	0.313	1.0	0.141	1.28	0.957	0.130	**0.42**
13.05	42.80	7543	48	244.0	142.9	61	0.66	2.0		17			7543	0.91	68.1	105.3	0.90	0.313	1.0	0.145	1.29	0.955	0.133	**0.42**
13.35	43.79	3262	69	249.7	145.6	25	2.28	2.6	Clay-Like	34			3262	0.91	29.3	68.9	0.90	0.313	1.0	0.106	1.15	0.977	0.101	**N/L**
13.65	44.77	3779	26	255.3	148.3	29	0.74	2.3		24			3779	0.90	33.8	71.5	0.89	0.313	1.0	0.109	1.15	0.976	0.102	**0.33**
13.95	45.76	5494	19	261.0	151.1	42	0.36	2.0		17			5494	0.90	48.9	81.4	0.89	0.313	1.0	0.117	1.18	0.972	0.110	**0.35**
14.25	46.74	3916	44	266.7	153.8	29	1.21	2.4		27			3916	0.90	34.7	74.3	0.89	0.313	1.0	0.111	1.16	0.975	0.104	**0.33**
14.55	47.72	4171	36	272.3	156.5	31	0.93	2.3		24			4171	0.89	36.8	75.5	0.88	0.313	1.0	0.112	1.16	0.975	0.105	**0.33**
14.85	48.71	1407	22	278.0	159.2	9	1.99	2.9	Clay-Like	45			1407	0.89	12.4	46.9	0.88	0.313	1.0	0.090	1.11	0.983	0.086	**N/L**
15.15	49.69	1342	14	283.6	161.9	8	1.33	2.9	Clay-Like	45			1342	0.88	11.7	46.1	0.88	0.313	1.0	0.090	1.11	0.983	0.085	**N/L**
15.45	50.68	1376	14	289.3	164.6	8	1.32	2.9	Clay-Like	45			1376	0.88	12.0	46.4	0.87	0.313	1.0	0.090	1.11	0.983	0.085	**N/L**
15.75	51.66	1213	13	295.0	167.4	7	1.38	3.0	Clay-Like	49			1213	0.88	10.5	44.5	0.87	0.312	1.0	0.088	1.11	0.984	0.084	**N/L**
16.05	52.64	1224	13	300.6	170.1	7	1.42	3.0	Clay-Like	49			1224	0.87	10.6	44.6	0.86	0.312	1.0	0.089	1.11	0.984	0.084	**N/L**
16.35	53.63	1212	13	306.3	172.8	7	1.41	3.0	Clay-Like	49			1212	0.87	10.4	44.4	0.86	0.312	1.0	0.088	1.10	0.984	0.084	**N/L**
16.65	54.61	1237	12	311.9	175.5	7	1.32	3.0	Clay-Like	49			1237	0.86	10.6	44.6	0.86	0.311	1.0	0.089	1.11	0.984	0.084	**N/L**
16.95	55.60	1266	12	317.6	178.2	7	1.26	2.9	Clay-Like	45			1266	0.86	10.8	44.8	0.85	0.311	1.0	0.089	1.11	0.984	0.084	**N/L**
17.25	56.58	1256	12	323.2	180.9	7	1.25	2.9	Clay-Like	45			1256	0.86	10.7	44.7	0.85	0.310	1.0	0.089	1.11	0.984	0.084	**N/L**
17.55	57.56	1252	11	328.9	183.7	7	1.21	2.9	Clay-Like	45			1252	0.85	10.6	44.6	0.85	0.310	1.0	0.089	1.11	0.984	0.084	**N/L**
17.85	58.55	1291	12	334.6	186.4	7	1.30	2.9	Clay-Like	45			1291	0.85	10.9	44.9	0.84	0.309	1.0	0.089	1.11	0.984	0.084	**N/L**
18.15	59.53	1222	12	340.2	189.1	6	1.31	3.0	Clay-Like	49			1222	0.85	10.3	44.2	0.84	0.309	1.0	0.088	1.10	0.984	0.083	**N/L**
18.45	60.52	1196	11	345.9	191.8	6	1.34	3.0	Clay-Like	49			1196	0.84	10.0	43.8	0.84	0.308	1.0	0.088	1.10	0.984	0.083	**N/L**
18.75	61.50	1223	13	351.5	194.5	6	1.45	3.0	Clay-Like	49			1223	0.84	10.2	44.1	0.83	0.307	1.0	0.088	1.10	0.984	0.083	**N/L**
19.05	62.48	1243	8	357.2	197.2	6	0.91	2.9	Clay-Like	45			1243	0.84	10.3	44.2	0.83	0.307	1.0	0.088	1.10	0.984	0.083	**N/L**
19.35	63.47	3506	24	362.9	200.0	22	0.75	2.4		27			3506	0.84	29.0	66.7	0.83	0.306	0.9	0.105	1.14	0.978	0.097	**0.32**
19.65	64.45	4519	57	368.5	202.7	29	1.36	2.4		27			4519	0.83	37.2	77.6	0.82	0.305	0.9	0.114	1.17	0.973	0.104	**0.34**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR03CPT-70**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0.5 ft	0.15 m
Approx. depth to ground water table		8.5 ft	2.59 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49																							
0.45	1.48																							
0.75	2.46																							
1.05	3.44																							
1.35	4.43																							
1.65	5.41																							
1.95	6.40																							
2.25	7.38																							
2.55	8.36																							
2.85	9.35																							
3.15	10.33																							
3.45	11.32																							
3.75	12.30																							
4.05	13.28																							
4.35	14.27																							
4.65	15.25																							
4.95	16.24																							
5.25	17.22																							
5.55	18.20																							
5.85	19.19																							
6.15	20.17																							
6.45	21.16																							
6.75	22.14																							
7.05	23.12	95	1	131.0	87.2	1	0.10	3.5	Clay-Like	73			95	1.08	1.0	31.4	0.96	0.294	1.0	0.080	1.10	0.985	0.079	**N/L**
7.35	24.11	546	7	136.6	89.9	4	1.74	3.2	Clay-Like	58			546	1.03	5.6	37.8	0.96	0.296	1.0	0.084	1.10	0.985	0.083	**N/L**
7.65	25.09	702	10	142.3	92.6	6	1.77	3.1	Clay-Like	53			702	1.02	7.1	39.9	0.95	0.299	1.0	0.085	1.10	0.984	0.084	**N/L**
7.95	26.08	690	11	147.9	95.4	6	1.94	3.1	Clay-Like	53			690	1.02	6.9	39.7	0.95	0.301	1.0	0.085	1.10	0.984	0.084	**N/L**
8.25	27.06	704	11	153.6	98.1	6	1.95	3.1	Clay-Like	53			704	1.01	7.0	39.8	0.95	0.303	1.0	0.085	1.10	0.984	0.084	**N/L**
8.55	28.04	709	11	159.3	100.8	5	1.94	3.1	Clay-Like	53			709	1.00	7.0	39.8	0.95	0.305	1.0	0.085	1.10	0.984	0.084	**N/L**
8.85	29.03	712	10	164.9	103.5	5	1.86	3.1	Clay-Like	53			712	0.99	7.0	39.8	0.94	0.306	1.0	0.085	1.10	0.984	0.084	**N/L**
9.15	30.01	710	10	170.6	106.2	5	1.82	3.1	Clay-Like	53			710	0.99	6.9	39.7	0.94	0.308	1.0	0.085	1.10	0.984	0.084	**N/L**
9.45	31.00	730	10	176.2	108.9	5	1.75	3.1	Clay-Like	53			730	0.98	7.1	39.9	0.94	0.309	1.0	0.085	1.10	0.984	0.084	**N/L**
9.75	31.98	765	9	181.9	111.7	5	1.59	3.1	Clay-Like	53			765	0.97	7.4	40.3	0.93	0.310	1.0	0.086	1.10	0.984	0.084	**N/L**
10.05	32.96	787	10	187.5	114.4	6	1.59	3.1	Clay-Like	53			787	0.97	7.5	40.5	0.93	0.311	1.0	0.086	1.10	0.984	0.084	**N/L**
10.35	33.95	763	9	193.2	117.1	5	1.49	3.1	Clay-Like	53			763	0.96	7.3	40.1	0.93	0.312	1.0	0.085	1.10	0.984	0.083	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	761	7	198.9	119.8	5	1.22	3.1	Clay-Like	53			761	0.96	7.2	40.0	0.92	0.313	1.0	0.085	1.10	0.984	0.083	**N/L**
10.95	35.92	721	6	204.5	122.5	5	1.14	3.1	Clay-Like	53			721	0.95	6.8	39.5	0.92	0.314	1.0	0.085	1.10	0.984	0.083	**N/L**
11.25	36.90	737	5	210.2	125.2	5	1.02	3.1	Clay-Like	53			737	0.94	6.9	39.6	0.92	0.314	1.0	0.085	1.10	0.984	0.083	**N/L**
11.55	37.88	732	3	215.8	128.0	5	0.62	3.0	Clay-Like	49			732	0.94	6.8	39.5	0.91	0.315	1.0	0.085	1.10	0.984	0.082	**N/L**
11.85	38.87	816	3	221.5	130.7	5	0.44	2.9	Clay-Like	45			816	0.93	7.5	40.5	0.91	0.315	1.0	0.086	1.10	0.984	0.083	**N/L**
12.15	39.85	798	2	227.2	133.4	5	0.34	2.9	Clay-Like	45			798	0.93	7.3	40.2	0.91	0.316	1.0	0.086	1.10	0.984	0.083	**N/L**
12.45	40.84	813	1	232.8	136.1	5	0.23	2.8	Clay-Like	41			813	0.92	7.4	40.2	0.91	0.316	1.0	0.086	1.10	0.984	0.083	**N/L**
12.75	41.82	909	3	238.5	138.8	6	0.39	2.8	Clay-Like	41			909	0.92	8.3	41.3	0.90	0.316	1.0	0.086	1.10	0.984	0.083	**N/L**
13.05	42.80	883	2	244.1	141.5	5	0.24	2.8	Clay-Like	41			883	0.91	8.0	40.9	0.90	0.316	1.0	0.086	1.10	0.984	0.083	**N/L**
13.35	43.79	815	2	249.8	144.3	5	0.29	2.9	Clay-Like	45			815	0.91	7.3	40.2	0.90	0.316	1.0	0.086	1.10	0.984	0.082	**N/L**
13.65	44.77	767	3	255.5	147.0	4	0.66	3.0	Clay-Like	49			767	0.91	6.9	39.6	0.89	0.316	1.0	0.085	1.10	0.984	0.082	**N/L**
13.95	45.76	832	3	261.1	149.7	5	0.61	3.0	Clay-Like	49			832	0.90	7.4	40.3	0.89	0.316	1.0	0.086	1.10	0.984	0.082	**N/L**
14.25	46.74	834	5	266.8	152.4	5	0.91	3.0	Clay-Like	49			834	0.90	7.4	40.3	0.89	0.316	1.0	0.086	1.10	0.984	0.082	**N/L**
14.55	47.72	839	7	272.4	155.1	5	1.32	3.1	Clay-Like	53			839	0.89	7.4	40.3	0.88	0.316	1.0	0.086	1.10	0.984	0.082	**N/L**
14.85	48.71	813	8	278.1	157.8	4	1.51	3.2	Clay-Like	58			813	0.89	7.2	39.9	0.88	0.316	1.0	0.085	1.10	0.984	0.082	**N/L**
15.15	49.69	805	7	283.8	160.6	4	1.35	3.2	Clay-Like	58			805	0.88	7.1	39.8	0.88	0.316	1.0	0.085	1.10	0.984	0.081	**N/L**
15.45	50.68	797	8	289.4	163.3	4	1.58	3.2	Clay-Like	58			797	0.88	7.0	39.7	0.87	0.315	1.0	0.085	1.10	0.984	0.081	**N/L**
15.75	51.66	805	10	295.1	166.0	4	1.90	3.2	Clay-Like	58			805	0.88	7.0	39.7	0.87	0.315	1.0	0.085	1.10	0.984	0.081	**N/L**
16.05	52.64	848	10	300.7	168.7	4	1.87	3.2	Clay-Like	58			848	0.87	7.3	40.2	0.86	0.315	1.0	0.086	1.10	0.984	0.081	**N/L**
16.35	53.63	850	10	306.4	171.4	4	1.88	3.2	Clay-Like	58			850	0.87	7.3	40.2	0.86	0.314	1.0	0.086	1.10	0.984	0.081	**N/L**
16.65	54.61	873	11	312.0	174.1	4	2.04	3.2	Clay-Like	58			873	0.87	7.5	40.4	0.86	0.314	1.0	0.086	1.10	0.984	0.081	**N/L**
16.95	55.60	858	12	317.7	176.9	4	2.23	3.3	Clay-Like	62			858	0.86	7.3	40.1	0.85	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
17.25	56.58	842	13	323.4	179.6	4	2.51	3.3	Clay-Like	62			842	0.86	7.2	39.9	0.85	0.313	1.0	0.085	1.10	0.984	0.081	**N/L**
17.55	57.56	875	13	329.0	182.3	4	2.41	3.3	Clay-Like	62			875	0.86	7.4	40.2	0.85	0.312	1.0	0.086	1.10	0.984	0.081	**N/L**
17.85	58.55	1586	15	334.7	185.0	9	1.21	2.8	Clay-Like	41			1586	0.85	13.4	48.2	0.84	0.312	1.0	0.091	1.11	0.983	0.086	**N/L**
18.15	59.53	2121	35	340.3	187.7	13	1.95	2.8	Clay-Like	41			2121	0.85	17.8	54.2	0.84	0.311	1.0	0.095	1.12	0.982	0.089	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR03CPT-71**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		1 ft	0.30 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		1 ft	0.30 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	1853	3	2.7	2.7	112	0.16	1.5	Unsaturated	8			1853	1.70	31.2	34.0	1.00	0.204	1.1	0.081	1.10	0.985	0.088	**N/A**
0.45	1.48	3124	6	8.2	6.8	118	0.18	1.5		8			3124	1.70	52.6	55.9	1.00	0.247	1.1	0.096	1.12	0.981	0.104	**0.42**
0.75	2.46	3986	9	13.9	9.5	128	0.23	1.5		8			3986	1.70	67.1	70.7	1.00	0.298	1.1	0.108	1.15	0.977	0.116	**0.39**
1.05	3.44	3950	11	19.6	12.3	112	0.28	1.6		10			3950	1.70	66.5	75.4	1.00	0.326	1.1	0.112	1.16	0.975	0.120	**0.37**
1.35	4.43	2673	5	25.2	15.0	68	0.19	1.7		11			2673	1.65	43.8	57.4	1.00	0.344	1.1	0.098	1.12	0.981	0.105	**0.31**
1.65	5.41	2195	9	30.9	17.7	51	0.41	2.0		17			2195	1.58	34.4	63.4	1.00	0.355	1.1	0.102	1.13	0.979	0.110	**0.31**
1.95	6.40	525	4	36.5	20.4	11	0.76	2.7	Clay-Like	37			525	1.52	7.9	40.6	1.00	0.364	1.1	0.086	1.10	0.984	0.093	**N/L**
2.25	7.38	576	0	42.2	23.1	11	0.10	2.4		27			576	1.48	8.4	39.4	0.99	0.370	1.1	0.085	1.10	0.984	0.092	**0.25**
2.55	8.36	1125	3	47.9	25.8	21	0.24	2.2		22			1125	1.43	16.0	46.3	0.99	0.375	1.1	0.090	1.11	0.983	0.096	**0.26**
2.85	9.35	491	2	53.5	28.6	8	0.47	2.7	Clay-Like	37			491	1.40	6.8	39.1	0.99	0.379	1.1	0.085	1.10	0.984	0.090	**N/L**
3.15	10.33	456	2	59.2	31.3	7	0.57	2.8	Clay-Like	41			456	1.36	6.1	38.4	0.99	0.382	1.1	0.084	1.10	0.984	0.089	**N/L**
3.45	11.32	542	3	64.8	34.0	8	0.55	2.7	Clay-Like	37			542	1.33	7.2	39.6	0.99	0.384	1.1	0.085	1.10	0.984	0.090	**N/L**
3.75	12.30	468	3	70.5	36.7	7	0.65	2.9	Clay-Like	45			468	1.31	6.1	38.4	0.98	0.386	1.1	0.084	1.10	0.984	0.088	**N/L**
4.05	13.28	420	2	76.2	39.4	5	0.68	2.9	Clay-Like	45			420	1.28	5.3	37.5	0.98	0.387	1.1	0.084	1.10	0.985	0.087	**N/L**
4.35	14.27	341	2	81.8	42.1	4	0.77	3.1	Clay-Like	53			341	1.26	4.3	36.1	0.98	0.388	1.1	0.083	1.10	0.985	0.086	**N/L**
4.65	15.25	520	2	87.5	44.9	6	0.44	2.8	Clay-Like	41			520	1.24	6.4	38.7	0.98	0.389	1.1	0.085	1.10	0.984	0.088	**N/L**
4.95	16.24	462	2	93.1	47.6	5	0.48	2.9	Clay-Like	45			462	1.22	5.6	37.8	0.98	0.390	1.0	0.084	1.10	0.985	0.087	**N/L**
5.25	17.22	552	2	98.8	50.3	6	0.39	2.8	Clay-Like	41			552	1.20	6.6	39.0	0.97	0.390	1.0	0.085	1.10	0.984	0.087	**N/L**
5.55	18.20	568	2	104.5	53.0	6	0.53	2.8	Clay-Like	41			568	1.19	6.7	39.1	0.97	0.391	1.0	0.085	1.10	0.984	0.087	**N/L**
5.85	19.19	639	2	110.1	55.7	7	0.45	2.8	Clay-Like	41			639	1.17	7.4	40.1	0.97	0.391	1.0	0.085	1.10	0.984	0.087	**N/L**
6.15	20.17	650	2	115.8	58.4	7	0.44	2.8	Clay-Like	41			650	1.16	7.4	40.2	0.97	0.391	1.0	0.086	1.10	0.984	0.087	**N/L**
6.45	21.16	623	3	121.4	61.1	6	0.62	2.9	Clay-Like	45			623	1.14	7.0	39.8	0.96	0.391	1.0	0.085	1.10	0.984	0.087	**N/L**
6.75	22.14	634	3	127.1	63.9	6	0.60	2.9	Clay-Like	45			634	1.13	7.1	39.8	0.96	0.390	1.0	0.085	1.10	0.984	0.086	**N/L**
7.05	23.12	629	3	132.8	66.6	6	0.66	2.9	Clay-Like	45			629	1.12	7.0	39.7	0.96	0.390	1.0	0.085	1.10	0.984	0.086	**N/L**
7.35	24.11	526	3	138.4	69.3	5	0.83	3.0	Clay-Like	49			526	1.10	5.8	38.1	0.96	0.390	1.0	0.084	1.10	0.985	0.085	**N/L**
7.65	25.09	682	3	144.1	72.0	6	0.63	2.9	Clay-Like	45			682	1.09	7.4	40.2	0.95	0.389	1.0	0.086	1.10	0.984	0.086	**N/L**
7.95	26.08	718	3	149.7	74.7	7	0.56	2.8	Clay-Like	41			718	1.08	7.7	40.5	0.95	0.389	1.0	0.086	1.10	0.984	0.086	**N/L**
8.25	27.06	718	3	155.4	77.4	6	0.62	2.9	Clay-Like	45			718	1.07	7.6	40.6	0.95	0.388	1.0	0.086	1.10	0.984	0.086	**N/L**
8.55	28.04	922	3	161.0	80.2	8	0.34	2.7	Clay-Like	37			922	1.06	9.7	43.0	0.95	0.388	1.0	0.087	1.10	0.984	0.087	**N/L**
8.85	29.03	912	3	166.7	82.9	8	0.42	2.7	Clay-Like	37			912	1.05	9.5	42.7	0.94	0.387	1.0	0.087	1.10	0.984	0.087	**N/L**
9.15	30.01	901	3	172.4	85.6	8	0.37	2.7	Clay-Like	37			901	1.04	9.3	42.5	0.94	0.386	1.0	0.087	1.10	0.984	0.087	**N/L**
9.45	31.00	908	2	178.0	88.3	8	0.31	2.7	Clay-Like	37			908	1.04	9.3	42.5	0.94	0.385	1.0	0.087	1.10	0.984	0.086	**N/L**
9.75	31.98	960	2	183.7	91.0	8	0.20	2.6	Clay-Like	34			960	1.03	9.8	42.7	0.93	0.384	1.0	0.087	1.10	0.984	0.086	**N/L**
10.05	32.96	952	3	189.3	93.7	8	0.35	2.7	Clay-Like	37			952	1.02	9.6	42.9	0.93	0.384	1.0	0.087	1.10	0.984	0.086	**N/L**
10.35	33.95	902	2	195.0	96.5	7	0.32	2.7	Clay-Like	37			902	1.01	9.0	42.1	0.93	0.383	1.0	0.087	1.10	0.984	0.086	**N/L**

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
10.65	34.93	858	4	200.7	99.2	7	0.66	2.9	Clay-Like	45			858	1.00	8.5	41.8	0.92	0.382	1.0	0.087	1.10	0.984	0.085	**N/L**
10.95	35.92	905	4	206.3	101.9	7	0.63	2.8	Clay-Like	41			905	1.00	8.9	42.2	0.92	0.381	1.0	0.087	1.10	0.984	0.085	**N/L**
11.25	36.90	873	5	212.0	104.6	6	0.70	2.9	Clay-Like	45			873	0.99	8.6	41.8	0.92	0.380	1.0	0.087	1.10	0.984	0.085	**N/L**
11.55	37.88	872	5	217.6	107.3	6	0.74	2.9	Clay-Like	45			872	0.98	8.5	41.7	0.91	0.379	1.0	0.087	1.10	0.984	0.085	**N/L**
11.85	38.87	907	5	223.3	110.0	6	0.70	2.9	Clay-Like	45			907	0.98	8.8	42.1	0.91	0.378	1.0	0.087	1.10	0.984	0.085	**N/L**
12.15	39.85	906	5	229.0	112.8	6	0.71	2.9	Clay-Like	45			906	0.97	8.7	42.0	0.91	0.377	1.0	0.087	1.10	0.984	0.085	**N/L**
12.45	40.84	927	5	234.6	115.5	6	0.69	2.9	Clay-Like	45			927	0.97	8.9	42.2	0.91	0.375	1.0	0.087	1.10	0.984	0.085	**N/L**
12.75	41.82	894	5	240.3	118.2	6	0.72	2.9	Clay-Like	45			894	0.96	8.5	41.7	0.90	0.374	1.0	0.087	1.10	0.984	0.084	**N/L**
13.05	42.80	919	5	245.9	120.9	6	0.76	2.9	Clay-Like	45			919	0.95	8.7	42.0	0.90	0.373	1.0	0.087	1.10	0.984	0.084	**N/L**
13.35	43.79	912	5	251.6	123.6	6	0.72	2.9	Clay-Like	45			912	0.95	8.6	41.8	0.90	0.372	1.0	0.087	1.10	0.984	0.084	**N/L**
13.65	44.77	953	5	257.3	126.3	6	0.74	2.9	Clay-Like	45			953	0.94	8.9	42.3	0.89	0.371	1.0	0.087	1.10	0.984	0.084	**N/L**
13.95	45.76	948	5	262.9	129.1	6	0.78	2.9	Clay-Like	45			948	0.94	8.8	42.1	0.89	0.370	1.0	0.087	1.10	0.984	0.084	**N/L**
14.25	46.74	950	5	268.6	131.8	6	0.75	2.9	Clay-Like	45			950	0.93	8.8	42.1	0.89	0.368	1.0	0.087	1.10	0.984	0.084	**N/L**
14.55	47.72	965	5	274.2	134.5	6	0.75	2.9	Clay-Like	45			965	0.93	8.9	42.2	0.88	0.367	1.0	0.087	1.10	0.984	0.084	**N/L**
14.85	48.71	1014	5	279.9	137.2	6	0.74	2.9	Clay-Like	45			1014	0.92	9.3	42.8	0.88	0.366	1.0	0.087	1.10	0.984	0.084	**N/L**
15.15	49.69	1160	5	285.5	139.9	7	0.54	2.8	Clay-Like	41			1160	0.92	10.5	44.4	0.88	0.365	1.0	0.088	1.10	0.984	0.085	**N/L**
15.45	50.68	1908	3	291.2	142.6	13	0.21	2.4		27			1908	0.91	17.2	51.1	0.87	0.363	1.0	0.093	1.11	0.982	0.089	**0.25**
15.75	51.66	1850	9	296.9	145.4	13	0.58	2.6	Clay-Like	34			1850	0.91	16.6	51.9	0.87	0.362	1.0	0.094	1.11	0.982	0.090	**N/L**
16.05	52.64	2011	33	302.5	148.1	14	1.96	2.8	Clay-Like	41			2011	0.90	18.0	54.4	0.86	0.361	1.0	0.095	1.12	0.982	0.091	**N/L**
16.35	53.63	3111	69	308.2	150.8	23	2.48	2.7	Clay-Like	37			3111	0.90	27.7	67.2	0.86	0.359	1.0	0.105	1.14	0.978	0.099	**N/L**
16.65	54.61	3427	95	313.8	153.5	25	3.07	2.7	Clay-Like	37			3427	0.90	30.4	70.8	0.86	0.358	1.0	0.108	1.15	0.977	0.102	**N/L**
16.95	55.60	2885	82	319.5	156.2	20	3.18	2.8	Clay-Like	41			2885	0.89	25.5	64.5	0.85	0.357	1.0	0.103	1.14	0.979	0.097	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR03CPT-72**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	1668	11	2.7	2.7	100	0.64	1.8	Unsaturated	13			1668	1.70	28.1	45.7	1.00	0.204	1.1	0.089	1.11	0.983	0.097	**N/A**
0.45	1.48	302	3																					
0.75	2.46																							
1.05	3.44																							
1.35	4.43																							
1.65	5.41																							
1.95	6.40	795	16	35.3	35.3	13	2.15	2.8	Unsaturated	41			795	1.32	10.4	44.2	1.00	0.203	1.1	0.088	1.10	0.984	0.093	**N/A**
2.25	7.38	2343	61	40.7	40.7	36	2.67	2.5	Unsaturated	30			2343	1.27	29.5	68.4	0.99	0.203	1.1	0.106	1.14	0.977	0.111	**N/A**
2.55	8.36	1165	29	46.1	46.1	16	2.57	2.8	Unsaturated	41			1165	1.23	14.2	49.3	0.99	0.203	1.1	0.092	1.11	0.983	0.095	**N/A**
2.85	9.35	7352	99	51.6	50.6	102	1.35	2.0		17			7352	1.20	87.4	129.1	0.99	0.206	1.1	0.195	1.46	0.929	0.198	**0.96**
3.15	10.33	4260	103	57.3	53.3	57	2.45	2.3		24			4260	1.18	49.9	92.7	0.99	0.217	1.1	0.129	1.23	0.965	0.132	**0.61**
3.45	11.32	817	12	62.9	56.0	10	1.53	2.8	Clay-Like	41			817	1.17	9.5	42.9	0.99	0.226	1.0	0.087	1.10	0.984	0.089	**N/L**
3.75	12.30																							
4.05	13.28																							
4.35	14.27																							
4.65	15.25																							
4.95	16.24	5939	34	91.2	69.6	70	0.58	1.9		15			5939	1.10	64.9	95.3	0.98	0.261	1.0	0.131	1.24	0.963	0.131	**0.50**
5.25	17.22	5853	48	96.9	72.3	67	0.84	2.0		17			5853	1.09	63.3	99.3	0.97	0.266	1.0	0.136	1.26	0.960	0.136	**0.51**
5.55	18.20	6910	58	102.5	75.0	78	0.86	2.0		17			6910	1.08	74.0	112.6	0.97	0.271	1.0	0.156	1.33	0.948	0.153	**0.57**
5.85	19.19	10052	83	108.2	77.7	112	0.84	1.8		13			10052	1.07	106.6	136.4	0.97	0.275	1.0	0.220	1.53	0.918	0.209	**0.76**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR03CPT-73**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		0 ft	0.00 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		0 ft	0.00 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.15	0.49	2332	27	2.8	1.4	199	1.14	1.7		11			2332	1.70	39.3	52.4	1.00	0.425	1.1	0.094	1.11	0.982	0.102	**0.24**
0.45	1.48	5091	38	8.5	4.1	250	0.75	1.5		8			5091	1.70	85.7	89.7	1.00	0.425	1.1	0.125	1.21	0.967	0.133	**0.31**
0.75	2.46	3994	40	14.1	6.8	152	1.00	1.8		13			3994	1.70	67.2	90.9	1.00	0.425	1.1	0.127	1.22	0.966	0.134	**0.32**
1.05	3.44	10245	88	19.8	9.5	329	0.86	1.5		8			10245	1.70	172.4	178.6	1.00	0.425	1.1	0.686	2.07	0.834	0.629	**1.48**
1.35	4.43	4134	39	25.5	12.2	117	0.96	1.8		13			4134	1.70	69.6	93.7	1.00	0.425	1.1	0.130	1.23	0.964	0.137	**0.32**
1.65	5.41	1623	26	31.1	14.9	41	1.61	2.3		24			1623	1.66	26.6	62.1	1.00	0.424	1.1	0.101	1.13	0.980	0.109	**0.26**
1.95	6.40	647	10	36.8	17.7	14	1.70	2.7	Clay-Like	37			647	1.58	10.2	43.6	1.00	0.423	1.1	0.088	1.10	0.984	0.095	**N/L**
2.25	7.38	457	3	42.4	20.4	9	0.78	2.7	Clay-Like	37			457	1.53	6.9	39.2	0.99	0.423	1.1	0.085	1.10	0.984	0.092	**N/L**
2.55	8.36	632	4	48.1	23.1	12	0.61	2.6	Clay-Like	34			632	1.48	9.2	42.0	0.99	0.422	1.1	0.087	1.10	0.984	0.094	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B387**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	21985	73	5.4	5.4	938	0.33	0.9	Unsaturated	2			21985	1.70	370.0	370.0	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	38932	171	10.8	10.8	1174	0.44	1.0	Unsaturated	3			38932	1.70	655.3	655.3	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	30830	145	16.3	16.3	759	0.47	1.1	Unsaturated	4			30830	1.62	494.1	494.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	9923	57	21.7	21.7	211	0.57	1.5	Unsaturated	8			9923	1.50	147.4	152.9	1.00	0.204	1.1	0.309	1.70	0.890	0.303	**N/A**
1.50	4.92	2093	42	27.1	27.1	39	2.05	2.4	Unsaturated	27			2093	1.41	29.3	67.1	1.00	0.204	1.1	0.105	1.14	0.978	0.113	**N/A**
1.80	5.90	4659	83	32.5	32.5	81	1.79	2.1	Unsaturated	19			4659	1.35	62.2	102.6	1.00	0.203	1.1	0.141	1.28	0.957	0.148	**N/A**
2.10	6.89	6595	131	38.0	38.0	106	2.00	2.1	Unsaturated	19			6595	1.29	84.5	131.0	0.99	0.203	1.1	0.201	1.48	0.926	0.204	**N/A**
2.40	7.87	4945	67	43.4	43.4	74	1.36	2.1	Unsaturated	19			4945	1.25	61.2	101.3	0.99	0.203	1.1	0.139	1.27	0.958	0.145	**N/A**
2.70	8.86	2610	51	48.8	48.8	36	1.98	2.4	Unsaturated	27			2610	1.21	31.3	69.8	0.99	0.202	1.1	0.107	1.15	0.977	0.111	**N/A**
3.00	9.84	1957	25	54.4	51.9	26	1.34	2.5		30			1957	1.19	23.1	59.9	0.99	0.212	1.1	0.099	1.13	0.980	0.102	**0.48**
3.30	10.82	1846	27	60.1	54.6	24	1.52	2.5		30			1846	1.18	21.5	57.7	0.99	0.222	1.0	0.098	1.12	0.981	0.100	**0.45**
3.60	11.81	945	11	65.8	57.4	12	1.22	2.7	Clay-Like	37			945	1.16	10.9	44.6	0.99	0.231	1.0	0.088	1.11	0.984	0.090	**N/L**
3.90	12.79	1726	34	71.4	60.1	21	2.04	2.6	Clay-Like	34			1726	1.15	19.6	55.9	0.98	0.239	1.0	0.096	1.12	0.981	0.098	**N/L**
4.20	13.78	3629	46	77.1	62.8	45	1.29	2.3		24			3629	1.13	40.7	80.6	0.98	0.246	1.0	0.116	1.18	0.972	0.118	**0.48**
4.50	14.76	2918	21	82.7	65.5	35	0.72	2.2		22			2918	1.12	32.4	67.6	0.98	0.252	1.0	0.105	1.14	0.978	0.107	**0.42**
4.80	15.74	7029	37	88.4	68.2	83	0.53	1.8		13			7029	1.11	77.2	102.4	0.98	0.258	1.0	0.141	1.27	0.957	0.140	**0.54**
5.10	16.73	8885	101	94.0	70.9	104	1.15	1.9		15			8885	1.10	96.6	133.3	0.97	0.264	1.0	0.208	1.50	0.923	0.202	**0.76**
5.40	17.71	5334	54	99.7	73.7	61	1.03	2.1		19			5334	1.09	57.4	96.5	0.97	0.269	1.0	0.133	1.24	0.962	0.132	**0.49**
5.70	18.70	27427	386	105.4	76.4	311	1.41	1.7		11			27427	1.08	292.3	331.9	0.97	0.273	1.1	2.000	2.20	0.813	1.763	**2.00**
6.00	19.68	32570	301	111.0	79.1	363	0.93	1.5		8			32570	1.07	344.0	354.1	0.97	0.277	1.1	2.000	2.20	0.813	1.746	**2.00**
6.30	20.66	13796	97	116.7	81.8	150	0.71	1.7		11			13796	1.06	144.4	168.5	0.97	0.281	1.0	0.479	1.91	0.858	0.428	**1.52**
6.60	21.65	9342	37	122.3	84.5	100	0.40	1.7		11			9342	1.05	96.9	116.1	0.96	0.284	1.0	0.163	1.36	0.944	0.157	**0.55**
6.90	22.63	8311	46	128.0	87.2	87	0.57	1.8		13			8311	1.04	85.5	112.1	0.96	0.288	1.0	0.156	1.33	0.948	0.150	**0.52**
7.20	23.62	8717	24	133.7	89.9	90	0.28	1.7		11			8717	1.03	89.0	107.3	0.96	0.290	1.0	0.148	1.30	0.953	0.143	**0.49**
7.50	24.60	9875	37	139.3	92.7	100	0.38	1.7		11			9875	1.02	100.0	119.5	0.95	0.293	1.0	0.170	1.38	0.940	0.162	**0.55**
7.80	25.58	9794	39	145.0	95.4	98	0.40	1.7		11			9794	1.02	98.4	117.8	0.95	0.295	1.0	0.166	1.37	0.942	0.158	**0.53**
8.10	26.57	5947	41	150.6	98.1	58	0.71	2.0		17			5947	1.01	59.3	94.4	0.95	0.298	1.0	0.130	1.23	0.964	0.126	**0.42**
8.40	27.55	2938	27	156.3	100.8	28	0.96	2.4		27			2938	1.00	29.1	66.9	0.95	0.299	1.0	0.105	1.14	0.978	0.102	**0.34**
8.70	28.54	2581	26	162.0	103.5	24	1.08	2.4		27			2581	0.99	25.4	61.9	0.94	0.301	1.0	0.101	1.13	0.980	0.099	**0.33**
9.00	29.52	906	7	167.6	106.2	7	0.98	2.9	Clay-Like	45			906	0.99	8.8	42.2	0.94	0.303	1.0	0.087	1.10	0.984	0.085	**N/L**
9.30	30.50	768	5	173.3	109.0	6	0.82	2.9	Clay-Like	45			768	0.98	7.5	40.3	0.94	0.304	1.0	0.086	1.10	0.984	0.084	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B388**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		8.5 ft	2.59 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.5 ft	2.59 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	13078	74	5.4	5.4	558	0.56	1.2	Unsaturated	4			13078	1.70	220.1	220.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	26032	92	10.8	10.8	785	0.35	1.0	Unsaturated	3			26032	1.70	438.2	438.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	20914	90	16.3	16.3	515	0.43	1.1	Unsaturated	4			20914	1.62	335.2	335.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	9961	61	21.7	21.7	212	0.62	1.5	Unsaturated	8			9961	1.50	148.0	153.5	1.00	0.204	1.1	0.314	1.71	0.889	0.307	**N/A**
1.50	4.92	5704	50	27.1	27.1	108	0.87	1.8	Unsaturated	13			5704	1.41	79.9	105.6	1.00	0.204	1.1	0.145	1.29	0.955	0.152	**N/A**
1.80	5.90	5248	54	32.5	32.5	91	1.03	2.0	Unsaturated	17			5248	1.35	70.1	107.7	1.00	0.203	1.1	0.148	1.30	0.953	0.155	**N/A**
2.10	6.89	7672	110	38.0	38.0	123	1.44	2.0	Unsaturated	17			7672	1.29	98.3	142.7	0.99	0.203	1.1	0.247	1.59	0.908	0.247	**N/A**
2.40	7.87	5475	121	43.4	43.4	82	2.23	2.2	Unsaturated	22			5475	1.25	67.7	113.4	0.99	0.203	1.1	0.158	1.34	0.947	0.164	**N/A**
2.70	8.86	3901	53	48.9	47.8	55	1.39	2.2		22			3901	1.22	47.0	86.5	0.99	0.207	1.1	0.122	1.20	0.969	0.127	**0.61**
3.00	9.84	11483	93	54.6	50.5	160	0.81	1.7		11			11483	1.20	136.5	159.8	0.99	0.218	1.1	0.369	1.79	0.877	0.356	**1.63**
3.30	10.82	10626	92	60.2	53.3	144	0.87	1.8		13			10626	1.18	124.6	157.1	0.99	0.228	1.1	0.343	1.75	0.882	0.333	**1.46**
3.60	11.81	7031	42	65.9	56.0	92	0.60	1.8		13			7031	1.17	81.3	107.2	0.99	0.237	1.1	0.148	1.30	0.953	0.150	**0.63**
3.90	12.79	9492	94	71.5	58.7	122	0.99	1.8		13			9492	1.15	108.4	138.5	0.98	0.245	1.1	0.228	1.55	0.915	0.225	**0.92**
4.20	13.78	5641	88	77.2	61.4	71	1.58	2.2		22			5641	1.14	63.7	108.1	0.98	0.252	1.1	0.149	1.31	0.952	0.150	**0.60**
4.50	14.76	2802	40	82.9	64.1	34	1.47	2.4		27			2802	1.13	31.3	69.7	0.98	0.258	1.0	0.107	1.15	0.977	0.109	**0.42**
4.80	15.74	3532	106	88.5	66.8	42	3.08	2.5		30			3532	1.12	39.0	81.1	0.98	0.264	1.0	0.117	1.18	0.972	0.118	**0.45**
5.10	16.73	1669	22	94.2	69.6	19	1.40	2.6	Clay-Like	34			1669	1.10	18.2	54.0	0.97	0.269	1.0	0.095	1.12	0.982	0.096	**N/L**
5.40	17.71	3477	48	99.8	72.3	39	1.43	2.3		24			3477	1.09	37.6	76.5	0.97	0.274	1.0	0.113	1.17	0.974	0.113	**0.41**
5.70	18.70	7238	95	105.5	75.0	82	1.33	2.1		19			7238	1.08	77.5	122.1	0.97	0.278	1.0	0.176	1.40	0.937	0.171	**0.61**
6.00	19.68	6885	52	111.1	77.7	76	0.77	1.9		15			6885	1.07	73.1	105.1	0.97	0.282	1.0	0.144	1.29	0.955	0.142	**0.50**
6.30	20.66	3737	38	116.8	80.4	40	1.05	2.2		22			3737	1.06	39.3	76.5	0.97	0.286	1.0	0.113	1.17	0.974	0.112	**0.39**
6.60	21.65	1849	23	122.5	83.1	19	1.32	2.6	Clay-Like	34			1849	1.05	19.3	55.4	0.96	0.289	1.0	0.096	1.12	0.981	0.096	**N/L**
6.90	22.63	631	8	128.1	85.9	5	1.63	3.1	Clay-Like	53			631	1.04	6.5	39.1	0.96	0.292	1.0	0.085	1.10	0.984	0.084	**N/L**
7.20	23.62	620	8	133.8	88.6	5	1.56	3.1	Clay-Like	53			620	1.04	6.4	38.9	0.96	0.295	1.0	0.085	1.10	0.984	0.084	**N/L**
7.50	24.60	641	8	139.4	91.3	5	1.57	3.1	Clay-Like	53			641	1.03	6.5	39.1	0.95	0.298	1.0	0.085	1.10	0.984	0.084	**N/L**
7.80	25.58	721	9	145.1	94.0	6	1.55	3.0	Clay-Like	49			721	1.02	7.3	40.1	0.95	0.300	1.0	0.085	1.10	0.984	0.085	**N/L**
8.10	26.57	2720	33	150.8	96.7	26	1.29	2.4		27			2720	1.01	27.2	64.4	0.95	0.302	1.0	0.103	1.14	0.979	0.101	**0.33**
8.40	27.55	22548	228	156.4	99.4	223	1.02	1.7		11			22548	1.00	224.2	256.6	0.95	0.304	1.0	2.000	2.20	0.813	1.634	**2.00**
8.70	28.54	34788	359	162.1	102.2	340	1.04	1.6		10			34788	1.00	343.4	368.4	0.94	0.306	1.0	2.000	2.20	0.813	1.621	**2.00**
9.00	29.52	35366	291	167.7	104.9	341	0.83	1.5		8			35366	0.99	346.7	356.9	0.94	0.307	1.0	2.000	2.20	0.813	1.608	**2.00**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B390**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	11251	32	5.4	5.4	480	0.28	1.0	Unsaturated	3			11251	1.70	189.4	189.4	1.00	0.204	1.1	1.092	2.20	0.813	0.977	**N/A**
0.60	1.97	17777	111	10.8	10.8	536	0.62	1.3	Unsaturated	6			17777	1.70	299.2	299.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	12693	76	16.3	16.3	312	0.60	1.4	Unsaturated	7			12693	1.62	203.4	205.1	1.00	0.204	1.1	2.554	2.20	0.813	2.000	**N/A**
1.20	3.94	7035	33	21.7	21.7	150	0.47	1.6	Unsaturated	10			7035	1.50	104.5	115.6	1.00	0.204	1.1	0.162	1.35	0.945	0.168	**N/A**
1.50	4.92	6325	47	27.1	27.1	120	0.75	1.8	Unsaturated	13			6325	1.41	88.6	115.6	1.00	0.204	1.1	0.162	1.35	0.945	0.168	**N/A**
1.80	5.90	5440	41	32.5	32.5	94	0.76	1.9	Unsaturated	15			5440	1.35	72.6	104.5	1.00	0.203	1.1	0.144	1.29	0.955	0.151	**N/A**
2.10	6.89	3616	16	38.0	38.0	58	0.45	1.9	Unsaturated	15			3616	1.29	46.3	73.0	0.99	0.203	1.1	0.110	1.16	0.976	0.116	**N/A**
2.40	7.87	2492	16	43.4	43.4	37	0.66	2.2	Unsaturated	22			2492	1.25	30.8	65.5	0.99	0.203	1.1	0.104	1.14	0.978	0.108	**N/A**
2.70	8.86	2231	22	48.8	48.8	31	1.01	2.3	Unsaturated	24			2231	1.21	26.8	62.3	0.99	0.202	1.1	0.101	1.13	0.980	0.105	**N/A**
3.00	9.84	1214	21	54.4	51.9	16	1.84	2.7	Clay-Like	37			1214	1.19	14.3	49.2	0.99	0.212	1.0	0.092	1.11	0.983	0.094	**N/L**
3.30	10.82	668	9	60.1	54.6	8	1.49	2.9	Clay-Like	45			668	1.18	7.8	40.8	0.99	0.222	1.0	0.086	1.10	0.984	0.088	**N/L**
3.60	11.81	1604	14	65.8	57.4	20	0.90	2.5		30			1604	1.16	18.4	53.7	0.99	0.231	1.0	0.095	1.12	0.982	0.097	**0.42**
3.90	12.79	4231	16	71.4	60.1	53	0.38	1.9		15			4231	1.15	48.1	75.0	0.98	0.239	1.0	0.111	1.16	0.975	0.114	**0.48**
4.20	13.78	6132	30	77.1	62.8	76	0.49	1.8		13			6132	1.13	68.8	92.8	0.98	0.246	1.0	0.129	1.23	0.965	0.130	**0.53**
4.50	14.76	5586	34	82.7	65.5	68	0.62	1.9		15			5586	1.12	62.0	91.8	0.98	0.252	1.0	0.128	1.22	0.965	0.128	**0.51**
4.80	15.74	2669	37	88.4	68.2	31	1.45	2.4		27			2669	1.11	29.3	67.1	0.98	0.258	1.0	0.105	1.14	0.978	0.106	**0.41**
5.10	16.73	2742	23	94.0	70.9	31	0.85	2.3		24			2742	1.10	29.8	66.3	0.97	0.264	1.0	0.104	1.14	0.978	0.105	**0.40**
5.40	17.71	1256	15	99.7	73.7	13	1.32	2.7	Clay-Like	37			1256	1.09	13.5	48.1	0.97	0.269	1.0	0.091	1.11	0.983	0.091	**N/L**
5.70	18.70	655	6	105.4	76.4	6	1.12	3.0	Clay-Like	49			655	1.08	7.0	39.7	0.97	0.273	1.0	0.085	1.10	0.984	0.085	**N/L**
6.00	19.68	479	4	111.0	79.1	4	1.11	3.1	Clay-Like	53			479	1.07	5.1	37.1	0.97	0.277	1.0	0.083	1.10	0.985	0.083	**N/L**
6.30	20.66	514	2	116.7	81.8	4	0.62	3.0	Clay-Like	49			514	1.06	5.4	37.6	0.97	0.281	1.0	0.084	1.10	0.985	0.084	**N/L**
6.60	21.65	543	2	122.3	84.5	5	0.58	3.0	Clay-Like	49			543	1.05	5.6	37.9	0.96	0.284	1.0	0.084	1.10	0.985	0.084	**N/L**
6.90	22.63	495	3	128.0	87.2	4	0.70	3.1	Clay-Like	53			495	1.04	5.1	37.2	0.96	0.288	1.0	0.084	1.10	0.985	0.083	**N/L**
7.20	23.62	521	6	133.7	89.9	4	1.52	3.2	Clay-Like	58			521	1.03	5.3	37.5	0.96	0.290	1.0	0.084	1.10	0.985	0.083	**N/L**
7.50	24.60	608	5	139.3	92.7	5	1.02	3.0	Clay-Like	49			608	1.02	6.2	38.6	0.95	0.293	1.0	0.084	1.10	0.984	0.084	**N/L**
7.80	25.58	614	3	145.0	95.4	5	0.67	3.0	Clay-Like	49			614	1.02	6.2	38.6	0.95	0.295	1.0	0.084	1.10	0.984	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B391**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		8.5 ft	2.59 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.5 ft	2.59 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	17669	50	5.4	5.4	754	0.29	0.9	Unsaturated	2			17669	1.70	297.4	297.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	24911	171	10.8	10.8	751	0.69	1.2	Unsaturated	4			24911	1.70	419.3	419.3	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	11970	12	16.3	16.3	294	0.10	1.0	Unsaturated	3			11970	1.62	191.9	191.9	1.00	0.204	1.1	1.230	2.20	0.813	1.100	**N/A**
1.20	3.94	1376	16	21.7	21.7	29	1.18	2.4	Unsaturated	27			1376	1.50	20.4	55.4	1.00	0.204	1.1	0.096	1.12	0.981	0.104	**N/A**
1.50	4.92	1764	52	27.1	27.1	33	2.99	2.6	Unsaturated	34			1764	1.41	24.7	62.7	1.00	0.204	1.1	0.102	1.13	0.979	0.109	**N/A**
1.80	5.90	3545	20	32.5	32.5	61	0.57	1.9	Unsaturated	15			3545	1.35	47.3	74.2	1.00	0.203	1.1	0.111	1.16	0.975	0.119	**N/A**
2.10	6.89	6666	54	38.0	38.0	107	0.81	1.8	Unsaturated	13			6666	1.29	85.4	112.0	0.99	0.203	1.1	0.155	1.33	0.949	0.162	**N/A**
2.40	7.87	9182	98	43.4	43.4	138	1.07	1.8	Unsaturated	13			9182	1.25	113.6	144.5	0.99	0.203	1.1	0.256	1.61	0.905	0.255	**N/A**
2.70	8.86	6561	171	48.9	47.8	94	2.63	2.2		22			6561	1.22	79.1	128.1	0.99	0.207	1.1	0.192	1.45	0.930	0.196	**0.95**
3.00	9.84	8382	300	54.6	50.5	116	3.61	2.3		24			8382	1.20	99.6	158.0	0.99	0.218	1.1	0.352	1.77	0.881	0.341	**1.56**
3.30	10.82	6928	175	60.2	53.3	94	2.55	2.2		22			6928	1.18	81.2	130.8	0.99	0.228	1.1	0.200	1.47	0.926	0.201	**0.88**
3.60	11.81	6590	103	65.9	56.0	87	1.58	2.1		19			6590	1.17	76.2	120.4	0.99	0.237	1.1	0.172	1.39	0.939	0.174	**0.73**
3.90	12.79	7197	118	71.5	58.7	92	1.66	2.1		19			7197	1.15	82.2	128.1	0.98	0.245	1.1	0.192	1.45	0.930	0.191	**0.78**
4.20	13.78	5347	78	77.2	61.4	67	1.48	2.2		22			5347	1.14	60.4	103.8	0.98	0.252	1.1	0.142	1.28	0.956	0.144	**0.57**
4.50	14.76	4741	52	82.9	64.1	58	1.12	2.1		19			4741	1.13	52.9	90.8	0.98	0.258	1.0	0.126	1.22	0.966	0.128	**0.49**
4.80	15.74	1647	29	88.5	66.8	19	1.87	2.7	Clay-Like	37			1647	1.12	18.2	54.4	0.98	0.264	1.0	0.095	1.12	0.982	0.097	**N/L**
5.10	16.73	3651	59	94.2	69.6	42	1.66	2.3		24			3651	1.10	39.9	79.5	0.97	0.269	1.0	0.115	1.18	0.973	0.116	**0.43**
5.40	17.71	6452	24	99.8	72.3	74	0.38	1.8		13			6452	1.09	69.8	93.9	0.97	0.274	1.0	0.130	1.23	0.964	0.129	**0.47**
5.70	18.70	6410	29	105.5	75.0	72	0.46	1.8		13			6410	1.08	68.6	92.6	0.97	0.278	1.0	0.128	1.23	0.965	0.128	**0.46**
6.00	19.68	4393	55	111.1	77.7	48	1.29	2.2		22			4393	1.07	46.6	86.0	0.97	0.282	1.0	0.121	1.20	0.969	0.121	**0.43**
6.30	20.66	2037	35	116.8	80.4	21	1.83	2.6	Clay-Like	34			2037	1.06	21.4	58.3	0.97	0.286	1.0	0.098	1.12	0.981	0.098	**N/L**
6.60	21.65	1059	10	122.5	83.1	10	1.05	2.8	Clay-Like	41			1059	1.05	11.0	45.0	0.96	0.289	1.0	0.089	1.11	0.984	0.089	**N/L**
6.90	22.63	996	10	128.1	85.9	9	1.19	2.8	Clay-Like	41			996	1.04	10.3	44.0	0.96	0.292	1.0	0.088	1.10	0.984	0.088	**N/L**
7.20	23.62	784	10	133.8	88.6	7	1.47	3.0	Clay-Like	49			784	1.04	8.0	41.2	0.96	0.295	1.0	0.086	1.10	0.984	0.086	**N/L**
7.50	24.60	735	8	139.4	91.3	6	1.27	3.0	Clay-Like	49			735	1.03	7.5	40.4	0.95	0.298	1.0	0.086	1.10	0.984	0.085	**N/L**
7.80	25.58	733	6	145.1	94.0	6	1.09	3.0	Clay-Like	49			733	1.02	7.4	40.3	0.95	0.300	1.0	0.086	1.10	0.984	0.085	**N/L**
8.10	26.57	717	3	150.8	96.7	6	0.57	2.9	Clay-Like	45			717	1.01	7.2	40.0	0.95	0.302	1.0	0.085	1.10	0.984	0.084	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B392**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314

Test Boring Information:

Approx. ground elevation		8.7 ft	2.65 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.7 ft	2.65 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	13807	38	5.4	5.4	589	0.28	1.0	Unsaturated	3			13807	1.70	232.4	232.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	19655	68	10.8	10.8	593	0.35	1.0	Unsaturated	3			19655	1.70	330.8	330.8	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	23177	57	16.3	16.3	570	0.25	0.9	Unsaturated	2			23177	1.62	371.5	371.5	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	42841	137	21.7	21.7	913	0.32	0.9	Unsaturated	2			42841	1.50	636.5	636.5	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	31710	383	27.1	27.1	605	1.21	1.5	Unsaturated	8			31710	1.41	444.2	456.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	17042	166	32.5	32.5	296	0.98	1.6	Unsaturated	10			17042	1.35	227.5	245.7	1.00	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.10	6.89	20800	242	38.0	38.0	335	1.17	1.6	Unsaturated	10			20800	1.29	266.6	287.1	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.40	7.87	16983	195	43.4	43.4	256	1.15	1.7	Unsaturated	11			16983	1.25	210.1	241.1	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.70	8.86	8603	139	48.8	48.4	122	1.63	2.0		17			8603	1.21	103.4	149.0	0.99	0.204	1.1	0.282	1.66	0.898	0.279	**1.36**
3.00	9.84	3406	55	54.5	51.1	47	1.63	2.3		24			3406	1.20	40.4	80.2	0.99	0.215	1.1	0.116	1.18	0.972	0.120	**0.56**
3.30	10.82	1667	26	60.2	53.8	22	1.60	2.6	Clay-Like	34			1667	1.18	19.5	55.7	0.99	0.225	1.0	0.096	1.12	0.981	0.099	**N/L**
3.60	11.81	3333	32	65.8	56.5	43	0.98	2.2		22			3333	1.17	38.5	75.4	0.99	0.234	1.1	0.112	1.16	0.975	0.114	**0.49**
3.90	12.79	4387	33	71.5	59.2	56	0.76	2.0		17			4387	1.15	50.0	82.8	0.98	0.242	1.0	0.118	1.19	0.971	0.121	**0.50**
4.20	13.78	4867	40	77.1	62.0	60	0.84	2.0		17			4867	1.14	54.8	88.7	0.98	0.249	1.0	0.124	1.21	0.967	0.126	**0.50**
4.50	14.76	7934	46	82.8	64.7	97	0.59	1.8		13			7934	1.12	88.4	115.3	0.98	0.256	1.1	0.162	1.35	0.945	0.161	**0.63**
4.80	15.74	6639	52	88.5	67.4	79	0.80	1.9		15			6639	1.11	73.1	105.2	0.98	0.262	1.0	0.144	1.29	0.955	0.144	**0.55**
5.10	16.73	7142	46	94.1	70.1	84	0.66	1.9		15			7142	1.10	77.9	110.8	0.97	0.267	1.0	0.153	1.32	0.950	0.152	**0.57**
5.40	17.71	8987	35	99.8	72.8	103	0.39	1.7		11			8987	1.09	97.0	116.1	0.97	0.272	1.0	0.163	1.36	0.944	0.160	**0.59**
5.70	18.70	8664	39	105.4	75.5	98	0.46	1.7		11			8664	1.08	92.6	111.3	0.97	0.276	1.0	0.154	1.33	0.949	0.151	**0.55**
6.00	19.68	9107	34	111.1	78.3	101	0.38	1.7		11			9107	1.07	96.4	115.5	0.97	0.280	1.0	0.162	1.35	0.945	0.158	**0.56**
6.30	20.66	9551	40	116.8	81.0	104	0.43	1.7		11			9551	1.06	100.2	119.7	0.97	0.284	1.0	0.171	1.38	0.940	0.165	**0.58**
6.60	21.65	9384	40	122.4	83.7	101	0.44	1.7		11			9384	1.05	97.6	116.9	0.96	0.287	1.0	0.165	1.36	0.943	0.159	**0.55**
6.90	22.63	7596	34	128.1	86.4	80	0.46	1.8		13			7596	1.04	78.4	103.8	0.96	0.290	1.0	0.142	1.28	0.956	0.139	**0.48**
7.20	23.62	2990	35	133.7	89.1	30	1.24	2.4		27			2990	1.03	30.6	68.8	0.96	0.293	1.0	0.106	1.15	0.977	0.105	**0.36**
7.50	24.60	846	14	139.4	91.8	7	1.97	3.0	Clay-Like	49			846	1.03	8.6	41.9	0.95	0.296	1.0	0.087	1.10	0.984	0.086	**N/L**
7.80	25.58	739	10	145.1	94.6	6	1.66	3.0	Clay-Like	49			739	1.02	7.4	40.4	0.95	0.298	1.0	0.086	1.10	0.984	0.085	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B393**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		8.7 ft	2.65 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.7 ft	2.65 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	24945	78	5.4	5.4	1064	0.31	0.8	Unsaturated	2			24945	1.70	419.9	419.9	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	35671	173	10.8	10.8	1076	0.48	1.0	Unsaturated	3			35671	1.70	600.4	600.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	35494	158	16.3	16.3	874	0.44	1.0	Unsaturated	3			35494	1.62	568.9	568.9	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	38492	136	21.7	21.7	821	0.35	0.9	Unsaturated	2			38492	1.50	571.8	571.8	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	18146	66	27.1	27.1	346	0.37	1.2	Unsaturated	4			18146	1.41	254.2	254.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	4060	45	32.5	32.5	70	1.13	2.1	Unsaturated	19			4060	1.35	54.2	92.4	1.00	0.203	1.1	0.128	1.23	0.965	0.136	**N/A**
2.10	6.89	3753	75	38.0	38.0	60	2.03	2.3	Unsaturated	24			3753	1.29	48.1	90.3	0.99	0.203	1.1	0.126	1.22	0.966	0.133	**N/A**
2.40	7.87	5297	103	43.4	43.4	79	1.96	2.2	Unsaturated	22			5297	1.25	65.5	110.5	0.99	0.203	1.1	0.153	1.32	0.950	0.159	**N/A**
2.70	8.86	7692	177	48.8	48.4	109	2.32	2.1		19			7692	1.21	92.5	141.1	0.99	0.204	1.1	0.239	1.57	0.911	0.240	**1.17**
3.00	9.84	4057	50	54.5	51.1	56	1.25	2.2		22			4057	1.20	48.1	87.9	0.99	0.215	1.1	0.123	1.21	0.968	0.127	**0.59**
3.30	10.82	3597	54	60.2	53.8	48	1.53	2.3		24			3597	1.18	42.1	82.4	0.99	0.225	1.1	0.118	1.19	0.971	0.121	**0.54**
3.60	11.81	5576	38	65.8	56.5	73	0.69	1.9		15			5576	1.17	64.3	94.6	0.99	0.234	1.1	0.131	1.24	0.963	0.133	**0.57**
3.90	12.79	8454	56	71.5	59.2	108	0.67	1.8		13			8454	1.15	96.3	124.5	0.98	0.242	1.1	0.182	1.42	0.934	0.182	**0.75**
4.20	13.78	7714	50	77.1	62.0	96	0.65	1.8		13			7714	1.14	86.9	113.6	0.98	0.249	1.1	0.158	1.34	0.947	0.159	**0.64**
4.50	14.76	9070	69	82.8	64.7	111	0.76	1.8		13			9070	1.12	101.0	129.9	0.98	0.256	1.1	0.197	1.47	0.927	0.194	**0.76**
4.80	15.74	5008	111	88.5	67.4	60	2.25	2.3		24			5008	1.11	55.2	99.6	0.98	0.262	1.0	0.137	1.26	0.960	0.137	**0.52**
5.10	16.73	3596	43	94.1	70.1	42	1.23	2.3		24			3596	1.10	39.2	78.6	0.97	0.267	1.0	0.115	1.17	0.973	0.115	**0.43**
5.40	17.71	9344	74	99.8	72.8	108	0.80	1.8		13			9344	1.09	100.9	129.8	0.97	0.272	1.0	0.197	1.46	0.928	0.190	**0.70**
5.70	18.70	13028	24	105.4	75.5	148	0.19	1.4		7			13028	1.08	139.3	140.6	0.97	0.276	1.0	0.237	1.57	0.912	0.225	**0.82**
6.00	19.68	13011	30	111.1	78.3	145	0.23	1.4		7			13011	1.07	137.8	139.1	0.97	0.280	1.0	0.230	1.55	0.914	0.218	**0.78**
6.30	20.66	23894	21	116.8	81.0	263	0.10	1.1		4			23894	1.06	250.8	250.8	0.97	0.284	1.1	2.000	2.20	0.813	1.734	**2.00**
6.60	21.65	16382	24	122.4	83.7	177	0.15	1.3		6			16382	1.05	170.4	170.6	0.96	0.287	1.0	0.514	1.94	0.853	0.454	**1.58**
6.90	22.63	9512	23	128.1	86.4	100	0.24	1.6		10			9512	1.04	98.1	108.8	0.96	0.290	1.0	0.150	1.31	0.952	0.145	**0.50**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B394**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		8.8 ft	2.68 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.8 ft	2.68 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	17760	67	5.4	5.4	757	0.37	1.0	Unsaturated	3			17760	1.70	298.9	298.9	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	16555	44	10.8	10.8	499	0.27	1.0	Unsaturated	3			16555	1.70	278.7	278.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	10738	60	16.3	16.3	264	0.56	1.4	Unsaturated	7			10738	1.62	172.1	173.6	1.00	0.204	1.1	0.570	1.99	0.846	0.531	**N/A**
1.20	3.94	27754	104	21.7	21.7	592	0.37	1.1	Unsaturated	4			27754	1.50	412.3	412.3	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	28401	235	27.1	27.1	541	0.83	1.4	Unsaturated	7			28401	1.41	397.8	400.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	10192	48	32.5	32.5	177	0.48	1.5	Unsaturated	8			10192	1.35	136.1	141.3	1.00	0.203	1.1	0.240	1.57	0.911	0.241	**N/A**
2.10	6.89	7090	99	38.0	38.0	114	1.40	2.0	Unsaturated	17			7090	1.29	90.9	133.5	0.99	0.203	1.1	0.209	1.50	0.923	0.212	**N/A**
2.40	7.87	7194	173	43.4	43.4	108	2.42	2.2	Unsaturated	22			7194	1.25	89.0	140.9	0.99	0.203	1.1	0.239	1.57	0.911	0.239	**N/A**
2.70	8.86	4403	104	48.8	48.7	62	2.39	2.3		24			4403	1.21	52.9	96.6	0.99	0.203	1.1	0.133	1.24	0.962	0.138	**0.68**
3.00	9.84	3924	76	54.5	51.4	54	1.96	2.3		24			3924	1.20	46.4	88.1	0.99	0.214	1.1	0.124	1.21	0.968	0.127	**0.60**
3.30	10.82	3987	60	60.1	54.1	53	1.52	2.2		22			3987	1.18	46.6	85.9	0.99	0.224	1.1	0.121	1.20	0.969	0.125	**0.56**
3.60	11.81	3067	24	65.8	56.8	40	0.80	2.2		22			3067	1.16	35.3	71.4	0.99	0.233	1.0	0.108	1.15	0.976	0.111	**0.48**
3.90	12.79	2413	29	71.5	59.5	30	1.26	2.4		27			2413	1.15	27.5	64.7	0.98	0.241	1.0	0.103	1.14	0.979	0.105	**0.44**
4.20	13.78	3527	25	77.1	62.2	43	0.72	2.1		19			3527	1.14	39.7	74.0	0.98	0.248	1.0	0.111	1.16	0.975	0.112	**0.45**
4.50	14.76	4394	22	82.8	65.0	53	0.51	2.0		17			4394	1.12	48.9	81.4	0.98	0.255	1.0	0.117	1.18	0.972	0.118	**0.46**
4.80	15.74	2116	29	88.4	67.7	24	1.42	2.5		30			2116	1.11	23.3	60.1	0.98	0.261	1.0	0.100	1.13	0.980	0.101	**0.39**
5.10	16.73	1351	23	94.1	70.4	15	1.82	2.7	Clay-Like	37			1351	1.10	14.7	49.7	0.97	0.266	1.0	0.092	1.11	0.983	0.093	**N/L**
5.40	17.71	850	10	99.8	73.1	9	1.38	2.9	Clay-Like	45			850	1.09	9.2	42.6	0.97	0.271	1.0	0.087	1.10	0.984	0.088	**N/L**
5.70	18.70	745	11	105.4	75.8	7	1.75	3.0	Clay-Like	49			745	1.08	8.0	41.1	0.97	0.275	1.0	0.086	1.10	0.984	0.086	**N/L**
6.00	19.68	747	8	111.1	78.5	7	1.19	2.9	Clay-Like	45			747	1.07	7.9	40.9	0.97	0.279	1.0	0.086	1.10	0.984	0.086	**N/L**
6.30	20.66	698	8	116.7	81.3	6	1.31	3.0	Clay-Like	49			698	1.06	7.3	40.2	0.97	0.283	1.0	0.086	1.10	0.984	0.085	**N/L**
6.60	21.65	621	7	122.4	84.0	5	1.43	3.1	Clay-Like	53			621	1.05	6.5	39.0	0.96	0.286	1.0	0.085	1.10	0.984	0.084	**N/L**
6.90	22.63	571	8	128.1	86.7	5	1.82	3.2	Clay-Like	58			571	1.04	5.9	38.2	0.96	0.289	1.0	0.084	1.10	0.984	0.084	**N/L**
7.20	23.62	542	8	133.7	89.4	4	1.92	3.2	Clay-Like	58			542	1.03	5.5	37.8	0.96	0.292	1.0	0.084	1.10	0.985	0.083	**N/L**
7.50	24.60	540	10	139.4	92.1	4	2.49	3.3	Clay-Like	62			540	1.02	5.5	37.6	0.95	0.295	1.0	0.084	1.10	0.985	0.083	**N/L**
7.80	25.58	531	8	145.0	94.8	4	2.01	3.3	Clay-Like	62			531	1.02	5.3	37.4	0.95	0.297	1.0	0.084	1.10	0.985	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B395**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		8.5 ft	2.59 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.5 ft	2.59 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	18266	68	5.4	5.4	779	0.37	1.0	Unsaturated	3			18266	1.70	307.4	307.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	27258	207	10.8	10.8	822	0.76	1.2	Unsaturated	4			27258	1.70	458.8	458.8	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	21002	216	16.3	16.3	517	1.03	1.4	Unsaturated	7			21002	1.62	336.6	339.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	25102	144	21.7	21.7	535	0.57	1.2	Unsaturated	4			25102	1.50	372.9	372.9	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	25416	129	27.1	27.1	484	0.51	1.2	Unsaturated	4			25416	1.41	356.0	356.0	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	16897	261	32.5	32.5	294	1.55	1.7	Unsaturated	11			16897	1.35	225.6	258.1	1.00	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.10	6.89	12475	135	38.0	38.0	201	1.09	1.7	Unsaturated	11			12475	1.29	159.9	185.6	0.99	0.203	1.1	0.919	2.19	0.815	0.824	**N/A**
2.40	7.87	14686	229	43.4	43.4	221	1.57	1.8	Unsaturated	13			14686	1.25	181.7	223.1	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.70	8.86	20654	253	48.9	47.8	296	1.23	1.6		10			20654	1.22	249.1	268.5	0.99	0.207	1.1	2.000	2.20	0.813	1.789	**2.00**
3.00	9.84	16402	262	54.6	50.5	228	1.60	1.8		13			16402	1.20	194.9	238.4	0.99	0.218	1.1	2.000	2.20	0.813	1.789	**2.00**
3.30	10.82	6262	76	60.2	53.3	84	1.23	2.0		17			6262	1.18	73.4	111.8	0.99	0.228	1.1	0.155	1.33	0.949	0.158	**0.69**
3.60	11.81	6243	59	65.9	56.0	82	0.96	2.0		17			6243	1.17	72.2	110.3	0.99	0.237	1.1	0.153	1.32	0.950	0.155	**0.65**
3.90	12.79	5488	39	71.5	58.7	70	0.71	1.9		15			5488	1.15	62.7	92.6	0.98	0.245	1.1	0.128	1.23	0.965	0.131	**0.53**
4.20	13.78	1660	23	77.2	61.4	20	1.43	2.6	Clay-Like	34			1660	1.14	18.7	54.7	0.98	0.252	1.0	0.096	1.12	0.982	0.097	**N/L**
4.50	14.76	867	15	82.9	64.1	10	1.91	2.9	Clay-Like	45			867	1.13	9.7	43.3	0.98	0.258	1.0	0.088	1.10	0.984	0.089	**N/L**
4.80	15.74	766	14	88.5	66.8	8	2.09	3.0	Clay-Like	49			766	1.12	8.5	41.7	0.98	0.264	1.0	0.087	1.10	0.984	0.088	**N/L**
5.10	16.73	661	10	94.2	69.6	7	1.79	3.0	Clay-Like	49			661	1.10	7.2	40.1	0.97	0.269	1.0	0.085	1.10	0.984	0.086	**N/L**
5.40	17.71	639	10	99.8	72.3	6	1.81	3.1	Clay-Like	53			639	1.09	6.9	39.6	0.97	0.274	1.0	0.085	1.10	0.984	0.086	**N/L**
5.70	18.70	660	11	105.5	75.0	6	1.92	3.1	Clay-Like	53			660	1.08	7.1	39.9	0.97	0.278	1.0	0.085	1.10	0.984	0.086	**N/L**
6.00	19.68	655	10	111.1	77.7	6	1.83	3.1	Clay-Like	53			655	1.07	6.9	39.7	0.97	0.282	1.0	0.085	1.10	0.984	0.085	**N/L**
6.30	20.66	649	11	116.8	80.4	6	2.15	3.1	Clay-Like	53			649	1.06	6.8	39.5	0.97	0.286	1.0	0.085	1.10	0.984	0.085	**N/L**
6.60	21.65	659	12	122.5	83.1	6	2.24	3.1	Clay-Like	53			659	1.05	6.9	39.6	0.96	0.289	1.0	0.085	1.10	0.984	0.085	**N/L**
6.90	22.63	654	12	128.1	85.9	6	2.34	3.1	Clay-Like	53			654	1.04	6.8	39.4	0.96	0.292	1.0	0.085	1.10	0.984	0.085	**N/L**
7.20	23.62	639	17	133.8	88.6	5	3.29	3.2	Clay-Like	58			639	1.04	6.6	39.1	0.96	0.295	1.0	0.085	1.10	0.984	0.084	**N/L**
7.50	24.60	614	16	139.4	91.3	5	3.40	3.3	Clay-Like	62			614	1.03	6.2	38.6	0.95	0.298	1.0	0.084	1.10	0.984	0.084	**N/L**
7.80	25.58	599	15	145.1	94.0	5	3.37	3.3	Clay-Like	62			599	1.02	6.0	38.4	0.95	0.300	1.0	0.084	1.10	0.984	0.083	**N/L**
8.10	26.57	590	12	150.8	96.7	4	2.78	3.3	Clay-Like	62			590	1.01	5.9	38.2	0.95	0.302	1.0	0.084	1.10	0.984	0.083	**N/L**
8.40	27.55	589	12	156.4	99.4	4	2.74	3.3	Clay-Like	62			589	1.00	5.9	38.1	0.95	0.304	1.0	0.084	1.10	0.985	0.083	**N/L**
8.70	28.54	603	12	162.1	102.2	4	2.79	3.3	Clay-Like	62			603	1.00	6.0	38.3	0.94	0.306	1.0	0.084	1.10	0.984	0.083	**N/L**
9.00	29.52	604	17	167.7	104.9	4	3.87	3.4	Clay-Like	67			604	0.99	5.9	38.1	0.94	0.307	1.0	0.084	1.10	0.985	0.083	**N/L**
9.30	30.50	624	12	173.4	107.6	4	2.76	3.3	Clay-Like	62			624	0.98	6.1	38.4	0.94	0.309	1.0	0.084	1.10	0.984	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B396**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		9 ft	2.74 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		9 ft	2.74 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	17356	38	5.4	5.4	740	0.22	0.8	Unsaturated	2			17356	1.70	292.1	292.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	37577	184	10.8	10.8	1133	0.49	1.0	Unsaturated	3			37577	1.70	632.5	632.5	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	30152	277	16.3	16.3	742	0.92	1.3	Unsaturated	6			30152	1.62	483.3	483.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	16326	194	21.7	21.7	348	1.19	1.6	Unsaturated	10			16326	1.50	242.5	261.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	18253	164	27.1	27.1	348	0.90	1.5	Unsaturated	8			18253	1.41	255.7	263.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	14188	169	32.5	32.5	247	1.20	1.7	Unsaturated	11			14188	1.35	189.4	218.2	1.00	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.10	6.89	8589	81	38.0	38.0	138	0.94	1.8	Unsaturated	13			8589	1.29	110.1	140.4	0.99	0.203	1.1	0.236	1.56	0.912	0.237	**N/A**
2.40	7.87	9032	131	43.4	43.4	136	1.46	1.9	Unsaturated	15			9032	1.25	111.8	151.5	0.99	0.203	1.1	0.299	1.69	0.893	0.294	**N/A**
2.70	8.86	7945	202	48.8	48.8	112	2.56	2.2	Unsaturated	22			7945	1.21	95.3	149.1	0.99	0.202	1.1	0.283	1.66	0.898	0.279	**N/A**
3.00	9.84	2798	70	54.4	51.9	38	2.57	2.5		30			2798	1.19	33.0	73.1	0.99	0.212	1.1	0.110	1.16	0.976	0.113	**0.54**
3.30	10.82	17597	217	60.1	54.6	236	1.24	1.7		11			17597	1.18	204.9	235.3	0.99	0.222	1.1	2.000	2.20	0.813	1.789	**2.00**
3.60	11.81	48686	566	65.8	57.4	638	1.16	1.4		7			48686	1.16	559.7	563.4	0.99	0.231	1.1	2.000	2.20	0.813	1.789	**2.00**
3.90	12.79	49589	497	71.4	60.1	635	1.00	1.4		7			49589	1.15	563.1	566.9	0.98	0.239	1.1	2.000	2.20	0.813	1.789	**2.00**
4.20	13.78	24221	181	77.1	62.8	303	0.75	1.5		8			24221	1.13	271.9	280.3	0.98	0.246	1.1	2.000	2.20	0.813	1.789	**2.00**
4.50	14.76	13774	228	82.7	65.5	168	1.67	1.9		15			13774	1.12	152.9	200.9	0.98	0.252	1.1	1.991	2.20	0.813	1.781	**2.00**
4.80	15.74	7323	189	88.4	68.2	87	2.62	2.2		22			7323	1.11	80.4	129.8	0.98	0.258	1.1	0.197	1.46	0.928	0.192	**0.74**
5.10	16.73	3156	96	94.0	70.9	36	3.14	2.6	Clay-Like	34			3156	1.10	34.3	75.6	0.97	0.264	1.0	0.112	1.16	0.974	0.112	**N/L**
5.40	17.71	2647	63	99.7	73.7	29	2.46	2.6	Clay-Like	34			2647	1.09	28.5	67.8	0.97	0.269	1.0	0.106	1.14	0.978	0.106	**N/L**
5.70	18.70	2240	36	105.4	76.4	24	1.67	2.5		30			2240	1.08	23.9	60.9	0.97	0.273	1.0	0.100	1.13	0.980	0.100	**0.37**
6.00	19.68	1982	36	111.0	79.1	21	1.90	2.6	Clay-Like	34			1982	1.07	20.9	57.7	0.97	0.277	1.0	0.098	1.12	0.981	0.098	**N/L**
6.30	20.66	4036	49	116.7	81.8	43	1.24	2.3		24			4036	1.06	42.2	82.6	0.97	0.281	1.0	0.118	1.19	0.971	0.117	**0.42**
6.60	21.65	7236	43	122.3	84.5	77	0.61	1.9		15			7236	1.05	75.1	107.5	0.96	0.284	1.0	0.148	1.30	0.953	0.144	**0.51**
6.90	22.63	7133	50	128.0	87.2	75	0.72	1.9		15			7133	1.04	73.4	105.5	0.96	0.288	1.0	0.145	1.29	0.955	0.141	**0.49**
7.20	23.62	5182	42	133.7	89.9	53	0.84	2.1		19			5182	1.03	52.9	90.8	0.96	0.290	1.0	0.126	1.22	0.966	0.124	**0.43**
7.50	24.60	2101	35	139.3	92.7	20	1.78	2.6	Clay-Like	34			2101	1.02	21.3	58.1	0.95	0.293	1.0	0.098	1.12	0.981	0.097	**N/L**
7.80	25.58	856	26	145.0	95.4	7	3.67	3.2	Clay-Like	58			856	1.02	8.6	41.9	0.95	0.295	1.0	0.087	1.10	0.984	0.086	**N/L**
8.10	26.57	492	13	150.6	98.1	3	3.87	3.4	Clay-Like	67			492	1.01	4.9	36.8	0.95	0.298	1.0	0.083	1.10	0.985	0.082	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B397**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		7.7 ft	2.35 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7.7 ft	2.35 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	13494	61	5.4	5.4	575	0.45	1.1	Unsaturated	4			13494	1.70	227.1	227.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	24562	138	10.8	10.8	741	0.56	1.1	Unsaturated	4			24562	1.70	413.4	413.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	19016	190	16.3	16.3	468	1.00	1.5	Unsaturated	8			19016	1.62	304.8	314.0	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	9782	62	21.7	21.7	208	0.63	1.5	Unsaturated	8			9782	1.50	145.3	150.8	1.00	0.204	1.1	0.294	1.68	0.894	0.289	**N/A**
1.50	4.92	10643	91	27.1	27.1	203	0.86	1.6	Unsaturated	10			10643	1.41	149.1	162.7	1.00	0.204	1.1	0.401	1.83	0.871	0.385	**N/A**
1.80	5.90	11312	117	32.5	32.5	196	1.04	1.7	Unsaturated	11			11312	1.35	151.0	175.8	1.00	0.203	1.1	0.618	2.02	0.841	0.571	**N/A**
2.10	6.89	6943	36	38.0	38.0	111	0.53	1.7	Unsaturated	11			6943	1.29	89.0	107.3	0.99	0.203	1.1	0.148	1.30	0.953	0.155	**N/A**
2.40	7.87	4967	77	43.4	42.9	75	1.55	2.1		19			4967	1.25	61.6	101.9	0.99	0.205	1.1	0.140	1.27	0.958	0.146	**0.71**
2.70	8.86	3743	45	49.1	45.6	54	1.23	2.2		22			3743	1.23	45.7	84.8	0.99	0.218	1.1	0.120	1.19	0.970	0.125	**0.58**
3.00	9.84	3933	65	54.7	48.3	55	1.68	2.3		24			3933	1.21	47.3	89.3	0.99	0.229	1.1	0.125	1.21	0.967	0.129	**0.57**
3.30	10.82	6270	169	60.4	51.1	86	2.73	2.3		24			6270	1.20	74.3	124.8	0.99	0.238	1.1	0.183	1.42	0.934	0.186	**0.78**
3.60	11.81	11902	119	66.1	53.8	160	1.01	1.8		13			11902	1.18	139.2	174.0	0.99	0.247	1.1	0.577	1.99	0.845	0.537	**2.00**
3.90	12.79	11326	178	71.7	56.5	149	1.58	1.9		15			11326	1.17	130.7	174.3	0.98	0.255	1.1	0.585	2.00	0.845	0.543	**2.00**
4.20	13.78	11947	309	77.4	59.2	153	2.60	2.1		19			11947	1.15	136.2	196.7	0.98	0.262	1.1	1.576	2.20	0.813	1.410	**2.00**
4.50	14.76	11153	304	83.0	61.9	140	2.74	2.1		19			11153	1.14	125.6	183.3	0.98	0.268	1.1	0.831	2.15	0.822	0.751	**2.00**
4.80	15.74	2439	65	88.7	64.6	29	2.75	2.6	Clay-Like	34			2439	1.12	27.2	66.0	0.98	0.274	1.0	0.104	1.14	0.978	0.106	**N/L**
5.10	16.73	1091	19	94.4	67.4	12	1.95	2.8	Clay-Like	41			1091	1.11	12.0	46.4	0.97	0.279	1.0	0.090	1.11	0.983	0.091	**N/L**
5.40	17.71	1892	28	100.0	70.1	21	1.58	2.6	Clay-Like	34			1892	1.10	20.6	57.3	0.97	0.283	1.0	0.098	1.12	0.981	0.098	**N/L**
5.70	18.70	4015	49	105.7	72.8	46	1.26	2.2		22			4015	1.09	43.3	81.7	0.97	0.287	1.0	0.117	1.18	0.971	0.117	**0.41**
6.00	19.68	4000	58	111.3	75.5	44	1.49	2.3		24			4000	1.08	42.8	83.3	0.97	0.291	1.0	0.119	1.19	0.971	0.118	**0.41**
6.30	20.66	1374	24	117.0	78.2	14	1.92	2.8	Clay-Like	41			1374	1.07	14.6	49.8	0.97	0.295	1.0	0.092	1.11	0.983	0.092	**N/L**
6.60	21.65	470	16	122.7	80.9	4	4.54	3.4	Clay-Like	67			470	1.06	4.9	36.8	0.96	0.298	1.0	0.083	1.10	0.985	0.083	**N/L**
6.90	22.63	454	16	128.3	83.7	4	4.81	3.5	Clay-Like	73			454	1.05	4.7	36.4	0.96	0.301	1.0	0.083	1.10	0.985	0.083	**N/L**
7.20	23.62	461	15	134.0	86.4	3	4.73	3.5	Clay-Like	73			461	1.04	4.8	36.5	0.96	0.303	1.0	0.083	1.10	0.985	0.083	**N/L**
7.50	24.60	503	16	139.6	89.1	4	4.41	3.4	Clay-Like	67			503	1.03	5.1	37.1	0.95	0.305	1.0	0.083	1.10	0.985	0.083	**N/L**
7.80	25.58	544	13	145.3	91.8	4	3.31	3.3	Clay-Like	62			544	1.03	5.5	37.7	0.95	0.308	1.0	0.084	1.10	0.985	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B398**

Test Boring Information:

Approx. ground elevation		7.3 ft	2.23 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7.3 ft	2.23 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	7513	18	5.4	5.4	320	0.24	1.1	Unsaturated	4			7513	1.70	126.5	126.5	1.00	0.204	1.1	0.187	1.44	0.932	0.192	**N/A**
0.60	1.97	10816	58	10.8	10.8	326	0.53	1.3	Unsaturated	6			10816	1.70	182.0	182.2	1.00	0.204	1.1	0.795	2.13	0.824	0.721	**N/A**
0.90	2.95	16283	78	16.3	16.3	401	0.48	1.2	Unsaturated	4			16283	1.62	261.0	261.0	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	24006	218	21.7	21.7	512	0.91	1.4	Unsaturated	7			24006	1.50	356.6	359.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	13229	231	27.1	27.1	252	1.75	1.8	Unsaturated	13			13229	1.41	185.3	227.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	13349	151	32.5	32.5	232	1.14	1.7	Unsaturated	11			13349	1.35	178.2	205.8	1.00	0.203	1.1	2.667	2.20	0.813	2.000	**N/A**
2.10	6.89	15777	246	38.0	38.0	254	1.56	1.8	Unsaturated	13			15777	1.29	202.2	246.8	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.40	7.87	10155	136	43.5	41.8	155	1.34	1.9		15			10155	1.26	126.9	169.7	0.99	0.211	1.1	0.499	1.93	0.855	0.469	**2.00**
2.70	8.86	4087	126	49.2	44.5	60	3.11	2.4		27			4087	1.24	50.2	94.9	0.99	0.223	1.1	0.131	1.24	0.963	0.137	**0.61**
3.00	9.84	3461	60	54.8	47.2	49	1.77	2.3		24			3461	1.22	41.9	82.1	0.99	0.234	1.1	0.118	1.19	0.971	0.122	**0.52**
3.30	10.82	2255	31	60.5	50.0	31	1.40	2.4		27			2255	1.20	26.9	63.9	0.99	0.244	1.1	0.102	1.13	0.979	0.106	**0.43**
3.60	11.81	1978	27	66.2	52.7	26	1.42	2.5		30			1978	1.19	23.3	60.1	0.99	0.253	1.1	0.100	1.13	0.980	0.103	**0.41**
3.90	12.79	2083	11	71.8	55.4	27	0.57	2.3		24			2083	1.17	24.2	58.9	0.98	0.260	1.0	0.099	1.12	0.981	0.101	**0.39**
4.20	13.78	2255	17	77.5	58.1	28	0.77	2.3		24			2255	1.16	25.8	61.1	0.98	0.267	1.0	0.100	1.13	0.980	0.103	**0.38**
4.50	14.76	2239	28	83.1	60.8	27	1.28	2.4		27			2239	1.14	25.3	61.9	0.98	0.273	1.0	0.101	1.13	0.980	0.103	**0.38**
4.80	15.74	3084	30	88.8	63.5	37	1.00	2.3		24			3084	1.13	34.5	72.5	0.98	0.279	1.0	0.109	1.16	0.976	0.111	**0.40**
5.10	16.73	3800	20	94.5	66.3	45	0.54	2.1		19			3800	1.12	42.0	77.0	0.97	0.284	1.0	0.113	1.17	0.974	0.114	**0.40**
5.40	17.71	2749	19	100.1	69.0	32	0.72	2.2		22			2749	1.11	30.1	64.6	0.97	0.288	1.0	0.103	1.14	0.979	0.104	**0.36**
5.70	18.70	937	4	105.8	71.7	10	0.44	2.6	Clay-Like	34			937	1.09	10.2	43.2	0.97	0.292	1.0	0.088	1.10	0.984	0.088	**N/L**
6.00	19.68	788	4	111.4	74.4	8	0.56	2.8	Clay-Like	41			788	1.08	8.5	41.6	0.97	0.296	1.0	0.086	1.10	0.984	0.087	**N/L**
6.30	20.66	2691	19	117.1	77.1	29	0.75	2.3		24			2691	1.07	28.6	64.7	0.97	0.299	1.0	0.103	1.14	0.979	0.103	**0.34**
6.60	21.65	4346	27	122.8	79.8	47	0.64	2.1		19			4346	1.06	45.8	81.7	0.96	0.302	1.0	0.117	1.18	0.971	0.116	**0.39**
6.90	22.63	2120	25	128.4	82.6	22	1.25	2.5		30			2120	1.05	22.1	58.6	0.96	0.305	1.0	0.098	1.12	0.981	0.098	**0.32**
7.20	23.62	536	7	134.1	85.3	4	1.63	3.2	Clay-Like	58			536	1.05	5.6	37.8	0.96	0.307	1.0	0.084	1.10	0.985	0.083	**N/L**
7.50	24.60	516	6	139.7	88.0	4	1.69	3.2	Clay-Like	58			516	1.04	5.3	37.4	0.95	0.309	1.0	0.084	1.10	0.985	0.083	**N/L**
7.80	25.58	499	6	145.4	90.7	4	1.73	3.2	Clay-Like	58			499	1.03	5.1	37.1	0.95	0.311	1.0	0.083	1.10	0.985	0.083	**N/L**
8.10	26.57	503	5	151.0	93.4	4	1.30	3.2	Clay-Like	58			503	1.02	5.1	37.1	0.95	0.313	1.0	0.083	1.10	0.985	0.083	**N/L**
8.40	27.55	517	5	156.7	96.1	4	1.42	3.2	Clay-Like	58			517	1.01	5.2	37.3	0.95	0.315	1.0	0.084	1.10	0.985	0.083	**N/L**
8.70	28.54	522	5	162.4	98.9	4	1.41	3.2	Clay-Like	58			522	1.01	5.2	37.3	0.94	0.316	1.0	0.084	1.10	0.985	0.082	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B399**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		7.5 ft	2.29 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7.5 ft	2.29 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	5342	20	5.4	5.4	228	0.38	1.4	Unsaturated	7			5342	1.70	89.9	90.9	1.00	0.204	1.1	0.127	1.22	0.966	0.134	**N/A**
0.60	1.97	7151	65	10.8	10.8	215	0.91	1.6	Unsaturated	10			7151	1.70	120.4	132.4	1.00	0.204	1.1	0.205	1.49	0.924	0.208	**N/A**
0.90	2.95	8202	82	16.3	16.3	202	1.00	1.7	Unsaturated	11			8202	1.62	131.5	154.2	1.00	0.204	1.1	0.319	1.72	0.888	0.312	**N/A**
1.20	3.94	15017	146	21.7	21.7	320	0.97	1.5	Unsaturated	8			15017	1.50	223.1	230.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	10962	178	27.1	27.1	209	1.63	1.8	Unsaturated	13			10962	1.41	153.5	190.6	1.00	0.204	1.1	1.156	2.20	0.813	1.034	**N/A**
1.80	5.90	4940	208	32.5	32.5	85	4.23	2.4	Unsaturated	27			4940	1.35	65.9	115.7	1.00	0.203	1.1	0.162	1.36	0.945	0.169	**N/A**
2.10	6.89	5458	115	38.0	38.0	87	2.12	2.2	Unsaturated	22			5458	1.29	70.0	116.2	0.99	0.203	1.1	0.163	1.36	0.944	0.170	**N/A**
2.40	7.87	5044	42	43.5	42.4	76	0.83	2.0		17			5044	1.26	62.8	98.7	0.99	0.208	1.1	0.136	1.25	0.960	0.142	**0.68**
2.70	8.86	3432	20	49.1	45.1	50	0.59	2.0		17			3432	1.24	42.0	72.9	0.99	0.221	1.1	0.110	1.16	0.976	0.114	**0.52**
3.00	9.84	3396	26	54.8	47.8	48	0.77	2.1		19			3396	1.22	41.0	75.6	0.99	0.232	1.1	0.112	1.16	0.974	0.116	**0.50**
3.30	10.82	2730	27	60.5	50.5	37	1.01	2.3		24			2730	1.20	32.4	69.8	0.99	0.241	1.1	0.107	1.15	0.977	0.111	**0.46**
3.60	11.81	4509	43	66.1	53.2	60	0.96	2.1		19			4509	1.18	52.9	90.7	0.99	0.250	1.1	0.126	1.22	0.966	0.130	**0.52**
3.90	12.79	5562	77	71.8	55.9	73	1.40	2.1		19			5562	1.17	64.4	105.3	0.98	0.258	1.1	0.145	1.29	0.955	0.147	**0.57**
4.20	13.78	2455	42	77.4	58.7	31	1.76	2.5		30			2455	1.15	28.0	66.5	0.98	0.264	1.0	0.104	1.14	0.978	0.107	**0.40**
4.50	14.76	8881	98	83.1	61.4	112	1.12	1.9		15			8881	1.14	100.3	137.8	0.98	0.271	1.1	0.225	1.54	0.916	0.221	**0.82**
4.80	15.74	10417	267	88.7	64.1	128	2.59	2.1		19			10417	1.13	116.3	171.4	0.98	0.276	1.1	0.528	1.95	0.852	0.489	**1.77**
5.10	16.73	930	24	94.4	66.8	10	2.90	3.0	Clay-Like	49			930	1.12	10.3	44.2	0.97	0.281	1.0	0.088	1.10	0.984	0.089	**N/L**
5.40	17.71	727	14	100.1	69.5	7	2.23	3.0	Clay-Like	49			727	1.10	7.9	41.1	0.97	0.286	1.0	0.086	1.10	0.984	0.087	**N/L**
5.70	18.70	641	11	105.7	72.2	6	2.09	3.1	Clay-Like	53			641	1.09	6.9	39.7	0.97	0.290	1.0	0.085	1.10	0.984	0.086	**N/L**
6.00	19.68	612	11	111.4	75.0	6	2.25	3.1	Clay-Like	53			612	1.08	6.6	39.2	0.97	0.293	1.0	0.085	1.10	0.984	0.085	**N/L**
6.30	20.66	552	10	117.0	77.7	5	2.22	3.2	Clay-Like	58			552	1.07	5.9	38.2	0.97	0.297	1.0	0.084	1.10	0.984	0.084	**N/L**
6.60	21.65	567	9	122.7	80.4	5	2.08	3.2	Clay-Like	58			567	1.06	6.0	38.3	0.96	0.300	1.0	0.084	1.10	0.984	0.084	**N/L**
6.90	22.63	626	8	128.4	83.1	5	1.56	3.1	Clay-Like	53			626	1.05	6.5	39.1	0.96	0.303	1.0	0.085	1.10	0.984	0.085	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B400**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		7 ft	2.13 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7 ft	2.13 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	17434	65	5.4	5.4	744	0.38	1.0	Unsaturated	3			17434	1.70	293.4	293.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	15114	88	10.8	10.8	456	0.59	1.3	Unsaturated	6			15114	1.70	254.4	254.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	13516	77	16.3	16.3	333	0.57	1.4	Unsaturated	7			13516	1.62	216.6	218.4	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	21973	478	21.7	21.7	468	2.18	1.8	Unsaturated	13			21973	1.50	326.4	390.1	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	19713	263	27.1	27.1	376	1.33	1.6	Unsaturated	10			19713	1.41	276.1	297.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	12935	256	32.5	32.5	225	1.98	1.9	Unsaturated	15			12935	1.35	172.7	224.7	1.00	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.10	6.89	26569	302	38.0	38.0	428	1.14	1.5	Unsaturated	8			26569	1.29	340.5	350.6	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.40	7.87	20297	303	43.6	41.0	314	1.49	1.7		11			20297	1.27	254.9	290.6	0.99	0.216	1.1	2.000	2.20	0.813	1.789	**2.00**
2.70	8.86	8211	158	49.3	43.7	123	1.93	2.0		17			8211	1.25	101.4	146.5	0.99	0.228	1.1	0.267	1.63	0.902	0.265	**1.16**
3.00	9.84	4453	168	54.9	46.4	64	3.81	2.5		30			4453	1.23	54.1	101.3	0.99	0.239	1.1	0.139	1.27	0.958	0.144	**0.60**
3.30	10.82	2775	111	60.6	49.1	38	4.10	2.6	Clay-Like	34			2775	1.21	33.2	74.2	0.99	0.248	1.1	0.111	1.16	0.975	0.115	**N/L**
3.60	11.81	2899	39	66.2	51.9	39	1.39	2.3		24			2899	1.19	34.2	72.1	0.99	0.257	1.1	0.109	1.15	0.976	0.112	**0.44**
3.90	12.79	6863	79	71.9	54.6	91	1.16	2.0		17			6863	1.18	79.9	119.9	0.98	0.264	1.1	0.171	1.39	0.940	0.173	**0.65**
4.20	13.78	5233	56	77.6	57.3	68	1.09	2.1		19			5233	1.16	60.2	100.0	0.98	0.271	1.1	0.137	1.26	0.959	0.140	**0.52**
4.50	14.76	2876	29	83.2	60.0	36	1.04	2.3		24			2876	1.15	32.7	70.1	0.98	0.277	1.0	0.107	1.15	0.977	0.109	**0.39**
4.80	15.74	3118	34	88.9	62.7	38	1.13	2.3		24			3118	1.13	35.0	73.1	0.98	0.283	1.0	0.110	1.16	0.976	0.112	**0.39**
5.10	16.73	3299	32	94.5	65.4	39	0.99	2.2		22			3299	1.12	36.6	73.0	0.97	0.287	1.0	0.110	1.16	0.976	0.111	**0.39**
5.40	17.71	4934	50	100.2	68.2	58	1.03	2.1		19			4934	1.11	54.2	92.4	0.97	0.292	1.0	0.128	1.23	0.965	0.129	**0.44**
5.70	18.70	8232	100	105.8	70.9	96	1.23	2.0		17			8232	1.10	89.5	131.8	0.97	0.296	1.0	0.203	1.48	0.925	0.197	**0.67**
6.00	19.68	8272	116	111.5	73.6	95	1.43	2.0		17			8272	1.09	89.0	131.2	0.97	0.299	1.0	0.201	1.48	0.926	0.194	**0.65**
6.30	20.66	3893	39	117.2	76.3	43	1.03	2.2		22			3893	1.08	41.5	79.4	0.97	0.302	1.0	0.115	1.18	0.973	0.115	**0.38**
6.60	21.65	1187	21	122.8	79.0	12	1.97	2.8	Clay-Like	41			1187	1.07	12.5	47.1	0.96	0.305	1.0	0.090	1.11	0.983	0.090	**N/L**
6.90	22.63	590	10	128.5	81.7	5	2.14	3.2	Clay-Like	58			590	1.06	6.2	38.6	0.96	0.308	1.0	0.084	1.10	0.984	0.084	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B401**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Atmospheric pressure	P_a	101.3 kPa

Test Boring Information:

Approx. ground elevation		8.8 ft	2.68 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		8.8 ft	2.68 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	708	2	5.4	5.4	30	0.24	2.1	Unsaturated	19			708	1.70	11.9	38.6	1.00	0.204	1.1	0.084	1.10	0.984	0.091	**N/A**
0.60	1.97	761	103	10.8	10.8	23	13.75	3.2	Unsaturated	58			761	1.70	12.8	47.6	1.00	0.204	1.1	0.091	1.11	0.983	0.098	**N/A**
0.90	2.95	1837	440	16.3	16.3	45	24.17	3.2	Unsaturated	58			1837	1.62	29.5	70.1	1.00	0.204	1.1	0.107	1.15	0.977	0.115	**N/A**
1.20	3.94	1873	213	21.7	21.7	40	11.49	3.0	Unsaturated	49			1873	1.50	27.8	67.9	1.00	0.204	1.1	0.106	1.14	0.978	0.114	**N/A**
1.50	4.92	1110	3	27.1	27.1	21	0.27	2.3	Unsaturated	24			1110	1.41	15.5	47.5	1.00	0.204	1.1	0.091	1.11	0.983	0.097	**N/A**
1.80	5.90	632	6	32.5	32.5	10	1.02	2.7	Unsaturated	37			632	1.35	8.4	41.3	1.00	0.203	1.1	0.086	1.10	0.984	0.091	**N/A**
2.10	6.89	679	8	38.0	38.0	10	1.32	2.8	Unsaturated	41			679	1.29	8.7	41.9	0.99	0.203	1.1	0.087	1.10	0.984	0.091	**N/A**
2.40	7.87	1259	169	43.4	43.4	18	13.88	3.2	Unsaturated	58			1259	1.25	15.6	51.3	0.99	0.203	1.1	0.093	1.11	0.982	0.097	**N/A**
2.70	8.86	601	7	48.8	48.7	8	1.33	2.9	Clay-Like	45			601	1.21	7.2	40.0	0.99	0.203	1.0	0.085	1.10	0.984	0.088	**N/L**
3.00	9.84	175	10	54.5	51.4	2	8.02	3.9	Clay-Like	96			175	1.28	2.2	32.7	0.99	0.214	1.0	0.081	1.10	0.985	0.083	**N/L**
3.30	10.82	537	199	60.1	54.1	6	41.61	3.9	Clay-Like	96			537	1.18	6.3	38.1	0.99	0.224	1.0	0.084	1.10	0.985	0.086	**N/L**
3.60	11.81	1869	32	65.8	56.8	24	1.75	2.6	Clay-Like	34			1869	1.16	21.5	58.5	0.99	0.233	1.0	0.098	1.12	0.981	0.101	**N/L**
3.90	12.79	2254	169	71.5	59.5	28	7.73	2.9	Clay-Like	45			2254	1.15	25.7	64.9	0.98	0.241	1.0	0.103	1.14	0.979	0.105	**N/L**
4.20	13.78	1282	19	77.1	62.2	15	1.56	2.7	Clay-Like	37			1282	1.14	14.4	49.3	0.98	0.248	1.0	0.092	1.11	0.983	0.093	**N/L**
4.50	14.76	4049	30	82.8	65.0	49	0.76	2.1		19			4049	1.12	45.0	80.8	0.98	0.255	1.0	0.117	1.18	0.972	0.118	**0.46**
4.80	15.74	2042	3	88.4	67.7	24	0.13	2.1		19			2042	1.11	22.5	52.1	0.98	0.261	1.0	0.094	1.11	0.982	0.095	**0.36**
5.10	16.73	12113	15	94.1	70.4	142	0.13	1.4		7			12113	1.10	131.9	133.2	0.97	0.266	1.1	0.208	1.50	0.923	0.201	**0.76**
5.40	17.71	15529	31	99.8	73.1	179	0.20	1.3		6			15529	1.09	167.4	167.6	0.97	0.271	1.1	0.465	1.90	0.860	0.425	**1.57**
5.70	18.70	2179	21	105.4	75.8	24	1.02	2.4		27			2179	1.08	23.3	59.1	0.97	0.275	1.0	0.099	1.13	0.980	0.099	**0.36**
6.00	19.68	220	10	111.1	78.5	1	8.89	4.0	Clay-Like	103			220	1.08	2.4	32.7	0.97	0.279	1.0	0.081	1.10	0.985	0.081	**N/L**
6.30	20.66	305	8	116.7	81.3	2	4.45	3.7	Clay-Like	84			305	1.06	3.2	34.2	0.97	0.283	1.0	0.082	1.10	0.985	0.081	**N/L**
6.60	21.65	1619	20	122.4	84.0	16	1.35	2.6	Clay-Like	34			1619	1.05	16.8	52.2	0.96	0.286	1.0	0.094	1.11	0.982	0.093	**N/L**
6.90	22.63	8940	96	128.1	86.7	94	1.09	2.0		17			8940	1.04	92.2	135.1	0.96	0.289	1.0	0.214	1.51	0.920	0.202	**0.70**
7.20	23.62	3990	36	133.7	89.4	41	0.93	2.2		22			3990	1.03	40.8	78.4	0.96	0.292	1.0	0.114	1.17	0.973	0.113	**0.39**
7.50	24.60	2133	19	139.4	92.1	21	0.94	2.5		30			2133	1.02	21.6	57.9	0.95	0.295	1.0	0.098	1.12	0.981	0.097	**0.33**
7.80	25.58	1577	15	145.0	94.8	15	1.08	2.6	Clay-Like	34			1577	1.02	15.9	50.9	0.95	0.297	1.0	0.093	1.11	0.982	0.092	**N/L**
8.10	26.57	3489	22	150.7	97.5	34	0.66	2.2		22			3489	1.01	34.9	70.8	0.95	0.299	1.0	0.108	1.15	0.977	0.106	**0.35**
8.40	27.55	7565	102	156.3	100.3	74	1.38	2.1		19			7565	1.00	75.0	118.9	0.95	0.301	1.0	0.169	1.38	0.941	0.159	**0.53**
8.70	28.54	7876	64	162.0	103.0	76	0.82	2.0		17			7876	0.99	77.6	117.0	0.94	0.303	1.0	0.165	1.36	0.943	0.155	**0.51**
9.00	29.52	10630	242	167.7	105.7	101	2.31	2.2		22			10630	0.99	104.0	160.3	0.94	0.305	1.0	0.375	1.80	0.876	0.326	**1.07**
9.30	30.50	8667	38	173.3	108.4	81	0.44	1.8		13			8667	0.98	84.2	110.5	0.94	0.306	1.0	0.153	1.32	0.950	0.144	**0.47**
9.60	31.49	1117	10	179.0	111.1	9	1.07	2.8	Clay-Like	41			1117	0.98	10.8	44.7	0.93	0.307	1.0	0.089	1.11	0.984	0.087	**N/L**
9.90	32.47	628	7	184.6	113.8	4	1.69	3.2	Clay-Like	58			628	0.97	6.0	38.4	0.93	0.308	1.0	0.084	1.10	0.984	0.082	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B402**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		6.6 ft	2.01 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		6.6 ft	2.01 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable
N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	15131	52	5.4	5.4	645	0.34	1.0	Unsaturated	3			15131	1.70	254.7	254.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	15866	94	10.8	10.8	478	0.59	1.3	Unsaturated	6			15866	1.70	267.1	267.3	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	9979	62	16.3	16.3	245	0.62	1.5	Unsaturated	8			9979	1.62	159.9	165.8	1.00	0.204	1.1	0.440	1.87	0.864	0.418	**N/A**
1.20	3.94	12063	92	21.7	21.7	257	0.76	1.5	Unsaturated	8			12063	1.50	179.2	185.5	1.00	0.204	1.1	0.915	2.18	0.816	0.821	**N/A**
1.50	4.92	8019	69	27.1	27.1	152	0.86	1.7	Unsaturated	11			8019	1.41	112.3	133.1	1.00	0.204	1.1	0.207	1.49	0.923	0.211	**N/A**
1.80	5.90	2371	59	32.5	32.5	41	2.51	2.5	Unsaturated	30			2371	1.35	31.7	71.3	1.00	0.203	1.1	0.108	1.15	0.976	0.116	**N/A**
2.10	6.89	3272	40	38.0	37.2	53	1.25	2.2		22			3272	1.30	42.2	80.2	0.99	0.208	1.1	0.116	1.18	0.972	0.123	**0.59**
2.40	7.87	5524	132	43.7	39.9	86	2.41	2.2		22			5524	1.28	69.9	116.1	0.99	0.222	1.1	0.163	1.36	0.944	0.169	**0.76**
2.70	8.86	12999	150	49.4	42.6	197	1.16	1.7		11			12999	1.26	161.6	187.5	0.99	0.234	1.1	1.001	2.20	0.813	0.896	**2.00**
3.00	9.84	16446	39	55.0	45.3	242	0.24	1.2		4			16446	1.24	201.2	201.2	0.99	0.245	1.1	2.019	2.20	0.813	1.806	**2.00**
3.30	10.82	9790	68	60.7	48.0	139	0.70	1.7		11			9790	1.22	117.9	139.3	0.99	0.255	1.1	0.231	1.55	0.914	0.232	**0.91**
3.60	11.81	9745	45	66.3	50.8	135	0.47	1.6		10			9745	1.20	115.7	127.4	0.99	0.263	1.1	0.190	1.44	0.931	0.193	**0.73**
3.90	12.79	5782	30	72.0	53.5	78	0.53	1.8		13			5782	1.18	67.7	91.5	0.98	0.270	1.1	0.127	1.22	0.966	0.131	**0.48**
4.20	13.78	6518	50	77.6	56.2	85	0.77	1.9		15			6518	1.17	75.3	107.8	0.98	0.277	1.1	0.148	1.30	0.953	0.151	**0.54**
4.50	14.76	6060	27	83.3	58.9	77	0.46	1.8		13			6060	1.15	69.2	93.2	0.98	0.283	1.1	0.129	1.23	0.964	0.131	**0.46**
4.80	15.74	5474	33	89.0	61.6	68	0.62	1.9		15			5474	1.14	61.7	91.5	0.98	0.288	1.0	0.127	1.22	0.966	0.129	**0.45**
5.10	16.73	10067	27	94.6	64.3	124	0.27	1.5		8			10067	1.13	112.3	117.0	0.97	0.293	1.1	0.165	1.36	0.943	0.164	**0.56**
5.40	17.71	9928	38	100.3	67.0	119	0.39	1.6		10			9928	1.11	109.5	120.9	0.97	0.297	1.1	0.173	1.39	0.939	0.171	**0.58**
5.70	18.70	5674	40	105.9	69.8	66	0.72	2.0		17			5674	1.10	61.9	97.6	0.97	0.301	1.0	0.134	1.25	0.961	0.134	**0.45**
6.00	19.68	3436	26	111.6	72.5	39	0.78	2.2		22			3436	1.09	37.1	73.7	0.97	0.304	1.0	0.110	1.16	0.975	0.111	**0.36**
6.30	20.66	5225	50	117.3	75.2	59	0.99	2.1		19			5225	1.08	55.9	94.6	0.97	0.307	1.0	0.131	1.24	0.963	0.130	**0.42**
6.60	21.65	6375	65	122.9	77.9	70	1.04	2.0		17			6375	1.07	67.6	104.6	0.96	0.310	1.0	0.144	1.29	0.955	0.141	**0.46**
6.90	22.63	4775	31	128.6	80.6	51	0.67	2.0		17			4775	1.06	50.2	83.0	0.96	0.312	1.0	0.119	1.19	0.971	0.118	**0.38**
7.20	23.62	8471	83	134.2	83.3	91	0.99	1.9		15			8471	1.05	88.2	123.3	0.96	0.315	1.0	0.179	1.41	0.936	0.172	**0.55**
7.50	24.60	6812	49	139.9	86.1	71	0.73	1.9		15			6812	1.04	70.4	101.8	0.95	0.317	1.0	0.140	1.27	0.958	0.136	**0.43**
7.80	25.58	754	17	145.6	88.8	6	2.77	3.1	Clay-Like	53			754	1.03	7.7	40.7	0.95	0.319	1.0	0.086	1.10	0.984	0.085	**N/L**
8.10	26.57	660	15	151.2	91.5	5	2.88	3.2	Clay-Like	58			660	1.03	6.7	39.3	0.95	0.320	1.0	0.085	1.10	0.984	0.084	**N/L**
8.40	27.55	684	15	156.9	94.2	5	2.78	3.2	Clay-Like	58			684	1.02	6.9	39.6	0.95	0.322	1.0	0.085	1.10	0.984	0.084	**N/L**
8.70	28.54	748	15	162.5	96.9	6	2.60	3.2	Clay-Like	58			748	1.01	7.5	40.4	0.94	0.323	1.0	0.086	1.10	0.984	0.085	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B403**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		7.2 ft	2.20 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		7.2 ft	2.20 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	18925	81	5.4	5.4	807	0.43	1.0	Unsaturated	3			18925	1.70	318.5	318.5	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	34589	127	10.8	10.8	1043	0.37	0.9	Unsaturated	2			34589	1.70	582.2	582.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	37536	113	16.3	16.3	924	0.30	0.9	Unsaturated	2			37536	1.62	601.6	601.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	30148	203	21.7	21.7	643	0.67	1.2	Unsaturated	4			30148	1.50	447.9	447.9	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	15268	290	27.1	27.1	291	1.90	1.8	Unsaturated	13			15268	1.41	213.9	260.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.80	5.90	17529	158	32.5	32.5	305	0.90	1.5	Unsaturated	8			17529	1.35	234.0	241.6	1.00	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.10	6.89	17709	146	38.0	38.0	285	0.82	1.5	Unsaturated	8			17709	1.29	227.0	234.4	0.99	0.203	1.1	2.000	2.20	0.813	1.789	**N/A**
2.40	7.87	41186	521	43.5	41.5	634	1.27	1.5		8			41186	1.26	515.5	529.7	0.99	0.213	1.1	2.000	2.20	0.813	1.789	**2.00**
2.70	8.86	24148	231	49.2	44.3	360	0.96	1.5		8			24148	1.24	297.2	306.3	0.99	0.225	1.1	2.000	2.20	0.813	1.789	**2.00**
3.00	9.84	4209	203	54.9	47.0	60	4.88	2.5		30			4209	1.22	51.0	97.2	0.99	0.236	1.1	0.134	1.25	0.961	0.139	**0.59**
3.30	10.82	3483	76	60.5	49.7	48	2.22	2.4		27			3483	1.21	41.6	83.4	0.99	0.246	1.1	0.119	1.19	0.970	0.123	**0.50**
3.60	11.81	6079	110	66.2	52.4	83	1.82	2.1		19			6079	1.19	71.6	114.5	0.99	0.254	1.1	0.160	1.35	0.946	0.163	**0.64**
3.90	12.79	12283	125	71.8	55.1	163	1.02	1.8		13			12283	1.17	142.7	178.0	0.98	0.262	1.1	0.672	2.06	0.835	0.617	**2.00**
4.20	13.78	12944	116	77.5	57.8	168	0.90	1.7		11			12944	1.16	148.5	173.0	0.98	0.268	1.1	0.558	1.98	0.848	0.520	**1.94**
4.50	14.76	7642	152	83.2	60.6	97	2.01	2.1		19			7642	1.14	86.6	133.6	0.98	0.274	1.1	0.209	1.50	0.922	0.207	**0.75**
4.80	15.74	2320	34	88.8	63.3	28	1.53	2.5		30			2320	1.13	26.0	63.8	0.98	0.280	1.0	0.102	1.13	0.979	0.104	**0.37**
5.10	16.73	2129	30	94.5	66.0	25	1.45	2.5		30			2129	1.12	23.6	60.5	0.97	0.285	1.0	0.100	1.13	0.980	0.101	**0.36**
5.40	17.71	4925	132	100.1	68.7	58	2.74	2.4		27			4925	1.11	54.0	99.9	0.97	0.289	1.0	0.137	1.26	0.959	0.137	**0.47**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B404**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		6.3 ft	1.92 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		6.3 ft	1.92 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	15151	35	5.4	5.4	646	0.23	0.9	Unsaturated	2			15151	1.70	255.0	255.0	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	19882	127	10.8	10.8	599	0.64	1.2	Unsaturated	4			19882	1.70	334.6	334.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	22225	254	16.3	16.3	547	1.15	1.5	Unsaturated	8			22225	1.62	356.2	366.7	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	17450	231	21.7	21.7	372	1.33	1.6	Unsaturated	10			17450	1.50	259.2	279.3	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.50	4.92	8982	162	27.1	27.1	171	1.81	1.9	Unsaturated	15			8982	1.41	125.8	168.4	1.00	0.204	1.1	0.478	1.91	0.858	0.451	**N/A**
1.80	5.90	7913	172	32.5	32.5	137	2.18	2.1	Unsaturated	19			7913	1.35	105.6	157.8	1.00	0.203	1.1	0.350	1.76	0.881	0.339	**N/A**
2.10	6.89	6087	159	38.1	36.3	100	2.63	2.2		22			6087	1.31	78.9	127.9	0.99	0.213	1.1	0.191	1.45	0.930	0.195	**0.92**
2.40	7.87	4300	91	43.8	39.1	68	2.15	2.3		24			4300	1.28	54.7	99.0	0.99	0.227	1.1	0.136	1.26	0.960	0.144	**0.63**
2.70	8.86	2527	83	49.4	41.8	38	3.34	2.6	Clay-Like	34			2527	1.26	31.6	72.0	0.99	0.239	1.1	0.109	1.15	0.976	0.114	**N/L**
3.00	9.84	3523	68	55.1	44.5	52	1.95	2.3		24			3523	1.24	43.3	84.0	0.99	0.250	1.1	0.120	1.19	0.970	0.125	**0.50**
3.30	10.82	6192	94	60.7	47.2	89	1.53	2.1		19			6192	1.22	74.9	118.8	0.99	0.259	1.1	0.169	1.38	0.941	0.174	**0.67**
3.60	11.81	7013	87	66.4	49.9	98	1.25	2.0		17			7013	1.20	83.6	124.5	0.99	0.268	1.1	0.182	1.42	0.934	0.185	**0.69**
3.90	12.79	10224	85	72.1	52.6	139	0.84	1.8		13			10224	1.19	120.2	152.1	0.98	0.275	1.1	0.303	1.69	0.892	0.297	**1.08**
4.20	13.78	7782	109	77.7	55.4	103	1.42	2.0		17			7782	1.17	90.3	132.8	0.98	0.281	1.1	0.206	1.49	0.924	0.206	**0.73**
4.50	14.76	3518	64	83.4	58.1	45	1.85	2.4		27			3518	1.16	40.3	81.7	0.98	0.287	1.1	0.117	1.18	0.971	0.120	**0.42**
4.80	15.74	810	16	89.0	60.8	9	2.23	3.0	Clay-Like	49			810	1.14	9.2	42.7	0.98	0.292	1.0	0.087	1.10	0.984	0.089	**N/L**
5.10	16.73	529	11	94.7	63.5	5	2.62	3.2	Clay-Like	58			529	1.13	5.9	38.3	0.97	0.297	1.0	0.084	1.10	0.984	0.085	**N/L**
5.40	17.71	510	11	100.4	66.2	5	2.68	3.2	Clay-Like	58			510	1.12	5.6	37.9	0.97	0.301	1.0	0.084	1.10	0.985	0.085	**N/L**
5.70	18.70	497	10	106.0	68.9	5	2.67	3.2	Clay-Like	58			497	1.11	5.4	37.6	0.97	0.304	1.0	0.084	1.10	0.985	0.085	**N/L**
6.00	19.68	474	9	111.7	71.7	4	2.35	3.3	Clay-Like	62			474	1.09	5.1	37.2	0.97	0.308	1.0	0.083	1.10	0.985	0.084	**N/L**
6.30	20.66	451	7	117.3	74.4	4	2.09	3.3	Clay-Like	62			451	1.08	4.8	36.7	0.97	0.311	1.0	0.083	1.10	0.985	0.084	**N/L**
6.60	21.65	485	7	123.0	77.1	4	1.97	3.2	Clay-Like	58			485	1.07	5.2	37.2	0.96	0.313	1.0	0.084	1.10	0.985	0.084	**N/L**
6.90	22.63	517	7	128.7	79.8	4	1.84	3.2	Clay-Like	58			517	1.06	5.4	37.6	0.96	0.316	1.0	0.084	1.10	0.985	0.084	**N/L**
7.20	23.62	516	6	134.3	82.5	4	1.45	3.2	Clay-Like	58			516	1.05	5.4	37.6	0.96	0.318	1.0	0.084	1.10	0.985	0.084	**N/L**
7.50	24.60	528	5	140.0	85.2	4	1.37	3.2	Clay-Like	58			528	1.05	5.5	37.7	0.95	0.320	1.0	0.084	1.10	0.985	0.083	**N/L**
7.80	25.58	553	3	145.6	88.0	4	0.86	3.1	Clay-Like	53			553	1.04	5.7	38.0	0.95	0.322	1.0	0.084	1.10	0.985	0.083	**N/L**

CONE PENETRATION TEST-BASED LIQUEFACTION ANALYSIS BASED ON IDRISS & BOULANGER (2008)

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**CPT-IR03B404**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g

Test Boring Information:

Approx. ground elevation		6 ft	1.83 m
Approx. water table elevation		0 ft	0.00 m
Approx. depth to ground water table		6 ft	1.83 m
Moist unit weight of soil	γ_m	115 pcf	18.08 kN/m^3
Saturated unit weight of soil	γ_{sat}	120 pcf	18.86 kN/m^3

Atmospheric pressure	P_a	101.3 kPa

N/A = Not Applicable

N/L = Non-liquefiable clay-like soil

Depth, Z (m)	Depth, Z (ft)	q_t (kPa)	f_s (kPa)	σ_{vc} (kPa)	σ'_{vc} (kPa)	Q	F	I_c	Soil Type	Fines (%)	Interpreted q_C Near Interface	Thin Layer Factor	Interpreted q_c	C_N	q_{c1N}	q_{c1N-cs}	Stress Reduction Factor (r_d)	CSR	K_σ for sand	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
0.30	0.98	22709	61	5.4	5.4	969	0.27	0.8	Unsaturated	2			22709	1.70	382.2	382.2	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.60	1.97	21035	351	10.8	10.8	634	1.67	1.6	Unsaturated	10			21035	1.70	354.1	379.6	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
0.90	2.95	12906	96	16.3	16.3	318	0.75	1.5	Unsaturated	8			12906	1.62	206.9	213.8	1.00	0.204	1.1	2.000	2.20	0.813	1.789	**N/A**
1.20	3.94	7273	53	21.7	21.7	155	0.72	1.7	Unsaturated	11			7273	1.50	108.0	128.4	1.00	0.204	1.1	0.192	1.45	0.930	0.197	**N/A**
1.50	4.92	2658	52	27.1	27.1	50	1.96	2.3	Unsaturated	24			2658	1.41	37.2	76.0	1.00	0.204	1.1	0.112	1.17	0.974	0.120	**N/A**
1.80	5.90	3908	72	32.5	32.5	68	1.85	2.2	Unsaturated	22			3908	1.35	52.2	93.2	1.00	0.203	1.1	0.129	1.23	0.964	0.137	**N/A**
2.10	6.89	3983	86	38.2	35.5	66	2.17	2.3		24			3983	1.32	52.0	95.4	0.99	0.218	1.1	0.132	1.24	0.963	0.139	**0.64**
2.40	7.87	2129	56	43.8	38.2	33	2.67	2.5		30			2129	1.29	27.2	65.4	0.99	0.232	1.1	0.104	1.14	0.979	0.109	**0.47**
2.70	8.86	3387	70	49.5	41.0	52	2.11	2.3		24			3387	1.27	42.5	83.0	0.99	0.245	1.1	0.119	1.19	0.971	0.125	**0.51**
3.00	9.84	9737	96	55.2	43.7	146	0.99	1.8		13			9737	1.25	120.3	152.2	0.99	0.255	1.1	0.304	1.69	0.892	0.298	**1.17**
3.30	10.82	7813	96	60.8	46.4	113	1.24	1.9		15			7813	1.23	95.0	131.4	0.99	0.264	1.1	0.202	1.48	0.925	0.205	**0.78**
3.60	11.81	675	10	66.5	49.1	9	1.69	2.9	Clay-Like	45			675	1.21	8.1	41.2	0.99	0.272	1.0	0.086	1.10	0.984	0.089	**N/L**
3.90	12.79	690	20	72.1	51.8	9	3.29	3.1	Clay-Like	53			690	1.19	8.1	41.3	0.98	0.279	1.0	0.086	1.10	0.984	0.089	**N/L**
4.20	13.78	532	13	77.8	54.5	6	2.86	3.2	Clay-Like	58			532	1.18	6.2	38.7	0.98	0.286	1.0	0.084	1.10	0.984	0.086	**N/L**
4.50	14.76	467	10	83.5	57.3	5	2.60	3.2	Clay-Like	58			467	1.16	5.4	37.5	0.98	0.291	1.0	0.084	1.10	0.985	0.085	**N/L**
4.80	15.74	448	9	89.1	60.0	5	2.46	3.2	Clay-Like	58			448	1.15	5.1	37.2	0.98	0.296	1.0	0.083	1.10	0.985	0.085	**N/L**
5.10	16.73	468	7	94.8	62.7	5	1.87	3.2	Clay-Like	58			468	1.13	5.3	37.4	0.97	0.301	1.0	0.084	1.10	0.985	0.085	**N/L**
5.40	17.71	486	7	100.4	65.4	5	1.72	3.2	Clay-Like	58			486	1.12	5.4	37.6	0.97	0.305	1.0	0.084	1.10	0.985	0.085	**N/L**
5.70	18.70	464	6	106.1	68.1	4	1.79	3.2	Clay-Like	58			464	1.11	5.1	37.2	0.97	0.308	1.0	0.083	1.10	0.985	0.084	**N/L**
6.00	19.68	467	4	111.7	70.8	4	1.10	3.1	Clay-Like	53			467	1.10	5.1	37.2	0.97	0.312	1.0	0.084	1.10	0.985	0.084	**N/L**
6.30	20.66	493	4	117.4	73.5	4	0.94	3.1	Clay-Like	53			493	1.09	5.3	37.5	0.97	0.314	1.0	0.084	1.10	0.985	0.084	**N/L**
6.60	21.65	512	3	123.1	76.3	4	0.85	3.0	Clay-Like	49			512	1.08	5.5	37.7	0.96	0.317	1.0	0.084	1.10	0.985	0.084	**N/L**
6.90	22.63	523	1	128.7	79.0	4	0.35	2.9	Clay-Like	45			523	1.07	5.5	37.7	0.96	0.319	1.0	0.084	1.10	0.985	0.084	**N/L**

Attachment F5
Analysis of Liquefaction Potential Using SPT Data

(This attachment is provided on CD only)

STANDARD PENETRATION TEST-BASED LIQUEFACTION AND SETTLEMENT ANALYSES, AND ESTIMATION OF RESIDUAL SHEAR STRENGTH RATIO

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Ishihara, K. and Yoshimine, M. (1992). "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," *Soils and Foundations* , Vol. 32, No. 1, pp. 173-188, March 1992.

3 - Tokimatsu, K. and Seed H.B. (1987). "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

4 - Pradel, D. (1998). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 4, April.

5 - Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 3, March.

6 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02B-600**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g
Number of equivalent cycles (Pradel, 1998)	N_c	20.3

Test Boring Information:

Ground elevation		14 ft
Water table elevation		3 ft
Depth to ground water table		11 ft
Moist unit weight of soil	γ_m	115 pcf
Saturated unit weight of soil	γ_{sat}	120 pcf

Input for N correction factors:

Is correction for non-standardized sampler required?	No	"No" or "Yes"
Borehole diameter	4.875 inch	
Energy applied by automatic hammer	75 %	

Factor of Safety Against Liquefaction

Based on Idriss & Boulanger (2008) and Boulanger & Idriss (2014)

Depth, Z (ft)	N	Soil Type	Fines Content (%)	PI "< 7" or "> 7"	σ_{vc} (psf)	σ'_{vc} (psf)	$\alpha(z)$	$\beta(z)$	r_d	CSR_{eq}	C_R	C_S	C_B	C_E	N_{60}	C_N	$N_{1,60}$	C_σ	K_σ	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
5.5	31	Sandy Silt	18.6	< 7	632.5	632.5	-0.060	0.007	1.00	0.204	0.800	1.00	1.05	1.25	33	1.52	49	0.30	1.10	4.2	53.6	2.000	2.20	0.81	1.789	**UNSAT**
9.5	25	Sandy Silt	18.6	< 7	1092.5	1092.5	-0.128	0.015	0.99	0.202	0.850	1.00	1.05	1.25	28	1.28	36	0.27	1.10	4.2	40.0	2.000	2.20	0.81	1.789	**UNSAT**
14.5	13	Gravelly Sand		< 7	1685	1466.6	-0.225	0.026	0.98	0.230	0.850	1.00	1.05	1.25	15	1.20	17	0.12	1.04	0.0	17.4	0.177	1.39	0.94	0.174	**0.76**
19.5	12	Gravelly Sand		< 7	2285	1754.6	-0.337	0.038	0.97	0.257	0.950	1.00	1.05	1.25	15	1.10	16	0.12	1.02	0.0	16.4	0.168	1.36	0.94	0.162	**0.63**

Settlement of Saturated Sand						
Ishihara & Yoshimine (1992) and Idriss & Boulanger (2008)						
γ_{lim}	F_α	γ_{max}	ΔZ_i	ε_v	DF_i	ΔS_i (inches)
0.000	-1.888	0.000	4.75	0.000	0.91	0.00
0.009	-0.807	0.000	4.5	0.000	0.84	0.00
0.213	0.650	0.142	5	0.026	0.76	1.17
0.237	0.695	0.237	2.5	0.027	0.68	0.55
			Subtotal			1.7

Settlement of Dry Sand									
Tokimatsu & Seed (1987) and Pradel (1998)									
$p = \sigma_m$ (tsf)	τ_{ave} (psf)	G_{max} (tsf)	τ_{ave}/G_{max}	a	b	γ_{eff} (%)	ε_{15} (%)	ε_{Nc} (%)	Settlement (inch)
0.212	129	3386	1.9E-05	0.1322	16237	1.98E-03	0.0007	0.0008	0.01
0.366	221	3225	3.4E-05	0.1382	11698	3.63E-03	0.0018	0.0021	0.02
0.491	337	1812	9.3E-05	0.1431	9803	1.10E-02	0.0131	0.0149	N/A
0.588	449	1871	1.2E-04	0.1469	8803	1.49E-02	0.0189	0.0217	N/A
								Subtotal	0.0

Residual Shear Strength		
Idriss & Boulanger (2008)		
$\Delta(N_1)_{60\text{-}Sr}$	$(N_1)_{60\text{-}Sr}$	S_u/σ_{vc}'
1.7	51	N/A
1.7	37	N/A
0.0	17	0.15
0.0	16	0.14
	Average	0.14

Total Settlement = 1.7 inches

STANDARD PENETRATION TEST-BASED LIQUEFACTION AND SETTLEMENT ANALYSES, AND ESTIMATION OF RESIDUAL SHEAR STRENGTH RATIO

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Ishihara, K. and Yoshimine, M. (1992). "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," *Soils and Foundations* , Vol. 32, No. 1, pp. 173-188, March 1992.

3 - Tokimatsu, K. and Seed H.B. (1987). "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

4 - Pradel, D. (1998). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 4, April.

5 - Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 3, March.

6 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02B-602**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g
Number of equivalent cycles (Pradel, 1998)	N_c	20.3

Test Boring Information:

Ground elevation		13 ft
Water table elevation		3 ft
Depth to ground water table		10 ft
Moist unit weight of soil	γ_m	115 pcf
Saturated unit weight of soil	γ_{sat}	120 pcf

Input for N correction factors:

Is correction for non-standardized sampler required?	No	"No" or "Yes"
Borehole diameter	4.875 inch	
Energy applied by automatic hammer	75 %	

Factor of Safety Against Liquefaction

Based on Idriss & Boulanger (2008) and Boulanger & Idriss (2014)

Depth, Z (ft)	N	Soil Type	Fines Content (%)	PI "< 7" or "> 7"	σ_{vc} (psf)	σ'_{vc} (psf)	$\alpha(z)$	$\beta(z)$	r_d	CSR_{eq}	C_R	C_S	C_B	C_E	N_{60}	C_N	$N_{1,60}$	C_σ	K_σ	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
6.5	30	Silty Sand		< 7	747.5	747.5	-0.076	0.009	1.00	0.203	0.800	1.00	1.05	1.25	32	1.44	45	0.30	1.10	0.0	45.5	2.000	2.20	0.81	1.789	**UNSAT**
11.5	8	Sandy Silt		< 7	1330	1236.4	-0.165	0.019	0.99	0.217	0.850	1.00	1.05	1.25	9	1.35	12	0.10	1.05	0.0	12.0	0.133	1.24	0.96	0.135	**0.62**
16.5	4	Lean Clay		> 7	1930	1524.4	-0.268	0.030	0.98	0.252	0.950	1.00	1.05	1.25	5	1.22	6	0.08	1.03	0.0	6.1	0.093	1.13	0.98	0.093	**N/A**

Settlement of Saturated Sand						
Ishihara & Yoshimine (1992) and Idriss & Boulanger (2008)						
γ_{lim}	F_α	γ_{max}	ΔZ_i	ε_v	DF_i	ΔS_i (inches)
0.002	-1.227	0.000	5.75	0.000	0.89	0.00
0.379	0.862	0.379	5	0.033	0.81	1.62
0.500	1.065	0.000	2.5	0.000	0.73	0.00
			Subtotal			1.6

Settlement of Dry Sand									
Tokimatsu & Seed (1987) and Pradel (1998)									
$p = \sigma_m$ (tsf)	τ_{ave} (psf)	G_{max} (tsf)	τ_{ave}/G_{max}	a	b	γ_{eff} (%)	ε_{15} (%)	ε_{Nc} (%)	Settlement (inch)
0.250	152	3388	2.2E-05	0.1337	14689	2.35E-03	0.0009	0.0010	0.01
0.414	268	1152	1.2E-04	0.1401	10861	1.53E-02	0.0281	0.0322	N/A
0.511	383	649	3.0E-04	0.1439	9578	8.90E-02	0.3701	0.4237	N/A
								Subtotal	0.0

Residual Shear Strength		
Idriss & Boulanger (2008)		
$\Delta(N_1)_{60\text{-}Sr}$	$(N_1)_{60\text{-}Sr}$	S_u/σ_{vc}'
0.0	45	N/A
0.0	12	0.10
0.0	6	N/A
	Average	0.10

Total Settlement = 1.6 inches

STANDARD PENETRATION TEST-BASED LIQUEFACTION AND SETTLEMENT ANALYSES, AND ESTIMATION OF RESIDUAL SHEAR STRENGTH RATIO

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Ishihara, K. and Yoshimine, M. (1992). "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," *Soils and Foundations* , Vol. 32, No. 1, pp. 173-188, March 1992.

3 - Tokimatsu, K. and Seed H.B. (1987). "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

4 - Pradel, D. (1998). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 4, April.

5 - Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 3, March.

6 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02B-605**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g
Number of equivalent cycles (Pradel, 1998)	N_c	20.3

Test Boring Information:

Ground elevation		6 ft
Water table elevation		0 ft
Depth to ground water table		6 ft
Moist unit weight of soil	γ_m	115 pcf
Saturated unit weight of soil	γ_{sat}	120 pcf

Input for N correction factors:

Is correction for non-standardized sampler required?	No	"No" or "Yes"
Borehole diameter	4.875 inch	
Energy applied by automatic hammer	75 %	

Factor of Safety Against Liquefaction

Based on Idriss & Boulanger (2008) and Boulanger & Idriss (2014)

Depth, Z (ft)	N	Soil Type	Fines Content (%)	PI "< 7" or "> 7"	σ_{vc} (psf)	σ'_{vc} (psf)	$\alpha(z)$	$\beta(z)$	r_d	CSR_{eq}	C_R	C_S	C_B	C_E	N_{60}	C_N	$N_{1,60}$	C_σ	K_σ	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
8.5	6	Sandy Gravel		< 7	990	834	-0.110	0.013	0.99	0.240	0.850	1.00	1.05	1.25	7	1.70	11	0.10	1.09	0.0	11.4	0.128	1.22	0.97	0.135	**0.56**
13.5	5	Gravelly Sand		< 7	1590	1122	-0.205	0.023	0.98	0.284	0.850	1.00	1.05	1.25	6	1.47	8	0.09	1.05	0.0	8.2	0.106	1.16	0.98	0.109	**0.38**
18.5	4	Gravelly Sand		< 7	2190	1410	-0.313	0.035	0.97	0.308	0.950	1.00	1.05	1.25	5	1.28	6	0.08	1.03	0.0	6.4	0.094	1.13	0.98	0.096	**0.31**
23.5	7	Sand		< 7	2790	1698	-0.434	0.049	0.96	0.321	0.950	1.00	1.05	1.25	9	1.13	10	0.09	1.02	0.0	9.9	0.117	1.19	0.97	0.116	**0.36**

Settlement of Saturated Sand						
Ishihara & Yoshimine (1992) and Idriss & Boulanger (2008)						
γ_{lim}	F_α	γ_{max}	ΔZ_i	ε_v	DF_i	ΔS_i (inches)
0.407	0.880	0.407	6.75	0.035	0.86	2.40
0.500	0.942	0.500	7.5	0.042	0.78	2.91
0.500	1.026	0.500	5	0.047	0.69	1.96
0.480	0.917	0.480	2.5	0.038	0.61	0.69
			Subtotal			8.0

Settlement of Dry Sand										
Tokimatsu & Seed (1987) and Pradel (1998)										
$p = \sigma_m$ (tsf)	τ_{ave} (psf)	G_{max} (tsf)	τ_{ave}/G_{max}	a	b	γ_{eff} (%)	ε_{15} (%)	ε_{Nc} (%)	Settlement (inch)
0.279	201	895	1.1E-04	0.1349	13755	1.61E-02	0.0317	0.0362	N/A
0.376	319	746	2.1E-04	0.1386	11512	4.92E-02	0.1438	0.1646	N/A
0.472	432	654	3.3E-04	0.1424	10037	1.42E-01	0.5587	0.6396	N/A
0.569	540	1108	2.4E-04	0.1461	8978	4.89E-02	0.1142	0.1307	N/A
								Subtotal	0.0

Residual Shear Strength		
Idriss & Boulanger (2008)		
$\Delta(N_1)_{60\text{-}Sr}$	$(N_1)_{60\text{-}Sr}$	S_u/σ_{vc}'
0.0	11	0.10
0.0	8	0.08
0.0	6	0.07
0.0	10	0.09
	Average	0.08

Total Settlement = 8.0 inches

STANDARD PENETRATION TEST-BASED LIQUEFACTION AND SETTLEMENT ANALYSES, AND ESTIMATION OF RESIDUAL SHEAR STRENGTH RATIO

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Ishihara, K. and Yoshimine, M. (1992). "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," *Soils and Foundations* , Vol. 32, No. 1, pp. 173-188, March 1992.

3 - Tokimatsu, K. and Seed H.B. (1987). "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

4 - Pradel, D. (1998). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 4, April.

5 - Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 3, March.

6 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR03B-606**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g
Number of equivalent cycles (Pradel, 1998)	N_c	20.3

Test Boring Information:

Ground elevation		9 ft
Water table elevation		1 ft
Depth to ground water table		8 ft
Moist unit weight of soil	γ_m	115 pcf
Saturated unit weight of soil	γ_{sat}	120 pcf

Input for N correction factors:

Is correction for non-standardized sampler required?	No	"No" or "Yes"
Borehole diameter	4.875 inch	
Energy applied by automatic hammer	75 %	

Factor of Safety Against Liquefaction

Based on Idriss & Boulanger (2008) and Boulanger & Idriss (2014)

Depth, Z (ft)	N	Soil Type	Fines Content (%)	PI "< 7" or "> 7"	σ_{vc} (psf)	σ'_{vc} (psf)	$\alpha(z)$	$\beta(z)$	r_d	CSR_{eq}	C_R	C_S	C_B	C_E	N_{60}	C_N	$N_{1,60}$	C_σ	K_σ	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
8.5	10	Silty Sand		< 7	980	948.8	-0.110	0.013	0.99	0.209	0.850	1.00	1.05	1.25	11	1.53	17	0.12	1.10	0.0	17.0	0.174	1.38	0.94	0.180	**0.86**
13.5	0.5	Silty Sand		< 7	1580	1236.8	-0.205	0.023	0.98	0.256	0.850	1.00	1.05	1.25	1	1.48	1	0.06	1.03	0.0	0.8	0.064	1.09	0.99	0.066	**0.26**
18.5	7	Silty Sand		< 7	2180	1524.8	-0.313	0.035	0.97	0.283	0.950	1.00	1.05	1.25	9	1.20	10	0.09	1.03	0.0	10.5	0.121	1.20	0.97	0.121	**0.43**

Settlement of Saturated Sand						
Ishihara & Yoshimine (1992) and Idriss & Boulanger (2008)						
γ_{lim}	F_α	γ_{max}	ΔZ_i	ε_v	DF_i	ΔS_i (inches)
0.221	0.665	0.069	6.75	0.023	0.86	1.58
0.500	1.750	0.500	5	0.086	0.78	3.99
0.449	0.903	0.449	2.5	0.036	0.69	0.75
			Subtotal			6.3

Settlement of Dry Sand										
Tokimatsu & Seed (1987) and Pradel (1998)										
$p = \sigma_m$ (tsf)	τ_{ave} (psf)	G_{max} (tsf)	τ_{ave}/G_{max}	a	b	γ_{eff} (%)	ε_{15} (%)	ε_{Nc} (%)	Settlement (inch)
0.318	199	1429	6.9E-05	0.1364	12731	8.13E-03	0.0099	0.0113	N/A
0.414	317	79	2.0E-03	0.1401	10859	7.08E+07	#######	#######	N/A
0.511	430	1114	1.9E-04	0.1439	9577	3.23E-02	0.0702	0.0803	N/A
								Subtotal	0.0

Residual Shear Strength		
Idriss & Boulanger (2008)		
$\Delta(N_1)_{60\text{-}Sr}$	$(N_1)_{60\text{-}Sr}$	S_u/σ_{vc}'
0.0	17	0.14
0.0	1	0.04
0.0	10	0.09
	Average	0.09

Total Settlement = 6.3 inches

STANDARD PENETRATION TEST-BASED LIQUEFACTION AND SETTLEMENT ANALYSES, AND ESTIMATION OF RESIDUAL SHEAR STRENGTH RATIO

References:

1 - Idriss, I.M. and Boulanger, R.W. (2008). *Soil Liquefaction During Earthquakes* , Earthquake Engineering Research Institute, EERI Publication MNO-12.

2 - Ishihara, K. and Yoshimine, M. (1992). "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," *Soils and Foundations* , Vol. 32, No. 1, pp. 173-188, March 1992.

3 - Tokimatsu, K. and Seed H.B. (1987). "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

4 - Pradel, D. (1998). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 4, April.

5 - Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). "Procedure to Evaluate Earthquake-Induced Settlements in Sand," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 3, March.

6 - Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT Based Liquefaction Triggering Procedures," Report No. UCD/CGM-14/01, University of California at Davis

Project	**Hunters Point Naval Shipyard, Parcel E Remedial Design**
Test Boring No	**IR02B295**

Earthquake Information:

Earthquake magnitude	M_w	8
Peak horizontal ground surface acceleration	a_{max}	0.314 g
Number of equivalent cycles (Pradel, 1998)	N_c	20.3

Test Boring Information:

Ground elevation		7.01 ft
Water table elevation		1 ft
Depth to ground water table		6.01 ft
Moist unit weight of soil	γ_m	115 pcf
Saturated unit weight of soil	γ_{sat}	120 pcf

Input for N correction factors:

Is correction for non-standardized sampler required?	No	"No" or "Yes"
Borehole diameter	10 inch	
Energy applied by automatic hammer	60 %	

Factor of Safety Against Liquefaction

Based on Idriss & Boulanger (2008) and Boulanger & Idriss (2014)

Depth, Z (ft)	N	Soil Type	Fines Content (%)	PI "< 7" or "> 7"	σ_{vc} (psf)	σ'_{vc} (psf)	$\alpha(z)$	$\beta(z)$	r_d	CSR_{eq}	C_R	C_S	C_B	C_E	N_{60}	C_N	$N_{1,60}$	C_σ	K_σ	$\Delta(N_1)_{60}$	$(N_1)_{60cs}$	$CRR_{M=7.5}$ at σ'_{vc}=1	MSF_{max}	MSF	CRR	$(FS)_L$
2.5	50	Silty Gravel		< 7	287.5	287.5	-0.016	0.002	1.00	0.205	0.750	1.00	1.15	1.00	43	1.70	73	0.30	1.10	0.0	73.3	2.000	2.20	0.81	1.789	**UNSAT**
6	23	Sandy Clay		> 7	690	690	-0.068	0.008	1.00	0.203	0.800	1.00	1.15	1.00	21	1.62	34	0.25	1.10	0.0	34.3	0.960	2.20	0.81	0.859	**UNSAT**
8.5	7	Snady Caly		> 7	989.95	834.57	-0.110	0.013	0.99	0.240	0.850	1.00	1.15	1.00	7	1.70	12	0.10	1.09	0.0	11.6	0.130	1.23	0.96	0.137	**N/A**
11	7	Sandy Clay		> 7	1289.95	978.57	-0.156	0.018	0.99	0.266	0.850	1.00	1.15	1.00	7	1.57	11	0.09	1.07	0.0	10.7	0.123	1.21	0.97	0.128	**N/A**
16	10	Sand		< 7	1889.95	1266.6	-0.257	0.029	0.98	0.297	0.950	1.00	1.15	1.00	11	1.31	14	0.11	1.06	0.0	14.3	0.151	1.30	0.95	0.152	**0.51**
21	10	Sand		< 7	2489.95	1554.6	-0.372	0.042	0.96	0.315	0.950	1.00	1.15	1.00	11	1.18	13	0.10	1.03	0.0	12.9	0.139	1.26	0.96	0.138	**0.44**

Settlement of Saturated Sand						
Ishihara & Yoshimine (1992) and Idriss & Boulanger (2008)						
γ_{lim}	F_α	γ_{max}	ΔZ_i	ε_v	DF_i	ΔS_i (inches)
0.000	-3.591	0.000	3	0.000	0.96	0.00
0.025	-0.385	0.000	3	0.000	0.90	0.00
0.396	0.873	0.000	2.5	0.000	0.86	0.00
0.437	0.897	0.000	3.75	0.000	0.82	0.00
0.295	0.781	0.295	5	0.030	0.73	1.31
0.346	0.834	0.346	2.5	0.032	0.65	0.62
			Subtotal			1.9

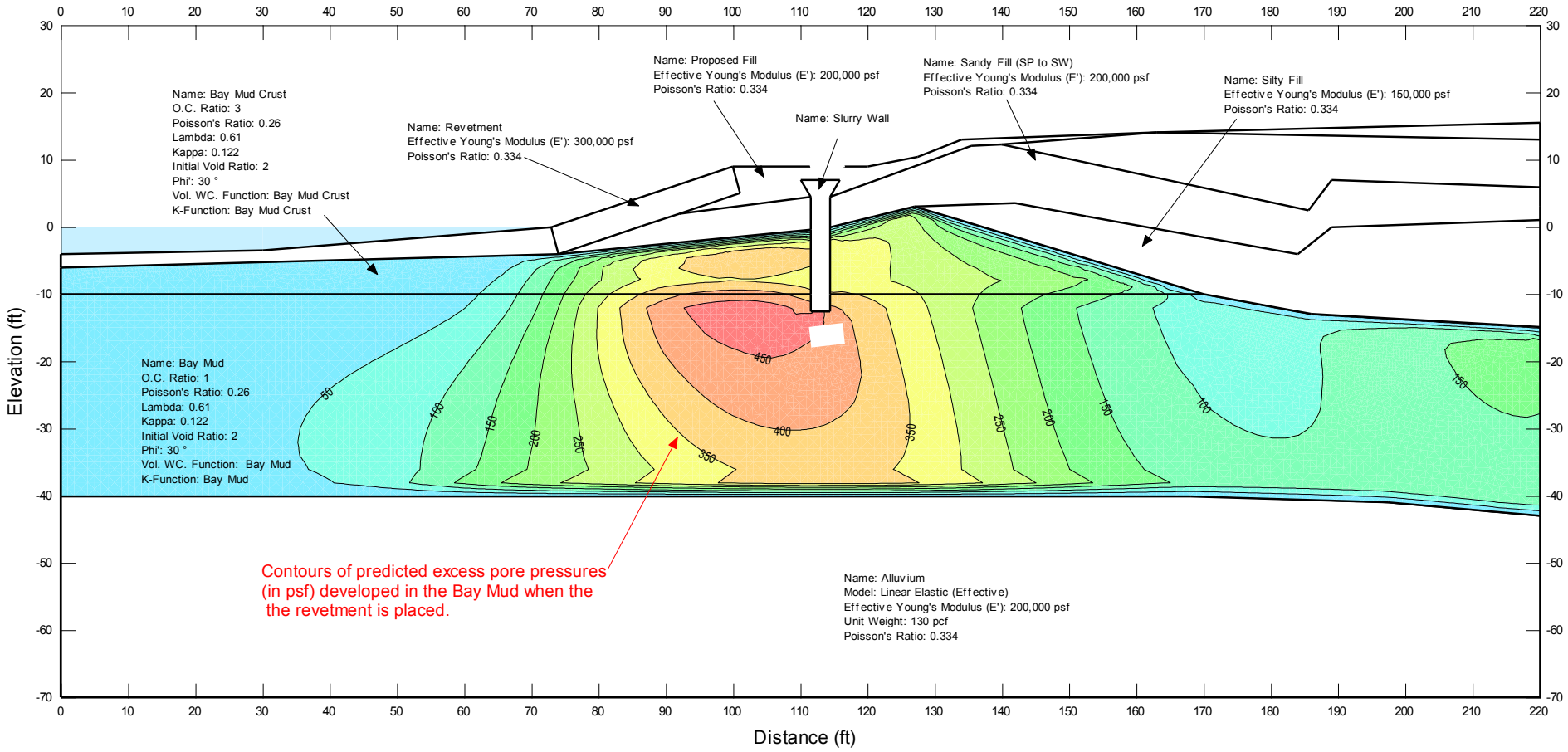
Settlement of Dry Sand										
Tokimatsu & Seed (1987) and Pradel (1998)										
$p = \sigma_m$ (tsf)	τ_{ave} (psf)	G_{max} (tsf)	τ_{ave}/G_{max}	a	b	γ_{eff} (%)	ε_{15} (%)	ε_{Nc} (%)	Settlement (inch)
0.096	59	3387	8.7E-06	0.1277	26060	8.91E-04	0.0002	0.0002	0.00
0.231	140	2454	2.9E-05	0.1330	15411	3.05E-03	0.0016	0.0018	0.01
0.280	201	916	1.1E-04	0.1349	13749	1.55E-02	0.0297	0.0341	N/A
0.328	260	914	1.4E-04	0.1368	12497	2.26E-02	0.0478	0.0547	N/A
0.424	376	1391	1.4E-04	0.1405	10705	1.89E-02	0.0282	0.0323	N/A
0.521	487	1382	1.8E-04	0.1443	9466	2.71E-02	0.0461	0.0528	N/A
								Subtotal	0.0

Residual Shear Strength		
Idriss & Boulanger (2008)		
$\Delta(N_1)_{60\text{-}Sr}$	$(N_1)_{60\text{-}Sr}$	S_u/σ_{vc}'
0.0	73	N/A
0.0	34	N/A
0.0	12	N/A
0.0	11	N/A
0.0	14	0.12
0.0	13	0.11
	Average	0.12

Total Settlement = 1.9 inches

Attachment F6
Static Slope Stability Analyses Results

(This attachment is provided on CD only)



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\A-A'_Rev-4.gsz

Place New Fill and Revetment

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/12/2015
Last Solved Time: 8:39:38 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Place New Fill and Revetment

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SIGMA/W
Parent: Insitu Stresses
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: Yes
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 days
Duration: 30 days
# of Steps: 1
Step Generation Method: Linear
Save Steps Every: 1

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Slurry Wall

Model: Linear Elastic (Total)
Stress Strain
Young's Modulus (E): 50,000 psf
Unit Weight: 90 pcf
Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)
- Data Point: (0.6951928, 0.00029257292)
- Data Point: (1.274275, 0.00026912696)
- Data Point: (2.3357215, 0.0002433421)
- Data Point: (4.2813324, 0.00021527057)

Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
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Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)

Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)

Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2

Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Lines

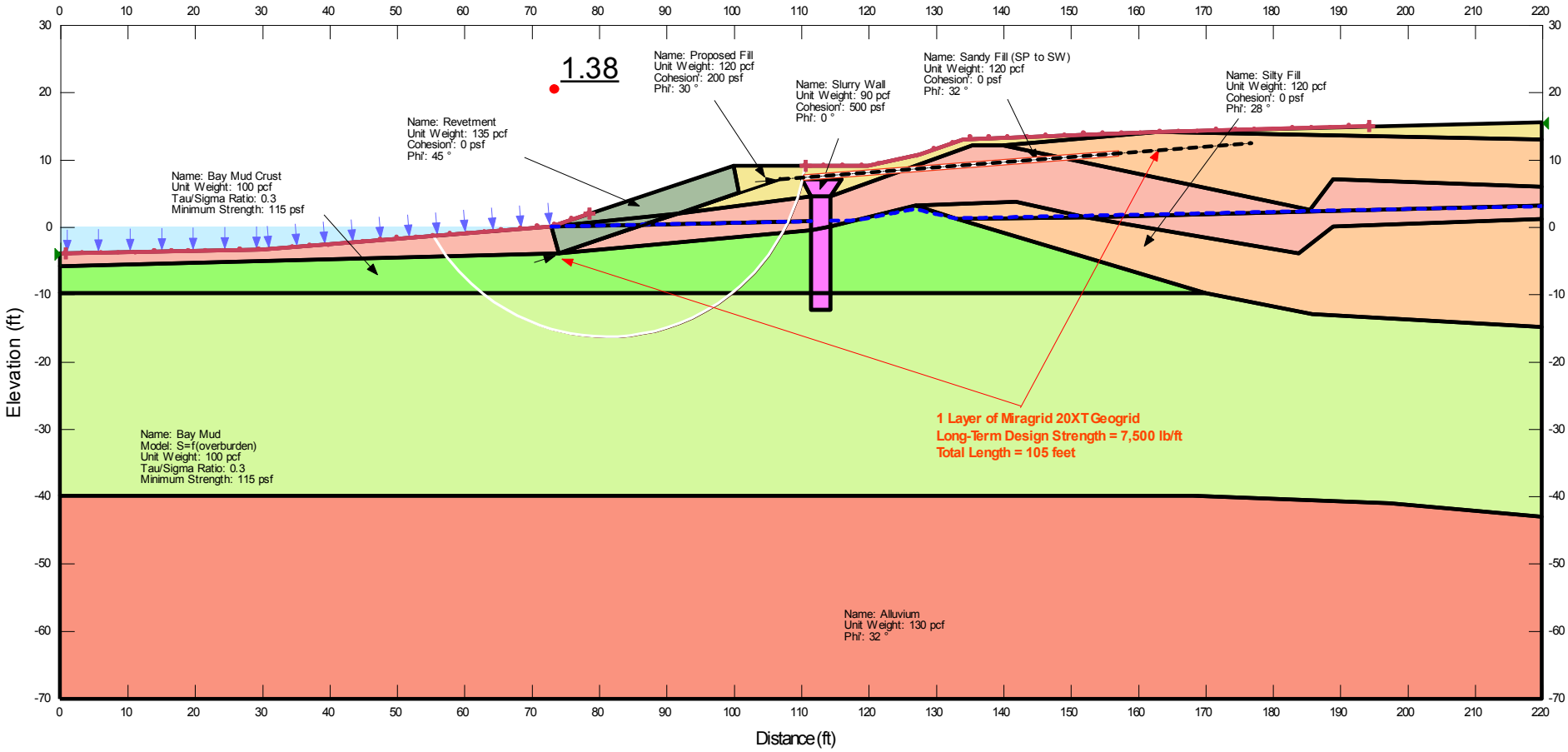
	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	40	36	Fixed X	30	90	
Line 2	36	37		168	0	Bay Water Level
Line 3	37	38		29.517	-1.94	Bay Water Level
Line 4	38	39		22.589	-5.08	Bay Water Level
Line 5	39	41	Fixed X	27	90	
Line 6	41	40	Fixed X/Y	220	0	
Line 7	33	15		74.027	1.55	
Line 8	15	23		37.663	5.33	
Line 9	34	35		3	0	
Line 10	30	31		16.279	-10.6	
Line 11	31	32		34.059	-3.37	
Line 12	32	39	Fixed X	28	90	
Line 13	23	24		3.0414	9.46	
Line 14	33	1	Fixed X	2	90	
Line 15	1	2		30.004	0.955	Bay Water Level
Line 16	2	3		43.142	4.65	Bay Water Level
Line 17	3	15		4.1231	-76	
Line 18	3	16		19.105	6.01	
Line 19	16	18		19.66	7.31	
Line 20	18	20		3	0	
Line 21	20	24		4.5	90	
Line 22	24	25		12.855	13.5	
Line 23	20	22		22.299	19.7	
Line 24	12	13		5.57	53	
Line 25	13	14		31.016	-1.85	
Line 26	29	28		31.016	1.85	
Line 27	28	27		6.4031	38.7	
Line 28	26	25		15.008	1.91	
Line 29	29	32	Fixed X	16	90	
Line 30	22	11		4.5044	2.54	
Line 31	11	12		46.659	-11.9	
Line 32	3	4		28.46	18.4	

Line 33	4	17		4.1231	-76	
Line 34	17	16		9.4868	18.4	
Line 35	18	19		2.9155	-59	
Line 36	19	21		6	0	
Line 37	21	20		2.9155	59	
Line 38	4	5		20	0	
Line 39	5	6		7.6485	11.3	
Line 40	6	7		6.9642	21	
Line 41	7	8		29.017	1.97	
Line 42	8	11		23.07	4.47	
Line 43	8	10		57.009	-1.01	
Line 44	10	14	Fixed X	7	90	
Line 45	8	9		57.02	1.51	
Line 46	9	10	Fixed X	2.5	90	
Line 47	36	42	Fixed X	30	90	
Line 48	43	34		2.5	90	
Line 49	35	44		2.5	90	
Line 50	42	43		111.5	0	
Line 51	44	30		55.5	0	
Line 52	43	44		3	0	
Line 53	42	33	Fixed X	4	90	
Line 54	23	43		9.5	90	
Line 55	24	44		10	90	
Line 56	18	45		3.8	90	
Line 57	45	23		1.2	90	
Line 58	25	46		6.4222	-16.7	
Line 59	46	30		38.5	-16.8	
Line 60	27	47		32.034	-9.98	
Line 61	47	26		10.63	-10.6	
Line 62	46	47		19.304	1.19	
Line 63	16	48		5.8822	17.8	
Line 64	48	15		13.092	18.7	
Line 65	3	48		13.401	0.855	
Line 66	48	45		25.105	1.14	
Line 67	14	49	Fixed X	3	90	
Line 68	49	47		67.566	1.23	

Line 69	49	29		2	90	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A1\A-A'_Rev-4.gsz

Static Slope Stability after Placement of New Fill and Revetment with Geogrid

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:22:24 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability after Placement of New Fill and Revetment with Geogrid

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SLOPE/W
Parent: Place New Fill and Revetment
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.97728, -3.98371) ft
Left-Zone Right Coordinate: (78.5, 1.83333) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (110.6, 9) ft
Right-Zone Right Coordinate: (194.2, 14.82105) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (220, 15.5) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (74, -4) ft

Inside Point: (107, 7) ft
Slip Surface Intersection: () ft
Length: 34.785054 ft
Direction: 198.43 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (107, 7) ft
Inside Point: (176.79523, 12.35033) ft
Slip Surface Intersection: (110.28208, 7.2515965) ft
Length: 70.000001 ft
Direction: 184.38 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 7,500 lbs
Pullout Force per Length: 159.51281 lbs/ft
Available Length: 66.708288 ft
Required Length: 47.018168 ft
Governing Component: Tensile Capacity

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6

Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25

Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24

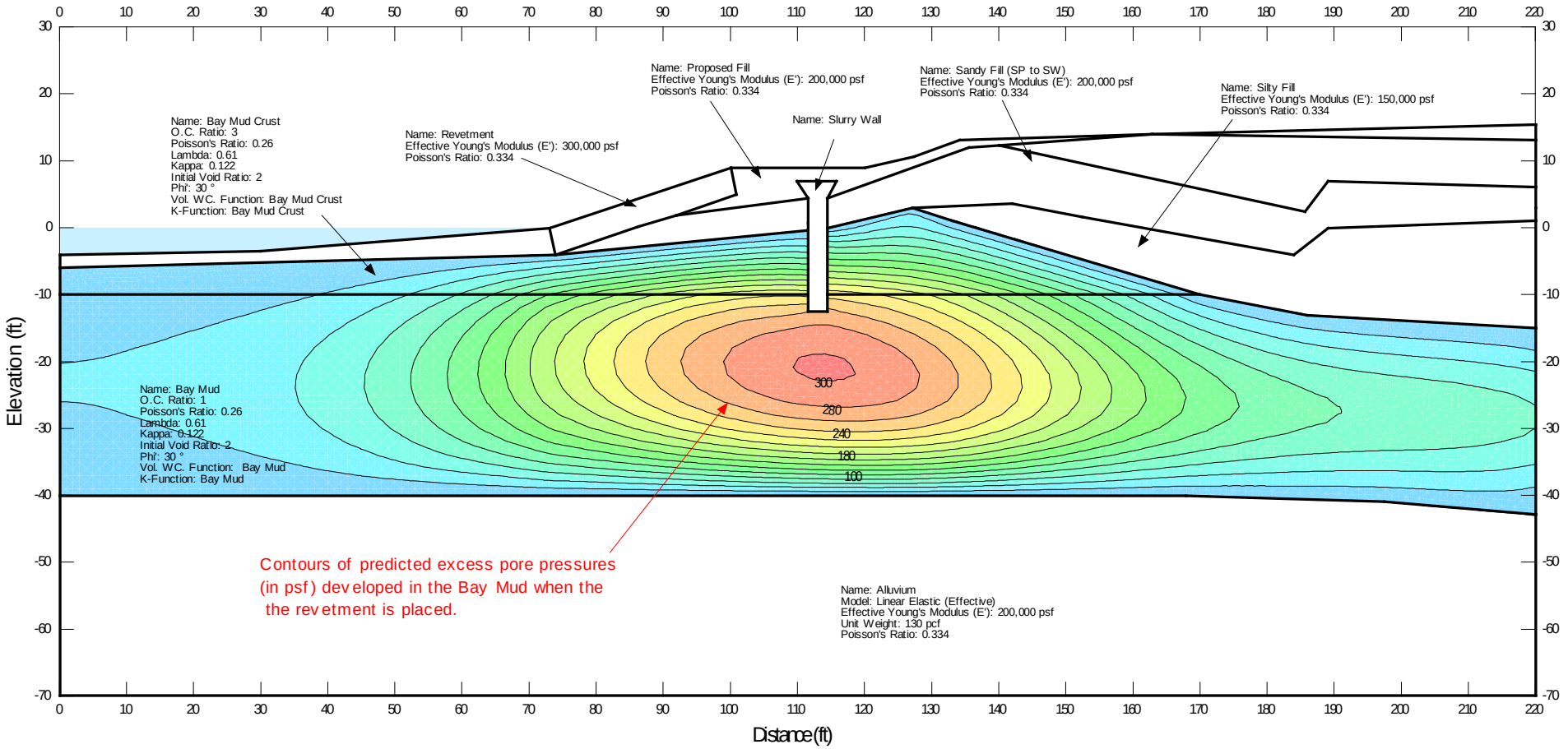
Current Slip Surface

Slip Surface: 7,171
F of S: 1.38
Volume: 813.44628 ft³
Weight: 90,113.208 lbs
Resisting Moment: 453,954.56 lbs-ft
Activating Moment: 329,328.57 lbs-ft
Resisting Force: 11,699.597 lbs
Activating Force: 8,483.2117 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (55.465557, -1.4272221) ft
Entry: (110.6, 9) ft
Radius: 29.681921 ft
Center: (81.232217, 13.306943) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	56.45562	-2.937318	183.28865	417.86734	146.58104	0
Slice 2	58.34687	-5.5416082	349.22743	615.43401	0	115
Slice 3	60.149244	-7.5468915	492.88464	767.18427	0	115
Slice 4	61.951618	-9.2289902	619.81708	894.47789	0	115
Slice 5	63.698405	-10.619669	727.39774	1,002.007	0	115
Slice 6	65.389604	-11.77348	820.39697	1,097.2383	0	121.77749
Slice 7	67.080803	-12.766572	906.13829	1,183.3437	0	127.95229
Slice 8	68.772002	-13.616861	984.57046	1,262.1949	0	132.03576
Slice 9	70.463201	-14.337607	1,055.9111	1,335.5981	0	134.36037
Slice 10	72.1544	-14.938778	1,120.6112	1,404.6984	0	135.08992
Slice 11	73.5	-15.345474	1,168.1189	1,506.0568	0	149.75964
Slice 12	74.885714	-15.674364	1,211.7554	1,633.2594	0	172.31546
Slice 13	76.657143	-16.00656	1,261.3606	1,752.1417	0	187.62205

Slice 14	78.428571	-16.228873	1,302.8489	1,866.8103	0	202.06722
Slice 15	80.2	-16.343782	1,336.4862	1,976.7224	0	215.64559
Slice 16	81.971429	-16.352541	1,362.2878	2,080.8234	0	228.39016
Slice 17	83.742857	-16.255245	1,380.2758	2,177.5518	0	240.29716
Slice 18	85.514286	-16.050835	1,390.2834	2,264.8331	0	251.38486
Slice 19	87.333333	-15.725508	1,391.7366	2,341.9616	0	262.02758
Slice 20	89.2	-15.269131	1,384.0142	2,404.8618	0	272.10766
Slice 21	91.066667	-14.680935	1,366.5658	2,372.7585	0	281.15099
Slice 22	92.951454	-13.943804	1,338.5677	2,397.2886	0	289.04845
Slice 23	94.854361	-13.042751	1,299.7982	2,391.6009	0	295.41697
Slice 24	96.757269	-11.966409	1,247.9368	2,351.1497	0	300.45438
Slice 25	98.660176	-10.690972	1,142.0348	2,261.8459	0	315.73116
Slice 26	99.805815	-9.8442101	1,067.6977	1,967.5486	0	325.73552
Slice 27	100.5	-9.2615467	1,010.9496	2,039.916	0	317.47152
Slice 28	102.04959	-7.7994603	871.75588	1,855.0407	0	304.74928
Slice 29	104.14876	-5.4842382	754.34494	1,537.8358	0	269.34036
Slice 30	106.24793	-2.5482304	511.46801	1,108.7947	0	252.94767
Slice 31	107.68458	-0.13026286	52.298153	566.77968	321.48374	0
Slice 32	108.78402	2.4374167	-106.52495	340.69851	212.89205	0
Slice 33	109.7482	5.1202064	-213.18457	-66.594198	-38.448178	200
Slice 34	110.08619	6.3549994	-205.86302	-201.40598	-116.28179	200
Slice 35	110.20435	6.8563567	-201.8255	-2,042.3874	-0	500
Slice 36	110.41817	8	-200	-238.82601	-137.88626	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\A-A'_Rev-4.gsz

5-Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:01:40 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

5-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SIGMA/W
Parent: Place New Fill and Revetment
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 30 days
Duration: 1,825 days
# of Steps: 50
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 10

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf

Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud

K-Function: Bay Mud

Ky'/Kx' Ratio: 0.5

Rotation: 0 °

K-Modifier Function: Bay Mud K Modifier Funtion

Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf

Unit Weight: 130 pcf

Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 150,000 psf

Unit Weight: 120 pcf

Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain

O.C. Ratio: 3

Poisson's Ratio: 0.26

Lambda: 0.61

Kappa: 0.122

Initial Void Ratio: 2

Unit Weight: 100 pcf

Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud Crust

K-Function: Bay Mud Crust

Ky'/Kx' Ratio: 0.5

Rotation: 0 °

K-Modifier Function: Bay Mus Crust K Modifier Function

Load Response Ratio: 1

Slurry Wall

Model: Linear Elastic (Total)

Stress Strain

Young's Modulus (E): 50,000 psf

Unit Weight: 90 pcf

Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)
- Data Point: (0.6951928, 0.00029257292)
- Data Point: (1.274275, 0.00026912696)
- Data Point: (2.3357215, 0.0002433421)
- Data Point: (4.2813324, 0.00021527057)

Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)

Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)

Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2

Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Lines

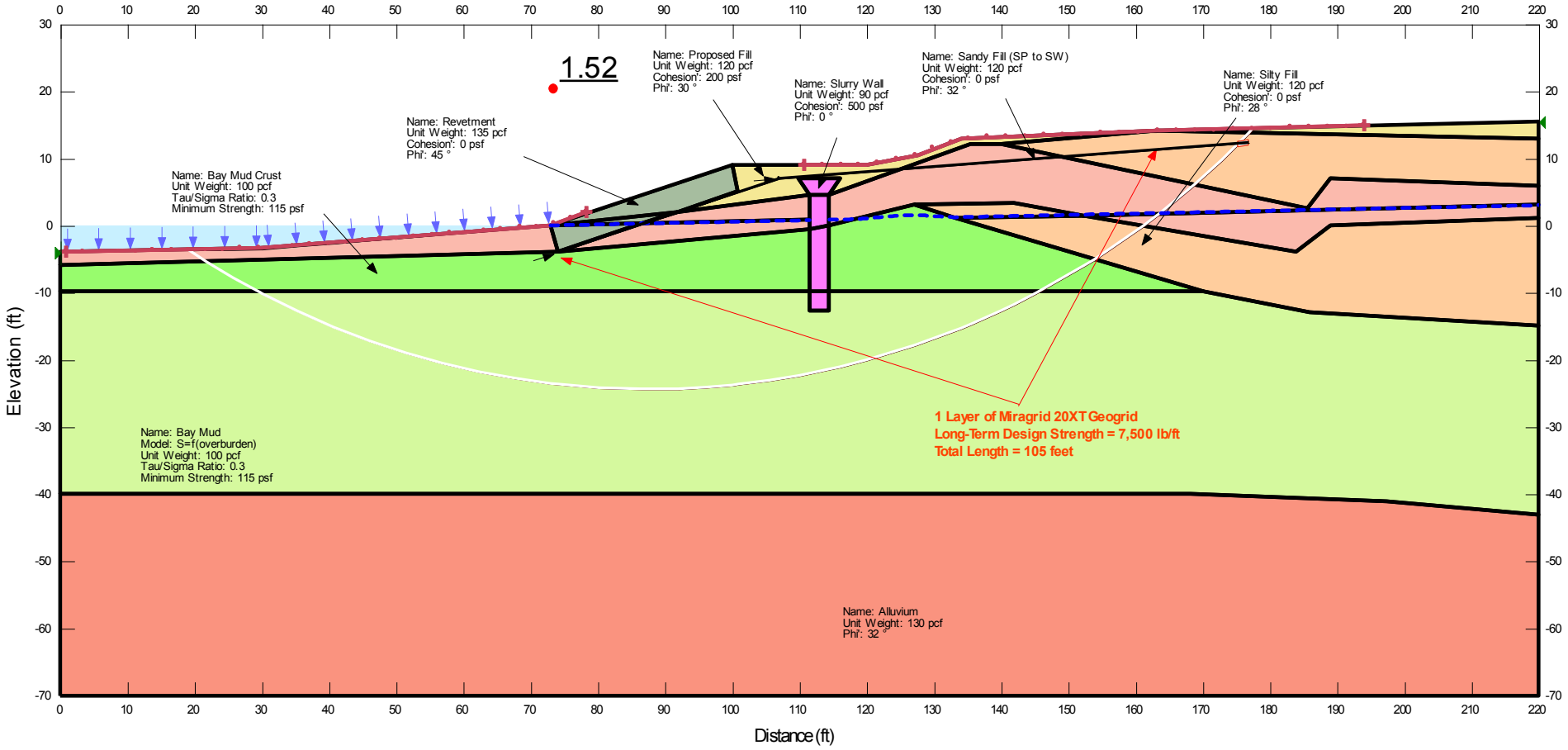
	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	40	36	Fixed X	30	90	
Line 2	36	37		168	0	Bay Water Level
Line 3	37	38		29.517	-1.94	Bay Water Level
Line 4	38	39		22.589	-5.08	Bay Water Level
Line 5	39	41	Fixed X	27	90	
Line 6	41	40	Fixed X/Y	220	0	
Line 7	33	15		74.027	1.55	
Line 8	15	23		37.663	5.33	
Line 9	34	35		3	0	
Line 10	30	31		16.279	-10.6	
Line 11	31	32		34.059	-3.37	
Line 12	32	39	Fixed X	28	90	
Line 13	23	24		3.0414	9.46	
Line 14	33	1	Fixed X	2	90	
Line 15	1	2		30.004	0.955	Bay Water Level
Line 16	2	3		43.142	4.65	Bay Water Level
Line 17	3	15		4.1231	-76	
Line 18	3	16		19.105	6.01	
Line 19	16	18		19.66	7.31	
Line 20	18	20		3	0	
Line 21	20	24		4.5	90	
Line 22	24	25		12.855	13.5	
Line 23	20	22		22.299	19.7	
Line 24	12	13		5.57	53	
Line 25	13	14		31.016	-1.85	
Line 26	29	28		31.016	1.85	
Line 27	28	27		6.4031	38.7	
Line 28	26	25		15.008	1.91	

Line 29	29	32	Fixed X	16	90	
Line 30	22	11		4.5044	2.54	
Line 31	11	12		46.659	-11.9	
Line 32	3	4		28.46	18.4	
Line 33	4	17		4.1231	-76	
Line 34	17	16		9.4868	18.4	
Line 35	18	19		2.9155	-59	
Line 36	19	21		6	0	
Line 37	21	20		2.9155	59	
Line 38	4	5		20	0	
Line 39	5	6		7.6485	11.3	
Line 40	6	7		6.9642	21	
Line 41	7	8		29.017	1.97	
Line 42	8	11		23.07	4.47	
Line 43	8	10		57.009	-1.01	
Line 44	10	14	Fixed X	7	90	
Line 45	8	9		57.02	1.51	
Line 46	9	10	Fixed X	2.5	90	
Line 47	36	42	Fixed X	30	90	
Line 48	43	34		2.5	90	
Line 49	35	44		2.5	90	
Line 50	42	43		111.5	0	
Line 51	44	30		55.5	0	
Line 52	43	44		3	0	
Line 53	42	33	Fixed X	4	90	
Line 54	23	43		9.5	90	
Line 55	24	44		10	90	
Line 56	18	45		3.8	90	
Line 57	45	23		1.2	90	
Line 58	25	46		6.4222	-16.7	
Line 59	46	30		38.5	-16.8	
Line 60	27	47		32.034	-9.98	
Line 61	47	26		10.63	-10.6	
Line 62	46	47		19.304	1.19	
Line 63	16	48		5.8822	17.8	
Line 64	48	15		13.092	18.7	

Line 65	3	48		13.401	0.855	
Line 66	48	45		25.105	1.14	
Line 67	14	49	Fixed X	3	90	
Line 68	49	47		67.566	1.23	
Line 69	49	29		2	90	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A1\A-A'_Rev-4.gsz

Static Slope Stability 5 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:05:22 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.97728, -3.98371) ft
Left-Zone Right Coordinate: (78.5, 1.83333) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (110.6, 9) ft
Right-Zone Right Coordinate: (194.2, 14.82105) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (220, 15.5) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (74, -4) ft

Inside Point: (107, 7) ft
Slip Surface Intersection: () ft
Length: 34.785054 ft
Direction: 198.43 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (107, 7) ft
Inside Point: (176.77674, 12.35) ft
Slip Surface Intersection: (175.24378, 12.232463) ft
Length: 69.98154 ft
Direction: 184.38 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 624.84089 lbs
Pullout Force per Length: 406.41028 lbs/ft
Available Length: 1.5374633 ft
Required Length: 1.5374633 ft
Governing Component: Pullout Resistance

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6

Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25

Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24

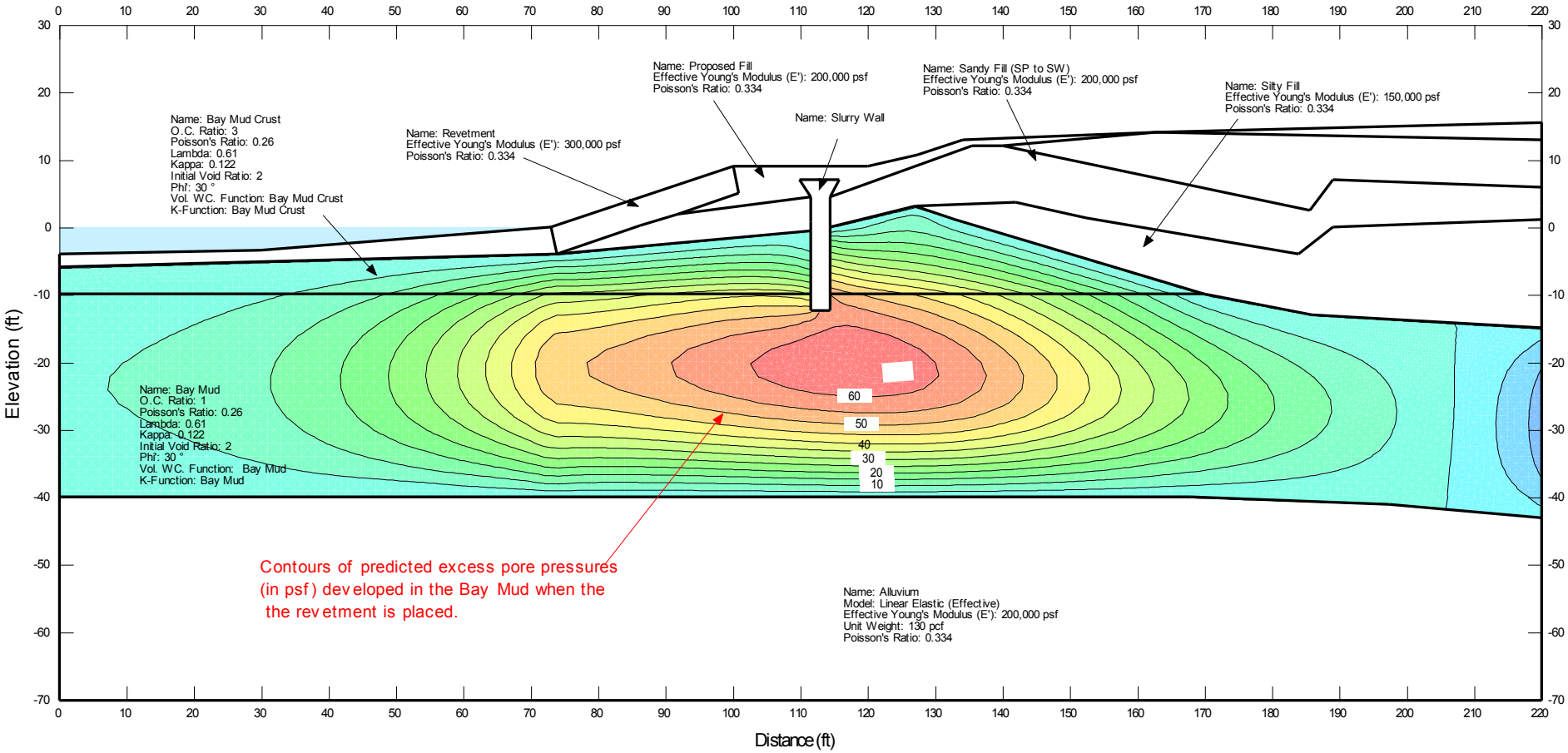
Current Slip Surface

Slip Surface: 2,656
F of S: 1.52
Volume: 3,255.0604 ft³
Weight: 349,983.37 lbs
Resisting Moment: 7,808,358.8 lbs-ft
Activating Moment: 5,126,003 lbs-ft
Resisting Force: 57,769.804 lbs
Activating Force: 37,923.104 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (19.166929, -3.6805512) ft
Entry: (177.35768, 14.377834) ft
Radius: 123.36034 ft
Center: (87.574292, 98.975212) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	20.501423	-4.5451956	283.62021	354.92204	44.554326	0
Slice 2	23.817622	-6.6065137	415.49832	612.46444	0	115
Slice 3	27.78103	-8.9015937	565.68674	848.14018	0	115
Slice 4	29.881367	-10.06277	642.26184	968.10965	0	115
Slice 5	32.6875	-11.461224	734.82872	1,124.1226	0	115
Slice 6	38.0625	-13.974976	903.73976	1,411.3669	0	128.81505
Slice 7	43.4375	-16.183083	1,056.1744	1,670.0935	0	156.01626
Slice 8	48.8125	-18.102891	1,193.6708	1,895.0599	0	179.04995
Slice 9	54.1875	-19.748422	1,316.7035	2,087.1163	0	198.19445
Slice 10	59.5625	-21.130978	1,425.5458	2,247.1611	0	213.70683
Slice 11	64.9375	-22.259577	1,520.9825	2,376.1425	0	225.62216
Slice 12	70.3125	-23.141276	1,602.7059	2,475.1676	0	234.24448
Slice 13	73.5	-23.578588	1,646.5549	2,575.8696	0	253.22227

Slice 14	77.1	-23.900263	1,685.8377	2,772.2372	0	302.14558
Slice 15	83.3	-24.272027	1,741.4891	3,024.6788	0	367.38107
Slice 16	89.2	-24.342624	1,776.4902	3,228.8313	0	426.56966
Slice 17	94	-24.201378	1,791.8788	3,370.149	0	472.7777
Slice 18	98	-23.927387	1,794.0954	3,468.7249	0	509.65297
Slice 19	100.5	-23.705048	1,791.063	3,472.4438	0	516.74254
Slice 20	103.25	-23.364068	1,781.0497	3,383.034	0	498.22715
Slice 21	107.75	-22.702691	1,755.7743	3,280.8469	0	483.44845
Slice 22	110.75	-22.186153	1,732.127	3,170.3921	0	462.11651
Slice 23	113	-21.72672	1,708.2655	2,816.4041	0	362.82197
Slice 24	115.25	-21.238081	1,681.4057	3,037.946	0	444.39072
Slice 25	118	-20.556332	1,640.0263	2,980.0666	0	443.64208
Slice 26	123.5	-18.981264	1,535.2668	2,854.5956	0	445.09786
Slice 27	127.25	-17.830359	1,453.2329	2,795.7387	0	457.59213
Slice 28	130.325	-16.701403	1,369.8291	2,816.3551	0	495.20997
Slice 29	133.575	-15.486563	1,277.7366	2,840.1154	0	537.26287
Slice 30	134.75	-15.005342	1,240.7718	2,816.0739	0	542.86451
Slice 31	137.75	-13.692906	1,139.4076	2,705.8639	0	543.07121
Slice 32	141	-12.21038	1,022.7087	2,581.2541	0	543.53985
Slice 33	143.69292	-10.864935	915.66995	2,467.6398	0	543.52001
Slice 34	148.91792	-7.9740835	670.74862	2,220.2384	0	546.24289
Slice 35	153.12665	-5.5237015	457.72801	2,008.6085	0	549.50305
Slice 36	157.51008	-2.545712	266.47343	1,606.4942	712.50171	0
Slice 37	162.10843	0.68389094	70.802059	1,217.3469	716.44073	0
Slice 38	163.27555	1.5741307	16.737395	1,120.7114	689.83952	0
Slice 39	166.16705	3.9519127	-127.95397	898.48997	561.43884	0
Slice 40	170.77974	7.9405564	-312	565.26659	300.55758	0
Slice 41	174.77324	11.762	-312	225.57892	119.94244	0
Slice 42	177.06383	14.068127	-254.82994	-72.832099	-42.049632	200



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30-Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:27:16 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

30-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SIGMA/W
Parent: 5-Year Consolidation after Construction
Method: Coupled Stress/PWP
Settings
- Initial Stress: Parent Analysis
- Initial PWP: Parent Analysis
- Exclude cumulative values: No

Control
- Apply Body Force in All Steps: No
- Saturated Zone Only: No

Convergence
- Maximum Number of Iterations: 50
- Minimum Pressure Head Difference: 0.001
- Minimum Displacement Difference: 0.001

Significant Digits: 3
Hydraulic Under-Relaxation Criteria
Under-Relaxation Initial Rate: 1
Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 1,855 days
Duration: 9,125 days
# of Steps: 200
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 200

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61

Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain

O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Slurry Wall

Model: Linear Elastic (Total)

Stress Strain

Young's Modulus (E): 50,000 psf

Unit Weight: 90 pcf
Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)

Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)

Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function

Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days

Residual Water Content: 0.2 ft^3/ft^3

Maximum: 1,000

Minimum: 0.01

Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)

Function: K-Modifier vs. Y-Effective Stress

Curve Fit to Data: 0 %

Segment Curvature: 100 %

Y-Intercept: 0.96838408

Data Points: Y-Effective Stress (psf), K-Modifier

Data Point: (750, 1)

Data Point: (1,300, 0.6)

Data Point: (2,200, 0.3)

Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)

Function: K-Modifier vs. Y-Effective Stress

Curve Fit to Data: 0 %

Segment Curvature: 0 %

Y-Intercept: 0.9677369

Data Points: Y-Effective Stress (psf), K-Modifier

Data Point: (150, 1)

Data Point: (800, 0.55)

Data Point: (1,300, 0.375)

Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function

Function: Vol. Water Content vs. Pore-Water Pressure

Mv: 0.00012 /psf

Saturated Water Content: 0.74073295 ft^3/ft^3

Residual Water Content: 0.074073295 ft^3/ft^3

Curve Fit to Data: 100 %

Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)

Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7

Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Lines

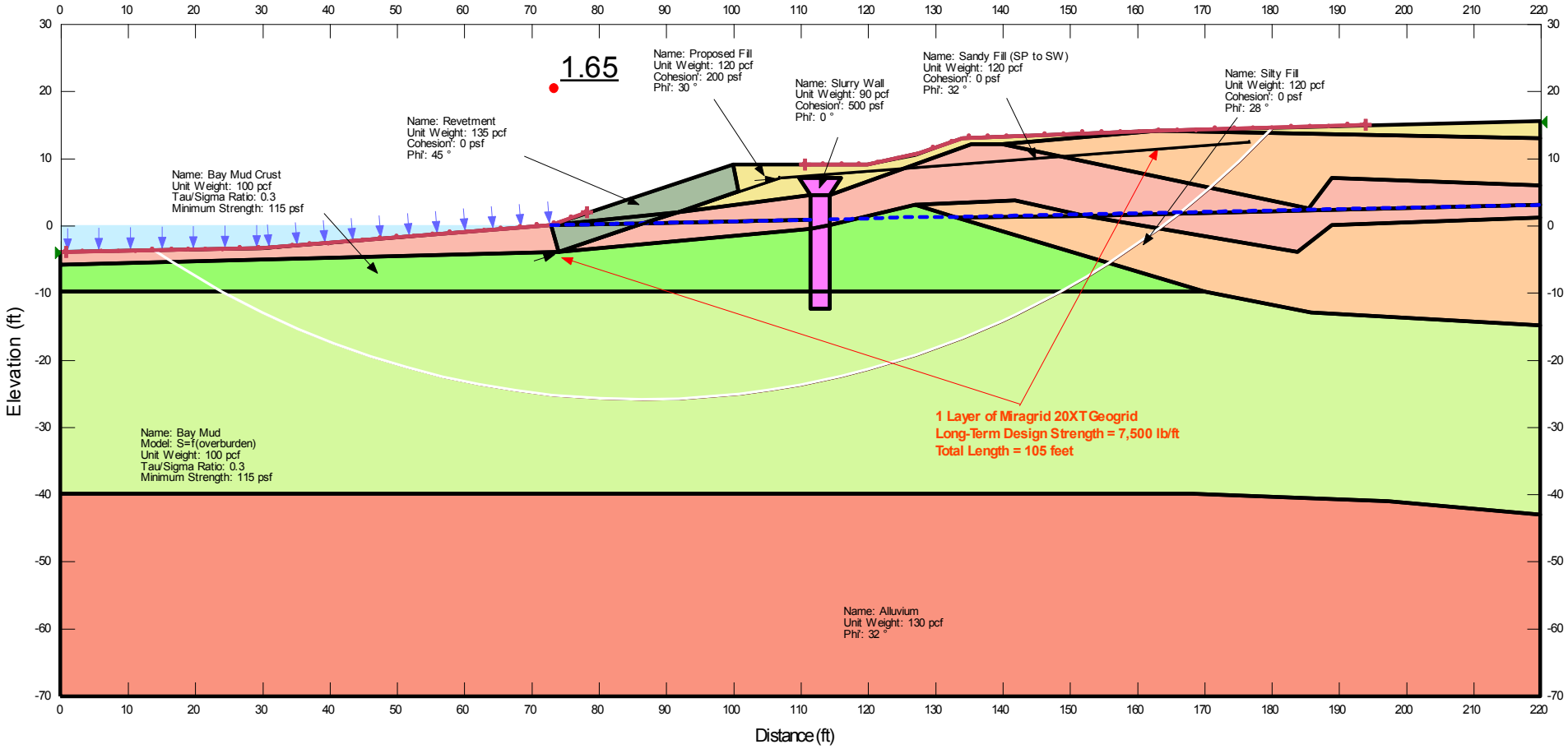
	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	40	36	Fixed X	30	90	
Line 2	36	37		168	0	Bay Water Level
Line 3	37	38		29.517	-1.94	Bay Water Level
Line 4	38	39		22.589	-5.08	Bay Water Level
Line 5	39	41	Fixed X	27	90	
Line 6	41	40	Fixed X/Y	220	0	
Line 7	33	15		74.027	1.55	
Line 8	15	23		37.663	5.33	
Line 9	34	35		3	0	
Line 10	30	31		16.279	-10.6	
Line 11	31	32		34.059	-3.37	
Line 12	32	39	Fixed X	28	90	
Line 13	23	24		3.0414	9.46	
Line 14	33	1	Fixed X	2	90	
Line 15	1	2		30.004	0.955	Bay Water Level
Line 16	2	3		43.142	4.65	Bay Water Level
Line 17	3	15		4.1231	-76	
Line 18	3	16		19.105	6.01	
Line 19	16	18		19.66	7.31	
Line 20	18	20		3	0	
Line 21	20	24		4.5	90	
Line 22	24	25		12.855	13.5	
Line 23	20	22		22.299	19.7	
Line 24	12	13		5.57	53	
Line 25	13	14		31.016	-1.85	
Line 26	29	28		31.016	1.85	
Line 27	28	27		6.4031	38.7	
Line 28	26	25		15.008	1.91	
Line 29	29	32	Fixed X	16	90	
Line 30	22	11		4.5044	2.54	
Line 31	11	12		46.659	-11.9	
Line 32	3	4		28.46	18.4	

Line 33	4	17		4.1231	-76	
Line 34	17	16		9.4868	18.4	
Line 35	18	19		2.9155	-59	
Line 36	19	21		6	0	
Line 37	21	20		2.9155	59	
Line 38	4	5		20	0	
Line 39	5	6		7.6485	11.3	
Line 40	6	7		6.9642	21	
Line 41	7	8		29.017	1.97	
Line 42	8	11		23.07	4.47	
Line 43	8	10		57.009	-1.01	
Line 44	10	14	Fixed X	7	90	
Line 45	8	9		57.02	1.51	
Line 46	9	10	Fixed X	2.5	90	
Line 47	36	42	Fixed X	30	90	
Line 48	43	34		2.5	90	
Line 49	35	44		2.5	90	
Line 50	42	43		111.5	0	
Line 51	44	30		55.5	0	
Line 52	43	44		3	0	
Line 53	42	33	Fixed X	4	90	
Line 54	23	43		9.5	90	
Line 55	24	44		10	90	
Line 56	18	45		3.8	90	
Line 57	45	23		1.2	90	
Line 58	25	46		6.4222	-16.7	
Line 59	46	30		38.5	-16.8	
Line 60	27	47		32.034	-9.98	
Line 61	47	26		10.63	-10.6	
Line 62	46	47		19.304	1.19	
Line 63	16	48		5.8822	17.8	
Line 64	48	15		13.092	18.7	
Line 65	3	48		13.401	0.855	
Line 66	48	45		25.105	1.14	
Line 67	14	49	Fixed X	3	90	
Line 68	49	47		67.566	1.23	

Line 69	49	29		2	90	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\A-A'_Rev-4.gsz

Static Slope Stability 30 Years after Construction (2)

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:28:00 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 30 Years after Construction (2)

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SLOPE/W
Parent: 30-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.97728, -3.98371) ft
Left-Zone Right Coordinate: (78.5, 1.83333) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (110.6, 9) ft
Right-Zone Right Coordinate: (194.2, 14.82105) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (220, 15.5) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (74, -4) ft

Inside Point: (107, 7) ft
Slip Surface Intersection: () ft
Length: 34.785054 ft
Direction: 198.43 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (107, 7) ft
Inside Point: (176.77674, 12.35) ft
Slip Surface Intersection: () ft
Length: 69.98154 ft
Direction: 184.38 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13
Point 32	220	-15
Point 33	0	-6

Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25

Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24

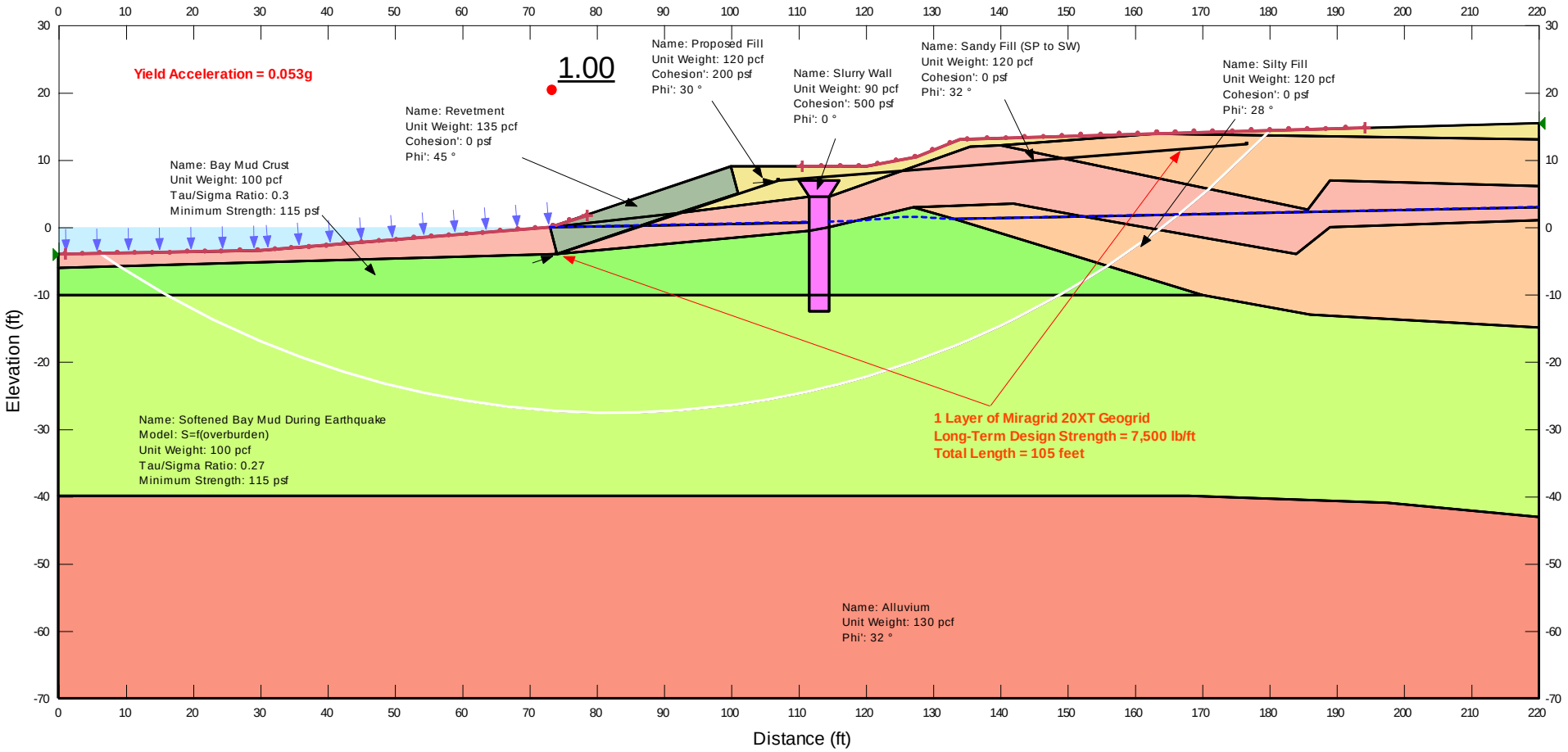
Current Slip Surface

Slip Surface: 1,985
F of S: 1.65
Volume: 3,576.2269 ft³
Weight: 383,387.65 lbs
Resisting Moment: 9,553,894 lbs-ft
Activating Moment: 5,788,158.9 lbs-ft
Resisting Force: 67,832.415 lbs
Activating Force: 41,104.719 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (13.969887, -3.7671686) ft
Entry: (180.16473, 14.451703) ft
Radius: 129.09282 ft
Center: (86.347781, 103.12716) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	15.322159	-4.6582541	290.67506	362.56982	44.924834	0
Slice 2	20.417688	-7.7746698	486.68227	727.76954	0	115
Slice 3	27.080472	-11.509401	723.05141	1,114.746	0	115
Slice 4	32.6875	-14.24745	897.062	1,417.4461	0	132.30424
Slice 5	38.0625	-16.560311	1,044.8189	1,689.4255	0	164.05136
Slice 6	43.4375	-18.591962	1,175.5233	1,928.8323	0	192.47796
Slice 7	48.8125	-20.35632	1,290.0811	2,136.2809	0	217.72973
Slice 8	54.1875	-21.864731	1,389.2606	2,312.4441	0	239.91659
Slice 9	59.5625	-23.126387	1,473.4059	2,458.108	0	259.21105
Slice 10	64.9375	-24.148643	1,543.1432	2,574.1464	0	275.64593
Slice 11	70.3125	-24.937242	1,598.6363	2,661.5589	0	289.34435
Slice 12	73.5	-25.323762	1,626.7881	2,755.5634	0	311.50749
Slice 13	77.1	-25.596483	1,648.7529	2,944.8422	0	364.15761

Slice 14	83.3	-25.892423	1,676.4052	3,186.417	0	435.51814
Slice 15	89.2	-25.90376	1,686.6274	3,381.8508	0	500.36256
Slice 16	96	-25.541802	1,675.8341	3,561.489	0	570.68383
Slice 17	100.5	-25.186592	1,661.6875	3,612.7738	0	600.00149
Slice 18	103.25	-24.834246	1,644.8005	3,521.641	0	583.20724
Slice 19	107.75	-24.158725	1,611.0972	3,416.5244	0	570.53261
Slice 20	110.75	-23.636027	1,583.7523	3,304.2392	0	550.12512
Slice 21	113	-23.175121	1,558.9532	2,948.9058	0	451.06768
Slice 22	115.25	-22.6863	1,532.2713	3,170.0463	0	532.57763
Slice 23	118	-22.00812	1,494.1546	3,111.7798	0	530.95723
Slice 24	123.5	-20.449992	1,403.589	2,986.6937	0	528.66308
Slice 25	127.25	-19.314239	1,335.4891	2,928.9623	0	537.43164
Slice 26	130.325	-18.20681	1,267.6554	2,952.2584	0	571.02429
Slice 27	133.575	-17.015831	1,193.5708	2,979.6494	0	608.39066
Slice 28	134.75	-16.545426	1,164.0868	2,956.9835	0	612.07252
Slice 29	137.75	-15.265206	1,083.2062	2,850.747	0	607.10064
Slice 30	141	-13.821007	991.26776	2,731.465	0	601.29095
Slice 31	145.26731	-11.676843	853.54835	2,553.5175	0	591.32639
Slice 32	150.49231	-8.8788534	671.09014	2,321.8278	0	578.09618
Slice 33	154.1183	-6.7285229	528.92216	2,142.6672	0	567.32077
Slice 34	159.3933	-3.2220941	311.0779	1,702.8317	740.00863	0
Slice 35	163.23925	-0.56744289	150.32536	1,416.8451	673.42048	0
Slice 36	164.9374	0.72966452	71.548396	1,237.428	728.52241	0
Slice 37	168.68996	3.7498525	-112.13256	939.10525	586.81809	0
Slice 38	173.10254	7.5741481	-312	615.80176	327.42761	0
Slice 39	177.34036	11.604599	-312	251.03447	133.4774	0
Slice 40	179.812	14.081472	-254.82507	-61.176168	-35.320077	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\A-A'_Rev-4.gsz

Yield Acceleration 5 Years after Construction (Su/p'=0.27)

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File Information

Tool Version: 8.15.1.11236
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:18:48 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Yield Acceleration 5 Years after Construction (Su/p'=0.27)

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.97728, -3.98371) ft
Left-Zone Right Coordinate: (78.5, 1.83333) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (110.6, 9) ft
Right-Zone Right Coordinate: (194.2, 14.82105) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (220, 15.5) ft

Seismic Coefficients

Horz Seismic Coef.: 0.053

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (74, -4) ft
Inside Point: (107, 7) ft
Slip Surface Intersection: () ft
Length: 34.785054 ft
Direction: 198.43 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (107, 7) ft
Inside Point: (176.71172, 12.35) ft
Slip Surface Intersection: () ft
Length: 69.91671 ft
Direction: 184.39 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft

Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13

Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Softened Bay Mud During Earthquake	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38

Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24

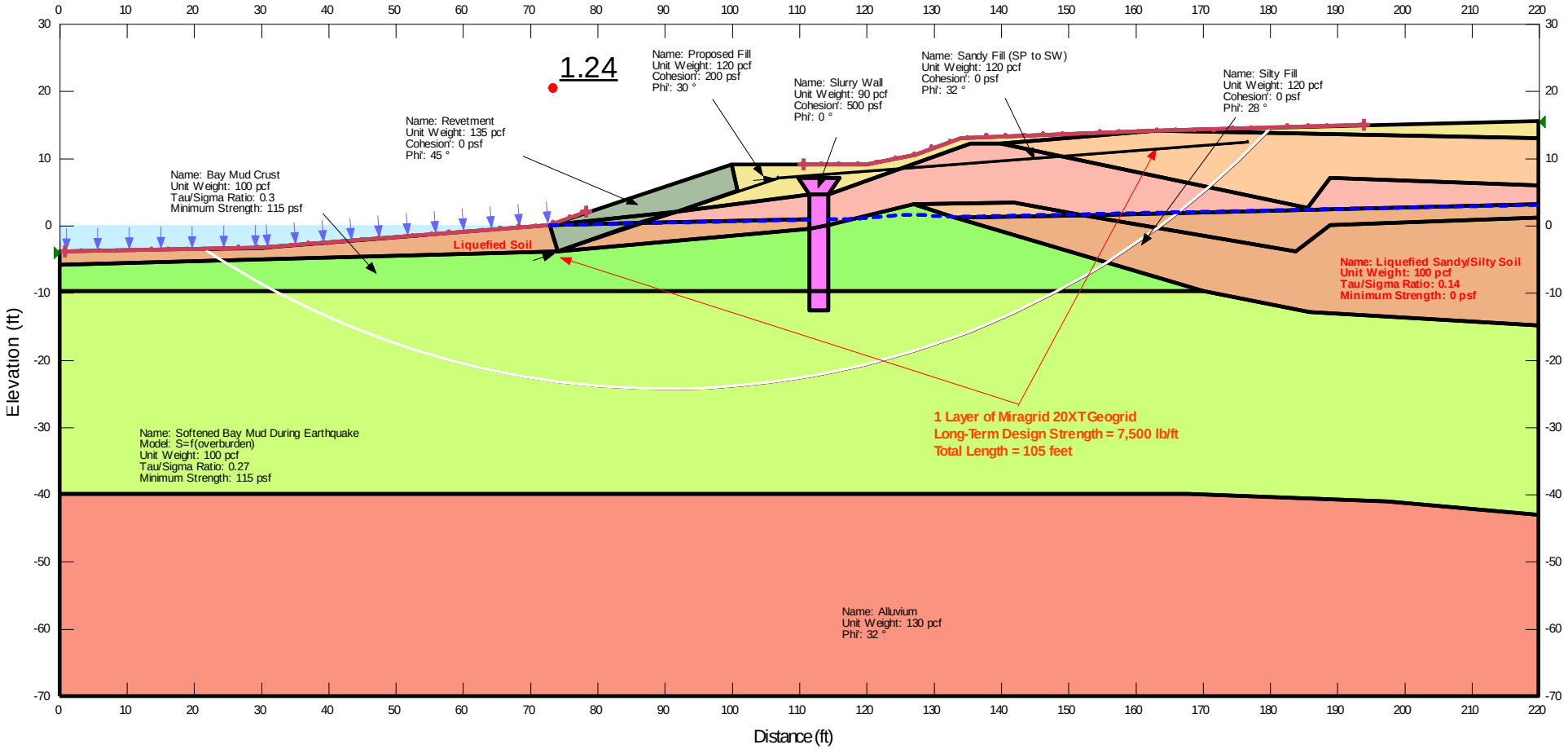
Current Slip Surface

Slip Surface: 962
F of S: 1.00
Volume: 3,865.6943 ft³
Weight: 412,632.08 lbs
Resisting Moment: 8,812,894.5 lbs-ft
Activating Moment: 8,809,530.1 lbs-ft
Resisting Force: 59,738.112 lbs
Activating Force: 59,723.2 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (6.1743226, -3.8970946) ft
Entry: (180.16473, 14.451703) ft
Radius: 134.66313 ft
Center: (82.43213, 107.09347) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	7.5652434	-4.8275181	301.23713	399.52291	61.415769	0
Slice 2	12.440283	-7.8789708	496.52475	768.84682	0	115
Slice 3	19.443301	-11.863294	754.54179	1,186.3342	0	115
Slice 4	26.4811	-15.334762	980.25665	1,558.7707	0	122.56038
Slice 5	33.071429	-18.15341	1,166.2773	1,884.6326	0	152.27657
Slice 6	39.214286	-20.404997	1,318.4224	2,154.8462	0	178.86971
Slice 7	45.357143	-22.325988	1,452.7179	2,381.6002	0	201.35616
Slice 8	51.5	-23.930965	1,570.2851	2,565.8305	0	219.82685
Slice 9	57.642857	-25.231456	1,671.2773	2,708.9573	0	234.55169

Slice 10	63.785714	-26.236391	1,756.9668	2,812.6736	0	245.42824
Slice 11	69.928571	-26.952433	1,826.7316	2,879.1397	0	252.80435
Slice 12	73.5	-27.272168	1,862.2921	2,958.2336	0	269.37763
Slice 13	77.1	-27.428283	1,888.9266	3,127.8673	0	312.35356
Slice 14	83.3	-27.531175	1,925.6915	3,334.4239	0	368.90532
Slice 15	89.2	-27.37026	1,945.818	3,496.777	0	419.94038
Slice 16	96	-26.824069	1,947.4664	3,639.5229	0	474.89595
Slice 17	100.5	-26.351111	1,940.4852	3,667.4573	0	496.16798
Slice 18	103.25	-25.931296	1,927.9237	3,564.6102	0	478.0636
Slice 19	107.75	-25.148415	1,897.9623	3,441.4663	0	462.74737
Slice 20	110.75	-24.556324	1,872.1594	3,319.1951	0	442.09071
Slice 21	113	-24.045356	1,847.0665	2,963.642	0	351.66666
Slice 22	115.25	-23.50725	1,818.7696	3,171.3194	0	424.13095
Slice 23	118	-22.771018	1,777.3761	3,105.0216	0	421.98994
Slice 24	123.5	-21.102012	1,672.3227	2,965.4499	0	420.84319
Slice 25	127.25	-19.892541	1,589.8571	2,897.3683	0	430.62328
Slice 26	130.325	-18.729003	1,506.5859	2,909.4513	0	463.50982
Slice 27	133.575	-17.479217	1,414.448	2,924.1795	0	500.42616
Slice 28	134.75	-16.988505	1,377.6262	2,898.2368	0	505.17276
Slice 29	137.75	-15.658317	1,277.0465	2,785.8195	0	504.6677
Slice 30	141	-14.161344	1,161.38	2,659.8568	0	504.42065
Slice 31	145.46993	-11.839165	979.41635	2,463.7914	0	503.1495
Slice 32	150.69493	-8.9677337	743.02936	2,192.325	0	559.8002
Slice 33	154.1905	-6.8392479	558.66193	2,005.4311	0	561.94128
Slice 34	159.4655	-3.2760925	314.53934	1,557.3113	660.79361	0
Slice 35	163.2716	-0.60528843	152.72812	1,277.4435	598.0218	0
Slice 36	164.99378	0.72448838	71.943192	1,088.4494	635.18355	0
Slice 37	168.71872	3.7493679	-112.0657	812.78913	507.88702	0
Slice 38	175.2253	9.6798054	-312	367.30632	195.30024	0
Slice 39	179.81112	14.081488	-254.82207	-103.16468	-59.562158	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\A-A\A-A'_Rev-4.gsz

Post-Liquefaction Slope Stability 5 Years after Construction

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File Information

Tool Version: 8.15
File Name: A-A'_Rev-4.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2015\Slope Stability\A-A'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:15:12 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Post-Liquefaction Slope Stability 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section A-A'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Liquefied Sandy/Silty Soil

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.14
Minimum Strength: 0 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.97728, -3.98371) ft
Left-Zone Right Coordinate: (78.5, 1.83333) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (110.6, 9) ft
Right-Zone Right Coordinate: (194.2, 14.82105) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (220, 15.5) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (74, -4) ft
Inside Point: (107, 7) ft
Slip Surface Intersection: () ft
Length: 34.785054 ft
Direction: 198.43 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (107, 7) ft
Inside Point: (176.79813, 12.31233) ft
Slip Surface Intersection: () ft
Length: 69.999999 ft
Direction: 184.35 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft

Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10
Point 31	186	-13

Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	220	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	40,36,37,38,39,41	6,540.3
Region 2	Softened Bay Mud During Earthquake	36,42,43,34,35,44,30,31,32,39,38,37	6,492.3
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Liquefied Sandy/Silty Soil	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Liquefied Sandy/Silty Soil	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Liquefied Sandy/Silty Soil	47,27,28,29,32,31,30,46	815.97
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38

Region 13	Silty Fill	11,8,10,14,13,12	516.63
Region 14	Proposed Fill	8,9,10	71.25
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Liquefied Sandy/Silty Soil	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5
Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24

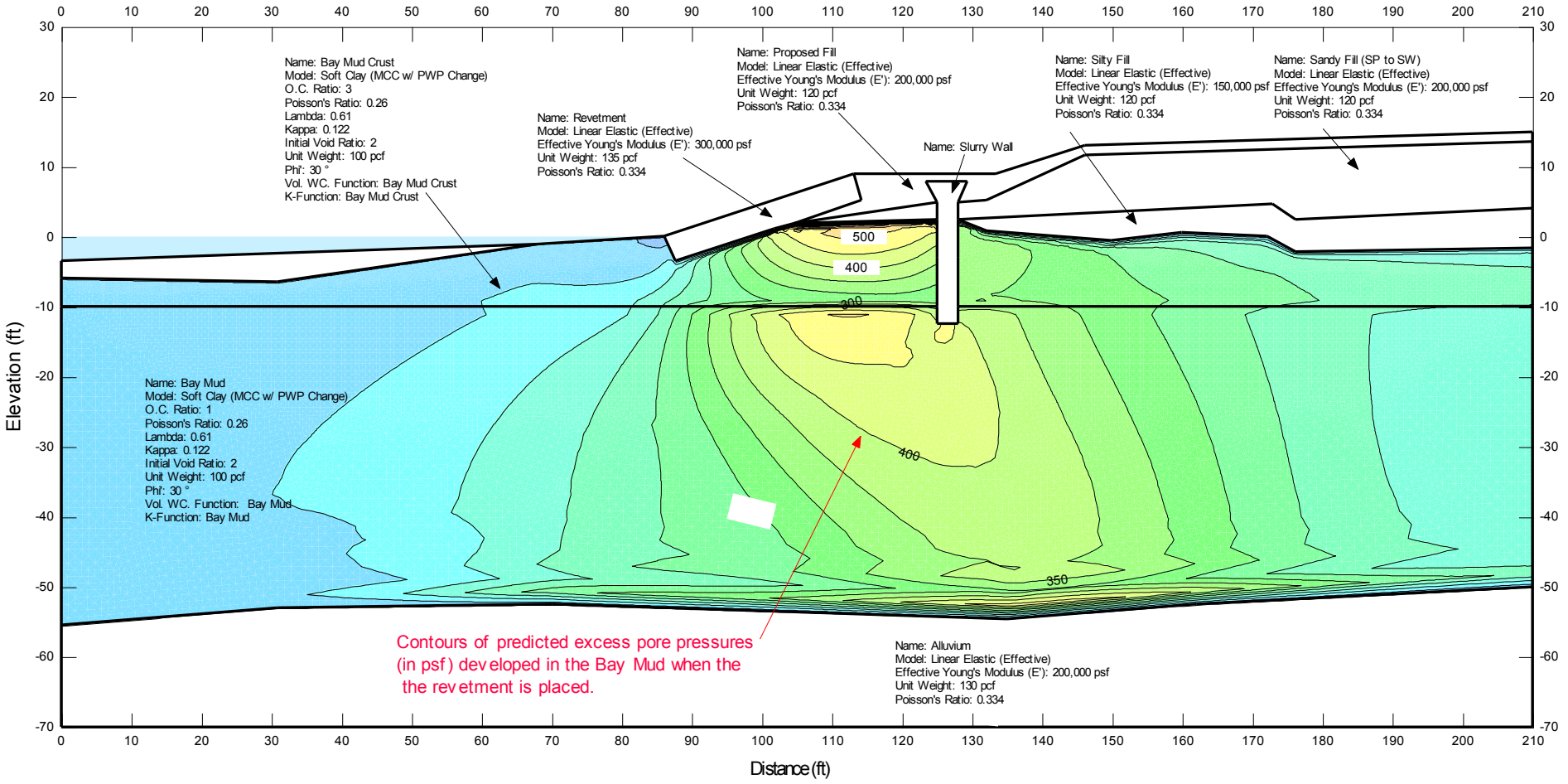
Current Slip Surface

Slip Surface: 3,008
F of S: 1.24
Volume: 3,303.0821 ft³
Weight: 349,159.51 lbs
Resisting Moment: 6,462,688.6 lbs-ft
Activating Moment: 5,211,096.1 lbs-ft
Resisting Force: 48,190.378 lbs
Activating Force: 38,838.23 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (21.76545, -3.6372425) ft
Entry: (180.16473, 14.451703) ft
Radius: 123.52755 ft
Center: (90.258397, 99.162424) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	23.079606	-4.4889758	280.11209	316.55579	0	4.5988195
Slice 2	27.19688	-7.0057003	442.01698	631.71888	0	115
Slice 3	31.221499	-9.3353457	595.39073	876.1017	0	115
Slice 4	34.977811	-11.268897	724.05955	1,088.0749	0	115
Slice 5	40.047436	-13.665838	886.2994	1,353.4293	0	115
Slice 6	45.117061	-15.7893	1,034.2104	1,593.8474	0	124.03389
Slice 7	50.186686	-17.654235	1,168.6683	1,808.6406	0	142.27269
Slice 8	55.256312	-19.272886	1,290.1644	1,993.4651	0	157.36148
Slice 9	60.325937	-20.655257	1,398.9699	2,148.98	0	169.49716

Slice 10	65.395562	-21.809465	1,495.4169	2,275.9483	0	178.80924
Slice 11	70.465187	-22.742003	1,579.2396	2,375.2926	0	185.54482
Slice 12	73.5	-23.222038	1,624.9942	2,521.4927	0	213.2216
Slice 13	77.1	-23.622719	1,669.1611	2,754.665	0	264.83243
Slice 14	83.3	-24.129893	1,733.3102	2,990.4952	0	316.69084
Slice 15	89.2	-24.328849	1,775.7047	3,196.0597	0	368.43246
Slice 16	94	-24.292231	1,797.037	3,353.6692	0	413.14273
Slice 17	98	-24.106011	1,804.2851	3,464.926	0	448.9275
Slice 18	100.5	-23.938807	1,804.9	3,475.4631	0	456.80306
Slice 19	103.25	-23.659212	1,798.5183	3,393.2161	0	441.90624
Slice 20	107.75	-23.099315	1,779.3474	3,302.5407	0	431.48111
Slice 21	110.75	-22.651249	1,760.4055	3,199.3405	0	414.04991
Slice 22	113	-22.244107	1,739.9114	2,870.6733	0	331.96481
Slice 23	115.25	-21.808186	1,716.4548	3,096.1271	0	405.88123
Slice 24	118	-21.192244	1,680.199	3,041.6793	0	405.60086
Slice 25	123.5	-19.752856	1,585.9457	2,923.4308	0	407.73776
Slice 26	127.25	-18.695999	1,510.7263	2,869.7905	0	419.68197
Slice 27	130.325	-17.648547	1,434.393	2,895.2643	0	453.82962
Slice 28	133.575	-16.520423	1,349.0203	2,921.7443	0	491.46223
Slice 29	134.75	-16.071712	1,315.0411	2,892.7953	0	494.52399
Slice 30	137.75	-14.844865	1,220.2319	2,770.7045	0	490.01357
Slice 31	141	-13.457032	1,111.4848	2,634.2455	0	485.17111
Slice 32	145.0369	-11.503237	956.75813	2,445.0047	0	478.25324
Slice 33	150.2619	-8.7837104	730.06074	2,163.2107	0	523.65237
Slice 34	154.03885	-6.6093406	540.8776	1,952.39	0	519.38812
Slice 35	159.31385	-3.1636391	307.32913	1,760.2927	0	229.5769
Slice 36	163.20391	-0.52681082	147.74491	1,524.8068	0	216.99486
Slice 37	164.87586	0.73531847	71.117229	1,409.8916	0	210.69162
Slice 38	168.65875	3.7503512	-112.20343	874.46101	546.42389	0
Slice 39	173.0955	7.5715704	-312	574.39097	305.40909	0
Slice 40	177.33932	11.600943	-312	232.83161	123.79876	0
Slice 41	179.81298	14.081455	-254.82839	-84.627023	-48.859435	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Place New Fill and Revetment

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/6/2015
Last Solved Time: 10:16:22 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Place New Fill and Revetment

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SIGMA/W
Parent: Insitu Stresses
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: Yes
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 days
Duration: 7 days
# of Steps: 1
Step Generation Method: Linear
Save Steps Every: 1

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic
- Vol. WC. Function: Bay Mud
- K-Function: Bay Mud
- Ky'/Kx' Ratio: 0.5
- Rotation: 0 °
- K-Modifier Function: Bay Mud K Modifier Funtion
- Load Response Ratio: 1

Alluvium
Model: Linear Elastic (Effective)
Stress Strain
- Effective Young's Modulus (E'): 200,000 psf
- Unit Weight: 130 pcf
- Poisson's Ratio: 0.334

Silty Fill
Model: Linear Elastic (Effective)
Stress Strain
- Effective Young's Modulus (E'): 150,000 psf
- Unit Weight: 120 pcf
- Poisson's Ratio: 0.334

Bay Mud Crust
Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
- O.C. Ratio: 3
- Poisson's Ratio: 0.26
- Lambda: 0.61
- Kappa: 0.122
- Initial Void Ratio: 2
- Unit Weight: 100 pcf
- Phi': 30 °

Hydraulic
- Vol. WC. Function: Bay Mud Crust
- K-Function: Bay Mud Crust
- Ky'/Kx' Ratio: 0.5
- Rotation: 0 °
- K-Modifier Function: Bay Mus Crust K Modifier Function
- Load Response Ratio: 1

Slurry Wall
Model: Linear Elastic (Total)
Stress Strain
- Young's Modulus (E): 50,000 psf
- Unit Weight: 90 pcf
- Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)
- Data Point: (0.6951928, 0.00029257292)
- Data Point: (1.274275, 0.00026912696)
- Data Point: (2.3357215, 0.0002433421)
- Data Point: (4.2813324, 0.00021527057)

Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)

Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure

Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %

Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)

Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)

Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7

Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10
Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Lines

	Start	End	Stress/Strain	Length (ft)	Angle (°)	Hydraulic

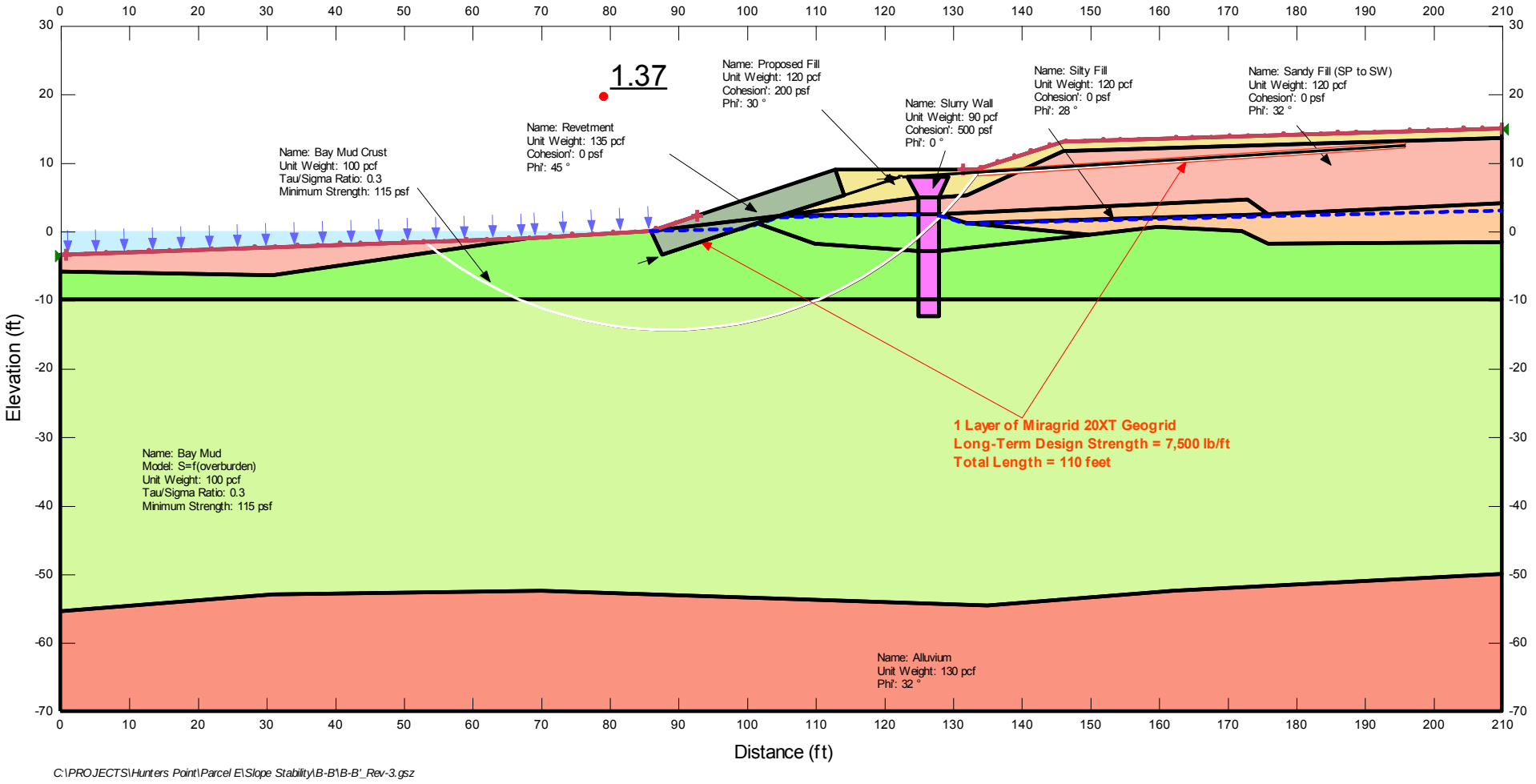
	Point	Point	Boundary			Boundary
Line 1	44	38	Fixed X	14.5	90	
Line 2	38	39		31.101	4.61	Bay Water Level
Line 3	39	40		39.003	0.735	Bay Water Level
Line 4	40	41		65.031	-1.76	Bay Water Level
Line 5	41	42		27.074	4.24	Bay Water Level
Line 6	42	43		48.065	2.98	Bay Water Level
Line 7	43	45	Fixed X	20	90	
Line 8	45	44	Fixed X/Y	210	0	
Line 9	38	32	Fixed X	45.5	90	
Line 10	32	33		125	0	
Line 11	33	34		2.5	90	
Line 12	34	35		3	0	
Line 13	35	36		2.5	90	
Line 14	36	37		82	0	
Line 15	37	43	Fixed X	40	90	
Line 16	30	31		3	0	
Line 17	31	36		7	90	
Line 18	36	33		3	0	
Line 19	33	30		7	90	
Line 20	30	18		5.5	90	
Line 21	18	19		3	0	
Line 22	19	31		5.5	90	
Line 23	18	11		2.5	90	
Line 24	11	14		3	0	
Line 25	14	19		2.5	90	
Line 26	11	12		3.1765	-61.8	
Line 27	12	13		6	0	
Line 28	13	14		3.1765	61.8	
Line 29	32	47	Fixed X	4	90	
Line 30	47	48		31.004	-0.924	
Line 31	48	2		37.407	8.46	
Line 32	2	3		18.028	3.18	Bay Water Level
Line 33	9	29		8.9069	-20.4	
Line 34	29	30		15.033	-3.81	
Line 35	19	23		4.272	-20.6	

Line 36	23	24		18.062	-4.76	
Line 37	24	31		22.142	6.48	
Line 38	24	25		10.05	5.71	
Line 39	25	26		12.01	-2.39	
Line 40	26	27		4.4721	-26.6	
Line 41	27	28		34.004	0.843	
Line 42	28	37	Fixed X	8.5	90	
Line 43	9	10		3.3049	17.6	
Line 44	10	18		20.204	1.13	
Line 45	4	46		3.8897	-72	
Line 46	46	10		9.9298	18.8	
Line 47	10	11		20.407	8.17	
Line 48	22	28	Fixed X	5.5	90	
Line 49	23	21		44.026	1.95	
Line 50	21	22		34.033	2.53	
Line 51	19	20		45.044	2.54	
Line 52	20	21		3.6056	-33.7	
Line 53	14	15		4.005	2.86	
Line 54	15	16		15.435	24.9	
Line 55	16	17		64.025	1.61	
Line 56	17	22	Fixed X	9.5	90	
Line 57	4	5		20.5	0	
Line 58	5	6		13.124	17.7	
Line 59	6	7		64.031	1.79	
Line 60	7	17	Fixed X	1.5	90	
Line 61	3	10		18.917	6.37	
Line 62	3	4		28.46	18.4	
Line 63	47	1	Fixed X	2.5	90	
Line 64	1	2		68.046	2.11	Bay Water Level
Line 65	3	8		3.9361	-64.4	
Line 66	8	9		14.705	18.4	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579

Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56
Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Static Slope Stability after Placement of New Fill and Revetment with Geogrid

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:54:34 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability after Placement of New Fill and Revetment with Geogrid

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SLOPE/W
Parent: Place New Fill and Revetment
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.73568, -3.47295) ft
Left-Zone Right Coordinate: (92.75, 2.25) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (131.5, 9) ft
Right-Zone Right Coordinate: (210, 15) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -3.5) ft
Right Coordinate: (210, 15) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (87.7, -3.55) ft

Inside Point: (122.401, 7.76771) ft
Slip Surface Intersection: () ft
Length: 36.499999 ft
Direction: 198.06 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (122.5, 7.8) ft
Inside Point: (195.84938, 12.50302) ft
Slip Surface Intersection: (133.61884, 8.5129187) ft
Length: 73.5 ft
Direction: 183.67 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 3,245.951 lbs
Pullout Force per Length: 52.053211 lbs/ft
Available Length: 62.358324 ft
Required Length: 62.358324 ft
Governing Component: Pullout Resistance

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10

Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56

Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806

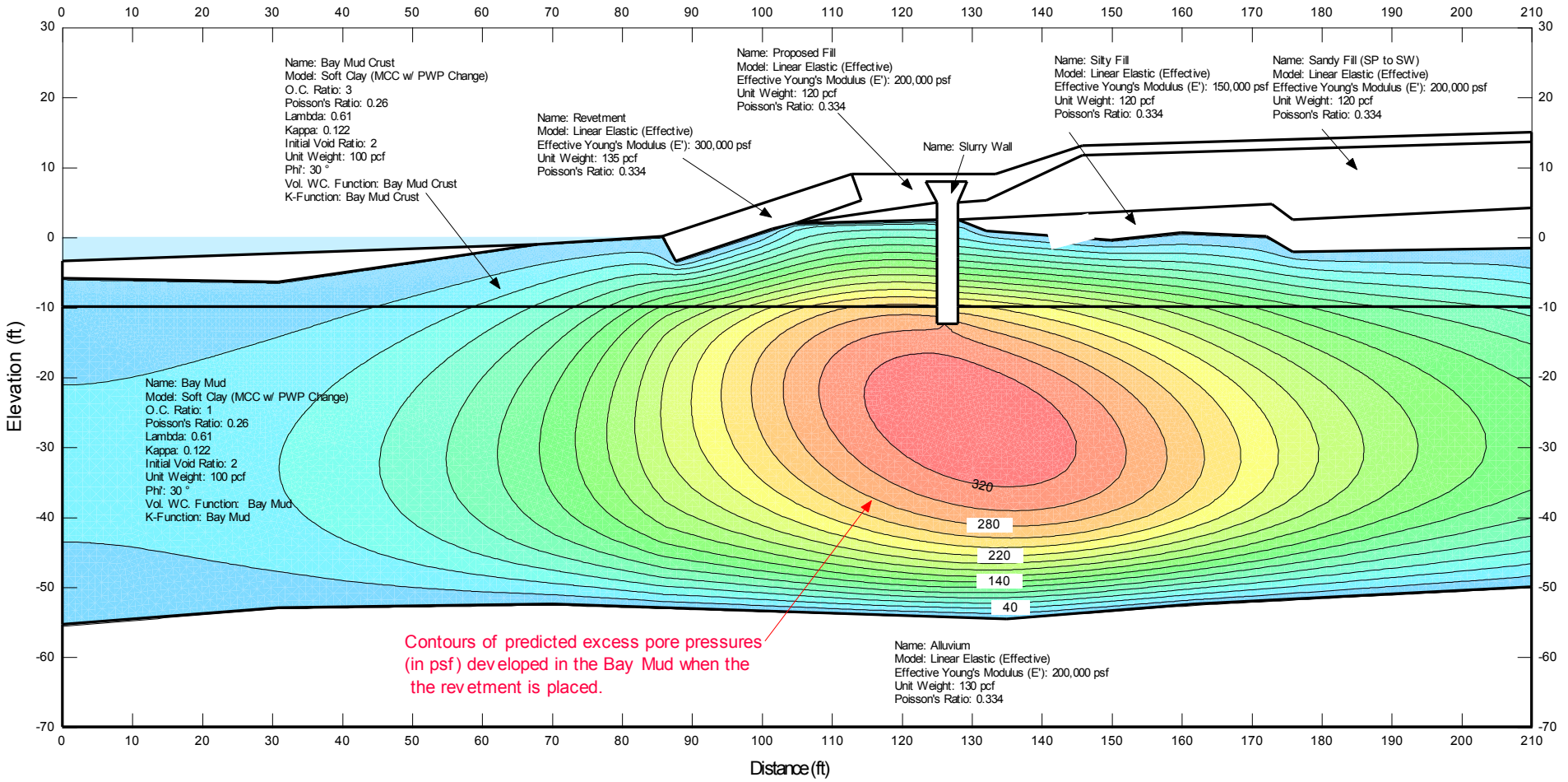
Current Slip Surface

Slip Surface: 5,814
F of S: 1.37
Volume: 984.40016 ft³
Weight: 104,447.18 lbs
Resisting Moment: 971,424.01 lbs-ft
Activating Moment: 710,725.6 lbs-ft
Resisting Force: 15,082.858 lbs
Activating Force: 11,036.274 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (53.090142, -1.5481566) ft
Entry: (134.10814, 9.1946059) ft
Radius: 55.590335 ft
Center: (88.645058, 41.185124) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	53.970983	-2.2513075	140.48159	206.33346	41.148812	0
Slice 2	56.364982	-4.0346241	265.70483	432.39259	0	115
Slice 3	59.391295	-6.0518839	409.44296	619.08045	0	115
Slice 4	62.417609	-7.7991614	535.26439	779.55492	0	115
Slice 5	65.443922	-9.3046723	641.63695	917.06504	0	115
Slice 6	67.47854	-10.214738	700.73921	1,000.0731	0	115
Slice 7	69.285714	-10.907292	745.82781	1,066.6592	0	115
Slice 8	71.857143	-11.792533	809.55428	1,154.5711	0	115
Slice 9	74.428571	-12.540178	867.16375	1,229.9689	0	115
Slice 10	77	-13.155919	919.65416	1,293.3956	0	115
Slice 11	79.571429	-13.644214	969.00352	1,345.2195	0	115
Slice 12	82.142857	-14.008451	1,016.7655	1,385.6571	0	115
Slice 13	84.714286	-14.251083	1,064.6113	1,414.7912	0	115
Slice 14	86.85	-14.369713	1,107.4313	1,529.6	0	128.97449
Slice 15	89.095	-14.385882	1,150.4579	1,677.2049	0	160.6141
Slice 16	91.885	-14.293119	1,195.6293	1,759.8899	0	172.17977

Slice 17	94.675	-14.059387	1,228.6597	1,828.0511	0	183.15869
Slice 18	97.465	-13.682878	1,248.3401	1,881.1294	0	193.85933
Slice 19	100.255	-13.160619	1,255.0226	1,918.453	0	204.0868
Slice 20	103.225	-12.434337	1,246.0614	1,940.137	0	214.94921
Slice 21	106.1	-11.575992	1,228.1433	1,951.2471	0	225.99084
Slice 22	108.7	-10.642876	1,164.8319	1,939.8793	0	247.79888
Slice 23	110.16652	-10.069919	1,084.9432	1,876.176	0	271.95396
Slice 24	111.66652	-9.3930447	956.3496	1,900.5473	0	307.99972
Slice 25	113.6	-8.484639	861.27213	1,808.6999	0	315.75614
Slice 26	115.59805	-7.4077341	824.84869	1,677.6964	0	284.89448
Slice 27	118.39414	-5.7460753	764.511	1,505.8154	0	252.81381
Slice 28	121.19024	-3.849545	678.58146	1,310.6152	0	221.36456
Slice 29	123.04414	-2.480098	605.4611	1,157.6106	0	201.99699
Slice 30	124.25	-1.4953108	549.7373	1,029.8452	0	176.42724
Slice 31	126.5	0.52693538	0	452.35715	0	500
Slice 32	128.20765	2.1338877	28.849335	553.1893	0	215.08436
Slice 33	128.50381	2.4352924	-87.79521	464.44854	246.95167	0
Slice 34	129.04615	3.0065925	-122.62557	457.58618	285.93158	0
Slice 35	130.23652	4.3177561	-202.64511	364.56413	227.80495	0
Slice 36	132.23652	6.7479998	-222.61417	51.130105	29.51998	200
Slice 37	133.80407	8.7709767	-203.64828	-117.45809	-67.814458	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

5-Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/6/2015
Last Solved Time: 10:24:54 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

5-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SIGMA/W
Parent: Place New Fill and Revetment
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 7 days
Duration: 1,825 days
# of Steps: 50
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 10

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf

Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud

K-Function: Bay Mud

Ky'/Kx' Ratio: 0.5

Rotation: 0 °

K-Modifier Function: Bay Mud K Modifier Funtion

Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf

Unit Weight: 130 pcf

Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 150,000 psf

Unit Weight: 120 pcf

Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain

O.C. Ratio: 3

Poisson's Ratio: 0.26

Lambda: 0.61

Kappa: 0.122

Initial Void Ratio: 2

Unit Weight: 100 pcf

Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud Crust

K-Function: Bay Mud Crust

Ky'/Kx' Ratio: 0.5

Rotation: 0 °

K-Modifier Function: Bay Mus Crust K Modifier Function

Load Response Ratio: 1

Slurry Wall

Model: Linear Elastic (Total)

Stress Strain

Young's Modulus (E): 50,000 psf

Unit Weight: 90 pcf

Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)
- Data Point: (0.6951928, 0.00029257292)
- Data Point: (1.274275, 0.00026912696)
- Data Point: (2.3357215, 0.0002433421)
- Data Point: (4.2813324, 0.00021527057)

Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)

Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)

Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7

Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10
Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Lines

	Start	End	Stress/Strain	Length (ft)	Angle (°)	Hydraulic

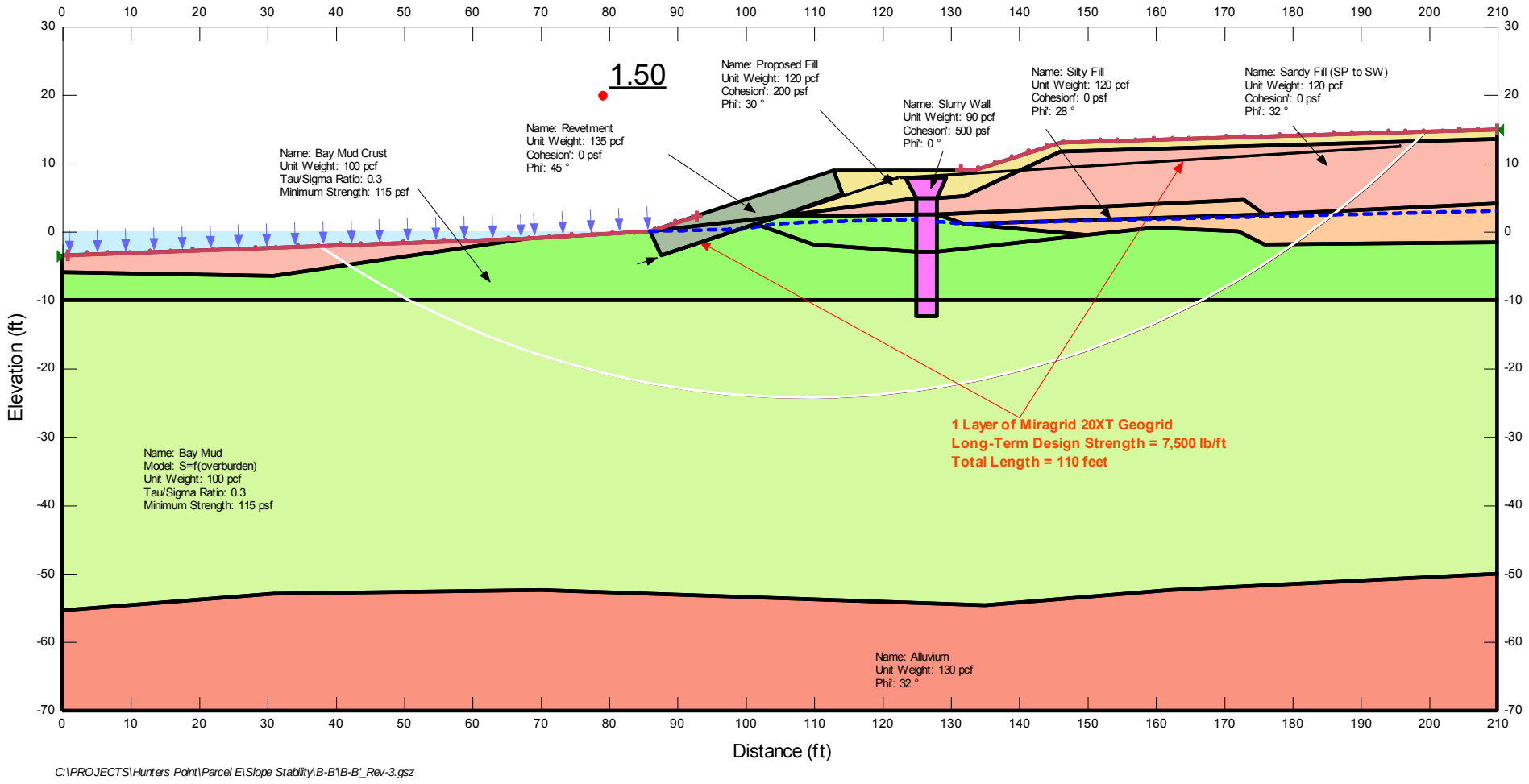
	Point	Point	Boundary			Boundary
Line 1	44	38	Fixed X	14.5	90	
Line 2	38	39		31.101	4.61	Bay Water Level
Line 3	39	40		39.003	0.735	Bay Water Level
Line 4	40	41		65.031	-1.76	Bay Water Level
Line 5	41	42		27.074	4.24	Bay Water Level
Line 6	42	43		48.065	2.98	Bay Water Level
Line 7	43	45	Fixed X	20	90	
Line 8	45	44	Fixed X/Y	210	0	
Line 9	38	32	Fixed X	45.5	90	
Line 10	32	33		125	0	
Line 11	33	34		2.5	90	
Line 12	34	35		3	0	
Line 13	35	36		2.5	90	
Line 14	36	37		82	0	
Line 15	37	43	Fixed X	40	90	
Line 16	30	31		3	0	
Line 17	31	36		7	90	
Line 18	36	33		3	0	
Line 19	33	30		7	90	
Line 20	30	18		5.5	90	
Line 21	18	19		3	0	
Line 22	19	31		5.5	90	
Line 23	18	11		2.5	90	
Line 24	11	14		3	0	
Line 25	14	19		2.5	90	
Line 26	11	12		3.1765	-61.8	
Line 27	12	13		6	0	
Line 28	13	14		3.1765	61.8	
Line 29	32	47	Fixed X	4	90	
Line 30	47	48		31.004	-0.924	
Line 31	48	2		37.407	8.46	
Line 32	2	3		18.028	3.18	Bay Water Level
Line 33	9	29		8.9069	-20.4	
Line 34	29	30		15.033	-3.81	
Line 35	19	23		4.272	-20.6	

Line 36	23	24		18.062	-4.76	
Line 37	24	31		22.142	6.48	
Line 38	24	25		10.05	5.71	
Line 39	25	26		12.01	-2.39	
Line 40	26	27		4.4721	-26.6	
Line 41	27	28		34.004	0.843	
Line 42	28	37	Fixed X	8.5	90	
Line 43	9	10		3.3049	17.6	
Line 44	10	18		20.204	1.13	
Line 45	4	46		3.8897	-72	
Line 46	46	10		9.9298	18.8	
Line 47	10	11		20.407	8.17	
Line 48	22	28	Fixed X	5.5	90	
Line 49	23	21		44.026	1.95	
Line 50	21	22		34.033	2.53	
Line 51	19	20		45.044	2.54	
Line 52	20	21		3.6056	-33.7	
Line 53	14	15		4.005	2.86	
Line 54	15	16		15.435	24.9	
Line 55	16	17		64.025	1.61	
Line 56	17	22	Fixed X	9.5	90	
Line 57	4	5		20.5	0	
Line 58	5	6		13.124	17.7	
Line 59	6	7		64.031	1.79	
Line 60	7	17	Fixed X	1.5	90	
Line 61	3	10		18.917	6.37	
Line 62	3	4		28.46	18.4	
Line 63	47	1	Fixed X	2.5	90	
Line 64	1	2		68.046	2.11	Bay Water Level
Line 65	3	8		3.9361	-64.4	
Line 66	8	9		14.705	18.4	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579

Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56
Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Static Slope Stability5 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:48:22 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.73568, -3.47295) ft
Left-Zone Right Coordinate: (92.75, 2.25) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (131.5, 9) ft
Right-Zone Right Coordinate: (210, 15) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -3.5) ft
Right Coordinate: (210, 15) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (87.7, -3.55) ft

Inside Point: (122.401, 7.76771) ft
Slip Surface Intersection: () ft
Length: 36.499999 ft
Direction: 198.06 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (122.5, 7.8) ft
Inside Point: (195.84957, 12.5) ft
Slip Surface Intersection: () ft
Length: 73.499996 ft
Direction: 183.67 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10

Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56

Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806

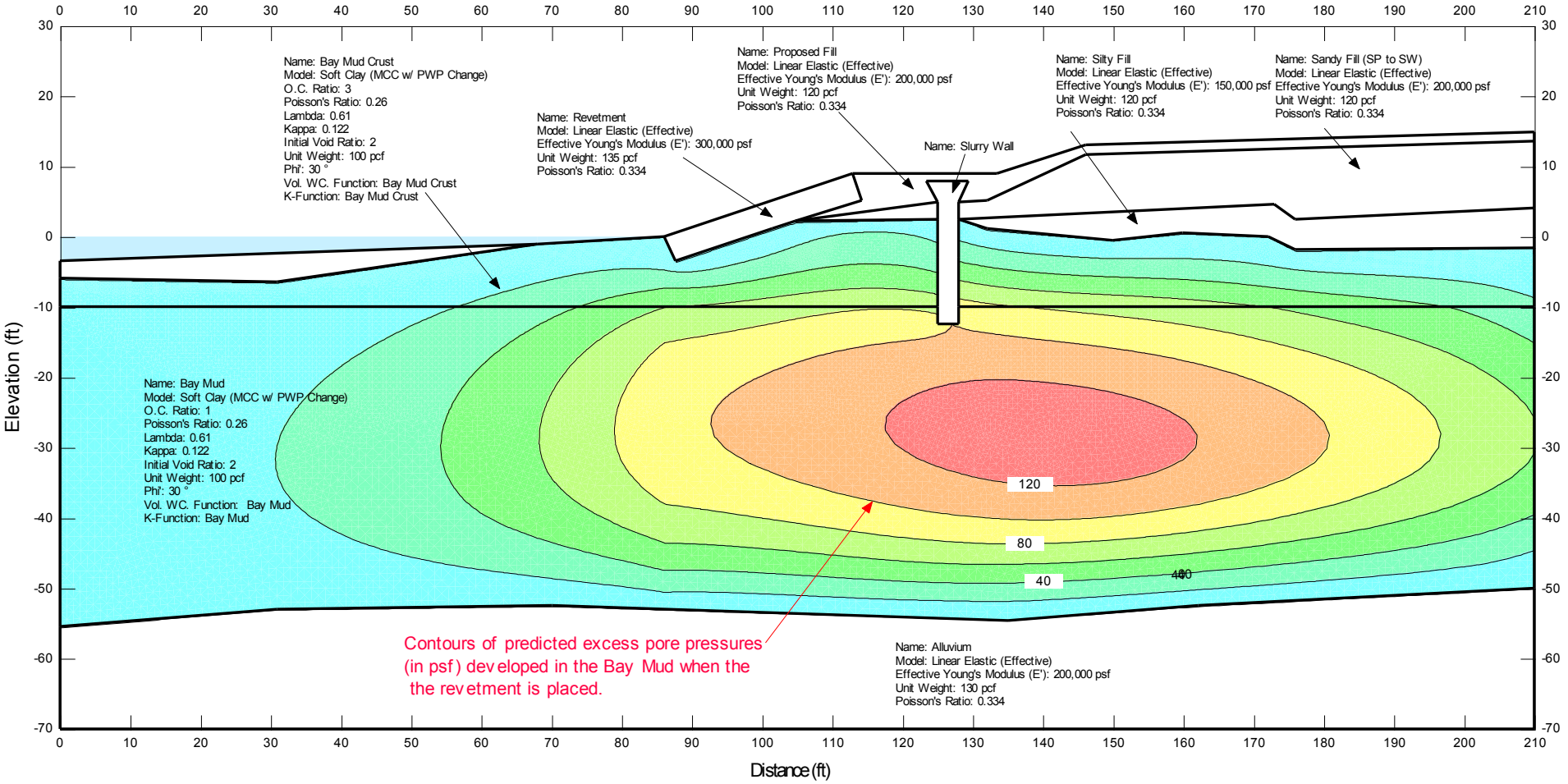
Current Slip Surface

Slip Surface: 4,383
F of S: 1.50
Volume: 3,453.6907 ft³
Weight: 367,430.52 lbs
Resisting Moment: 7,993,148.4 lbs-ft
Activating Moment: 5,342,685 lbs-ft
Resisting Force: 58,528.071 lbs
Activating Force: 39,146.267 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (37.691771, -2.1142731) ft
Entry: (199.45106, 14.670346) ft
Radius: 125.01434 ft
Center: (108.77112, 100.72691) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	39.783553	-3.4988347	218.32728	337.48827	74.460049	0
Slice 2	44.090373	-6.2229988	394.39959	660.91384	0	115
Slice 3	48.520451	-8.7813007	567.9696	918.45003	0	115
Slice 4	53.612908	-11.415286	749.93796	1,185.3619	0	115
Slice 5	59.367745	-14.068894	937.66932	1,460.0489	0	131.70103
Slice 6	65.122582	-16.379701	1,107.393	1,697.7906	0	148.63148
Slice 7	71	-18.403358	1,263.3285	1,911.236	0	163.70219
Slice 8	77	-20.143091	1,405.1242	2,099.6532	0	177.11547
Slice 9	83	-21.563862	1,529.0697	2,249.7514	0	186.31493
Slice 10	86.85	-22.347467	1,601.6596	2,435.2807	0	220.03864
Slice 11	90.025	-22.851552	1,652.744	2,666.2583	0	273.19834
Slice 12	94.675	-23.468128	1,719.9557	2,875.3641	0	318.03214
Slice 13	99.325	-23.908227	1,775.353	3,061.2514	0	361.11593
Slice 14	103.225	-24.154387	1,813.2214	3,201.7873	0	396.40269
Slice 15	107.4	-24.252859	1,842.0692	3,348.1647	0	437.5231
Slice 16	111.5	-24.24863	1,862.0929	3,487.0414	0	479.97115

Slice 17	113.6	-24.192683	1,868.0734	3,496.3144	0	484.95709
Slice 18	116.525	-24.024981	1,869.6572	3,428.4787	0	469.85921
Slice 19	121.175	-23.648602	1,861.724	3,359.4471	0	460.39532
Slice 20	124.25	-23.323147	1,849.0239	3,265.4471	0	441.47635
Slice 21	126.5	-23.014652	1,833.9314	2,960.3076	0	356.56014
Slice 22	128.75	-22.67832	1,815.654	3,180.115	0	433.74088
Slice 23	130.75	-22.333645	1,795.4241	3,189.7908	0	446.56961
Slice 24	132.75	-21.963811	1,772.3548	3,152.2139	0	445.58288
Slice 25	136.625	-21.102762	1,715.1869	3,167.2051	0	474.8393
Slice 26	142.875	-19.501862	1,601.5379	3,213.1799	0	536.03199
Slice 27	148	-17.954351	1,487.8973	3,162.4751	0	564.51135
Slice 28	152.5	-16.359584	1,369.4995	3,000.543	0	556.75016
Slice 29	157.5	-14.367442	1,221.0596	2,795.4842	0	544.14288
Slice 30	163.40338	-11.654493	1,019.3275	2,532.2236	0	529.26619
Slice 31	169.40338	-8.5593898	781.71399	2,242.3379	0	515.94714
Slice 32	172.5	-6.8225024	644.27815	2,084.1991	0	510.70413
Slice 33	174.5	-5.5989502	547.85831	1,985.8333	0	511.17351
Slice 34	178.05122	-3.3056726	367.26654	1,781.4081	0	504.86685
Slice 35	183.40008	0.51614392	114.83531	1,301.4923	630.95673	0
Slice 36	189.52222	5.3636828	-178.40864	790.91567	494.21896	0
Slice 37	195.17125	10.458894	-312	348.20448	217.58231	0
Slice 38	198.72342	13.916363	-255.91306	-35.967422	-20.765801	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

30 Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 10:03:24 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

30 Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SIGMA/W
Parent: 5-Year Consolidation after Construction
Method: Coupled Stress/PWP
Settings
- Initial Stress: Parent Analysis
- Initial PWP: Parent Analysis
- Exclude cumulative values: No

Control
- Apply Body Force in All Steps: No
- Saturated Zone Only: No

Convergence
- Maximum Number of Iterations: 50
- Minimum Pressure Head Difference: 0.001
- Minimum Displacement Difference: 0.001

Significant Digits: 3
Hydraulic Under-Relaxation Criteria
Under-Relaxation Initial Rate: 1
Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 1,832 days
Duration: 9,125 days
# of Steps: 200
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 200

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61

Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain

O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Slurry Wall

Model: Linear Elastic (Total)

Stress Strain

Young's Modulus (E): 50,000 psf

Unit Weight: 90 pcf
Poisson's Ratio: 0.49

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)
- Data Point: (0.018329807, 0.00038967277)
- Data Point: (0.033598183, 0.00037792234)
- Data Point: (0.061584821, 0.00036462391)
- Data Point: (0.11288379, 0.00034960021)
- Data Point: (0.20691381, 0.00033268641)
- Data Point: (0.37926902, 0.00031372429)

Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
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Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)

Data Point: (1,000, 2.0258119e-006)

Estimation Properties

Hyd. K-Function Estimation Method: Van Genuchten Function

Volume Water Content Function: Bay Mud

Saturated Kx: 0.0004 ft/days

Residual Water Content: 0.2 ft^3/ft^3

Maximum: 1,000

Minimum: 0.01

Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)

Function: K-Modifier vs. Y-Effective Stress

Curve Fit to Data: 0 %

Segment Curvature: 100 %

Y-Intercept: 0.96838408

Data Points: Y-Effective Stress (psf), K-Modifier

Data Point: (750, 1)

Data Point: (1,300, 0.6)

Data Point: (2,200, 0.3)

Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)

Function: K-Modifier vs. Y-Effective Stress

Curve Fit to Data: 0 %

Segment Curvature: 0 %

Y-Intercept: 0.9677369

Data Points: Y-Effective Stress (psf), K-Modifier

Data Point: (150, 1)

Data Point: (800, 0.55)

Data Point: (1,300, 0.375)

Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function

Function: Vol. Water Content vs. Pore-Water Pressure

Mv: 0.00012 /psf

Saturated Water Content: 0.74073295 ft^3/ft^3

Residual Water Content: 0.074073295 ft^3/ft^3

Curve Fit to Data: 100 %

Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)

Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8

Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10
Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

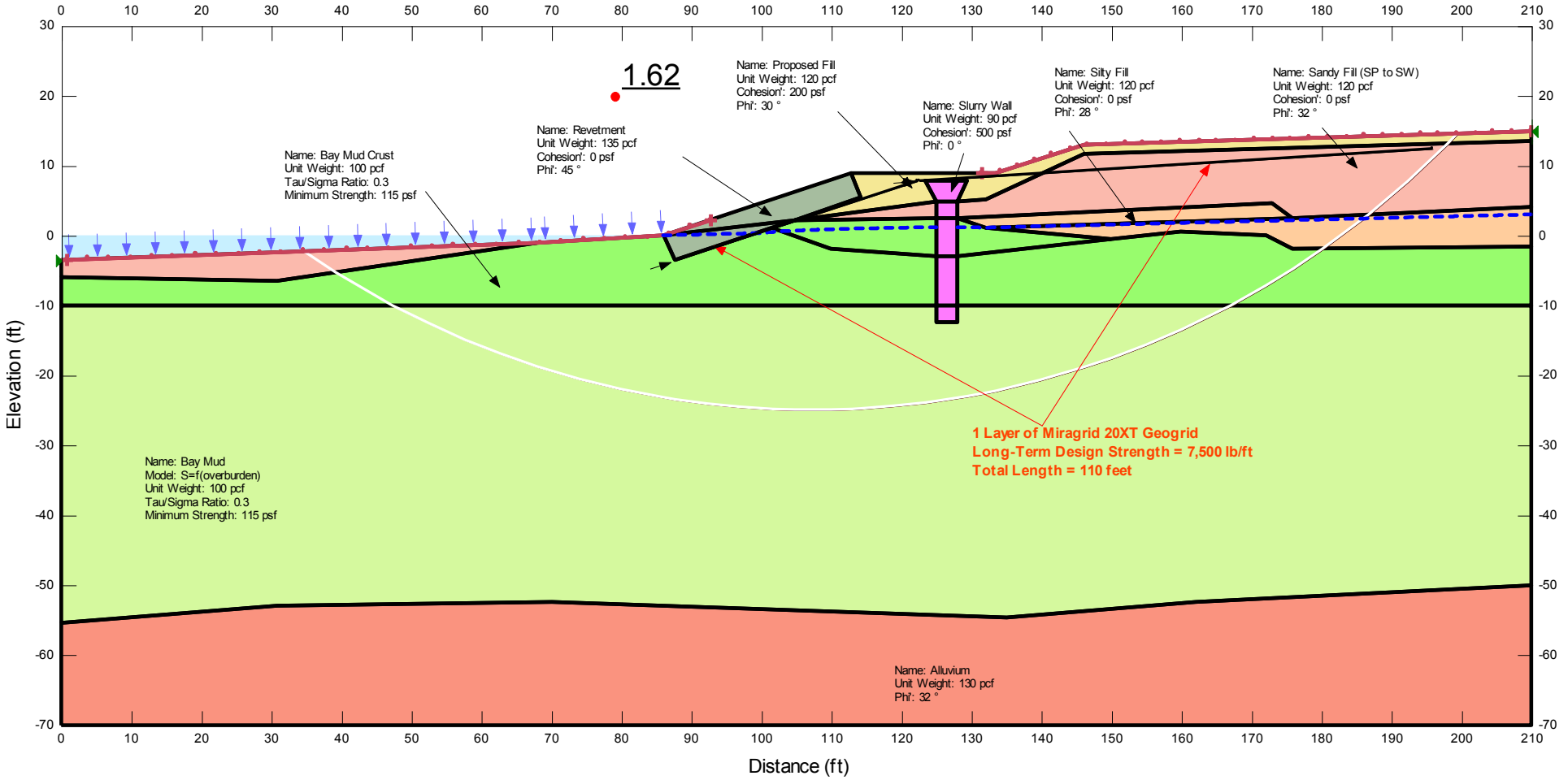
Lines

	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	44	38	Fixed X	14.5	90	
Line 2	38	39		31.101	4.61	Bay Water Level
Line 3	39	40		39.003	0.735	Bay Water Level
Line 4	40	41		65.031	-1.76	Bay Water Level
Line 5	41	42		27.074	4.24	Bay Water Level
Line 6	42	43		48.065	2.98	Bay Water Level
Line 7	43	45	Fixed X	20	90	
Line 8	45	44	Fixed X/Y	210	0	
Line 9	38	32	Fixed X	45.5	90	
Line 10	32	33		125	0	
Line 11	33	34		2.5	90	
Line 12	34	35		3	0	
Line 13	35	36		2.5	90	
Line 14	36	37		82	0	
Line 15	37	43	Fixed X	40	90	
Line 16	30	31		3	0	
Line 17	31	36		7	90	
Line 18	36	33		3	0	
Line 19	33	30		7	90	
Line 20	30	18		5.5	90	
Line 21	18	19		3	0	
Line 22	19	31		5.5	90	
Line 23	18	11		2.5	90	
Line 24	11	14		3	0	
Line 25	14	19		2.5	90	
Line 26	11	12		3.1765	-61.8	
Line 27	12	13		6	0	
Line 28	13	14		3.1765	61.8	
Line 29	32	47	Fixed X	4	90	
Line 30	47	48		31.004	-0.924	
Line 31	48	2		37.407	8.46	
Line 32	2	3		18.028	3.18	Bay Water Level

Line 33	9	29		8.9069	-20.4	
Line 34	29	30		15.033	-3.81	
Line 35	19	23		4.272	-20.6	
Line 36	23	24		18.062	-4.76	
Line 37	24	31		22.142	6.48	
Line 38	24	25		10.05	5.71	
Line 39	25	26		12.01	-2.39	
Line 40	26	27		4.4721	-26.6	
Line 41	27	28		34.004	0.843	
Line 42	28	37	Fixed X	8.5	90	
Line 43	9	10		3.3049	17.6	
Line 44	10	18		20.204	1.13	
Line 45	4	46		3.8897	-72	
Line 46	46	10		9.9298	18.8	
Line 47	10	11		20.407	8.17	
Line 48	22	28	Fixed X	5.5	90	
Line 49	23	21		44.026	1.95	
Line 50	21	22		34.033	2.53	
Line 51	19	20		45.044	2.54	
Line 52	20	21		3.6056	-33.7	
Line 53	14	15		4.005	2.86	
Line 54	15	16		15.435	24.9	
Line 55	16	17		64.025	1.61	
Line 56	17	22	Fixed X	9.5	90	
Line 57	4	5		20.5	0	
Line 58	5	6		13.124	17.7	
Line 59	6	7		64.031	1.79	
Line 60	7	17	Fixed X	1.5	90	
Line 61	3	10		18.917	6.37	
Line 62	3	4		28.46	18.4	
Line 63	47	1	Fixed X	2.5	90	
Line 64	1	2		68.046	2.11	Bay Water Level
Line 65	3	8		3.9361	-64.4	
Line 66	8	9		14.705	18.4	

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56
Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Static Slope Stability 30 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 10:04:06 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 30 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SLOPE/W
Parent: 30 Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.73568, -3.47295) ft
Left-Zone Right Coordinate: (92.75, 2.25) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (131.5, 9) ft
Right-Zone Right Coordinate: (210, 15) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -3.5) ft
Right Coordinate: (210, 15) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (87.7, -3.55) ft

Inside Point: (122.401, 7.76771) ft
Slip Surface Intersection: () ft
Length: 36.499999 ft
Direction: 198.06 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (122.5, 7.8) ft
Inside Point: (195.84957, 12.5) ft
Slip Surface Intersection: () ft
Length: 73.499996 ft
Direction: 183.67 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3
Point 32	0	-10
Point 33	125	-10

Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Bay Mud	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25
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Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56

Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806

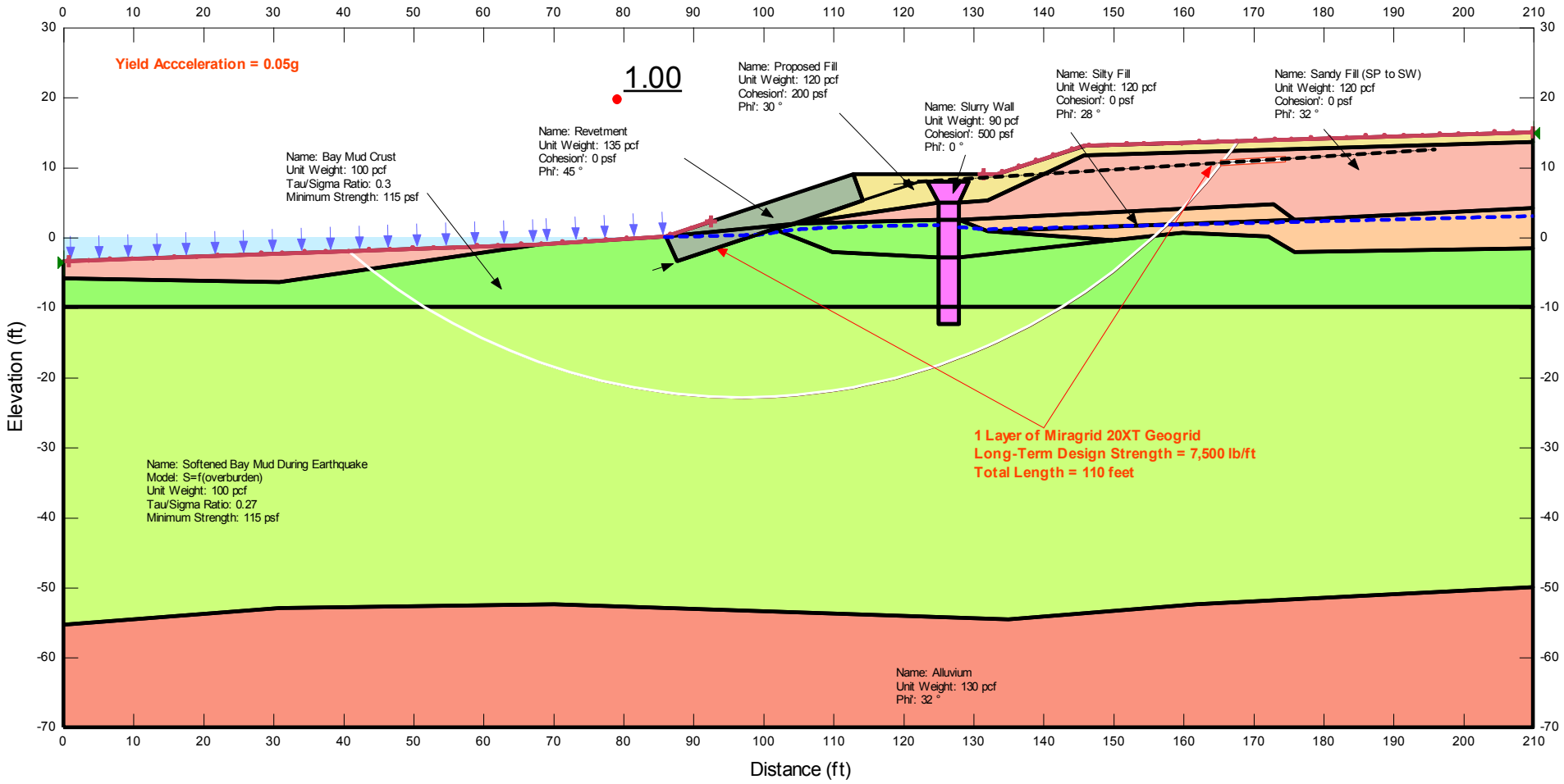
Current Slip Surface

Slip Surface: 4,042
F of S: 1.62
Volume: 3,568.9781 ft³
Weight: 379,154.04 lbs
Resisting Moment: 8,969,895 lbs-ft
Activating Moment: 5,552,305.1 lbs-ft
Resisting Force: 64,751.607 lbs
Activating Force: 40,098.294 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (34.612096, -2.2274965) ft
Entry: (199.45106, 14.670346) ft
Radius: 127.2578 ft
Center: (107.18134, 102.31078) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	36.914756	-3.7529943	234.18685	362.14225	79.95541	0
Slice 2	43.279338	-7.6392461	482.74207	803.48772	0	115
Slice 3	49.923602	-11.301437	722.90749	1,174.9262	0	115.52922
Slice 4	55.088287	-13.761821	885.75613	1,432.857	0	139.16092
Slice 5	60.252972	-15.945536	1,031.9151	1,659.9531	0	159.49942
Slice 6	65.417657	-17.867703	1,162.2614	1,856.9572	0	176.73528
Slice 7	71	-19.655057	1,285.5682	2,045.4435	0	194.58123
Slice 8	77	-21.277637	1,400.2969	2,220.6822	0	212.60002
Slice 9	83	-22.591071	1,496.2351	2,358.3824	0	226.98159
Slice 10	86.85	-23.309449	1,550.1815	2,535.6125	0	264.34152
Slice 11	90.025	-23.763409	1,585.9724	2,759.5651	0	320.58554
Slice 12	94.675	-24.30944	1,631.1019	2,959.3528	0	369.92762
Slice 13	99.325	-24.682915	1,665.4546	3,136.3618	0	417.32606
Slice 14	103.225	-24.875742	1,686.7446	3,269.7617	0	455.98637
Slice 15	107.4	-24.920267	1,699.3375	3,408.8504	0	500.36486
Slice 16	111.5	-24.864861	1,705.3768	3,540.8347	0	545.47292

Slice 17	113.6	-24.783622	1,705.0498	3,546.9306	0	551.59232
Slice 18	116.525	-24.58212	1,698.9563	3,475.0982	0	537.78364
Slice 19	121.175	-24.153653	1,682.0314	3,399.7597	0	529.45461
Slice 20	124.25	-23.794871	1,665.7513	3,301.8579	0	510.60986
Slice 21	126.5	-23.462959	1,649.1747	2,994.4372	0	425.43636
Slice 22	128.75	-23.103577	1,630.6271	3,211.0245	0	502.00667
Slice 23	130.75	-22.739	1,611.0036	3,218.3341	0	514.05642
Slice 24	132.75	-22.349577	1,589.5245	3,178.5552	0	512.00498
Slice 25	136.625	-21.452299	1,537.76	3,189.6099	0	538.55348
Slice 26	142.875	-19.795362	1,438.1646	3,230.368	0	593.84897
Slice 27	148	-18.20447	1,339.4851	3,176.4865	0	616.53856
Slice 28	152.5	-16.574073	1,236.2592	3,012.4292	0	603.15693
Slice 29	157.5	-14.544562	1,106.1032	2,805.6983	0	583.94341
Slice 30	163.51071	-11.734023	923.84933	2,536.2227	0	560.44312
Slice 31	169.51071	-8.6010908	715.48597	2,247.0838	0	537.21416
Slice 32	172.5	-6.9031416	599.97172	2,095.3698	0	526.41523
Slice 33	174.5	-5.6689447	515.96458	1,998.2276	0	522.84147
Slice 34	178.08239	-3.3362705	357.01393	1,794.4324	0	508.89288
Slice 35	183.44286	0.51711492	114.83932	1,316.8568	639.12406	0
Slice 36	189.53944	5.3674297	-178.61646	804.72462	502.84775	0
Slice 37	195.17643	10.462117	-312	355.16401	221.9311	0
Slice 38	198.72299	13.916351	-255.91301	-29.245657	-16.884988	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\B-B'_Rev-3.gsz

Yield Acceleration 5-Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:51:40 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Yield Acceleration 5-Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.73568, -3.47295) ft
Left-Zone Right Coordinate: (92.75, 2.25) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (131.5, 9) ft
Right-Zone Right Coordinate: (210, 15) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -3.5) ft
Right Coordinate: (210, 15) ft

Seismic Coefficients

Horz Seismic Coef.: 0.05

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (87.7, -3.55) ft
Inside Point: (122.3768, 7.84165) ft
Slip Surface Intersection: () ft
Length: 36.500002 ft
Direction: 198.19 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 5,200 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 5,200 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (122.5, 7.8) ft
Inside Point: (195.84938, 12.5031) ft
Slip Surface Intersection: (165.42838, 10.552531) ft
Length: 73.500005 ft
Direction: 183.67 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 5,200 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 5,200 lbs
Pullout Force: 5,200 lbs
Pullout Force per Length: 564.28762 lbs/ft
Available Length: 30.483467 ft

Required Length: 9.2151588 ft
Governing Component: Tensile Capacity

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3

Point 32	0	-10
Point 33	125	-10
Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Softened Bay Mud During Earthquake	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25

Region 13	Silty Fill	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56
Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806

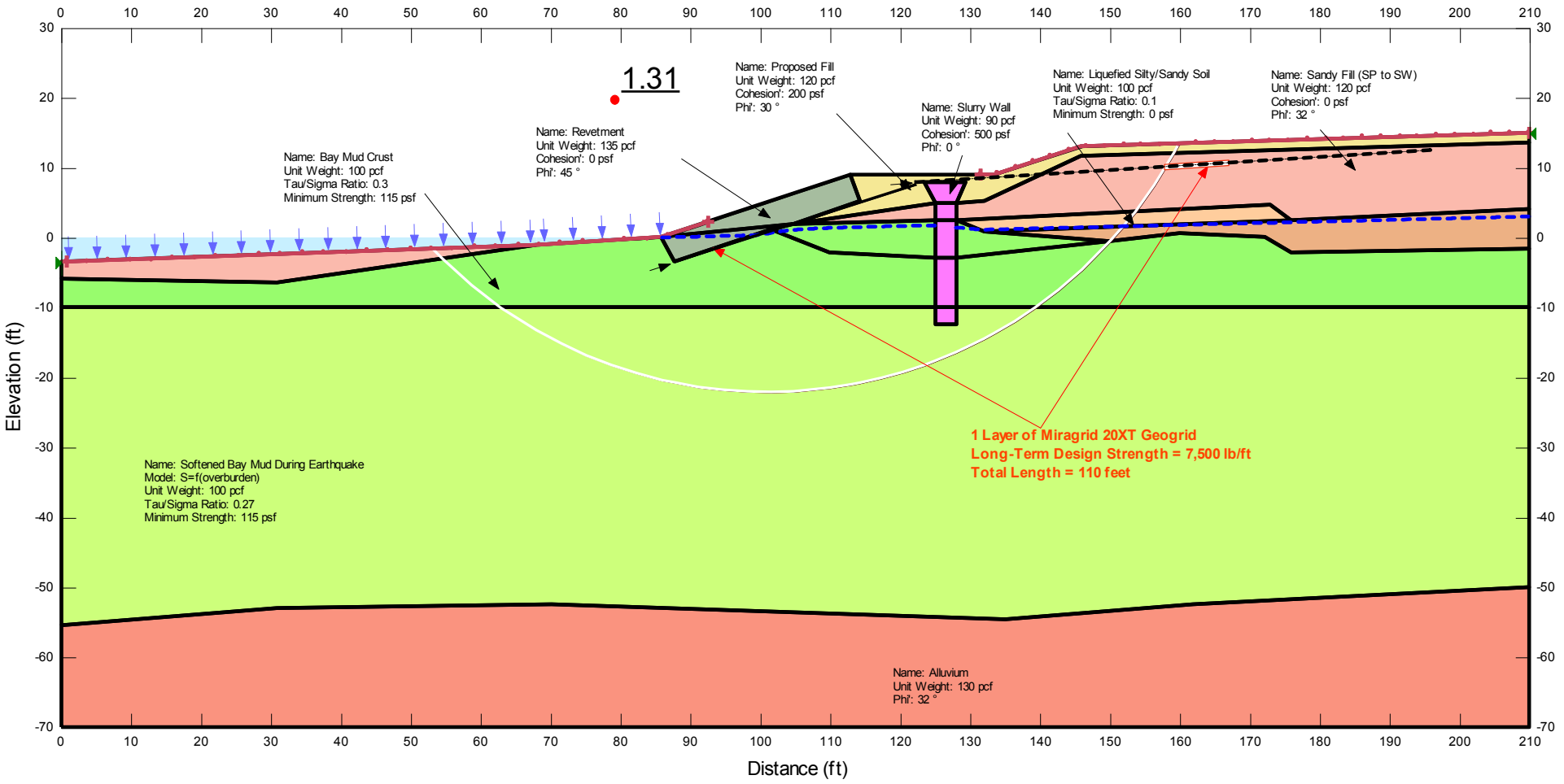
Current Slip Surface

Slip Surface: 4,593
F of S: 1.00
Volume: 2,445.6686 ft³
Weight: 258,071.82 lbs
Resisting Moment: 3,446,019 lbs-ft
Activating Moment: 3,439,448.3 lbs-ft
Resisting Force: 35,058.341 lbs
Activating Force: 35,005.07 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (40.771445, -2.0010498) ft
Entry: (167.80425, 13.681383) ft
Radius: 86.531077 ft
Center: (97.152277, 63.640622) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	42.345831	-3.2902385	205.31088	369.89502	102.84359	0
Slice 2	45.868528	-6.0138882	381.83307	679.90118	0	115
Slice 3	49.765149	-8.7241746	565.59042	951.51235	0	115
Slice 4	53.749277	-11.180951	734.65151	1,199.4606	0	115
Slice 5	57.820912	-13.401226	889.75462	1,423.5582	0	115

Slice 6	61.892547	-15.349304	1,029.158	1,625.1835	0	127.81699
Slice 7	65.964182	-17.044979	1,154.2259	1,796.6979	0	138.89159
Slice 8	70.25	-18.568199	1,270.9234	1,952.4459	0	149.30903
Slice 9	74.75	-19.9078	1,378.6553	2,090.2238	0	158.92866
Slice 10	79.25	-20.987073	1,471.2528	2,195.3955	0	165.60571
Slice 11	83.75	-21.815912	1,549.4898	2,269.7454	0	169.39839
Slice 12	86.85	-22.270713	1,596.8155	2,411.4862	0	197.27032
Slice 13	90.025	-22.564869	1,634.7992	2,608.7105	0	242.98317
Slice 14	94.675	-22.823708	1,679.8727	2,761.4752	0	279.65199
Slice 15	99.325	-22.831903	1,708.7637	2,881.9729	0	313.92268
Slice 16	103.225	-22.66266	1,721.0983	2,961.8273	0	341.35902
Slice 17	107.4	-22.241595	1,717.7701	3,035.5204	0	373.02744
Slice 18	111.5	-21.679109	1,702.7057	3,100.8959	0	405.63152
Slice 19	113.6	-21.310695	1,688.8334	3,075.6294	0	407.04249
Slice 20	116.525	-20.660231	1,659.0359	2,950.62	0	388.89279
Slice 21	121.175	-19.453774	1,595.7774	2,793.5472	0	372.90102
Slice 22	124.25	-18.534295	1,541.9732	2,645.1158	0	350.9334
Slice 23	126.5	-17.746084	1,492.4893	2,313.2362	0	270.84215
Slice 24	128.75	-16.91099	1,437.2668	2,464.0086	0	336.81343
Slice 25	130.75	-16.090052	1,380.216	2,422.5235	0	345.44183
Slice 26	132.75	-15.224784	1,317.8704	2,338.0713	0	341.78166
Slice 27	135.77277	-13.752096	1,209.4835	2,259.9111	0	356.20791
Slice 28	140.31832	-11.308968	1,026.0352	2,157.2932	0	388.94822
Slice 29	144.29555	-8.8921772	833.32469	2,009.0642	0	465.28039
Slice 30	148	-6.3309726	618.61544	1,801.161	0	476.59455
Slice 31	152.93879	-2.3949166	294.09589	1,402.6644	0	460.66159
Slice 32	156.81764	0.98293069	45.576924	985.00399	499.50223	0
Slice 33	158.76027	2.8948925	-70.796755	807.59598	429.4064	0
Slice 34	161.52106	5.8707542	-252.07702	533.50828	333.37298	0
Slice 35	165.03753	10.057354	-312	234.06129	146.25773	0
Slice 36	167.30001	12.983132	-255.93542	-107.80094	-62.2389	200



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Post-Liquefaction Slope Stability 5 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: B-B'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\B-B'\
Last Solved Date: 10/15/2015
Last Solved Time: 9:55:12 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Post-Liquefaction Slope Stability 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section B-B'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Liquefied Silty/Sandy Soil

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 0 psf

Slurry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.73568, -3.47295) ft
Left-Zone Right Coordinate: (92.75, 2.25) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (131.5, 9) ft
Right-Zone Right Coordinate: (210, 15) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -3.5) ft
Right Coordinate: (210, 15) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (87.7, -3.55) ft
Inside Point: (122.401, 7.76771) ft
Slip Surface Intersection: () ft
Length: 36.499999 ft
Direction: 198.06 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 5,200 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 5,200 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (122.5, 7.8) ft
Inside Point: (195.84938, 12.50302) ft
Slip Surface Intersection: (157.93931, 10.0723) ft
Length: 73.5 ft
Direction: 183.67 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 5,200 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 5,200 lbs
Pullout Force: 5,200 lbs
Pullout Force per Length: 571.0446 lbs/ft
Available Length: 37.987913 ft

Required Length: 9.1061189 ft
Governing Component: Tensile Capacity

Points

	X (ft)	Y (ft)
Point 1	0	-3.5
Point 2	68	-1
Point 3	86	0
Point 4	113	9
Point 5	133.5	9
Point 6	146	13
Point 7	210	15
Point 8	87.7	-3.55
Point 9	101.65	1.1
Point 10	104.8	2.1
Point 11	125	5
Point 12	123.5	7.8
Point 13	129.5	7.8
Point 14	128	5
Point 15	132	5.2
Point 16	146	11.7
Point 17	210	13.5
Point 18	125	2.5
Point 19	128	2.5
Point 20	173	4.5
Point 21	176	2.5
Point 22	210	4
Point 23	132	1
Point 24	150	-0.5
Point 25	160	0.5
Point 26	172	0
Point 27	176	-2
Point 28	210	-1.5
Point 29	110	-2
Point 30	125	-3
Point 31	128	-3

Point 32	0	-10
Point 33	125	-10
Point 34	125	-12.5
Point 35	128	-12.5
Point 36	128	-10
Point 37	210	-10
Point 38	0	-55.5
Point 39	31	-53
Point 40	70	-52.5
Point 41	135	-54.5
Point 42	162	-52.5
Point 43	210	-50
Point 44	0	-70
Point 45	210	-70
Point 46	114.2	5.3
Point 47	0	-6
Point 48	31	-6.5

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	44,38,39,40,41,42,43,45	3,579
Region 2	Softened Bay Mud During Earthquake	38,32,33,34,35,36,37,43,42,41,40,39	9,013.5
Region 3	Slurry Wall	30,31,36,33	21
Region 4	Slurry Wall	33,36,35,34	7.5
Region 5	Slurry Wall	30,18,19,31	16.5
Region 6	Slurry Wall	18,11,14,19	7.5
Region 7	Slurry Wall	11,12,13,14	12.6
Region 8	Bay Mud Crust	32,47,48,2,3,8,9,29,30,33	847.14
Region 9	Bay Mud Crust	31,19,23,24	50
Region 10	Bay Mud Crust	36,31,24,25,26,27,28,37	721
Region 11	Bay Mud Crust	9,10,18,30,29	92.758
Region 12	Sandy Fill (SP to SW)	10,11,18	25.25

Region 13	Liquefied Silty/Sandy Soil	23,21,22,28,27,26,25,24	243.5
Region 14	Silty Fill	19,20,21,23	84
Region 15	Sandy Fill (SP to SW)	19,14,15,16,17,22,21,20	666.6
Region 16	Proposed Fill	10,46,4,5,6,7,17,16,15,14,13,12,11	199.79
Region 17	Revetment	3,4,46,10	75.56
Region 18	Sandy Fill (SP to SW)	47,1,2,48	179.5
Region 19	Revetment	8,3,10,9	34.806

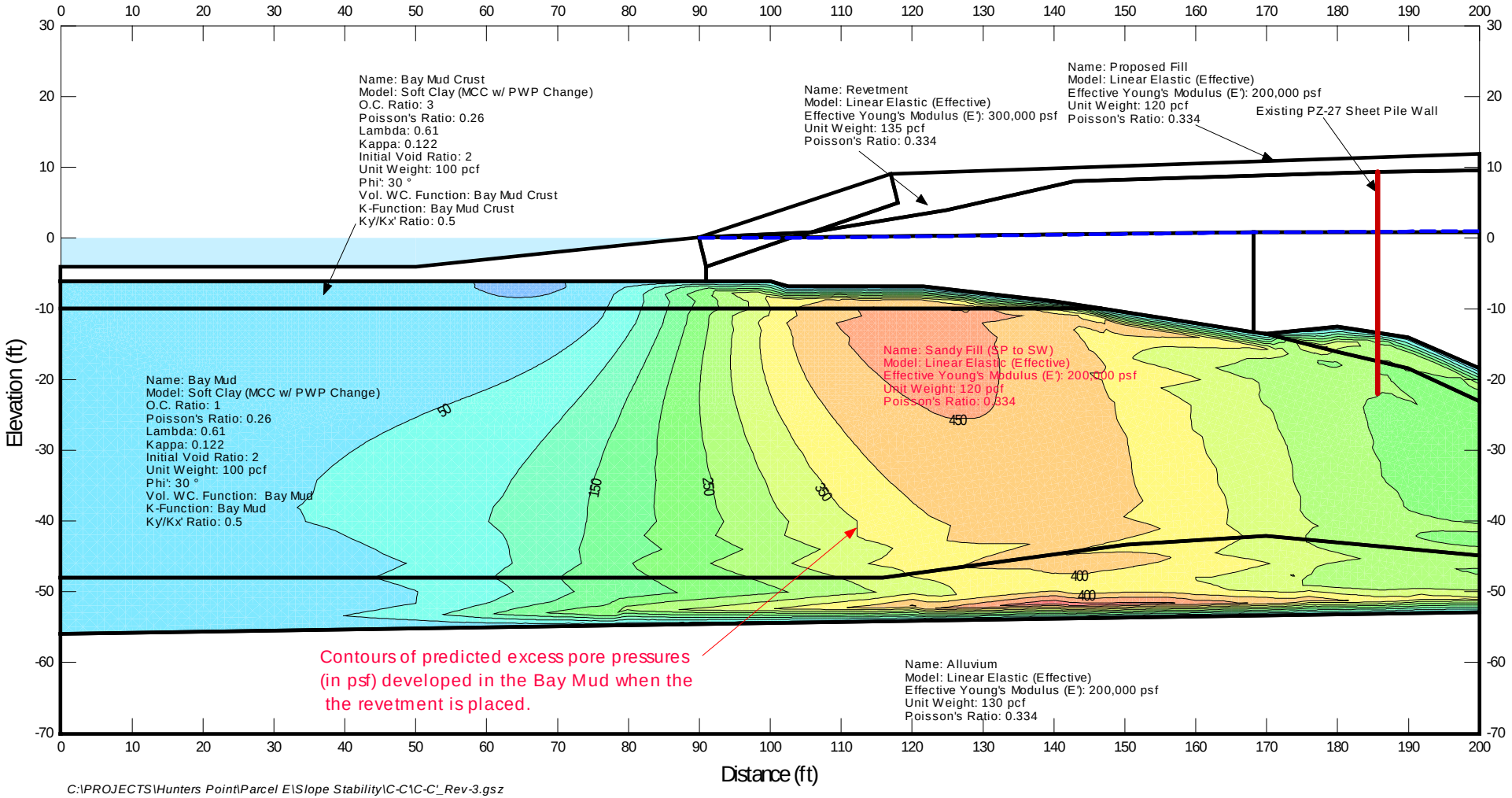
Current Slip Surface

Slip Surface: 5,925
F of S: 1.31
Volume: 2,051.7517 ft³
Weight: 215,964.49 lbs
Resisting Moment: 2,212,783.6 lbs-ft
Activating Moment: 1,692,609.9 lbs-ft
Resisting Force: 28,539.449 lbs
Activating Force: 21,820.18 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 1 slip surfaces
Exit: (53.090142, -1.5481566) ft
Entry: (159.89255, 13.434142) ft
Radius: 66.388244 ft
Center: (101.11172, 44.292081) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	53.806413	-2.2757707	142.00809	227.6783	53.532691	0
Slice 2	56.618211	-4.8988042	317.11453	547.65015	0	115
Slice 3	60.809266	-8.3971118	560.32605	892.52138	0	115
Slice 4	65.452397	-11.624662	790.71487	1,213.1931	0	115
Slice 5	69.8	-14.212683	980.24886	1,475.4699	0	115

Slice 6	73.4	-16.00332	1,115.7185	1,665.5773	0	123.73924
Slice 7	77	-17.532601	1,234.9159	1,827.4109	0	134.87695
Slice 8	80.6	-18.819616	1,338.927	1,960.8275	0	143.57373
Slice 9	84.2	-19.879001	1,428.6135	2,067.556	0	149.99218
Slice 10	86.85	-20.540357	1,487.2672	2,237.2739	0	180.12875
Slice 11	89.44375	-21.038769	1,535.195	2,444.6034	0	223.44034
Slice 12	92.93125	-21.566794	1,590.4307	2,601.2964	0	254.1709
Slice 13	96.41875	-21.907006	1,633.4769	2,734.2084	0	283.12164
Slice 14	99.90625	-22.062302	1,664.4051	2,844.2052	0	310.35153
Slice 15	103.225	-22.043806	1,682.6407	2,929.6148	0	335.03352
Slice 16	107.4	-21.746053	1,686.8373	3,021.2106	0	367.99966
Slice 17	111.5	-21.260768	1,676.5347	3,095.6783	0	401.40249
Slice 18	113.6	-20.908138	1,663.403	3,068.5338	0	403.03966
Slice 19	115.75	-20.442718	1,642.4518	2,975.4573	0	387.58053
Slice 20	118.85	-19.662316	1,602.8897	2,872.87	0	376.85994
Slice 21	121.95	-18.71982	1,549.8451	2,756.3588	0	365.4031
Slice 22	124.25	-17.928321	1,502.0842	2,622.2719	0	345.34214
Slice 23	126.5	-17.028375	1,444.6636	2,279.3511	0	264.37696
Slice 24	128.75	-16.063894	1,379.7415	2,417.5094	0	329.47369
Slice 25	130.75	-15.096634	1,311.1431	2,364.338	0	337.26922
Slice 26	132.75	-14.06621	1,235.6362	2,259.3901	0	332.22782
Slice 27	134.95466	-12.797274	1,141.1855	2,174.249	0	338.1443
Slice 28	137.86398	-10.967471	1,003.3593	2,076.1726	0	355.58094
Slice 29	140.98898	-8.744091	823.87719	1,919.7655	0	417.59395
Slice 30	144.32966	-6.0543426	597.33895	1,734.8054	0	442.66429
Slice 31	148.06186	-2.5540656	302.8666	1,415.7345	0	446.80885
Slice 32	151.07272	0.59746518	60.956982	1,328.6878	0	142.53151
Slice 33	152.80891	2.6600818	-65.129193	828.10278	440.31006	0
Slice 34	154.98609	5.5715557	-243.51834	549.09026	343.10967	0
Slice 35	157.76602	9.7877591	-312	236.81379	147.97768	0
Slice 36	159.52427	12.752077	-255.95198	-111.36637	-64.297406	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\C-C\C-C'_Rev-3.gsz

Place New Fill and Revetment

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File Information

Tool Version: 8.15.1.11236
File Name: C-C'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\C-C'\
Last Solved Date: 10/7/2015
Last Solved Time: 12:39:12 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Place New Fill and Revetment

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SIGMA/W
Parent: Insitu Stresses
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: Yes
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 days
Duration: 7 days
# of Steps: 7
Step Generation Method: Linear
Save Steps Every: 7

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic
- Vol. WC. Function: Bay Mud
- K-Function: Bay Mud
- Ky'/Kx' Ratio: 0.5
- Rotation: 0 °
- K-Modifier Function: Bay Mud K Modifier Funtion
- Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain
- Effective Young's Modulus (E'): 200,000 psf
- Unit Weight: 130 pcf
- Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain
- O.C. Ratio: 3
- Poisson's Ratio: 0.26
- Lambda: 0.61
- Kappa: 0.122
- Initial Void Ratio: 2
- Unit Weight: 100 pcf
- Phi': 30 °

Hydraulic
- Vol. WC. Function: Bay Mud Crust
- K-Function: Bay Mud Crust
- Ky'/Kx' Ratio: 0.5
- Rotation: 0 °
- K-Modifier Function: Bay Mus Crust K Modifier Function
- Load Response Ratio: 1

Interface

Model: Elastic-Plastic (Total)

Stress Strain
- Young's Modulus (E): 200,000 psf
- Cohesion: 0 psf
- Unit Weight: 120 pcf
- Poisson's Ratio: 0.3
- Phi: 25 °
- Dilation Angle: 0 °

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Structural Beams

PZ-27 Sheet Pile

E-Modulus: 4.176e+009 psf
Cross-sectional Area: 0.0529 ft²
Moment of Inertia: 0.00361 ft^4
Allow Tension: Yes
Allow Compression: Yes

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
- Coordinate 1: (0, 0) ft
- Coordinate 2: (94, 0) ft
- Coordinate 3: (106, 0.5) ft
- Coordinate 4: (118.5, 0.5) ft
- Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 100 %

Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
- Data Point: (0.01, 0.0004)

Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)

Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)

Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf

Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9

Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48
Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8

Point 42	168	-13.2
Point 43	91	-6

Lines

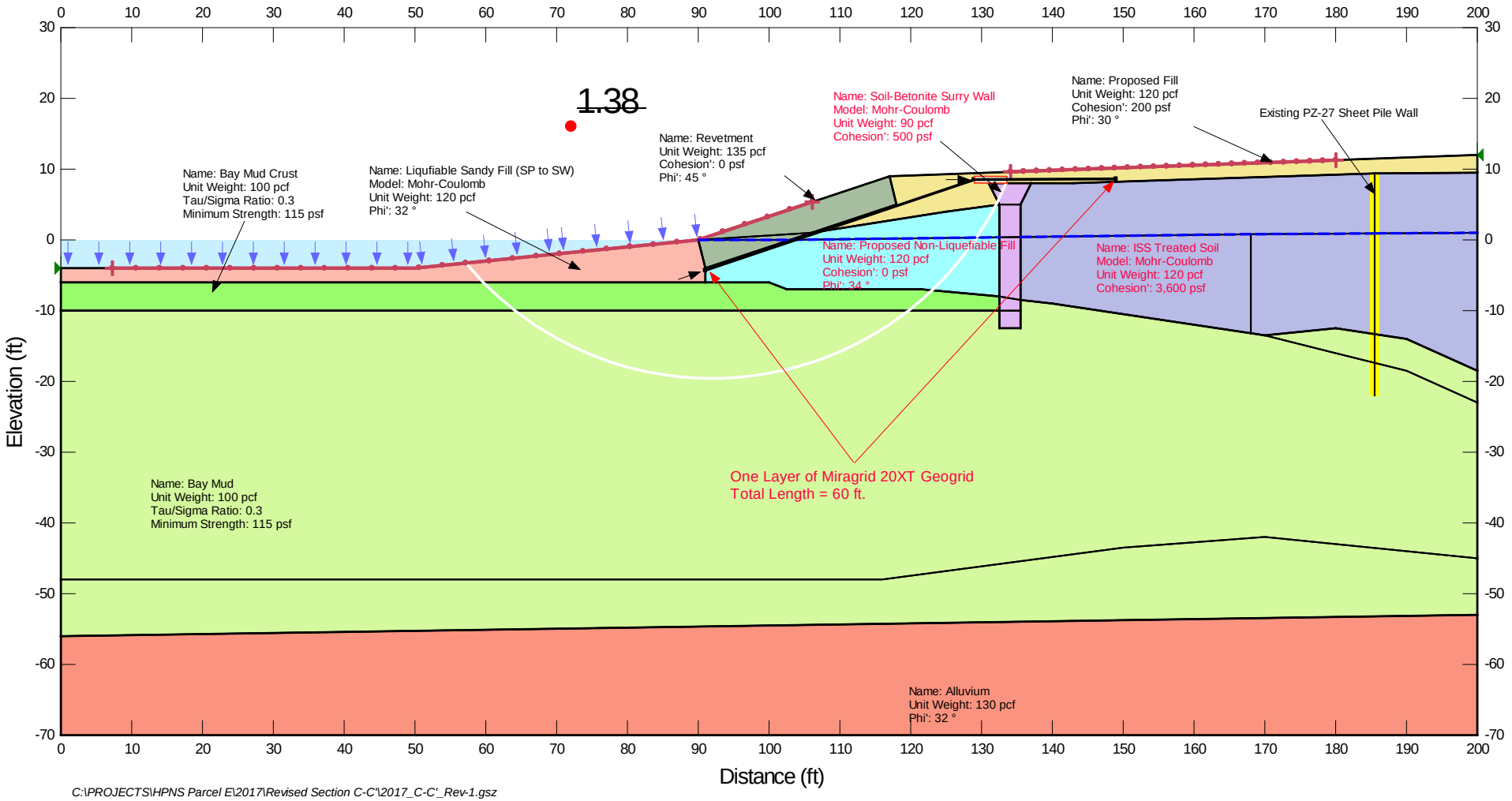
	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	33	31	Fixed X	14	90	
Line 2	31	32		200.02	0.859	Bay Water Level
Line 3	32	34	Fixed X	17	90	
Line 4	34	33	Fixed X/Y	200	0	
Line 5	31	26	Fixed X	8	90	
Line 6	26	27		116	0	
Line 7	27	28		34.297	7.54	
Line 8	28	29		20.056	4.29	
Line 9	29	30		30.15	-5.71	
Line 10	30	32	Fixed X	8	90	
Line 11	15	16		2.6926	-21.8	
Line 12	19	23		10.308	-14	
Line 13	23	24		10.308	-14	
Line 14	24	25		10.966	-24.2	
Line 15	25	30	Fixed X	22	90	
Line 16	19	20		10.05	5.71	
Line 17	20	21		10.112	-8.53	
Line 18	21	22		10.966	-24.2	
Line 19	22	25	Fixed X	4.5	90	
Line 20	14	1	Fixed X	2	90	
Line 21	1	2		50	0	Bay Water Level
Line 22	2	3		20.1	5.71	Bay Water Level
Line 23	4	7		4.1231	-76	
Line 24	7	8		12.649	18.4	
Line 25	4	8		13	0	
Line 26	4	9		16.031	3.58	
Line 27	9	8		3.1623	18.4	
Line 28	9	10		19.235	8.97	
Line 29	10	11		18.439	12.5	

Line 30	12	13	Fixed X	8.5	90	
Line 31	9	35		12.649	18.4	
Line 32	35	5		4.1231	-76	
Line 33	5	6		83.054	2.07	
Line 34	6	12	Fixed X	2.5	90	
Line 35	4	5		28.46	18.4	
Line 36	18	37		6.7742	-8.49	
Line 37	26	36	Fixed X	38	90	
Line 38	36	37		146.7	0	
Line 39	36	14	Fixed X	4	90	
Line 40	11	38		42.522	1.85	
Line 41	38	12		14.501	0.503	
Line 42	38	39		31.373	90	
Line 43	16	40		5.5	0	
Line 44	40	17		13.5	0	
Line 45	13	22	Fixed X	19.5	90	
Line 46	41	13		32.001	0.358	
Line 47	37	42		21.539	-8.54	
Line 48	42	19		2.0224	-8.53	
Line 49	42	41		14	90	
Line 50	41	8		65.005	0.705	
Line 51	17	18		18.608	-6.17	
Line 52	3	4		20.1	5.71	Bay Water Level
Line 53	14	43		91	0	
Line 54	43	15		9	0	
Line 55	7	43		2	90	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,37,42,19,23,24,25,30,29,28,27	7,015.2
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26

Region 7	Revetment	4,9,8	6.5
Region 8	Sandy Fill (SP to SW)	8,9,10,11,38,12,13,41	608.2
Region 9	Proposed Fill	9,35,5,6,12,38,11,10	239
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,18,37,36	506.1
Region 12	Sandy Fill (SP to SW)	7,8,41,42,37,18,17,40,16,15,43	663.98
Region 13	Sandy Fill (SP to SW)	41,13,22,21,20,19,42	480.5



C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Static Slope Stabil after Placement of Revetment with Treatment of Liquef. Soil & Geogrid

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:47:28 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stabil ater Placement of Revetment with Treatment of Liquef. Soil & Geogrid

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SLOPE/W
Parent: Place New Fill and Revetment
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Liqufiable Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Interface

Model: High Strength
Unit Weight: 120 pcf

Proposed Non-Liquefiable Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Soil-Betonite Surry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

ISS Treated Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (7.3, -4) ft
Left-Zone Right Coordinate: (106.1, 5.36667) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (134.1, 9.61807) ft
Right-Zone Right Coordinate: (180.03354, 11.27832) ft
Right-Zone Increment: 25
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (200, 12) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (91, -4.3) ft
Inside Point: (129, 8.5) ft
Slip Surface Intersection: () ft
Length: 40.09788 ft
Direction: 198.62 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (129, 8.5) ft
Inside Point: (149, 8.6) ft
Slip Surface Intersection: (133.66325, 8.5233163) ft
Length: 20.00025 ft
Direction: 180.29 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1

Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 593.12986 lbs
Pullout Force per Length: 127.19076 lbs/ft
Available Length: 4.6633092 ft
Required Length: 4.6633092 ft
Governing Component: Pullout Resistance (Active Zone)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48

Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5

Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5

Current Slip Surface

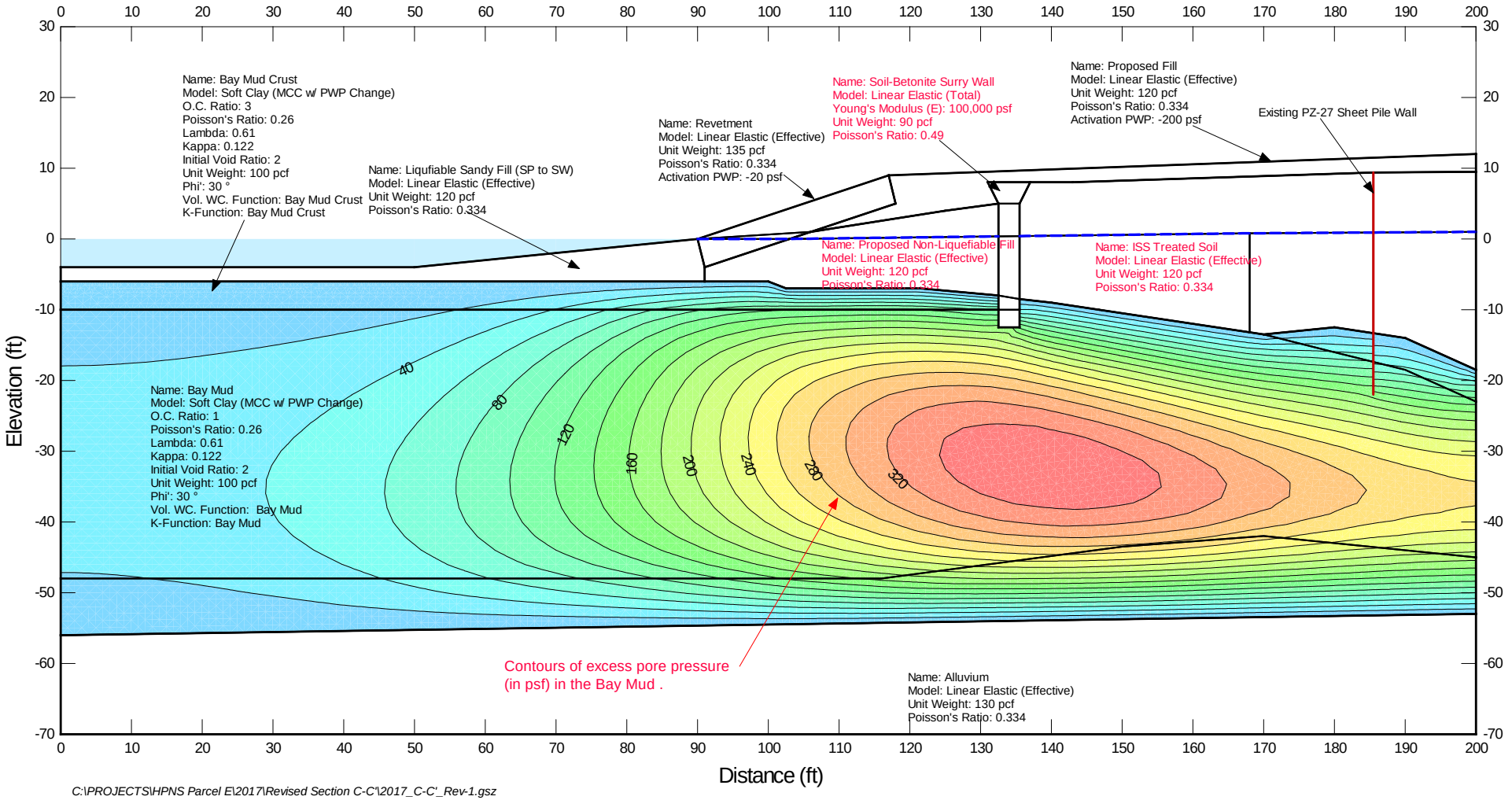
Slip Surface: 4,298
F of S: 1.38
Volume: 1,222.0556 ft³
Weight: 136,693.62 lbs
Resisting Moment: 1,169,196.9 lbs-ft
Activating Moment: 847,416.18 lbs-ft
Resisting Force: 20,440.986 lbs
Activating Force: 14,812.678 lbs
F of S Rank (Analysis): 1 of 8,866 slip surfaces
F of S Rank (Query): 1 of 5 slip surfaces
Exit: (57.19929, -3.280071) ft
Entry: (134.1, 9.6180723) ft
Radius: 45.093441 ft

Center: (91.901645, 25.515154) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	58.424297	-4.6400355	289.53822	461.20544	107.26958	0
Slice 2	60.765752	-7.0668946	438.34023	737.9182	0	115
Slice 3	62.998649	-9.0668946	568.37046	940.79554	0	115
Slice 4	65.586323	-11.058568	699.889	1,145.4957	0	115.60351
Slice 5	68.528774	-13.009723	836.06166	1,358.1179	0	138.3709
Slice 6	71.25	-14.546676	951.95496	1,524.3364	0	154.4138
Slice 7	73.75	-15.741012	1,047.3175	1,653.4003	0	165.95511
Slice 8	76.25	-16.753838	1,133.5098	1,763.0776	0	174.80219
Slice 9	78.75	-17.598008	1,212.3083	1,854.9601	0	180.80775
Slice 10	81.25	-18.283316	1,283.9288	1,930.3864	0	184.20082
Slice 11	83.75	-18.817156	1,347.3166	1,990.4297	0	185.5197
Slice 12	86.25	-19.204974	1,401.3349	2,035.8605	0	185.26876
Slice 13	88.75	-19.450559	1,446.4651	2,067.1697	0	183.41724
Slice 14	90.5	-19.553721	1,473.7044	2,132.294	0	196.25034
Slice 15	92.125	-19.563697	1,493.1775	2,225.5801	0	219.95767
Slice 16	94.375	-19.496305	1,514.9324	2,300.1394	0	238.40944
Slice 17	96.625	-19.315958	1,529.7058	2,362.0881	0	255.56702
Slice 18	98.875	-19.021281	1,537.0668	2,411.3277	0	271.51838
Slice 19	101.25	-18.580128	1,535.689	2,458.4403	0	290.19715
Slice 20	102.75	-18.253159	1,531.2106	2,485.9543	0	302.73161
Slice 21	104.5	-17.754455	1,515.8528	2,494.3412	0	313.37781
Slice 22	107	-16.962272	1,484.3093	2,496.4854	0	329.07537
Slice 23	109.125	-16.141687	1,445.6136	2,481.8542	0	341.56655
Slice 24	111.375	-15.137654	1,402.7586	2,451.8492	0	351.30204
Slice 25	113.625	-13.979981	1,349.7322	2,404.7502	0	359.47978
Slice 26	115.875	-12.654621	1,265.8854	2,336.2488	0	371.873
Slice 27	117.5	-11.60322	1,198.2464	2,231.7991	0	365.02328
Slice 28	118.8441	-10.6292	1,134.4826	2,103.08	0	346.93076
Slice 29	120.5941	-9.2523888	1,008.6101	1,953.7079	0	345.66529
Slice 30	122.25139	-7.8206967	693.41955	1,761.943	0	399.83801
Slice 31	124.00139	-6.1234484	398.23224	1,365.3045	652.2985	0

Slice 32	126.07558	-3.8589484	258.52043	1,102.3328	569.15863	0
Slice 33	128.22674	-1.1419462	90.631579	795.78517	475.6321	0
Slice 34	130.15116	1.6862625	-84.370689	523.54211	353.13361	0
Slice 35	131.51291	3.9927881	-227.25206	332.86859	224.5227	0
Slice 36	132.15289	5.1884184	-274.46945	89.59979	51.730463	200
Slice 37	132.86722	6.720031	0	-486.21377	-0	500
Slice 38	133.77724	8.8090361	-200	-131.2077	-75.752803	200



C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

5-Year Consolidation after Construction

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:47:52 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

5-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SIGMA/W
Parent: Place New Fill and Revetment
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1
        Under-Relaxation Min. Rate: 0.1

Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 7 days
Duration: 1,825 days
# of Steps: 50
Step Generation Method: Exponential
Initial Increment Size: 4 days
Save Steps Every: 10

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Liqufiable Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Interface

Model: Elastic-Plastic (Total)
Stress Strain
Young's Modulus (E): 200,000 psf
Cohesion: 0 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.3
Phi: 25 °
Dilation Angle: 0 °

Proposed Non-Liquefiable Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf

Poisson's Ratio: 0.334

Soil-Betonite Surry Wall

Model: Linear Elastic (Total)
Stress Strain
Young's Modulus (E): 100,000 psf
Unit Weight: 90 pcf
Poisson's Ratio: 0.49

ISS Treated Soil

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Structural Beams

PZ-27 Sheet Pile

E-Modulus: 4.176e+009 psf
Cross-sectional Area: 0.0529 ft²
Moment of Inertia: 0.00361 ft^4
Allow Tension: Yes
Allow Compression: Yes

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates

Coordinate 1: (0, 0) ft
Coordinate 2: (94, 0) ft
Coordinate 3: (106, 0.5) ft
Coordinate 4: (118.5, 0.5) ft
Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function

Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)

Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0

Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48
Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45

Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Lines

	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	33	31	Fixed X	14	90	
Line 2	31	32		200.02	0.859	Bay Water Level
Line 3	32	34	Fixed X	17	90	
Line 4	34	33	Fixed X/Y	200	0	
Line 5	31	26	Fixed X	8	90	
Line 6	26	27		116	0	

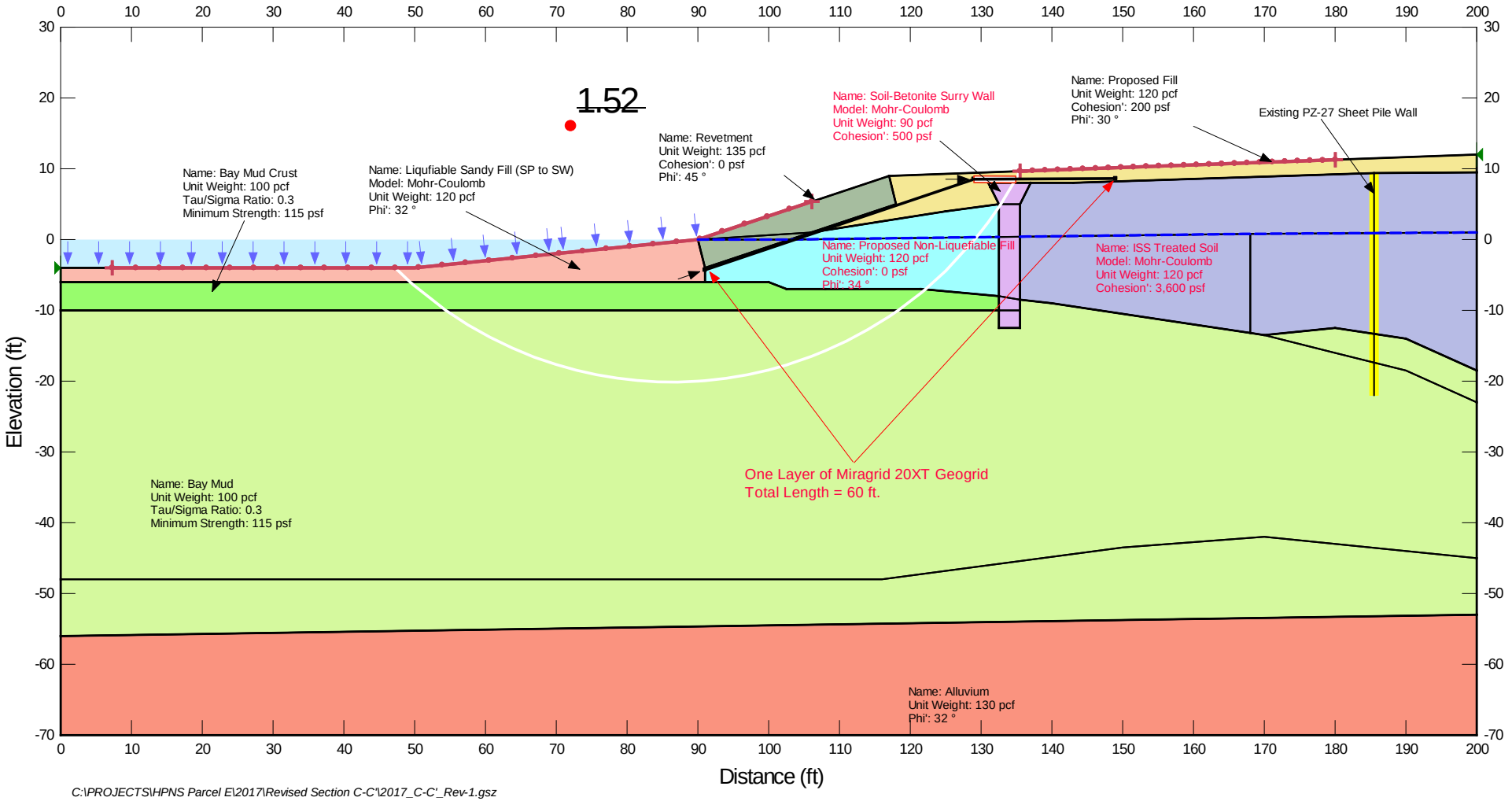
Line 7	27	28		34.297	7.54	
Line 8	28	29		20.056	4.29	
Line 9	29	30		30.15	-5.71	
Line 10	30	32	Fixed X	8	90	
Line 11	15	16		2.6926	-21.8	
Line 12	19	23		10.308	-14	
Line 13	23	24		10.308	-14	
Line 14	24	25		10.966	-24.2	
Line 15	25	30	Fixed X	22	90	
Line 16	19	20		10.05	5.71	
Line 17	20	21		10.112	-8.53	
Line 18	21	22		10.966	-24.2	
Line 19	22	25	Fixed X	4.5	90	
Line 20	14	1	Fixed X	2	90	
Line 21	1	2		50	0	Bay Water Level
Line 22	2	3		20.1	5.71	Bay Water Level
Line 23	4	7		4.1231	-76	
Line 24	7	8		12.649	18.4	
Line 25	4	8		13	0	
Line 26	4	9		16.031	3.58	
Line 27	9	8		3.1623	18.4	
Line 28	9	10		19.235	8.97	
Line 29	12	13	Fixed X	8.5	90	
Line 30	9	35		12.649	18.4	
Line 31	35	5		4.1231	-76	
Line 32	5	6		83.054	2.07	
Line 33	6	12	Fixed X	2.5	90	
Line 34	4	5		28.46	18.4	
Line 35	18	37		6.7742	-8.49	
Line 36	26	36	Fixed X	38	90	
Line 37	36	14	Fixed X	4	90	
Line 38	11	38		42.522	1.85	
Line 39	38	12		14.501	0.503	
Line 40	38	39		31.373	90	
Line 41	16	40		5.5	0	
Line 42	40	17		13.5	0	

Line 43	13	22	Fixed X	19.5	90	
Line 44	41	13		32.001	0.358	
Line 45	37	42		21.539	-8.54	
Line 46	42	19		2.0224	-8.53	
Line 47	42	41		14	90	
Line 48	3	4		20.1	5.71	Bay Water Level
Line 49	14	43		91	0	
Line 50	43	15		9	0	
Line 51	7	43		2	90	
Line 52	52	8		29.502	0.705	
Line 53	41	53		32.502	0.705	
Line 54	11	51		6	0	
Line 55	51	44		6	0	
Line 56	44	45		3.3541	-63.4	
Line 57	45	10		7.5664	7.59	
Line 58	51	50		3.3541	63.4	
Line 59	50	53		4.6	90	
Line 60	45	52		4.6369	90	
Line 61	52	46		8.3631	90	
Line 62	46	17		11.045	-5.19	
Line 63	49	18		4.5277	-6.34	
Line 64	49	53		8.9	90	
Line 65	36	54		132.5	0	
Line 66	46	54		2	90	
Line 67	54	47		2.5	90	
Line 68	47	48		3	0	
Line 69	48	55		2.5	90	
Line 70	55	49		1.5	90	
Line 71	50	45		3	0	
Line 72	53	52		3.0002	0.705	
Line 73	49	46		3.0414	-9.46	
Line 74	55	54		3	0	

Regions

	Material	Points	Area (ft²)

Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5



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Static Slope Stabil 5 Years after Construction with Non-Liquef. Fill, ISS Treatment Geogrid

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:51:10 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stabil 5 Years after Construction with Non-Liquef. Fill, ISS Treatment Geogrid

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Liqufiable Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Interface

Model: High Strength
Unit Weight: 120 pcf

Proposed Non-Liquefiable Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Soil-Betonite Surry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

ISS Treated Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (7.3, -4) ft
Left-Zone Right Coordinate: (106.1, 5.36667) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (135.5, 9.66867) ft
Right-Zone Right Coordinate: (180.03354, 11.27832) ft
Right-Zone Increment: 25
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (200, 12) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (91, -4.3) ft
Inside Point: (129, 8.5) ft
Slip Surface Intersection: () ft
Length: 40.09788 ft
Direction: 198.62 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (129, 8.5) ft
Inside Point: (149, 8.6) ft
Slip Surface Intersection: (134.88065, 8.5294033) ft
Length: 20.00025 ft
Direction: 180.29 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1

Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 767.27248 lbs
Pullout Force per Length: 130.47242 lbs/ft
Available Length: 5.8807256 ft
Required Length: 5.8807256 ft
Governing Component: Pullout Resistance (Active Zone)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48

Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7

Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5

Current Slip Surface

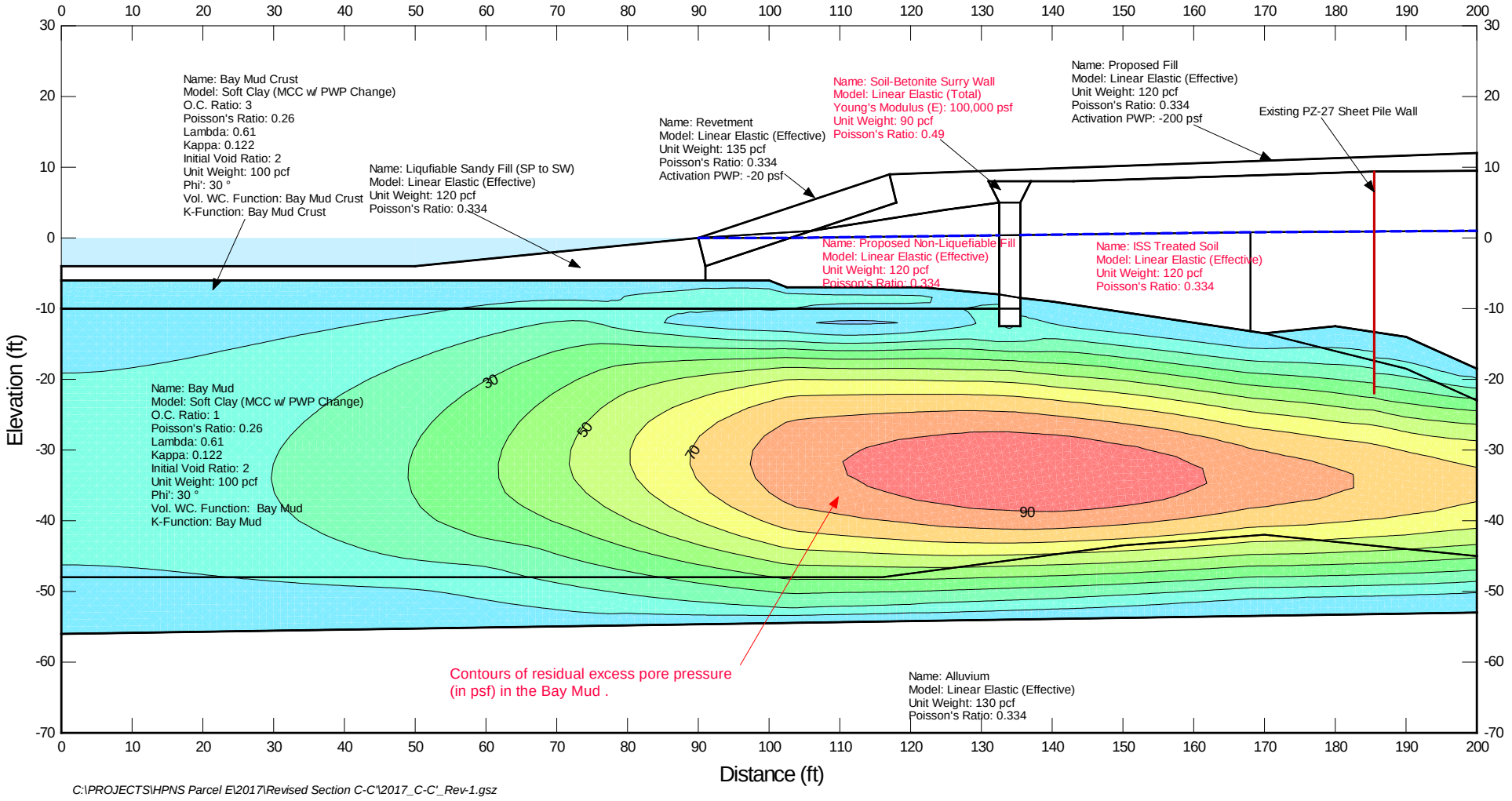
Slip Surface: 3,439
F of S: 1.52
Volume: 1,361.697 ft³
Weight: 151,107.56 lbs
Resisting Moment: 1,692,869 lbs-ft
Activating Moment: 1,112,231.5 lbs-ft
Resisting Force: 25,063.067 lbs
Activating Force: 16,465.813 lbs

F of S Rank (Analysis): 1 of 8,866 slip surfaces
F of S Rank (Query): 1 of 5 slip surfaces
Exit: (47.248157, -4) ft
Entry: (135.5, 9.6686747) ft
Radius: 55.442009 ft
Center: (86.344064, 35.310641) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	48.307957	-5	312	407.17316	59.470792	0
Slice 2	49.683878	-6.2786556	392.83559	586.06609	0	115
Slice 3	52.197347	-8.2786556	526.08073	794.39708	0	115
Slice 4	55.955225	-11.023494	712.38809	1,085.7255	0	115
Slice 5	59.076286	-12.929087	844.4886	1,291.9436	0	117.08985
Slice 6	62.197347	-14.566673	960.7765	1,476.9204	0	136.72426
Slice 7	65.318408	-15.962095	1,062.8839	1,634.5792	0	153.3479
Slice 8	68.439469	-17.134786	1,151.1459	1,767.2742	0	167.4432
Slice 9	71.428571	-18.066736	1,224.4221	1,872.9643	0	178.58401
Slice 10	74.285714	-18.784372	1,283.1543	1,954.8723	0	187.43059
Slice 11	77.142857	-19.343321	1,332.2444	2,019.3629	0	194.40917
Slice 12	80	-19.748431	1,371.8461	2,067.1864	0	199.61909
Slice 13	82.857143	-20.00309	1,402.1487	2,098.9574	0	203.10523
Slice 14	85.714286	-20.10938	1,422.9476	2,115.1779	0	204.9914
Slice 15	88.571429	-20.068156	1,434.155	2,116.2298	0	205.32962
Slice 16	90.5	-19.973111	1,437.1709	2,159.1586	0	219.79206
Slice 17	92.5	-19.767874	1,432.9341	2,240.797	0	248.65599
Slice 18	95.5	-19.348962	1,418.5354	2,302.158	0	276.40823
Slice 19	98.5	-18.760478	1,391.718	2,344.5749	0	302.79894
Slice 20	101.25	-18.074237	1,355.9038	2,376.5998	0	328.95598
Slice 21	102.75	-17.647769	1,331.3247	2,392.3205	0	344.53568
Slice 22	104.5	-17.050202	1,294.673	2,389.1625	0	358.60416
Slice 23	107	-16.128522	1,235.9276	2,376.6557	0	378.57739
Slice 24	109.5	-15.037081	1,159.7888	2,345.5881	0	398.67581
Slice 25	112.5	-13.544129	1,049.4217	2,287.4804	0	422.99736
Slice 26	115.5	-11.812989	911.85822	2,201.8044	0	448.33222
Slice 27	117.5	-10.545206	804.88026	2,088.4546	0	451.29271

Slice 28	118.14672	-10.102745	767.30807	2,017.2741	0	440.38204
Slice 29	119.89672	-8.7799112	632.63632	1,871.5109	0	443.37566
Slice 30	121.80329	-7.3074825	481.40142	1,714.2243	0	447.21954
Slice 31	123.55329	-5.7439334	374.20637	1,383.1601	680.54783	0
Slice 32	127.17654	-2.0541879	146.74891	968.13993	554.03524	0
Slice 33	130.17654	1.3883754	-65.763041	616.42649	415.78491	0
Slice 34	131.75	3.5237384	-197.80127	414.11696	279.32541	0
Slice 35	132.63346	4.7975372	0	-21.410096	-0	500
Slice 36	133.67988	6.5	0	-210.59542	-0	500
Slice 37	135.04642	8.8343373	-204.30944	-84.862563	-48.995424	200



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30-Year Consolidation after Construction

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:52:28 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

30-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SIGMA/W
Parent: 5-Year Consolidation after Construction
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3

Hydraulic Under-Relaxation Criteria
Under-Relaxation Initial Rate: 1
Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 1,832 days
Duration: 9,125 days
# of Steps: 200
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 200

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Liqufiable Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122

Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain

O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Interface

Model: Elastic-Plastic (Total)

Stress Strain

Young's Modulus (E): 200,000 psf
Cohesion: 0 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.3
Phi: 25 °
Dilation Angle: 0 °

Proposed Non-Liquefiable Fill

Model: Linear Elastic (Effective)

Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Soil-Betonite Surry Wall

Model: Linear Elastic (Total)
Stress Strain
Young's Modulus (E): 100,000 psf
Unit Weight: 90 pcf
Poisson's Ratio: 0.49

ISS Treated Soil

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Structural Beams

PZ-27 Sheet Pile

E-Modulus: 4.176e+009 psf
Cross-sectional Area: 0.0529 ft²
Moment of Inertia: 0.00361 ft^4
Allow Tension: Yes
Allow Compression: Yes

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
Coordinate 1: (0, 0) ft
Coordinate 2: (94, 0) ft
Coordinate 3: (106, 0.5) ft
Coordinate 4: (118.5, 0.5) ft
Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000

Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %

Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)

Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions

Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48

Point 27	116	-48
Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Lines

	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	33	31	Fixed X	14	90	
Line 2	31	32		200.02	0.859	Bay Water

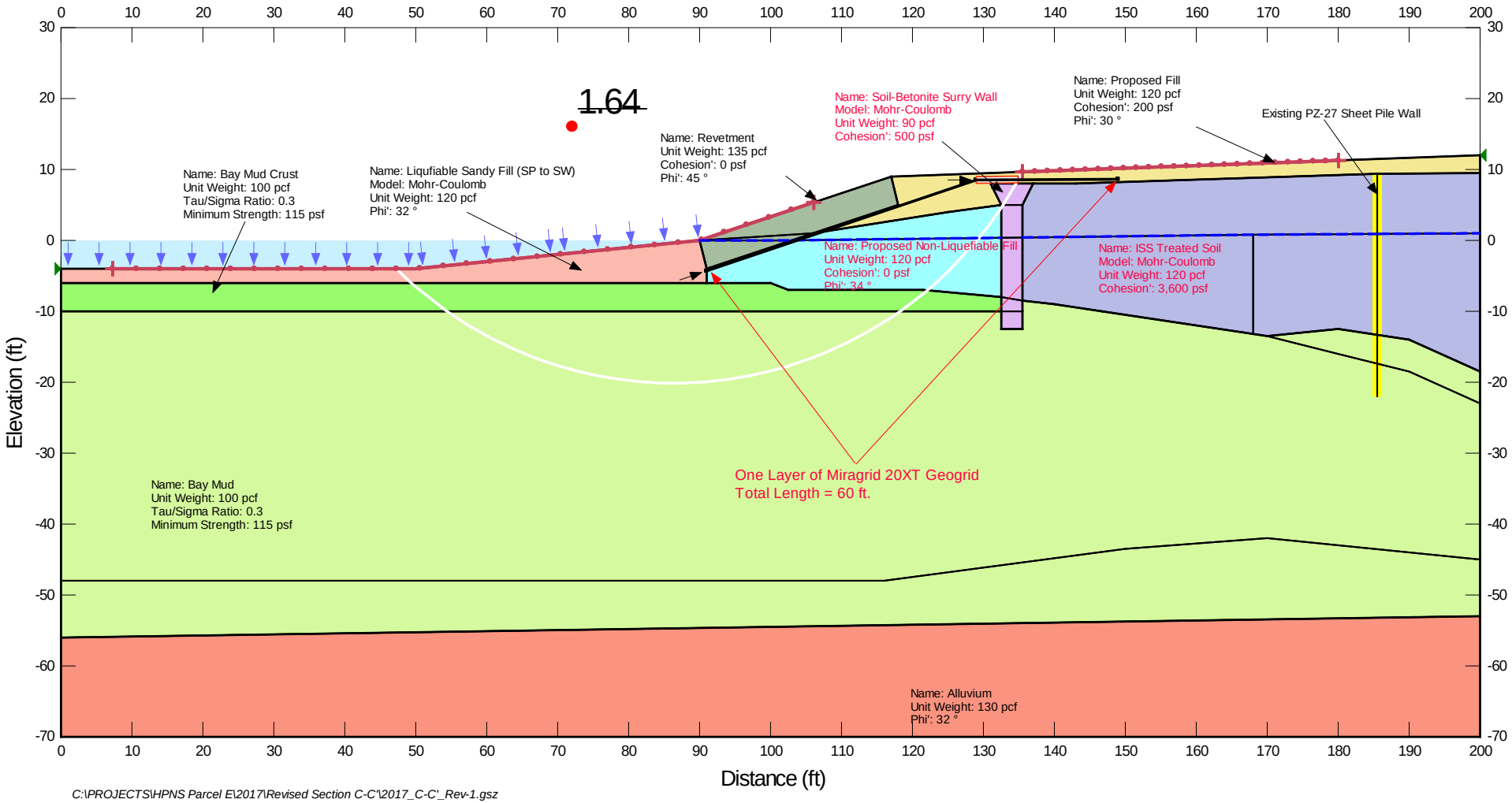
						Level
Line 3	32	34	Fixed X	17	90	
Line 4	34	33	Fixed X/Y	200	0	
Line 5	31	26	Fixed X	8	90	
Line 6	26	27		116	0	
Line 7	27	28		34.297	7.54	
Line 8	28	29		20.056	4.29	
Line 9	29	30		30.15	-5.71	
Line 10	30	32	Fixed X	8	90	
Line 11	15	16		2.6926	-21.8	
Line 12	19	23		10.308	-14	
Line 13	23	24		10.308	-14	
Line 14	24	25		10.966	-24.2	
Line 15	25	30	Fixed X	22	90	
Line 16	19	20		10.05	5.71	
Line 17	20	21		10.112	-8.53	
Line 18	21	22		10.966	-24.2	
Line 19	22	25	Fixed X	4.5	90	
Line 20	14	1	Fixed X	2	90	
Line 21	1	2		50	0	Bay Water Level
Line 22	2	3		20.1	5.71	Bay Water Level
Line 23	4	7		4.1231	-76	
Line 24	7	8		12.649	18.4	
Line 25	4	8		13	0	
Line 26	4	9		16.031	3.58	
Line 27	9	8		3.1623	18.4	
Line 28	9	10		19.235	8.97	
Line 29	12	13	Fixed X	8.5	90	
Line 30	9	35		12.649	18.4	
Line 31	35	5		4.1231	-76	
Line 32	5	6		83.054	2.07	
Line 33	6	12	Fixed X	2.5	90	
Line 34	4	5		28.46	18.4	
Line 35	18	37		6.7742	-8.49	

Line 36	26	36	Fixed X	38	90	
Line 37	36	14	Fixed X	4	90	
Line 38	11	38		42.522	1.85	
Line 39	38	12		14.501	0.503	
Line 40	38	39		31.373	90	
Line 41	16	40		5.5	0	
Line 42	40	17		13.5	0	
Line 43	13	22	Fixed X	19.5	90	
Line 44	41	13		32.001	0.358	
Line 45	37	42		21.539	-8.54	
Line 46	42	19		2.0224	-8.53	
Line 47	42	41		14	90	
Line 48	3	4		20.1	5.71	Bay Water Level
Line 49	14	43		91	0	
Line 50	43	15		9	0	
Line 51	7	43		2	90	
Line 52	52	8		29.502	0.705	
Line 53	41	53		32.502	0.705	
Line 54	11	51		6	0	
Line 55	51	44		6	0	
Line 56	44	45		3.3541	-63.4	
Line 57	45	10		7.5664	7.59	
Line 58	51	50		3.3541	63.4	
Line 59	50	53		4.6	90	
Line 60	45	52		4.6369	90	
Line 61	52	46		8.3631	90	
Line 62	46	17		11.045	-5.19	
Line 63	49	18		4.5277	-6.34	
Line 64	49	53		8.9	90	
Line 65	36	54		132.5	0	
Line 66	46	54		2	90	
Line 67	54	47		2.5	90	
Line 68	47	48		3	0	
Line 69	48	55		2.5	90	
Line 70	55	49		1.5	90	

Line 71	50	45		3	0	
Line 72	53	52		3.0002	0.705	
Line 73	49	46		3.0414	-9.46	
Line 74	55	54		3	0	

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5



C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Static Slope Stability 30 Years after Construction

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:52:58 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 30 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SLOPE/W
Parent: 30-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 30 °

Phi-B: 0 °

Liqufiable Sandy Fill (SP to SW)

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Bay Mud

Model: S=f(overburden)

Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3

Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Interface

Model: High Strength
Unit Weight: 120 pcf

Proposed Non-Liquefiable Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Soil-Betonite Surry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

ISS Treated Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (7.3, -4) ft
Left-Zone Right Coordinate: (106.1, 5.36667) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (135.5, 9.66867) ft
Right-Zone Right Coordinate: (180.03354, 11.27832) ft
Right-Zone Increment: 25
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (200, 12) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (91, -4.3) ft
Inside Point: (129, 8.5) ft
Slip Surface Intersection: () ft
Length: 40.09788 ft
Direction: 198.62 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (129, 8.5) ft
Inside Point: (149, 8.6) ft
Slip Surface Intersection: (134.88065, 8.5294033) ft
Length: 20.00025 ft
Direction: 180.29 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1

Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 767.27248 lbs
Pullout Force per Length: 130.47242 lbs/ft
Available Length: 5.8807256 ft
Required Length: 5.8807256 ft
Governing Component: Pullout Resistance (Active Zone)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48

Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Bay Mud	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5

Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5

Current Slip Surface

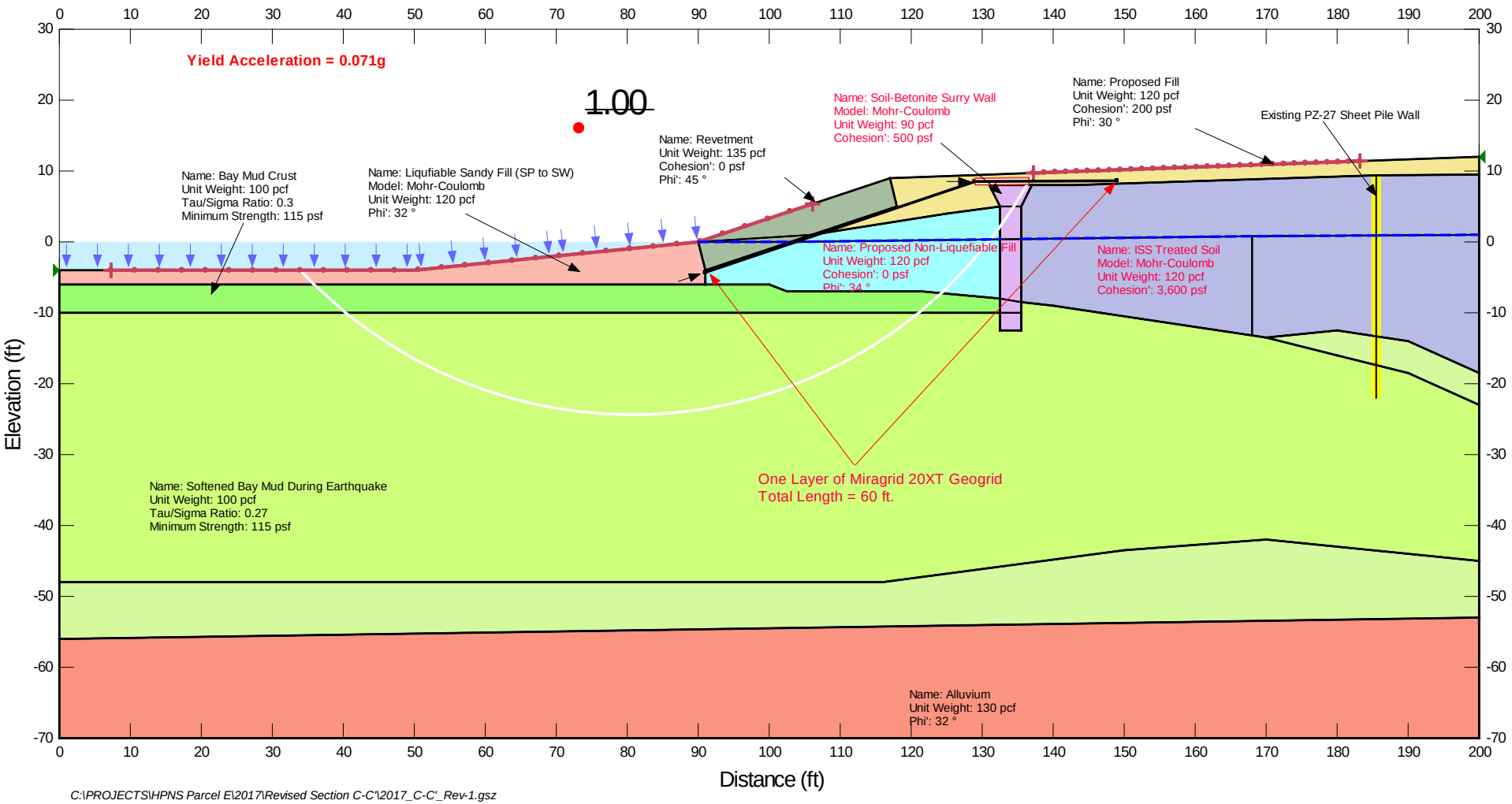
Slip Surface: 3,439
F of S: 1.64
Volume: 1,361.697 ft³
Weight: 151,107.56 lbs
Resisting Moment: 1,820,665.5 lbs-ft
Activating Moment: 1,112,231.5 lbs-ft
Resisting Force: 27,189.111 lbs
Activating Force: 16,605.931 lbs
F of S Rank (Analysis): 1 of 8,866 slip surfaces
F of S Rank (Query): 1 of 5 slip surfaces
Exit: (47.248157, -4) ft
Entry: (135.5, 9.6686747) ft
Radius: 55.442009 ft

Center: (86.344064, 35.310641) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	48.307957	-5	312	403.67016	57.281874	0
Slice 2	49.683878	-6.2786556	392.38218	582.36663	0	115
Slice 3	52.197347	-8.2786556	521.79629	792.72645	0	115
Slice 4	55.955225	-11.023494	700.3723	1,087.1182	0	115
Slice 5	59.076286	-12.929087	824.80075	1,297.7406	0	122.9962
Slice 6	62.197347	-14.566673	932.26064	1,484.8657	0	145.27902
Slice 7	65.318408	-15.962095	1,024.4254	1,644.2403	0	164.88544
Slice 8	68.439469	-17.134786	1,102.3111	1,778.0166	0	182.09366
Slice 9	71.428571	-18.066736	1,164.8801	1,884.1088	0	196.44662
Slice 10	74.285714	-18.784372	1,213.5194	1,965.743	0	208.32106
Slice 11	77.142857	-19.343321	1,252.1278	2,029.3663	0	218.44415
Slice 12	80	-19.748431	1,280.9713	2,075.7573	0	226.88152
Slice 13	82.857143	-20.00309	1,300.2276	2,105.5828	0	233.68157
Slice 14	85.714286	-20.10938	1,309.948	2,119.4073	0	238.89129
Slice 15	88.571429	-20.068156	1,310.1619	2,117.6919	0	242.52754
Slice 16	90.5	-19.973111	1,305.9241	2,158.6895	0	259.16611
Slice 17	92.5	-19.767874	1,294.5347	2,238.3412	0	290.17581
Slice 18	95.5	-19.348962	1,270.0804	2,296.5376	0	320.94472
Slice 19	98.5	-18.760478	1,234.3355	2,335.8024	0	350.01371
Slice 20	101.25	-18.074237	1,191.7139	2,365.1071	0	378.21293
Slice 21	102.75	-17.647769	1,164.7347	2,379.4978	0	394.51268
Slice 22	104.5	-17.050202	1,126.4796	2,374.9602	0	409.0622
Slice 23	107	-16.128522	1,067.0903	2,360.8312	0	429.22856
Slice 24	109.5	-15.037081	995.64051	2,329.0015	0	447.92029
Slice 25	112.5	-13.544129	897.05268	2,271.3184	0	468.70806
Slice 26	115.5	-11.812989	781.72127	2,188.3663	0	487.3733
Slice 27	117.5	-10.545206	696.95049	2,079.3785	0	483.67164
Slice 28	118.14672	-10.102745	667.33116	2,011.7817	0	470.37512
Slice 29	119.89672	-8.7799112	574.91932	1,869.6273	0	460.69076
Slice 30	121.80329	-7.3074825	472.55189	1,722.8895	0	449.87439
Slice 31	123.55329	-5.7439334	374.20637	1,399.685	691.69403	0

Slice 32	127.17654	-2.0541879	146.74891	985.19601	565.53971	0
Slice 33	130.17654	1.3883754	-65.763041	631.97585	426.27309	0
Slice 34	131.75	3.5237384	-197.80127	425.63453	287.09412	0
Slice 35	132.63346	4.7975372	0	14.938904	0	500
Slice 36	133.67988	6.5	0	-172.06887	-0	500
Slice 37	135.04642	8.8343373	-204.30944	-77.018517	-44.466661	200


Yield Acceleration = 0.071g
1.00
Name: Bay Mud Crust
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf
Name: Liqufiable Sandy Fill (SP to SW)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Phi': 32 °
Name: Revetment
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Name: Soil-Betonite Surry Wall
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Name: Proposed Fill
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Existing PZ-27 Sheet Pile Wall
Name: Proposed Non-Liquefiable Fill
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Name: ISS Treated Soil
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Name: Softened Bay Mud During Earthquake
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf
One Layer of Miragrid 20XT Geogrid
Total Length = 60 ft.
Name: Alluvium
Unit Weight: 130 pcf
Phi': 32 °
Elevation (ft)
Distance (ft)
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Yield Acceleration 5 Years after Construction

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:49:44 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Yield Acceleration 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 30 °

Phi-B: 0 °

Liqufiable Sandy Fill (SP to SW)

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Bay Mud

Model: S=f(overburden)

Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3

Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Interface

Model: High Strength
Unit Weight: 120 pcf

Proposed Non-Liquefiable Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Soil-Betonite Surry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

ISS Treated Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (7.3, -4) ft
Left-Zone Right Coordinate: (106.1, 5.36667) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (137.2, 9.73012) ft

Right-Zone Right Coordinate: (183.2, 11.39277) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (200, 12) ft

Seismic Coefficients

Horz Seismic Coef.: 0.071

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (91, -4.3) ft
Inside Point: (129, 8.5) ft
Slip Surface Intersection: () ft
Length: 40.09788 ft
Direction: 198.62 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (129, 8.5) ft
Inside Point: (149, 8.6) ft
Slip Surface Intersection: (136.54838, 8.5377419) ft
Length: 20.00025 ft

Direction: 180.29 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 1,021.0263 lbs
Pullout Force per Length: 135.26258 lbs/ft
Available Length: 7.5484758 ft
Required Length: 7.5484758 ft
Governing Component: Pullout Resistance (Active Zone)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5

Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23
Point 26	0	-48
Point 27	116	-48
Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Bay Mud	31,26,27,28,29,30,32	1,616.5
Region 3	Softened Bay Mud During Earthquake	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Liqufiable Sandy Fill (SP to SW)	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5

Current Slip Surface

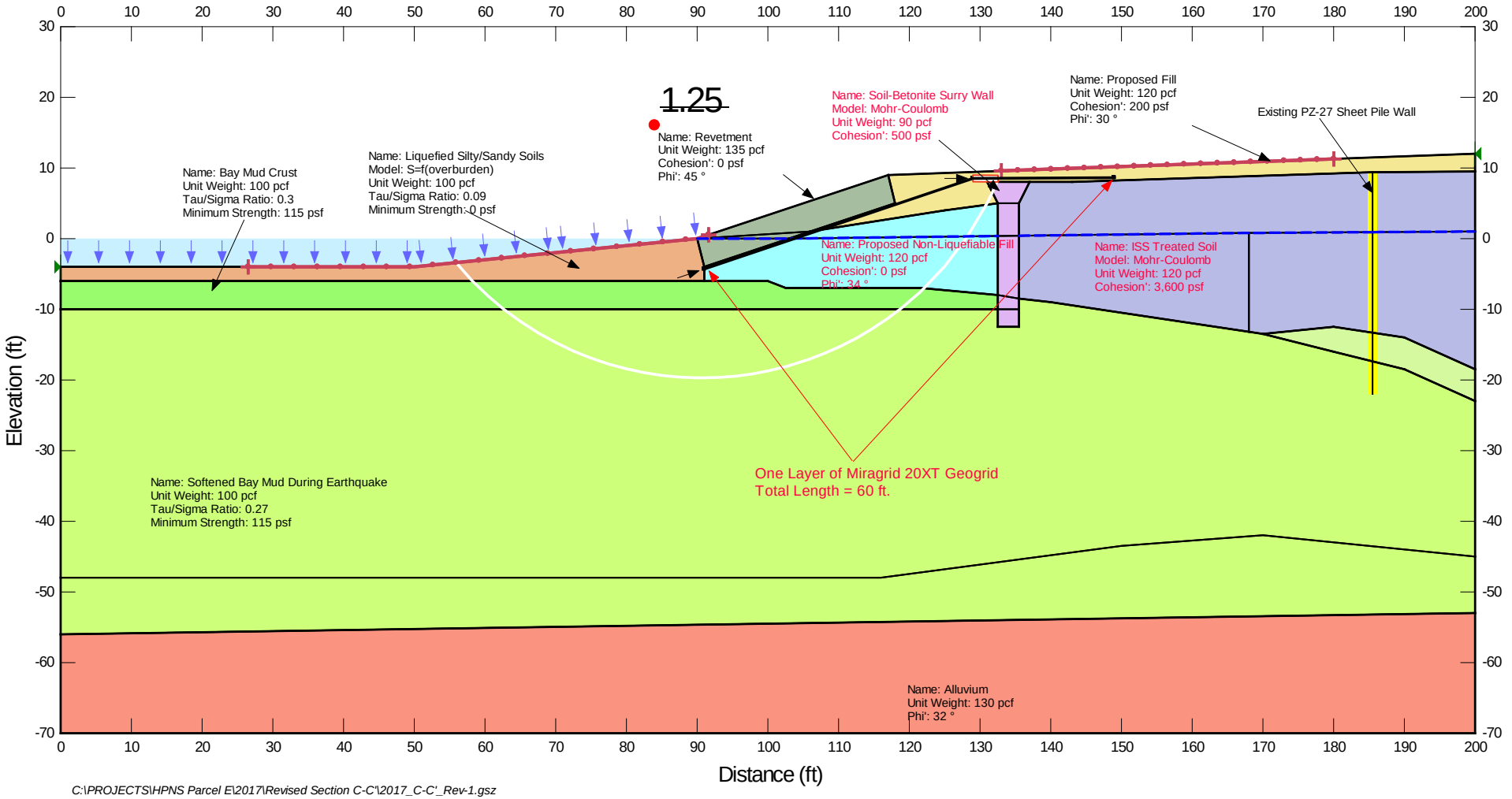
Slip Surface: 2,735
F of S: 1.00

Volume: 1,834.1881 ft³
Weight: 199,283.29 lbs
Resisting Moment: 2,168,787 lbs-ft
Activating Moment: 2,165,761.4 lbs-ft
Resisting Force: 27,819.395 lbs
Activating Force: 27,771.082 lbs
F of S Rank (Analysis): 1 of 10,571 slip surfaces
F of S Rank (Query): 1 of 5 slip surfaces
Exit: (33.932105, -4) ft
Entry: (137.2, 9.7301205) ft
Radius: 63.858409 ft
Center: (80.69724, 39.484693) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	34.90352	-5	312	478.56778	104.0831	0
Slice 2	38.104651	-8	504.61267	803.58074	0	115
Slice 3	41.945306	-11.230923	716.23036	1,123.8595	0	115
Slice 4	45.167183	-13.541255	868.76349	1,354.4044	0	115
Slice 5	48.389061	-15.566093	1,003.9869	1,559.1175	0	119.40005
Slice 6	51.666667	-17.362647	1,125.8157	1,757.4176	0	137.60521
Slice 7	55	-18.946747	1,235.2934	1,939.4593	0	156.00097
Slice 8	58.333333	-20.303146	1,331.296	2,093.1586	0	171.88701
Slice 9	61.666667	-21.447113	1,414.6441	2,220.444	0	185.45412
Slice 10	65	-22.390476	1,486.1147	2,322.9582	0	196.81186
Slice 11	68.333333	-23.142331	1,546.037	2,402.1804	0	206.11696
Slice 12	71.666667	-23.709537	1,595.1616	2,459.4067	0	213.35185
Slice 13	75	-24.097048	1,633.5734	2,495.8576	0	218.62747
Slice 14	78.333333	-24.30815	1,661.3488	2,512.6304	0	222.01187
Slice 15	81.666667	-24.344597	1,678.8811	2,510.6991	0	223.44621
Slice 16	85	-24.20669	1,685.9942	2,490.9308	0	222.98618
Slice 17	88.333333	-23.893287	1,682.3083	2,454.0423	0	220.70353
Slice 18	90.5	-23.614802	1,675.1449	2,470.8434	0	231.88553
Slice 19	92.5	-23.254941	1,661.8614	2,528.3468	0	256.13083
Slice 20	95.5	-22.615201	1,635.2242	2,556.4283	0	278.4499
Slice 21	98.5	-21.822064	1,597.7897	2,567.9988	0	299.54252
Slice 22	101.25	-20.961459	1,552.9039	2,573.4157	0	320.82535

Slice 23	102.75	-20.444442	1,524.764	2,575.2216	0	333.36365
Slice 24	104.5	-19.749687	1,484.6737	2,557.6199	0	344.32965
Slice 25	107	-18.69483	1,420.4964	2,525.4149	0	360.17638
Slice 26	109.5	-17.484354	1,342.1668	2,477.0053	0	375.64251
Slice 27	112.5	-15.864093	1,230.355	2,400.4233	0	394.48464
Slice 28	115.5	-14.026639	1,093.2669	2,299.0752	0	414.28718
Slice 29	117.5	-12.698436	986.86529	2,181.857	0	415.16469
Slice 30	119.53006	-11.172903	859.50146	1,995.077	0	401.96589
Slice 31	121.28006	-9.8189606	739.64941	1,824.3302	0	444.24323
Slice 32	122.8589	-8.4424967	595.44383	1,667.5748	0	449.00659
Slice 33	124.6089	-6.8766343	445.69761	1,348.226	608.7631	0
Slice 34	126.5	-4.960375	327.5754	1,141.0237	548.67782	0
Slice 35	129.5	-1.6342516	122.3293	792.68423	452.16011	0
Slice 36	131.07807	0.24629527	6.1951357	600.37413	400.77879	0
Slice 37	131.82807	1.2449811	-55.546857	499.47464	336.8999	0
Slice 38	133.47195	3.571711	0	-132.69673	-0	500
Slice 39	135.3492	6.5	0	-485.34415	-0	500
Slice 40	136.72726	8.8650602	-251.06753	-128.23521	-74.036636	200



C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\2017_C-C'_Rev-1.gsz

Post-Liquef Slope Stabil after New Fill & ISS Treatement & Geogrid

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File Information

File Name: 2017_C-C'_Rev-1.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/8/2017
Last Solved Time: 11:51:10 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Post-Liquef Slope Stabil after New Fill & ISS Treatement & Geogrid

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section C-C'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 30 °

Phi-B: 0 °

Bay Mud

Model: S=f(overburden)

Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3

Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Bay Mud Crust

Model: S=f(overburden)

Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3

Minimum Strength: 115 psf

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Liquefied Silty/Sandy Soils

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.09
Minimum Strength: 0 psf

Interface

Model: High Strength
Unit Weight: 120 pcf

Proposed Non-Liquefiable Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Soil-Betonite Surry Wall

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

ISS Treated Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 3,600 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (26.5, -4) ft
Left-Zone Right Coordinate: (91.6, 0.53333) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (133, 9.57831) ft
Right-Zone Right Coordinate: (180.03354, 11.27832) ft
Right-Zone Increment: 20

Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -4) ft
Right Coordinate: (200, 12) ft

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (91, -4.3) ft
Inside Point: (129, 8.5) ft
Slip Surface Intersection: () ft
Length: 40.09788 ft
Direction: 198.62 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed
Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (129, 8.5) ft
Inside Point: (149, 8.6) ft
Slip Surface Intersection: (132.57772, 8.5178886) ft
Length: 20.00025 ft
Direction: 180.29 °
F of S Dependent: No
Interface Adhesion: 0 psf
Interface Shear Angle: 28 °
Surface Area Factor: 2
Resistance Reduction Factor: 0.8
Force Distribution: Distributed

Anchorage: No
Tensile Capacity: 7,500 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 7,500 lbs
Pullout Force: 443.88836 lbs
Pullout Force per Length: 124.06874 lbs/ft
Available Length: 3.5777616 ft
Required Length: 3.5777616 ft
Governing Component: Pullout Resistance (Active Zone)

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	50	-4
Point 3	70	-2
Point 4	90	0
Point 5	117	9
Point 6	200	12
Point 7	91	-4
Point 8	103	0
Point 9	106	1
Point 10	125	4
Point 11	143	8
Point 12	200	9.5
Point 13	200	1
Point 14	0	-6
Point 15	100	-6
Point 16	102.5	-7
Point 17	121.5	-7
Point 18	140	-9
Point 19	170	-13.5
Point 20	180	-12.5
Point 21	190	-14
Point 22	200	-18.5
Point 23	180	-16
Point 24	190	-18.5
Point 25	200	-23

Point 26	0	-48
Point 27	116	-48
Point 28	150	-43.5
Point 29	170	-42
Point 30	200	-45
Point 31	0	-56
Point 32	200	-53
Point 33	0	-70
Point 34	200	-70
Point 35	118	5
Point 36	0	-10
Point 37	146.7	-10
Point 38	185.5	9.37281
Point 39	185.5	-22
Point 40	108	-7
Point 41	168	0.8
Point 42	168	-13.2
Point 43	91	-6
Point 44	131	8
Point 45	132.5	5
Point 46	132.5	-8
Point 47	132.5	-12.5
Point 48	135.5	-12.5
Point 49	135.5	-8.5
Point 50	135.5	5
Point 51	137	8
Point 52	132.5	0.36308
Point 53	135.5	0.4
Point 54	132.5	-10
Point 55	135.5	-10

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	33,31,32,34	3,100
Region 2	Softened Bay	31,26,27,28,29,30,32	1,616.5

	Mud During Earthquake		
Region 3	Softened Bay Mud During Earthquake	26,36,54,47,48,55,49,18,37,42,19,23,24,25,30,29,28,27	7,016.7
Region 4	Bay Mud	19,20,21,22,25,24,23	102.5
Region 5	Liquefied Silty/Sandy Soils	14,1,2,3,4,7,43	264
Region 6	Revetment	4,8,7	26
Region 7	Revetment	4,9,8	6.5
Region 8	ISS Treated Soil	51,50,53,41,13,12,38,11	515.45
Region 9	Proposed Fill	9,35,5,6,12,38,11,51,44,45,10	227
Region 10	Revetment	4,5,35,9	84.5
Region 11	Bay Mud Crust	14,43,15,16,40,17,46,54,36	493.25
Region 12	Proposed Non-Liquefiable Fill	7,8,52,46,17,40,16,15,43	267.11
Region 13	ISS Treated Soil	41,13,22,21,20,19,42	480.5
Region 14	Proposed Non-Liquefiable Fill	8,9,10,45,52	77.395
Region 15	ISS Treated Soil	53,41,42,37,18,49	369.6
Region 16	Soil-Betonite Surry Wall	44,51,50,45	13.5
Region 17	Soil-Betonite Surry Wall	45,50,53,52	13.855
Region 18	Soil-Betonite Surry Wall	52,53,49,46	25.895
Region 19	Soil-Betonite Surry Wall	46,49,55,54	5.25
Region 20	Soil-Betonite Surry Wall	54,55,48,47	7.5

Current Slip Surface

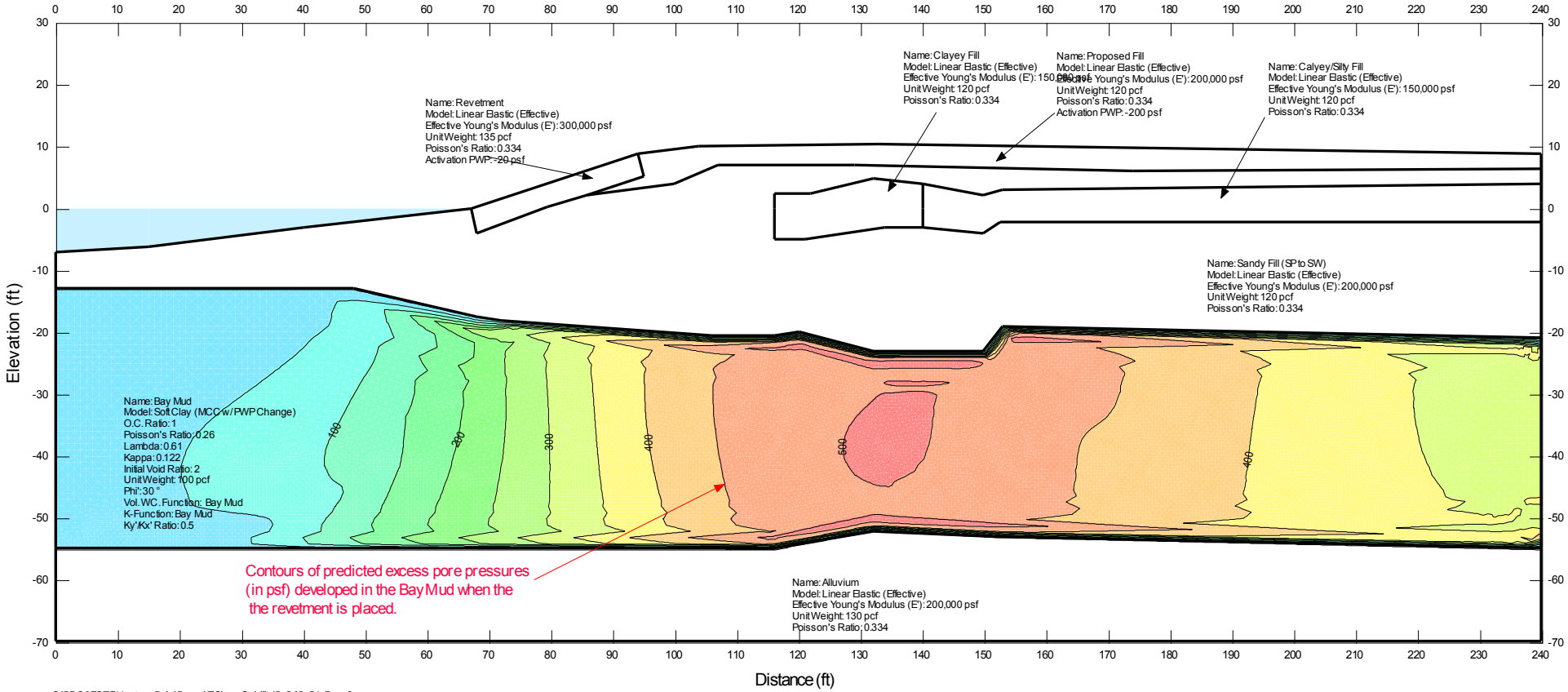
Slip Surface: 2,087
F of S: 1.25
Volume: 1,218.5377 ft³
Weight: 133,167.82 lbs
Resisting Moment: 1,110,347.3 lbs-ft

Activating Moment: 885,789.96 lbs-ft
Resisting Force: 19,395.707 lbs
Activating Force: 15,481.286 lbs
F of S Rank (Analysis): 1 of 4,851 slip surfaces
F of S Rank (Query): 1 of 5 slip surfaces
Exit: (55.894324, -3.4105676) ft
Entry: (133, 9.5783132) ft
Radius: 45.235423 ft
Center: (90.667379, 25.521735) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	57.05877	-4.7052838	293.60971	351.05805	0	4.7753681
Slice 2	59.332249	-7.0663911	447.09773	680.2356	0	115
Slice 3	61.550314	-9.0663911	585.78782	878.20447	0	115
Slice 4	63.882789	-10.899728	715.33808	1,061.1887	0	115
Slice 5	66.329674	-12.580917	835.9647	1,230.2507	0	115
Slice 6	68.776558	-14.039361	942.97129	1,377.961	0	115
Slice 7	71.25	-15.310765	1,037.8116	1,507.6246	0	115
Slice 8	73.75	-16.409506	1,121.9163	1,623.2877	0	123.64226
Slice 9	76.25	-17.334342	1,194.4025	1,720.7362	0	131.57957
Slice 10	78.75	-18.096386	1,256.5949	1,800.9565	0	137.90079
Slice 11	81.25	-18.704085	1,308.33	1,865.0446	0	142.87819
Slice 12	83.75	-19.16376	1,350.6443	1,913.7733	0	146.40254
Slice 13	86.25	-19.479962	1,383.682	1,947.7701	0	148.55784
Slice 14	88.75	-19.655713	1,407.4658	1,967.492	0	149.41949
Slice 15	90.5	-19.710615	1,419.555	2,065.1972	0	173.88176
Slice 16	92.125	-19.676184	1,424.9818	2,232.7064	0	219.41188
Slice 17	94.375	-19.547355	1,426.8373	2,299.0227	0	239.73252
Slice 18	96.625	-19.305291	1,420.6548	2,352.3313	0	259.16607
Slice 19	98.875	-18.948139	1,406.13	2,392.4589	0	277.74467
Slice 20	101.25	-18.439596	1,381.0551	2,429.3048	0	299.13419
Slice 21	102.75	-18.069393	1,361.3889	2,449.994	0	313.34861
Slice 22	104.5	-17.518011	1,328.3496	2,450.0266	0	326.2819
Slice 23	107	-16.648622	1,273.6868	2,439.7183	0	344.56736
Slice 24	109.125	-15.758297	1,213.983	2,413.5329	0	359.59863
Slice 25	111.375	-14.675733	1,136.2772	2,368.9562	0	375.64996

Slice 26	113.625	-13.433187	1,042.2089	2,304.8423	0	391.79964
Slice 27	115.875	-12.014687	929.47975	2,218.6516	0	408.23701
Slice 28	117.5	-10.890738	834.49882	2,099.7981	0	407.49579
Slice 29	118.33771	-10.261142	781.00095	2,002.4293	0	397.14715
Slice 30	120.08771	-8.789004	633.60823	1,805.5714	0	443.60539
Slice 31	121.77832	-7.3143061	482.15725	1,630.9549	0	447.1514
Slice 32	123.52832	-5.4912354	358.41884	1,254.5582	604.45363	0
Slice 33	126.61291	-1.8106961	131.12215	837.89359	476.72336	0
Slice 34	129.61291	2.6749721	-146.47955	424.25646	286.16459	0
Slice 35	131.36436	5.7910107	-231.81782	48.967004	28.271113	200
Slice 36	132.0501	7.2712757	0	-654.55372	-0	500
Slice 37	132.68574	8.7891566	-200	-143.20759	-82.680939	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\D-D'_Rev-3.gsz

Place Revetment and New Fill

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/7/2015
Last Solved Time: 12:54:20 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Place Revetment and New Fill

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SIGMA/W
Parent: Insitu Stresses
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 0 days
Duration: 7 days
# of Steps: 7
Step Generation Method: Linear
Save Steps Every: 7

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Clayey Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain

O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °

Hydraulic

Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Calyey/Silty Fill

Model: Linear Elastic (Effective)

Stress Strain

Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
Coordinate 1: (0, -3) ft
Coordinate 2: (44.5, -3) ft
Coordinate 3: (70, 0) ft
Coordinate 4: (116, 0) ft
Coordinate 5: (140, 0) ft
Coordinate 6: (200, 0.5) ft

K Functions

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3

Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Vol. Water Content Functions

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)

Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4
Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4

Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70
Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Lines

	Start	End	Stress/Strain	Length (ft)	Angle (°)	Hydraulic

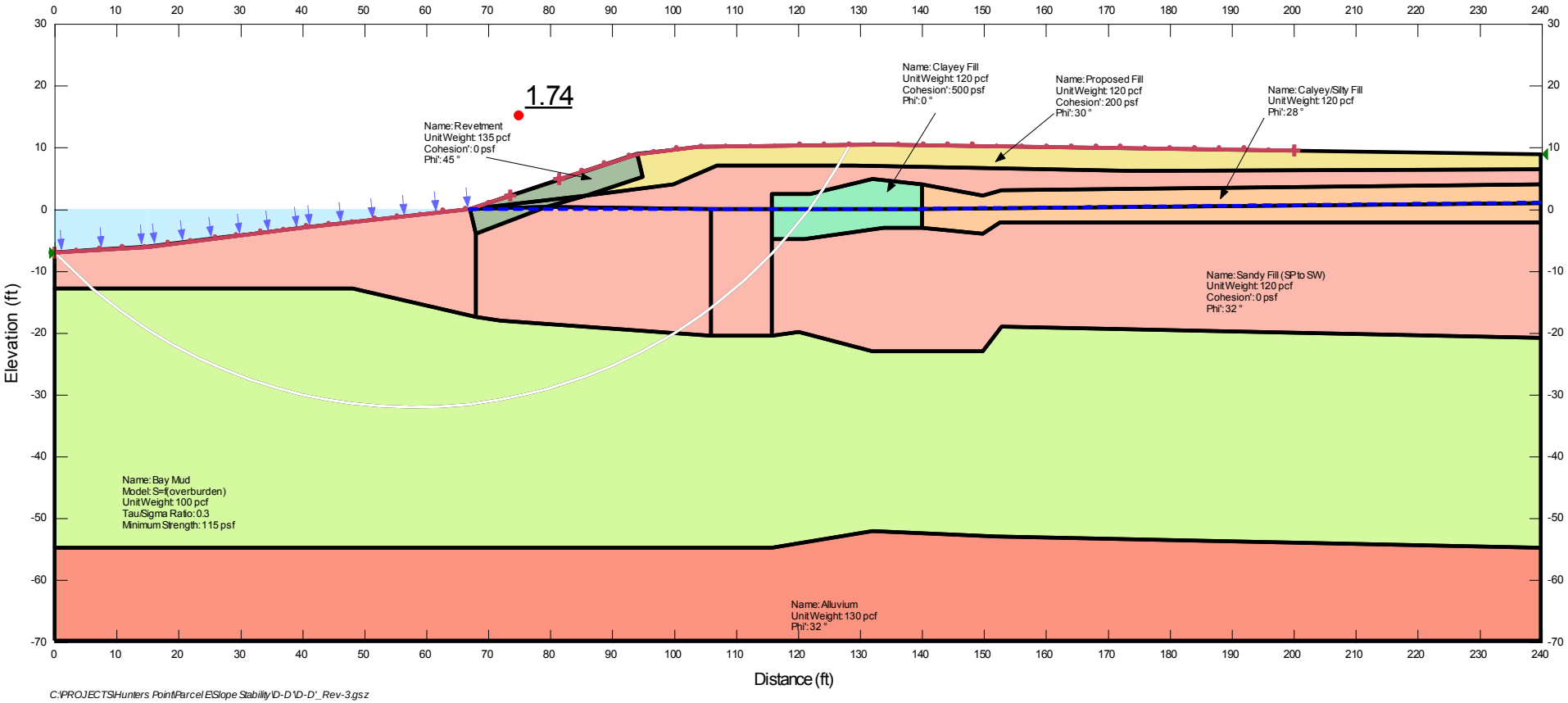
	Point	Point	Boundary			Boundary
Line 1	43	38	Fixed X	15	90	
Line 2	38	39		116	0	Bay Water Level
Line 3	39	40		16.279	10.6	Bay Water Level
Line 4	40	41		20.025	-2.86	Bay Water Level
Line 5	41	42		88.023	-1.3	Bay Water Level
Line 6	42	44	Fixed X	15	90	
Line 7	44	43	Fixed X/Y	240	0	
Line 8	38	31	Fixed X	42	90	
Line 9	32	33		4.0311	7.13	
Line 10	33	34		12.369	-14	
Line 11	34	35		18	0	
Line 12	35	36		5	53.1	
Line 13	36	37		87.023	-1.32	
Line 14	37	42	Fixed X	34	90	
Line 15	3	7		4.1231	-76	
Line 16	22	14		5	90	
Line 17	14	25		5	0	
Line 18	25	26		13.153	8.75	
Line 19	26	27		6	0	
Line 20	27	28		10.05	-5.71	
Line 21	28	29		3.2016	38.7	
Line 22	29	30		87.5	0	
Line 23	30	37	Fixed X	19	90	
Line 24	3	13		12.4	0.462	
Line 25	3	8		18.818	6.41	
Line 26	8	13		6.6098	17.6	
Line 27	3	4		28.46	18.4	
Line 28	9	8		9.7406	19.2	
Line 29	22	23		24	0	
Line 30	23	27		3	90	
Line 31	23	24		100	0.573	
Line 32	24	30	Fixed X	3	90	
Line 33	22	15		2.5	90	
Line 34	15	16		6	0	
Line 35	16	17		10.308	14	

Line 36	17	18		8.0623	-7.13	
Line 37	18	23		4	90	
Line 38	18	19		10.198	-11.3	
Line 39	19	20		3.1623	18.4	
Line 40	20	21		87.006	0.659	
Line 41	21	24	Fixed X	3	90	
Line 42	12	21	Fixed X	2.5	90	
Line 43	10	11		22	0	
Line 44	6	12	Fixed X	2.5	90	
Line 45	47	10		7.6158	23.2	
Line 46	32	14		15.5	90	
Line 47	1	2		15.033	3.81	Bay Water Level
Line 48	2	45		25.179	6.84	Bay Water Level
Line 49	45	3		27.166	6.34	Bay Water Level
Line 50	31	1	Fixed X	6	90	
Line 51	13	7		12.115	19.8	
Line 52	13	48		26.6	-0.215	
Line 53	48	22		10	0	
Line 54	46	49		34.092	-4.21	
Line 55	49	32		10	0	
Line 56	31	50		48	0	
Line 57	50	51		20.5	-12.7	
Line 58	51	46		4.0311	-7.13	
Line 59	49	48		20.5	90	
Line 60	5	52		29.004	0.988	
Line 61	52	6		107.01	-0.803	
Line 62	11	53		45.011	-1.27	
Line 63	53	12		66.002	0.434	
Line 64	7	51		13.5	90	
Line 65	4	9		3.8079	-76.3	
Line 66	8	47		14.426	7.57	
Line 67	4	5		10.05	5.71	

Regions

	Material	Points	Area (ft²)

Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Clayey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Clayey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205


1.74
Name: Revetment
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Name: Clayey Fill
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Name: Proposed Fill
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Name: Calyey/Silty Fill
Unit Weight: 120 pcf
Phi': 28 °
Name: Sandy Fill (SP to SW)
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Bay Mud
Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf
Name: Alluvium
Unit Weight: 130 pcf
Phi': 32 °
Elevation (ft)
Distance (ft)
C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D\D-D'_Rev-3.gsz

Static Slope Stability After Placement of New Fill and Revetment

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/7/2015
Last Solved Time: 1:14:38 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability After Placement of New Fill and Revetment

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SLOPE/W
Parent: Place Revetment and New Fill
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Calyey/Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, -7) ft
Left-Zone Right Coordinate: (73.64, 2.21333) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (81.5005, 4.8335) ft
Right-Zone Right Coordinate: (200.00786, 9.56064) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -7) ft
Right Coordinate: (240, 9) ft

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4

Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4
Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70

Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Calyey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Calyey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205

Current Slip Surface

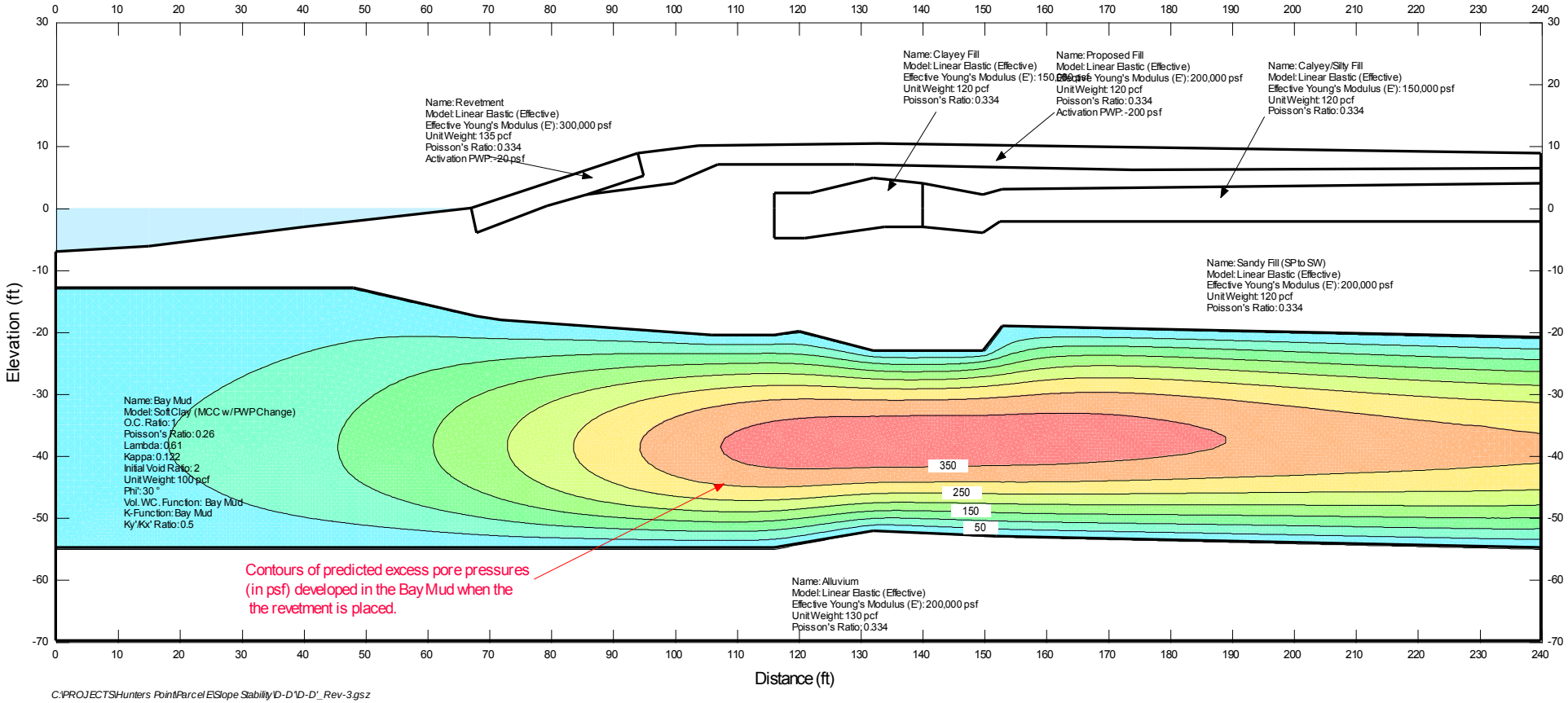
Slip Surface: 139
F of S: 1.74
Volume: 3,027.3439 ft³
Weight: 343,304.93 lbs
Resisting Moment: 5,408,253.8 lbs-ft
Activating Moment: 3,102,630.1 lbs-ft

Resisting Force: 57,477.861 lbs
Activating Force: 32,973.548 lbs
F of S Rank (Analysis): 1 of 7,161 slip surfaces
F of S Rank (Query): 1 of 10 slip surfaces
Exit: (0, -7) ft
Entry: (128.46856, 10.421872) ft
Radius: 79.59101 ft
Center: (58.028215, 47.474354) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	3.1414313	-10	624	923.02441	186.85119	0
Slice 2	8.462147	-14.736334	940.1531	1,457.1174	0	126.83249
Slice 3	12.820716	-17.977888	1,142.8485	1,829.1976	0	168.29158
Slice 4	17.083333	-20.73372	1,318.1728	2,153.0707	0	205.19975
Slice 5	21.25	-23.070468	1,467.8926	2,434.0268	0	239.02627
Slice 6	25.416667	-25.09285	1,600.1872	2,676.052	0	268.64932
Slice 7	29.583333	-26.826664	1,716.4143	2,881.5536	0	294.43565
Slice 8	33.75	-28.291808	1,817.8187	3,052.5851	0	316.60863
Slice 9	37.916667	-29.503682	1,905.6416	3,190.9976	0	335.25799
Slice 10	42	-30.459311	1,979.5593	3,295.7519	0	349.91153
Slice 11	46	-31.176504	2,040.2343	3,369.9783	0	360.90484
Slice 12	50.375	-31.711907	2,094.1191	3,432.0807	0	372.40772
Slice 13	55.125	-32.028175	2,138.6681	3,478.1315	0	384.06356
Slice 14	59.875	-32.059756	2,165.5606	3,492.0693	0	392.47574
Slice 15	64.625	-31.806991	2,178.2686	3,475.7546	0	396.61292
Slice 16	67.5	-31.549444	2,181.9041	3,503.8304	0	411.98708
Slice 17	70	-31.185119	2,176.8191	3,581.2189	0	444.27098
Slice 18	73.85	-30.505366	2,163.2401	3,634.502	0	476.01234
Slice 19	77.55	-29.661806	2,138.5495	3,664.3603	0	503.70693
Slice 20	82.55	-28.172495	2,081.4495	3,672.6416	0	538.36942
Slice 21	87.775	-26.314889	2,001.3356	3,653.1934	0	571.77022
Slice 22	91.925	-24.501172	1,915.8891	3,605.9179	0	594.35288
Slice 23	94.45	-23.29235	1,846.8795	3,528.8993	0	597.26039
Slice 24	97.45	-21.605539	1,778.3362	3,362.4227	0	570.31325
Slice 25	102	-18.823847	1,174.6081	2,918.3174	1,089.5905	0

Slice 26	105	-16.766176	1,046.2094	2,688.7016	1,026.3431	0
Slice 27	106.5	-15.651057	976.62598	2,558.0849	988.20517	0
Slice 28	109.25	-13.373059	834.47888	2,295.7565	913.10759	0
Slice 29	113.75	-9.2695207	578.41809	1,833.3953	784.19679	0
Slice 30	116.93555	-6.0300242	376.27351	1,475.961	687.16099	0
Slice 31	119.89068	-2.5	156	1,151.4244	0	500
Slice 32	122.97556	1.5051074	-93.918704	644.00297	0	500
Slice 33	125.30025	5.0051074	-299.72205	408.08694	255.00102	0
Slice 34	127.5141	8.7109359	-200	-1.1793173	-0.68087918	200



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\D-D'_Rev-3.gsz

5-Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/8/2015
Last Solved Time: 8:36:48 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

5-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SIGMA/W
Parent: Place Revetment and New Fill
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 7 days
Duration: 1,825 days
# of Steps: 50
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 10

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Clayey Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)

Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium
Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Calyey/Silty Fill
Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X
X: X-Displacement 0

Fixed X/Y
X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level
Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
Coordinate 1: (0, -3) ft
Coordinate 2: (44.5, -3) ft
Coordinate 3: (70, 0) ft
Coordinate 4: (116, 0) ft
Coordinate 5: (140, 0) ft
Coordinate 6: (200, 0.5) ft

K Functions

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3

Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Vol. Water Content Functions

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)

Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4
Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4

Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70
Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Lines

	Start	End	Stress/Strain	Length (ft)	Angle (°)	Hydraulic

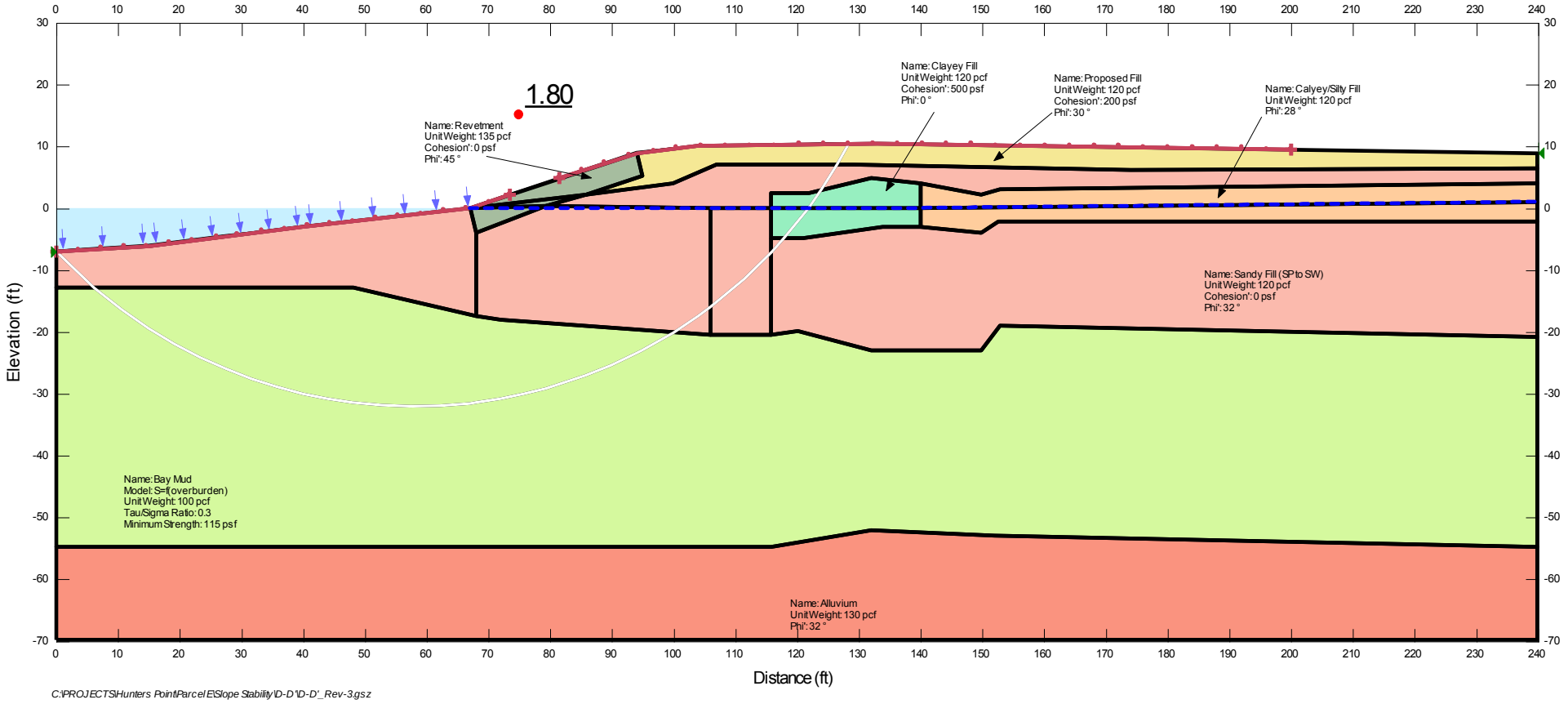
	Point	Point	Boundary			Boundary
Line 1	43	38	Fixed X	15	90	
Line 2	38	39		116	0	Bay Water Level
Line 3	39	40		16.279	10.6	Bay Water Level
Line 4	40	41		20.025	-2.86	Bay Water Level
Line 5	41	42		88.023	-1.3	Bay Water Level
Line 6	42	44	Fixed X	15	90	
Line 7	44	43	Fixed X/Y	240	0	
Line 8	38	31	Fixed X	42	90	
Line 9	32	33		4.0311	7.13	
Line 10	33	34		12.369	-14	
Line 11	34	35		18	0	
Line 12	35	36		5	53.1	
Line 13	36	37		87.023	-1.32	
Line 14	37	42	Fixed X	34	90	
Line 15	3	7		4.1231	-76	
Line 16	22	14		5	90	
Line 17	14	25		5	0	
Line 18	25	26		13.153	8.75	
Line 19	26	27		6	0	
Line 20	27	28		10.05	-5.71	
Line 21	28	29		3.2016	38.7	
Line 22	29	30		87.5	0	
Line 23	30	37	Fixed X	19	90	
Line 24	3	13		12.4	0.462	
Line 25	3	8		18.818	6.41	
Line 26	8	13		6.6098	17.6	
Line 27	3	4		28.46	18.4	
Line 28	9	8		9.7406	19.2	
Line 29	22	23		24	0	
Line 30	23	27		3	90	
Line 31	23	24		100	0.573	
Line 32	24	30	Fixed X	3	90	
Line 33	22	15		2.5	90	
Line 34	15	16		6	0	
Line 35	16	17		10.308	14	

Line 36	17	18		8.0623	-7.13	
Line 37	18	23		4	90	
Line 38	18	19		10.198	-11.3	
Line 39	19	20		3.1623	18.4	
Line 40	20	21		87.006	0.659	
Line 41	21	24	Fixed X	3	90	
Line 42	12	21	Fixed X	2.5	90	
Line 43	10	11		22	0	
Line 44	6	12	Fixed X	2.5	90	
Line 45	47	10		7.6158	23.2	
Line 46	32	14		15.5	90	
Line 47	1	2		15.033	3.81	Bay Water Level
Line 48	2	45		25.179	6.84	Bay Water Level
Line 49	45	3		27.166	6.34	Bay Water Level
Line 50	31	1	Fixed X	6	90	
Line 51	13	7		12.115	19.8	
Line 52	13	48		26.6	-0.215	
Line 53	48	22		10	0	
Line 54	46	49		34.092	-4.21	
Line 55	49	32		10	0	
Line 56	31	50		48	0	
Line 57	50	51		20.5	-12.7	
Line 58	51	46		4.0311	-7.13	
Line 59	49	48		20.5	90	
Line 60	5	52		29.004	0.988	
Line 61	52	6		107.01	-0.803	
Line 62	11	53		45.011	-1.27	
Line 63	53	12		66.002	0.434	
Line 64	7	51		13.5	90	
Line 65	4	9		3.8079	-76.3	
Line 66	8	47		14.426	7.57	
Line 67	4	5		10.05	5.71	

Regions

	Material	Points	Area (ft²)

Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Calyey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Calyey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205



C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\D-D'_Rev-3.gsz

Static Slope Stability 5 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/15/2015
Last Solved Time: 1:52:38 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey/Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, -7) ft
Left-Zone Right Coordinate: (73.64, 2.21333) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (81.5005, 4.8335) ft
Right-Zone Right Coordinate: (200.00786, 9.56064) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -7) ft
Right Coordinate: (240, 9) ft

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4

Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4
Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70

Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Calyey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Calyey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205

Current Slip Surface

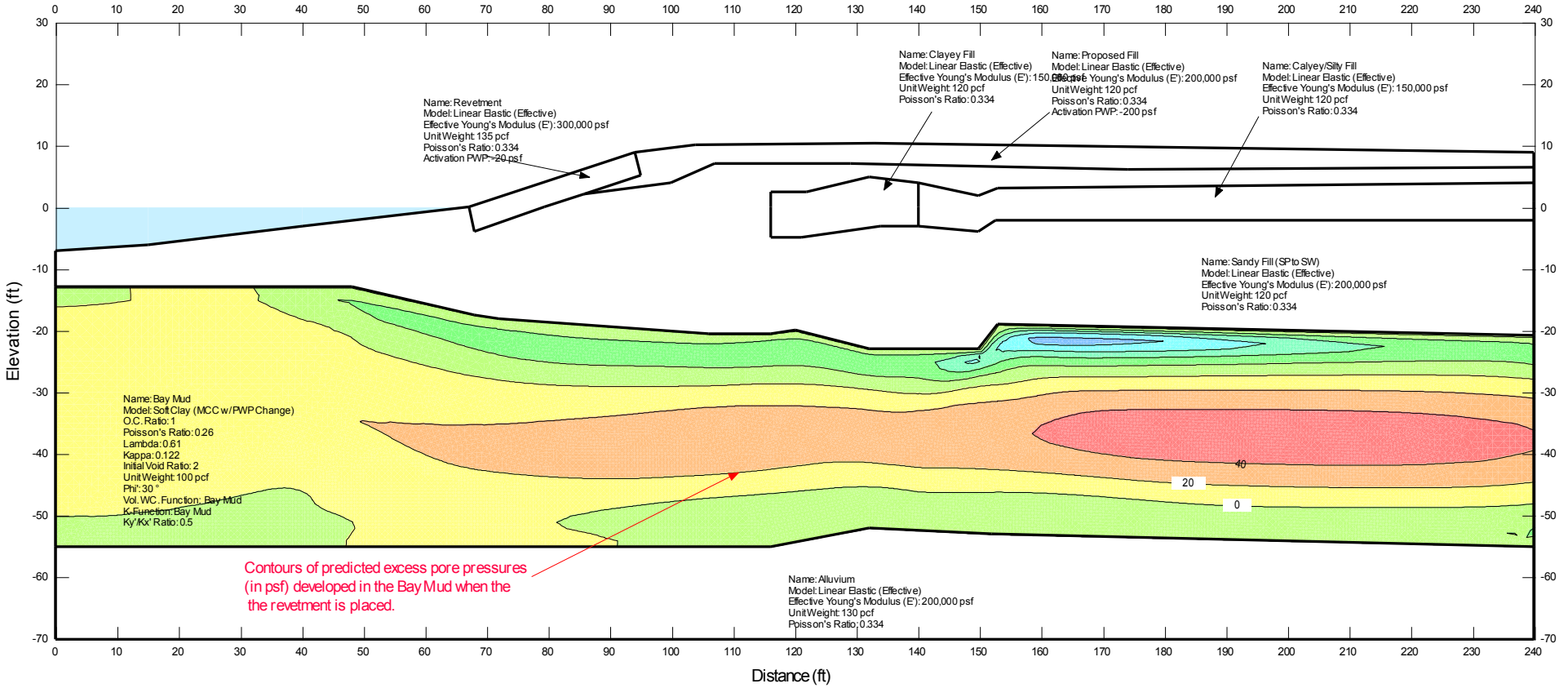
Slip Surface: 139
F of S: 1.80
Volume: 3,027.3439 ft³
Weight: 343,304.93 lbs
Resisting Moment: 5,591,000.3 lbs-ft
Activating Moment: 3,102,630.1 lbs-ft

Resisting Force: 59,562.454 lbs
Activating Force: 33,052.663 lbs
F of S Rank (Analysis): 1 of 7,161 slip surfaces
F of S Rank (Query): 1 of 10 slip surfaces
Exit: (0, -7) ft
Entry: (128.46856, 10.421872) ft
Radius: 79.59101 ft
Center: (58.028215, 47.474354) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	3.1414313	-10	624	918.44234	183.98799	0
Slice 2	8.462147	-14.736334	924.29448	1,458.4459	0	131.59008
Slice 3	12.820716	-17.977888	1,135.8706	1,829.6271	0	170.38494
Slice 4	17.083333	-20.73372	1,316.4811	2,153.3716	0	205.70726
Slice 5	21.25	-23.070468	1,470.5621	2,434.3881	0	238.22539
Slice 6	25.416667	-25.09285	1,605.3667	2,676.6731	0	267.09548
Slice 7	29.583333	-26.826664	1,722.7209	2,882.4851	0	292.54365
Slice 8	33.75	-28.291808	1,823.7824	3,053.8135	0	314.81953
Slice 9	37.916667	-29.503682	1,909.6217	3,192.4674	0	334.06396
Slice 10	42	-30.459311	1,980.0092	3,297.3635	0	349.77657
Slice 11	46	-31.176504	2,035.8145	3,371.6132	0	362.23077
Slice 12	50.375	-31.711907	2,082.0962	3,433.6028	0	376.01461
Slice 13	55.125	-32.028175	2,116.6341	3,479.3206	0	390.67378
Slice 14	59.875	-32.059756	2,134.1343	3,492.6733	0	401.90365
Slice 15	64.625	-31.806991	2,133.4323	3,475.5742	0	410.06379
Slice 16	67.5	-31.549444	2,125.866	3,503.0505	0	428.79852
Slice 17	70	-31.185119	2,109.8677	3,579.8491	0	464.35641
Slice 18	73.85	-30.505366	2,075.6963	3,631.9513	0	502.27548
Slice 19	77.55	-29.661806	2,027.6979	3,660.3112	0	536.9624
Slice 20	82.55	-28.172495	1,932.1088	3,665.7611	0	583.17164
Slice 21	87.775	-26.314889	1,798.8129	3,641.75	0	632.52702
Slice 22	91.925	-24.501172	1,654.2723	3,588.6901	0	672.83794
Slice 23	94.45	-23.29235	1,550.7353	3,507.4896	0	686.10366
Slice 24	97.45	-21.605539	1,398.2435	3,331.3322	0	684.34107
Slice 25	102	-18.823847	1,174.6081	2,925.0508	1,093.798	0

Slice 26	105	-16.766176	1,046.2094	2,696.067	1,030.9455	0
Slice 27	106.5	-15.651057	976.62598	2,565.7108	992.97042	0
Slice 28	109.25	-13.373059	834.47888	2,303.81	918.13995	0
Slice 29	113.75	-9.2695207	578.41809	1,841.9563	789.5463	0
Slice 30	116.93555	-6.0300242	376.27351	1,484.6612	692.59753	0
Slice 31	119.89068	-2.5	156	1,161.5106	0	500
Slice 32	122.97556	1.5051074	-93.918704	656.50111	0	500
Slice 33	125.30025	5.0051074	-299.72205	412.81241	257.95382	0
Slice 34	127.5141	8.7109359	-200	3.0597187	1.7665294	200


Name: Revetment
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf
Name: Clayey Fill
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Name: Proposed Fill
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf
Name: Calyey/Silty Fill
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Name: Sandy Fill (SP to SW)
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Name: Bay Mud
Model: Soft Clay (MCC w/ PWP Change)
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
40
20
0
Contours of predicted excess pore pressures (in psf) developed in the Bay Mud when the the revetment is placed.
Name: Alluvium
Model: Linear Elastic (Effective)
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334
Elevation (ft)
Distance (ft)
C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\D-D'_Rev-3.gsz

30-Year Consolidation after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/28/2015
Last Solved Time: 1:44:02 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

30-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SIGMA/W
Parent: 5-Year Consolidation after Construction
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001

Significant Digits: 3
Hydraulic Under-Relaxation Criteria
Under-Relaxation Initial Rate: 1
Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 1,832 days
Duration: 9,125 days
# of Steps: 200
Step Generation Method: Exponential
Initial Increment Size: 7 days
Save Steps Every: 100

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Clayey Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Clayey/Silty Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates
Coordinate 1: (0, -3) ft
Coordinate 2: (44.5, -3) ft
Coordinate 3: (70, 0) ft
Coordinate 4: (116, 0) ft
Coordinate 5: (140, 0) ft
Coordinate 6: (200, 0.5) ft

K Functions

Bay Mud

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3

Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)
Data Point: (2,750, 0.2)

Vol. Water Content Functions

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)

Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties

Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft^3/ft^3
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4
Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4

Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70
Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Lines

	Start	End	Stress/Strain	Length (ft)	Angle (°)	Hydraulic

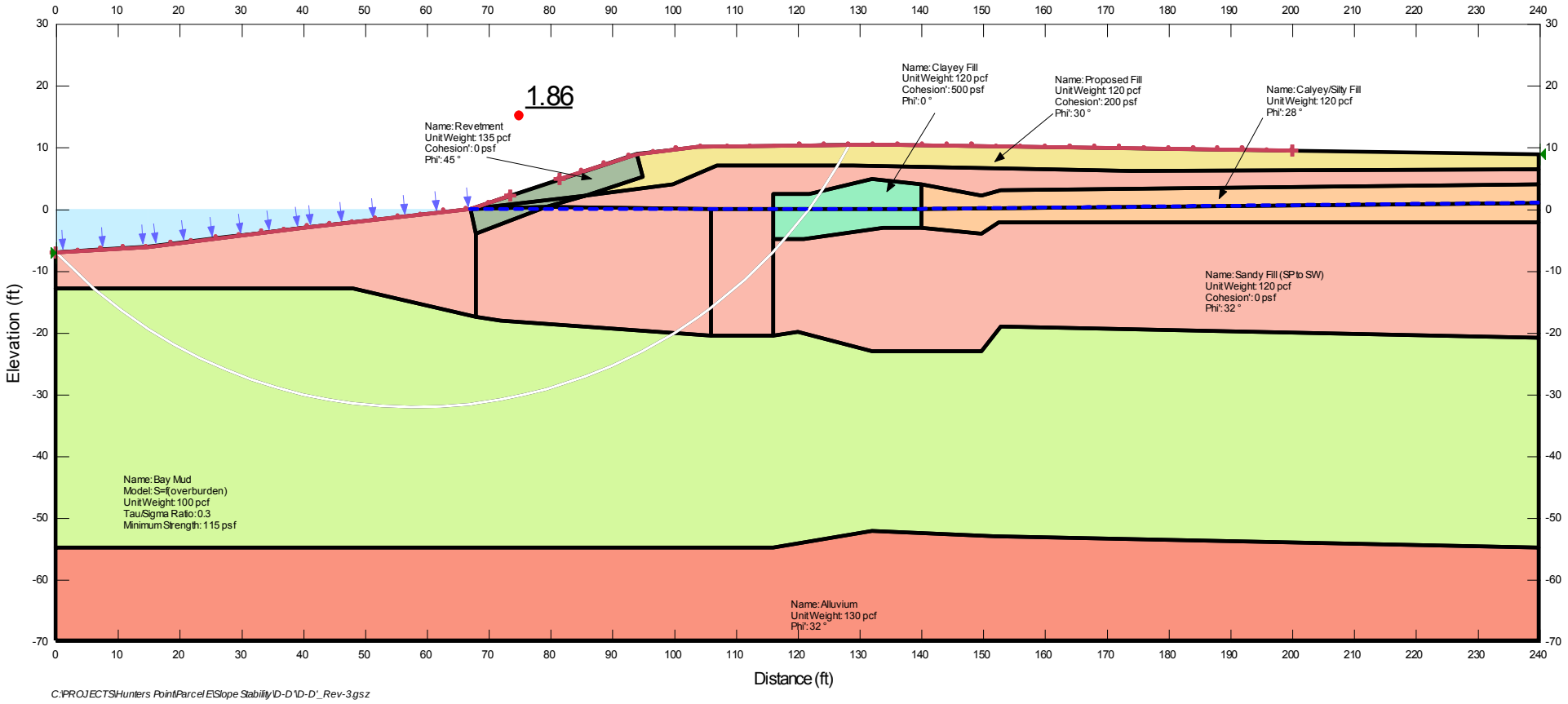
	Point	Point	Boundary			Boundary
Line 1	43	38	Fixed X	15	90	
Line 2	38	39		116	0	Bay Water Level
Line 3	39	40		16.279	10.6	Bay Water Level
Line 4	40	41		20.025	-2.86	Bay Water Level
Line 5	41	42		88.023	-1.3	Bay Water Level
Line 6	42	44	Fixed X	15	90	
Line 7	44	43	Fixed X/Y	240	0	
Line 8	38	31	Fixed X	42	90	
Line 9	32	33		4.0311	7.13	
Line 10	33	34		12.369	-14	
Line 11	34	35		18	0	
Line 12	35	36		5	53.1	
Line 13	36	37		87.023	-1.32	
Line 14	37	42	Fixed X	34	90	
Line 15	3	7		4.1231	-76	
Line 16	22	14		5	90	
Line 17	14	25		5	0	
Line 18	25	26		13.153	8.75	
Line 19	26	27		6	0	
Line 20	27	28		10.05	-5.71	
Line 21	28	29		3.2016	38.7	
Line 22	29	30		87.5	0	
Line 23	30	37	Fixed X	19	90	
Line 24	3	13		12.4	0.462	
Line 25	3	8		18.818	6.41	
Line 26	8	13		6.6098	17.6	
Line 27	3	4		28.46	18.4	
Line 28	9	8		9.7406	19.2	
Line 29	22	23		24	0	
Line 30	23	27		3	90	
Line 31	23	24		100	0.573	
Line 32	24	30	Fixed X	3	90	
Line 33	22	15		2.5	90	
Line 34	15	16		6	0	
Line 35	16	17		10.308	14	

Line 36	17	18		8.0623	-7.13	
Line 37	18	23		4	90	
Line 38	18	19		10.198	-11.3	
Line 39	19	20		3.1623	18.4	
Line 40	20	21		87.006	0.659	
Line 41	21	24	Fixed X	3	90	
Line 42	12	21	Fixed X	2.5	90	
Line 43	10	11		22	0	
Line 44	6	12	Fixed X	2.5	90	
Line 45	47	10		7.6158	23.2	
Line 46	32	14		15.5	90	
Line 47	1	2		15.033	3.81	Bay Water Level
Line 48	2	45		25.179	6.84	Bay Water Level
Line 49	45	3		27.166	6.34	Bay Water Level
Line 50	31	1	Fixed X	6	90	
Line 51	13	7		12.115	19.8	
Line 52	13	48		26.6	-0.215	
Line 53	48	22		10	0	
Line 54	46	49		34.092	-4.21	
Line 55	49	32		10	0	
Line 56	31	50		48	0	
Line 57	50	51		20.5	-12.7	
Line 58	51	46		4.0311	-7.13	
Line 59	49	48		20.5	90	
Line 60	5	52		29.004	0.988	
Line 61	52	6		107.01	-0.803	
Line 62	11	53		45.011	-1.27	
Line 63	53	12		66.002	0.434	
Line 64	7	51		13.5	90	
Line 65	4	9		3.8079	-76.3	
Line 66	8	47		14.426	7.57	
Line 67	4	5		10.05	5.71	

Regions

	Material	Points	Area (ft²)

Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Calyey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Calyey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205


1.86
Name: Revetment
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Name: Clayey Fill
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Name: Proposed Fill
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Name: Calyey/Silty Fill
Unit Weight: 120 pcf
Phi': 28 °
Name: Sandy Fill (SP to SW)
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Bay Mud
Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf
Name: Alluvium
Unit Weight: 130 pcf
Phi': 32 °
Elevation (ft)
Distance (ft)
C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\D-D'_Rev-3.gsz

Static Slope Stability 30 Years after Construction

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File Information

Tool Version: 8.15.1.11236
File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Slope Stability\D-D'\
Last Solved Date: 10/28/2015
Last Solved Time: 1:44:24 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static Slope Stability 30 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SLOPE/W
Parent: 30-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 45 °
Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Phi-B: 0 °

Bay Mud

Model: S=f(overburden)
Unit Weight: 100 pcf

Tau/Sigma Ratio: 0.3
Minimum Strength: 115 psf

Alluvium

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey/Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, -7) ft
Left-Zone Right Coordinate: (73.64, 2.21333) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (81.5005, 4.8335) ft
Right-Zone Right Coordinate: (200.00786, 9.56064) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -7) ft
Right Coordinate: (240, 9) ft

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9
Point 5	104	10
Point 6	240	9
Point 7	68	-4

Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4
Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52
Point 41	152	-53
Point 42	240	-55
Point 43	0	-70

Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Bay Mud	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Clayey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Clayey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205

Current Slip Surface

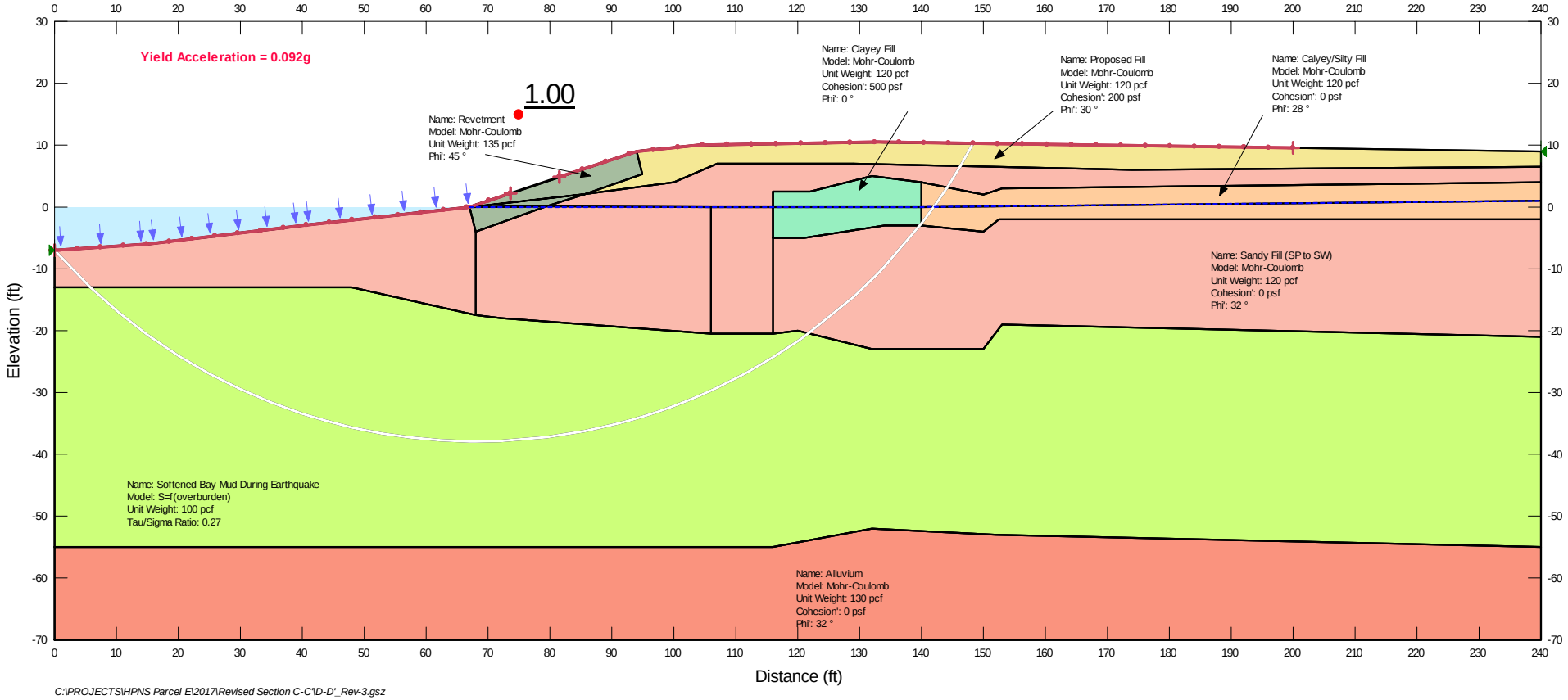
Slip Surface: 139
F of S: 1.86
Volume: 3,027.3439 ft³
Weight: 343,304.93 lbs
Resisting Moment: 5,772,369 lbs-ft
Activating Moment: 3,102,630.1 lbs-ft

Resisting Force: 61,725.222 lbs
Activating Force: 33,176.712 lbs
F of S Rank (Analysis): 1 of 7,161 slip surfaces
F of S Rank (Query): 1 of 10 slip surfaces
Exit: (0, -7) ft
Entry: (128.46856, 10.421872) ft
Radius: 79.59101 ft
Center: (58.028215, 47.474354) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	3.1414313	-10	624	914.45028	181.49348	0
Slice 2	8.462147	-14.736334	921.0766	1,458.2927	0	132.55544
Slice 3	12.820716	-17.977888	1,126.2151	1,830.791	0	173.28159
Slice 4	17.083333	-20.73372	1,300.6554	2,155.7556	0	210.45499
Slice 5	21.25	-23.070468	1,448.6947	2,437.792	0	244.78563
Slice 6	25.416667	-25.09285	1,577.1145	2,680.9234	0	275.57115
Slice 7	29.583333	-26.826664	1,687.5834	2,887.3662	0	303.08491
Slice 8	33.75	-28.291808	1,781.346	3,059.0659	0	327.55043
Slice 9	37.916667	-29.503682	1,859.3978	3,197.817	0	349.13113
Slice 10	42	-30.459311	1,921.4972	3,302.5414	0	367.33017
Slice 11	46	-31.176504	1,968.6319	3,376.3695	0	382.38555
Slice 12	50.375	-31.711907	2,004.6082	3,437.6174	0	399.261
Slice 13	55.125	-32.028175	2,027.025	3,482.2191	0	417.55651
Slice 14	59.875	-32.059756	2,031.6182	3,494.1464	0	432.65847
Slice 15	64.625	-31.806991	2,018.1932	3,475.3326	0	444.63551
Slice 16	67.5	-31.549444	2,003.3511	3,501.6697	0	465.55298
Slice 17	70	-31.185119	1,981.4918	3,577.4582	0	502.86918
Slice 18	73.85	-30.505366	1,939.918	3,627.9499	0	543.00898
Slice 19	77.55	-29.661806	1,887.327	3,654.7939	0	579.07368
Slice 20	82.55	-28.172495	1,792.5229	3,658.525	0	625.0474
Slice 21	87.775	-26.314889	1,671.8305	3,633.6285	0	670.62176
Slice 22	91.925	-24.501172	1,551.7168	3,581.3155	0	703.60458
Slice 23	94.45	-23.29235	1,470.686	3,501.4686	0	710.11845
Slice 24	97.45	-21.605539	1,356.7273	3,328.4084	0	696.79592
Slice 25	102	-18.823847	1,174.6081	2,930.6238	1,097.2804	0

Slice 26	105	-16.766176	1,046.2094	2,702.312	1,034.8477	0
Slice 27	106.5	-15.651057	976.62598	2,572.2482	997.05542	0
Slice 28	109.25	-13.373059	834.47888	2,310.8485	922.53812	0
Slice 29	113.75	-9.2695207	578.41809	1,849.6525	794.35544	0
Slice 30	116.93555	-6.0300242	376.27351	1,492.6219	697.57189	0
Slice 31	119.89068	-2.5	156	1,170.6407	0	500
Slice 32	122.97556	1.5051074	-93.918704	668.01772	0	500
Slice 33	125.30025	5.0051074	-299.72205	417.28257	260.74709	0
Slice 34	127.5141	8.7109359	-200	7.0961802	4.0969816	200


Yield Acceleration = 0.092g
1.00
Name: Revetment
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Phi': 45 °
Name: Clayey Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Name: Proposed Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 30 °
Name: Calyey/Silty Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Name: Sandy Fill (SP to SW)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Softened Bay Mud During Earthquake
Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Name: Alluvium
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 32 °
Elevation (ft)
Distance (ft)
C:\PROJECTS\HPNS Parcel E\2017\Revised Section C-C'\D-D'_Rev-3.gsz

Yield Acceleration 5 Years after Construction

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File Information

File Name: D-D'_Rev-3.gsz
Directory: C:\PROJECTS\HPNS Parcel E\2017\Revised Stability\
Last Solved Date: 8/10/2017
Last Solved Time: 10:15:02 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Yield Acceleration 5 Years after Construction

Description: HPNS, Parcel E Remedial Design, Slope Stability Analysis, Cross Section D-D'
Kind: SLOPE/W
Parent: 5-Year Consolidation after Construction
Method: Morgenstern-Price
Settings
    Side Function
        Interslice force function option: Half-Sine
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack

Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Revetment

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Proposed Fill

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 200 psf

Phi': 30 °

Phi-B: 0 °

Sandy Fill (SP to SW)

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 32 °

Phi-B: 0 °

Clayey Fill

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 500 psf

Phi': 0 °

Phi-B: 0 °

Alluvium

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion': 0 psf

Phi': 32 °
Phi-B: 0 °

Calyey/Silty Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Softened Bay Mud During Earthquake

Model: S=f(overburden)
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.27
Minimum Strength: 115 psf

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, -7) ft
Left-Zone Right Coordinate: (73.64, 2.21333) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (81.5005, 4.8335) ft
Right-Zone Right Coordinate: (200.00786, 9.56064) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, -7) ft
Right Coordinate: (240, 9) ft

Seismic Coefficients

Horz Seismic Coef.: 0.092

Points

	X (ft)	Y (ft)
Point 1	0	-7
Point 2	15	-6
Point 3	67	0
Point 4	94	9

Point 5	104	10
Point 6	240	9
Point 7	68	-4
Point 8	85.7	2.1
Point 9	94.9	5.3
Point 10	107	7
Point 11	129	7
Point 12	240	6.5
Point 13	79.4	0.1
Point 14	116	-5
Point 15	116	2.5
Point 16	122	2.5
Point 17	132	5
Point 18	140	4
Point 19	150	2
Point 20	153	3
Point 21	240	4
Point 22	116	0
Point 23	140	0
Point 24	240	1
Point 25	121	-5
Point 26	134	-3
Point 27	140	-3
Point 28	150	-4
Point 29	152.5	-2
Point 30	240	-2
Point 31	0	-13
Point 32	116	-20.5
Point 33	120	-20
Point 34	132	-23
Point 35	150	-23
Point 36	153	-19
Point 37	240	-21
Point 38	0	-55
Point 39	116	-55
Point 40	132	-52

Point 41	152	-53
Point 42	240	-55
Point 43	0	-70
Point 44	240	-70
Point 45	40	-3
Point 46	72	-18
Point 47	100	4
Point 48	106	0
Point 49	106	-20.5
Point 50	48	-13
Point 51	68	-17.5
Point 52	133	10.5
Point 53	174	6

Regions

	Material	Points	Area (ft²)
Region 1	Alluvium	43,38,39,40,41,42,44	3,762
Region 2	Softened Bay Mud During Earthquake	38,31,50,51,46,49,32,33,34,35,36,37,42,41,40,39	8,622.5
Region 3	Sandy Fill (SP to SW)	14,25,26,27,28,29,30,37,36,35,34,33,32	2,243.5
Region 4	Revetment	3,13,7	24.85
Region 5	Revetment	3,8,13	12.085
Region 6	Revetment	3,4,9,8	74.26
Region 7	Clayey Fill	22,23,27,26,25,14	95
Region 8	Calyey/Silty Fill	27,23,24,30,29,28	267.5
Region 9	Clayey Fill	22,15,16,17,18,23	88.5
Region 10	Calyey/Silty Fill	18,19,20,21,24,23	292
Region 11	Sandy Fill (SP to SW)	13,8,47,10,11,53,12,21,20,19,18,17,16,15,22,48	516.21
Region 12	Proposed Fill	4,5,52,6,12,53,11,10,47,8,9	521.99
Region 13	Sandy Fill (SP to SW)	1,2,45,3,7,51,50,31	676.5
Region 14	Sandy Fill (SP to SW)	7,13,48,49,46,51	704.6
Region 15	Sandy Fill (SP to SW)	48,22,14,32,49	205

Current Slip Surface

Slip Surface: 194

F of S: 1.00
Volume: 4,286.1971 ft³
Weight: 481,828.9 lbs
Resisting Moment: 7,398,862.8 lbs-ft
Activating Moment: 7,392,988.3 lbs-ft
Resisting Force: 70,024.214 lbs
Activating Force: 69,966.537 lbs
F of S Rank (Analysis): 1 of 7,161 slip surfaces
F of S Rank (Query): 1 of 10 slip surfaces
Exit: (0, -7) ft
Entry: (148.34042, 10.284947) ft
Radius: 90.693729 ft
Center: (68.212807, 52.769269) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	2.882391	-10	624	1,236.2902	382.60136	0
Slice 2	8.0735865	-15.047427	944.53076	1,577.887	0	120.96391
Slice 3	12.691196	-18.883868	1,194.8097	2,047.0102	0	161.76006
Slice 4	17.5	-22.360393	1,422.269	2,483.6152	0	201.27157
Slice 5	22.5	-25.507869	1,629.7146	2,883.9538	0	239.57432
Slice 6	27.5	-28.224501	1,810.8727	3,223.147	0	273.34189
Slice 7	32.5	-30.552696	1,968.5028	3,504.1365	0	302.97425
Slice 8	37.5	-32.524434	2,104.5797	3,729.8755	0	328.80158
Slice 9	42	-34.028637	2,210.8838	3,888.7219	0	348.83458
Slice 10	46	-35.138003	2,292.0146	3,993.8803	0	363.79414
Slice 11	50.375	-36.119974	2,366.6742	4,086.0534	0	380.59488
Slice 12	55.125	-36.943056	2,434.3856	4,160.6004	0	398.51527
Slice 13	59.875	-37.508884	2,486.9595	4,199.1254	0	413.57693
Slice 14	64.625	-37.822291	2,525.2459	4,204.8842	0	425.68084
Slice 15	67.5	-37.920281	2,543.3873	4,247.7658	0	445.20053
Slice 16	70	-37.884782	2,552.0926	4,341.4629	0	479.41096
Slice 17	75.7	-37.538596	2,555.8283	4,438.5371	0	532.82692
Slice 18	82.55	-36.727214	2,536.0082	4,507.1214	0	592.77901
Slice 19	87.775	-35.7641	2,496.5329	4,524.056	0	636.01863
Slice 20	91.925	-34.743375	2,445.5637	4,512.3152	0	668.44493
Slice 21	94.45	-34.045138	2,407.5828	4,459.648	0	676.46977
Slice 22	97.45	-33.040298	2,346.9708	4,327.0961	0	668.48907

Slice 23	102	-31.368316	2,236.4367	4,159.0521	0	669.73839
Slice 24	105	-30.12137	2,145.9428	4,030.0329	0	668.73402
Slice 25	106.5	-29.444716	2,094.4274	3,952.7211	0	665.60849
Slice 26	109.25	-28.069672	1,983.4723	3,798.4794	0	659.97638
Slice 27	113.75	-25.620436	1,768.819	3,531.8993	0	654.31719
Slice 28	118	-22.9992	1,521.2364	3,250.6141	0	651.41528
Slice 29	120.5	-21.332199	1,363.2128	3,075.2438	0	649.79417
Slice 30	121.37462	-20.70835	1,302.4417	3,013.9766	0	651.02776
Slice 31	125.37462	-17.48766	1,091.23	2,474.4955	864.36023	0
Slice 32	130.5	-13.120013	818.68883	2,005.598	741.66318	0
Slice 33	132.5	-11.199528	698.85053	1,804.7353	691.03355	0
Slice 34	133.5	-10.178456	635.13568	1,697.8337	664.04743	0
Slice 35	137	-6.1578968	384.25276	1,279.0872	559.15461	0
Slice 36	140.99426	-1.3180173	82.864699	837.36421	401.17451	0
Slice 37	143.06579	1.5956369	-97.654689	583.93559	310.48406	0
Slice 38	145.21387	4.8936422	-299.08479	323.74022	202.29534	0
Slice 39	147.31256	8.4504216	-200	-65.573345	-37.858789	200

Attachment F7
FLAC Modeling for Cross Section D-D'

(This attachment is provided on CD only)

TECHNICAL MEMORANDUM

Date:	August 16, 2017	**Project No.:**	1402317
To:	Doug Bielskis and David Tang	**Company:**	CES
From:	Nagesh Koragappa and Rich Haughey		
RE:	**RESULTS OF FLAC MODELING, CROSS SECTION D-D´, PARCEL E, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA**		

This technical memorandum presents the results of a 2-dimensional, non-linear dynamic modeling (NDM) performed by Golder Associates Inc. (Golder) for cross section DD´ at the IR-02 Southeast area, as part of the remedial design for Parcel E of the former Hunters Point Naval Shipyard (HPNS) located in San Francisco, California. The NDM was performed using the FLAC computer software, which is developed by Itasca Consulting Group Inc. (Itasca, 2016)[1] of Minneapolis, Minnesota.

1.0 INTRODUCTION

Appendix F of the Draft Design Basis Report (DDBR) prepared by Construction Engineering Services, LLC (CES, 2107)[2] for Parcel E at HPNS contains results of the geotechnical analyses performed by Golder. The DDBR identified that the IR-02 Southeast area of Parcel E, represented by cross section D-D', would have inadequate factors of safety against slope failure under post-liquefaction conditions. In other words, the results of analyses suggested that the proposed slope and revetment along the shoreline of IR-02 Southeast may undergo slope failure/lateral spreading during a major earthquake. The DDBR also preliminarily identified that the risk of slope failure can be mitigated by improving the entire thickness of the liquefiable soils located directly below the proposed revetment for a width of approximately 50 feet, along the full length of the shoreline located between IR-03 and IR-02 Southeast. It should be noted that the mitigation measure identified in the DDBR would be relatively expensive to implement.

As discussed in Section 5.1.1 of Appendix F of DDBR, the liquefaction analysis was based on empirical methods, which is very approximate because it does not fully account for the mechanics involved with shear wave propagation and the liquefaction process. Also, the conclusion regarding the likely post-liquefaction slope instability was based solely on a post-liquefaction slope stability analysis, which is a limit-equilibrium static analysis that assumes post-liquefaction residual shear strengths for the soils that are identified as liquefiable by the empirical-based liquefaction analysis. The limit-equilibrium analysis only computes a

[1] Itasca Consulting Group Inc. (2016). "FLAC, Fast Lagrangian Analysis of Continua, Dynamic Analysis".
[2] Construction Engineering Services, LLC (2017). "Draft Design Report, Parcel E, Hunters Point Naval Shipyard", dated January 2017.

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factor of safety, and does not account for actual stresses and strains/displacements involved. Also, it does not account for the time varying dynamic loading and site response during the earthquake.

During discussions with CES after submitting Appendix F of the DDBR, Golder indicated that performing a mechanics-based NDM using the FLAC computer program may provide more realistic results compared to the empirical-based liquefaction analysis and the limit-equilibrium-based post-liquefaction slope stability analysis discussed in the DDBR. The NDM is a fully-coupled simulation of the site response, liquefaction, and ground movements simultaneously, and has a strong theoretical framework. Golder submitted a proposal to CES on April 7, 2017 to perform the FLAC analysis, which was subsequently approved by CES.

Golder performed the FLAC modeling using the latest version of the FLAC (FLAC 8.0), as discussed below.

2.0 MODEL SETUP

2.1 Geometry

The modeled cross section is shown in Figure 1, which is based on Figure 9 in Appendix F of DDBR. The maximum allowable FLAC finite difference element size (Δx) was estimated based on the lowest shear wave velocity (V_s) within the Bay Mud (approximately 200 feet/second) and maximum frequency (f) of the acceleration history [i.e., $\Delta x \approx (V_s/10)/f$]. To avoiding extremely small element size and thus keep the computation time within reasonable limits, the acceleration time histories were filtered to remove frequencies greater than 10 Hertz, which does not significantly impact the results. Accordingly, the cross section shown in Figure 1 was subdivided into approximately 14,000 elements to have a maximum element size equal to less than or equal to 2 feet in any direction.

2.2 Material Constitutive Models and Parameters

2.2.1 Initial Static Equilibrium

During the initial static equilibrium computation, all soil layers shown in Figure 1 were assigned the Mohr-Coulomb plasticity model. The various model parameters used during this stage of the modeling are listed in Table 1, which are consistent with those discussed in Sections 6.4 and 7.3 and Attachment F7 of DDBR Appendix F. Note that the shear modulus (G) and bulk modulus (K) of each soil layer were estimated based on respective shear wave velocities using the equations shows at the bottom of Table 1. Figure 2 shows the FLAC model material types used in the initial static equilibrium computation, which is based on the material types and geometries shown in Figure 1.

After the initial model setup and computation of total and static pore pressures based on static equilibrium, the spatial variation of the G and K of the Bay Mud within each element of the FLAC model was captured

using a FISH function[3] based on the variation of the vertical effective stress (σ'_v). As discussed in Section 7.3 of Attachment F, V_s is a function of the undrained shear strength (S_u); i.e., $V_s=18\ (S_u)^{0.475}$. Also, as discussed in Section 6.4 of Attachment F, S_u is a function of σ'_v; i.e., $S_u=0.3\sigma'_v$. These relationships were implemented in the FISH function.

2.2.2 Non-Linear Dynamic Analysis

Before applying the dynamic loading, the constitutive model for the liquefiable sandy fill was switched from Mohr-Coulomb to UBCSAND (Beaty and Byrne, 2011)[4]. The UBCSAND input parameters were estimated mainly based on N values recorded in the log for soil boring B-605, after applying the appropriate correction for effective vertical stress, energy, and fines content (the corrected N is referred to as $N_{1,60\text{-}cs}$). The $N_{1,60\text{-}cs}$ was estimated to be around 12. The N values recorded in the historical soil borings located along cross section D-D´ (IR02B186, IR02B187, and IR02B295) are similar to those in soil boring B-605; however, these N values could not be converted to $N_{1,60\text{-}cs}$ because of the lack of required data regarding energy level, original ground elevation, and fines content. As a check, the $N_{1,60\text{-}cs}$ was also estimated based on the tip resistance values recorded in the log for cone penetration test, CPT-68, which shows an average value of 14. To be conservative, a $N_{1,60\text{-}cs}$ of 12 was used in the UBCSAND model.

Figure 3 shows the material types used in the dynamic analysis, which includes the UBCSAND model for the sandy fill. Table 2 summarizes the parameters used for the UBCSAND model.

2.2.3 Post-Liquefaction Condition

A post-earthquake analysis was run at the end of a seismic analysis. This analysis is similar to a standard post-liquefaction slope stability analysis (using residual strengths and limit equilibrium techniques), except both the inherent stability and the tendency for significant deformation are evaluated (Beaty and Byrne, 2011). This analysis was accomplished by first identifying those elements that have liquefied during the earthquake; elements that experience excess pore pressure ratio (r_u)[5] of greater than 0.8 were assumed to have liquefied in this analysis.

Consistent with (Beaty and Byrne, 2011) post-earthquake analysis was performed by first converting the constitutive model of the liquefiable elements with peak r_u values exceeding 0.8 from the UBCSAND model to the Mohr-Coulomb model and assigning the initial shear and bulk moduli. The liquefiable elements were assigned residual undrained shear strength (S_r) proportional to σ'_v. For a $N_{1,60\text{-}cs}$ of 12, the Sr/σ'_v ratio was

[3] FISH functions are computer programs written by Golder using a programing language called FISH which is built-in to FLAC (FISH is short for FLACish).
[4] Beaty M.H., and Byrne P.M. (2011), "UBCSAND Constitutive Model", Version 904aR, dated February 2011.
[5] r_u is the excess pore pressure divided by the mean effective stress within a zone. Typically, if r_u is greater than 1, the dynamic pore pressure exceeds the mean effective stress of the zone triggering liquefaction However, in this study, a r_u of greater than 0.8 is assumed to trigger liquefaction, to be conservative.

conservatively estimated to be 0.1 based on Idriss and Boulanger (2015)[6]. Golder wrote a FISH function to accomplish these changes. Then the dynamic analysis was run for a period of time (10 seconds beyond the end of the acceleration time history) to allow any residual motion to decay.

2.3 Input Ground Motions

The FLAC analysis for cross section D-D´ was performed using all four acceleration time histories listed in Section 4.3 of DDBR Appendix F (i.e., TU076.acc, TU051.acc, PS10.acc, and Izmit.acc). As discussed in Section 2.1, all four acceleration time histories were filtered to have a maximum frequency of 10 Hertz.

The base of the FLAC model was assumed to be a compliant base by assigning a quiet (or absorbing) boundary condition. The input acceleration or velocity time histories cannot be applied directly to a quiet boundary. Instead, the input horizontal acceleration time histories can be applied only as a shear stress time history. To accomplish this, each of the acceleration time history [ü(t)] was first integrated to obtain the velocity time history [ů(t)], which was then converted to shear stress time history [τ[t)] using the following equation implemented in a FISH function:

$$\tau(t) = MF\ [\rho\ V_s\ \dot{u}(t)]$$

Where,
MF a multiplication factor
ρ mass density of the base
V_s shear wave velocity of the base

The MF was estimated by running preliminary iterative FLAC analyses for each of the four acceleration time histories and comparing the computed velocity time history at the base of the model to the input velocity time history. The iterative analyses showed that a MF of 1.1 resulted in a good match between the input and the computed velocity time histories at the base.

3.0 MODELING RESULTS

Table 3 provides a summary of the maximum slope displacement predicted by the FLAC modeling for all four acceleration time histories. Table 4 summarizes the predicted horizontal and vertical displacement at the crest of the revetment slope. The results are discussed below in more detail.

3.1 Results of Modeling Using TCU076.acc

The key results from the FLAC modeling using TCU076.acc acceleration time history are presented in Figure 4 through 6:

[6] Idriss, I.M. and Boulanger, R.W. (2015). "2nd Ishihara Lecture: SPT- and CPT-Based Relationships for Residual Shear Strength of Liquefied Soils", *Soil Dynamics and Earthquake Engineering*, 68 (2015), pp. 57-68.

- Figure 4 shows the predicted liquefiable zone assuming that elements with peak r_u of greater than 0.8 are liquefiable. This figure also shows the initial FLAC finite difference grid (shown in black) and the distorted grid at the end of the acceleration time history (shown in red). FLAC predicted a maximum slope displacement of 4.9 feet.
- Figure 5 shows contours of maximum displacements at the end of the acceleration time history. This figure shows that the predicted slope displacement is mostly surficial and unlikely to result in catastrophic slope movement (vis-a-vis a more problematic deep-seated failure through the Bay Mud).
- Figure 6 shows the time history of the horizontal and vertical displacements of the revetment slope crest. In this figure, the time from 90 to 100 seconds corresponds to the post-earthquake analysis discussed in Section 2.2.3. FLAC predicted maximum horizontal and vertical displacements of the slope crest to be 2.9 and 1.1 feet, respectively. Figure 6 shows that the slope displacement ceases before the end of the acceleration time history with no post-earthquake displacement.

3.2 Results of Modeling Using TCU051.acc

The key results from the FLAC modeling using TCU051.acc acceleration time history are presented in Figure 7 through 9:

- Figure 7 shows the predicted liquefiable zone assuming that elements with peak r_u of greater than 0.8 are liquefiable. This figure also shows the distorted FLAC finite difference grid (red color). The maximum displacement was estimated to be 3.9 feet.
- Figure 8 shows contours of maximum displacements at the end of the acceleration time history. Again, this figure shows that the predicted slope displacement is mostly surficial and unlikely to result in catastrophic slope movement.
- Figure 9 shows the time history of the horizontal and vertical displacements of the revetment slope crest (again, 90 to 100 seconds corresponds to the post-earthquake period). FLAC predicted maximum horizontal and vertical displacements of the slope crest to be 1.8 and 0.8 feet, respectively. Figure 9 also shows that the slope displacement ceases before the end of the acceleration time history, and no post-earthquake displacement is predicted.

3.3 Results of Modeling Using PS10.acc

The key results from the FLAC modeling using PS10.acc acceleration time history are presented in Figure 10 through 12:

- Figure 10 shows the predicted liquefiable zone assuming that elements with peak r_u of greater than 0.8 are liquefiable. The maximum displacement was estimated to be 2 feet.
- Figure 11 shows contours of maximum displacements at the end of the acceleration time history.
- Figure 12 shows the time history of the horizontal and vertical displacements of the revetment slope crest (90 to 100 seconds corresponds to the post-earthquake period). FLAC predicted maximum horizontal and vertical displacements of the slope crest to be 1.4 and 0.3 feet, respectively. Figure 12 shows that the slope displacement ceases before the end of the acceleration time history, and no post-earthquake displacement is predicted.

3.4 Results of Modeling Using Izmit.acc

The key results from the FLAC modeling using Izmit.acc acceleration time history are presented in Figure 13 through 15:

- Figure 13 shows the predicted liquefiable zone assuming that elements with peak r_u of greater than 0.8 are liquefiable. The maximum displacement was estimated to be 2.2 feet.
- Figure 14 shows contours of maximum displacements at the end of the acceleration time history.
- Figure 15 shows the time history of the horizontal and vertical displacements of the revetment slope crest. FLAC predicted maximum horizontal and vertical displacements of the slope crest to be 1.4 and 0.7 feet, respectively.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The FLAC modeling results summarized in Table 1 show a maximum slope displacement of 4.9 feet (for the TCO76.acc acceleration time history). Table 1 also shows that the predicted maximum horizontal and vertical displacement of the slope crest are 2.9 and 1.1 feet, respectively.

Figures 5, 8, 11, and 14 show that the slope displacements are mostly surficial and located only within the potentially liquefiable sandy fill; i.e., the slope movements do not extend to the Bay Mud. Therefore, the 1-foot maximum allowable displacement criterion discussed in Section 7.2 of DDBR Attachment F is not applicable for cross section D-D'. For critical earthen structures, such as an earthen dam embankment, up to 3 feet[7] of permanent displacement is typically acceptable. However, it should be noted that the revetment slopes at IR-02 Southeast are much less critical than an earthen dam embankment. Additionally, the consequence of greater than 3 feet of permanent displacement of the revetment slope would be less severe at IR-02 Southeast because, unlike IR-02 Northwest and IR-03, there is no groundwater contamination that requires containment (via slurry wall) and the remaining contaminants in soil are relatively immobile (and therefore the soil cover does not include a protective liner). In the event of displacement following a major earthquake, the revetment slope and soil cover can be promptly repaired and there are no additional remedy components that would be impacted. Based on this information, a slope displacement of up to 5 feet at IR-02 Southeast may be acceptable.

Based on the above discussion, in lieu of implementing an expensive liquefaction mitigation measure at this time, it is recommended that the revetment slopes along the shoreline of IR-02 Southeast be inspected and repaired after major earthquakes, consistent with procedures specified in the preconstruction operation and maintenance plan (which, along with the DBR, is part of the Remedial Design package for Parcel E).

Attachments: Tables 1 through 3
Figures 1 through 15

[7] Duncan, A.M. and Wright, S.G. (2005). *Soil Strength and Slope Stability*, John Wiley & Sons, Inc.

Table 1
Initial FLAC Input Parameters
Cross Section D-D', Parcel E, Hunters Point Naval Shipyard

Property	Symbol	Units	Alluvium	Bay Mud	Sandy Fill	Clayey Fill	Silty/Clayey Fill	Revetment	Final Cover
Unit weight	γ	pcf	130	100	120	100	100	135	120
Density	ρ	slug/ft^3	4.04	3.11	3.73	3.11	3.11	4.19	3.73
Shear Wave Velocity	v_s	ft./sec	1000	300	600	300	300	1000	400
Shear Modulus	$G=(\gamma/g)v_s^2$	psf	4.04E+06	2.80E+05	1.34E+06	2.80E+05	2.80E+05	4.19E+06	5.96E+05
Young's Modulus	E	psf	1.01E+07	7.04E+05	3.49E+06	7.04E+05	7.04E+05	1.01E+07	1.55E+06
Poisson's Ration	ν		0.25	0.26	0.3	0.26	0.26	0.2	0.3
Bulk Modulus	K	psf	6.73E+06	4.89E+05	2.91E+06	4.89E+05	4.89E+05	5.59E+06	1.29E+06
Cohesion	c	psf	0	500	0	500	500	0	0
Friction Angle	ϕ	degrees	32	0	32	0	0	38	28
Dilation Angle	ψ	degrees	0	0	0	0	0	0	0
Hydraulic Conductivity	K_{sat}	cm/sec	1.00E-02	1.00E-07	1.00E-02	1.00E-07	1.00E-07	1.00E+03	1.00E-02
		ft./sec	3.28E-04	3.28E-09	3.28E-04	3.28E-09	3.28E-09	3.28E+01	3.28E-04
Permeability	k_{sat}	$(ft^2)/[(lbf/ft^2).s]$	5.26E-06	5.3E-11	5.3E-06	5.3E-11	5.3E-11	5.3E-01	5.3E-06
Porosity	θ		0.35	0.73	0.35	0.6	0.6	0.3	0.35
Corrected Blow count	$(N_1)_{60\text{-}cs}$	--	--	--	12	--	--	--	--

$G=(\gamma/g)V_s^2$

$E=G[2(1+\nu)]$

$K=E/[3(1-2\nu)]$

$K=\{G[2(1+\nu)]\}/\{3(1-2\nu)\}$

$k_{sat}=K_{sat}/62.4$

$S_u=0.3\sigma_v'$

$V_s=18(S_u)^{0.475}$

Table 2
UBCSAND Properties (FLAC 8.0 Version) for Liquefiable Sandy Fill
Cross Section D-D', Parcel E, Hunters Point Naval Shipyard

Unit of m_pa =	psf
Poisson's Ratio = ν =	0.3
K/G Ratio = [2(1-2ν)]/[3(1-3)] =	2.17

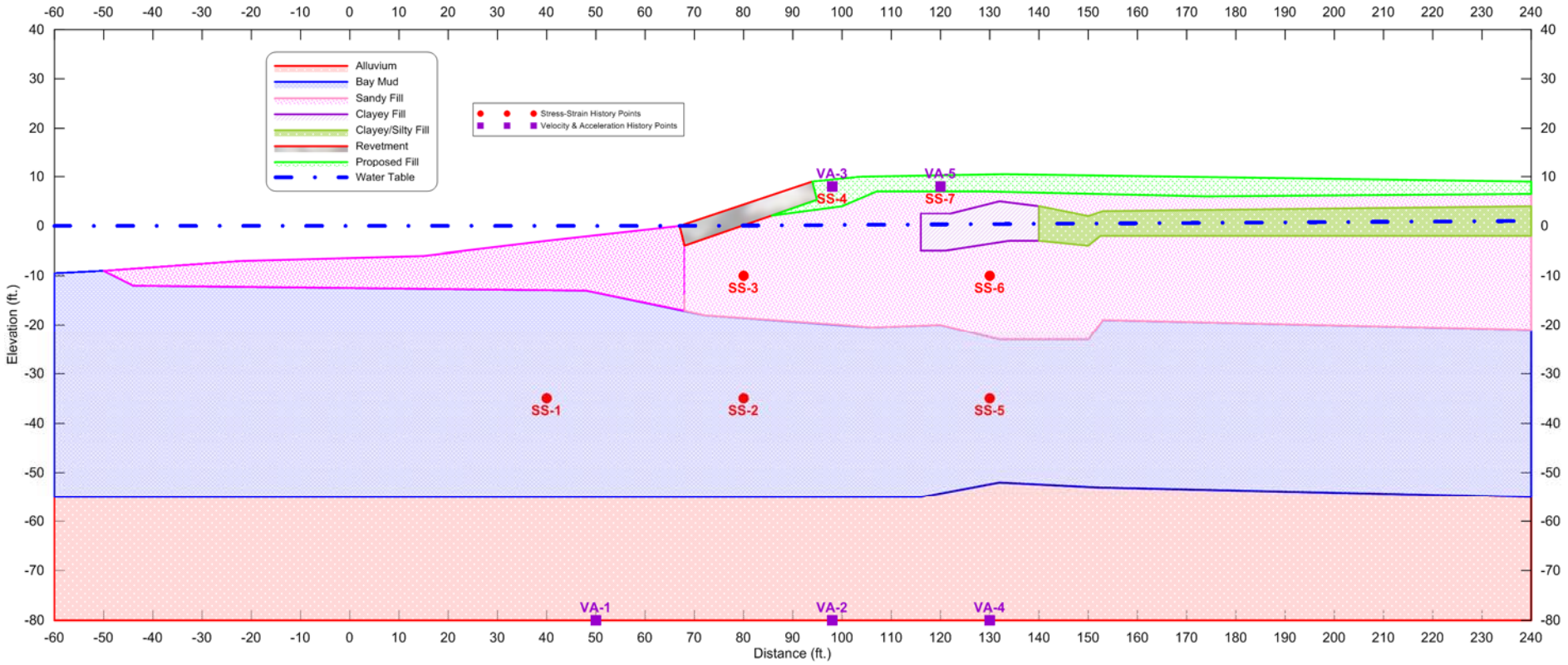
m_n160	12	m_me	0.5	m_phif	33.2	m_triax	--	*m_ratf*	--
m_pa	2116	m_kgp	529	m_anisofac	1	m_hfac1	1	*m_dt*	--
m_kge	993	m_rf	0.76	m_sat	1	m_hfac2	1	*m_ratcv*	--
m_ne	0.5	m_np	0.4	m_static	0	m_ratio	--	*m_ratmax*	--
m_kb	2151	m_phicv	32	m_ocr		m_ratmob	--		

Table 3
Summary of the Maximum Slope Displacements Predicted by FLAC Model
Cross Section D-D´, Parcel E, Hunters Point Naval Shipyard

Acceleration Time History	Maximum Displacement (ft.)
TCU076.acc	4.9
TCU051.acc	3.9
PS10.acc	2.0
Izmit.acc	2.2

Table 4
Horizontal and Vertical Displacements Predicted by FLAC Model for the Slope Crest
Cross Section D-D´, Parcel E, Hunters Point Naval Shipyard

Acceleration Time History	Horizontal Displacement of Crest (ft.)	Vertical Displacement of Crest (ft.)
TCU076.acc	2.9	1.1
TCU051.acc	1.8	0.8
PS10.acc	1.4	0.3
Izmit.acc	1.4	0.7



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Modeled Cross Section

Project No.: **1402317**	Date: **August 2017**	Figure: **1**

JOB TITLE : .

FLAC (Version 8.00)

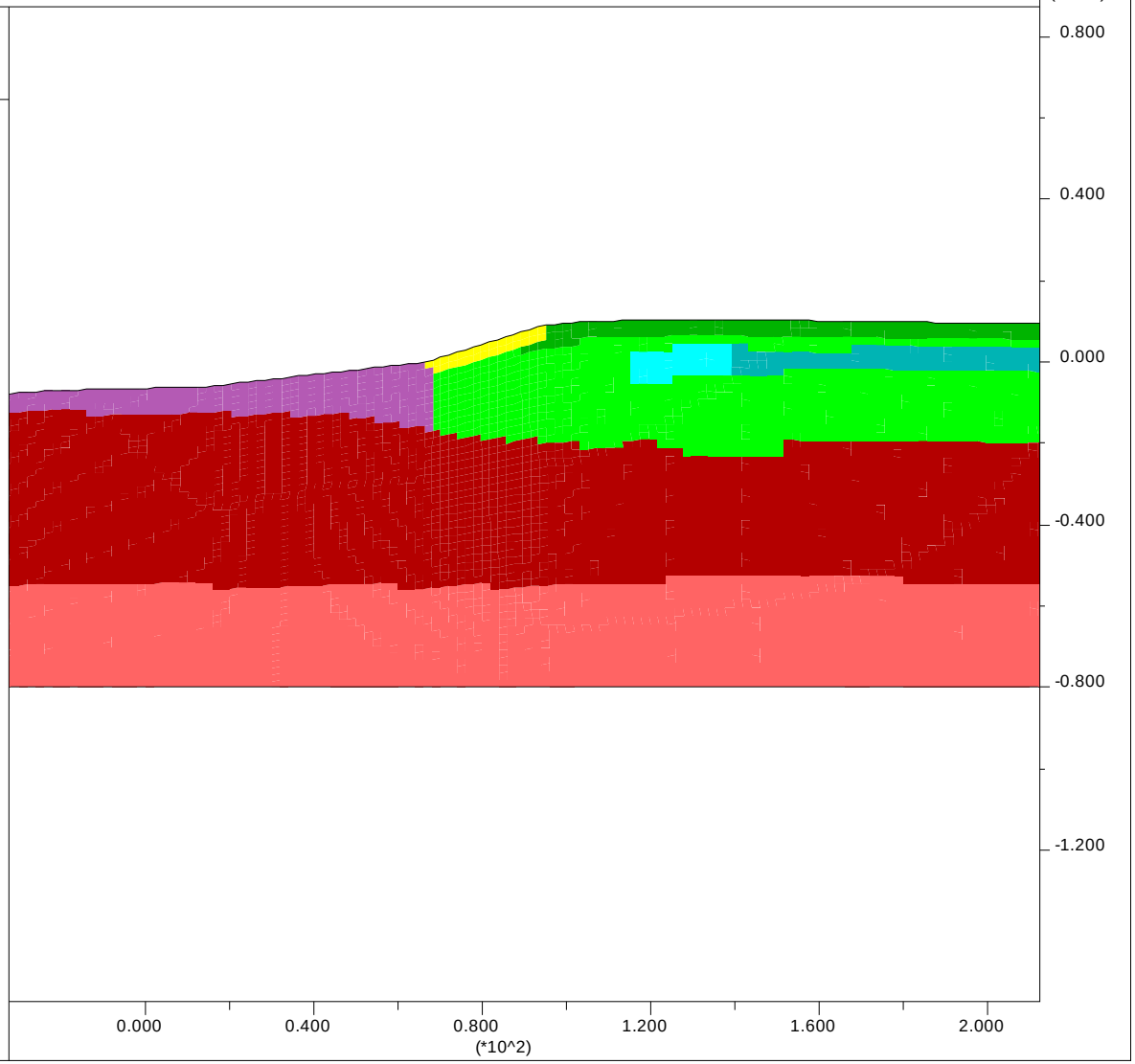
LEGEND

30-Jul-17 16:01
step 11819
Flow Time 1.9719E-07
-3.232E+01 <x< 2.123E+02
-1.572E+02 <y< 8.741E+01

User-defined Groups
- Alluvium:Mohr
- BayMud:Mohr
- SandyFill-1:Mohr
- Revetment:Mohr
- SandyFill-2:Mohr
- FinalCover:Mohr
- ClayeyFill:Mohr
- SandySiltyFill:Mohr

Boundary plot

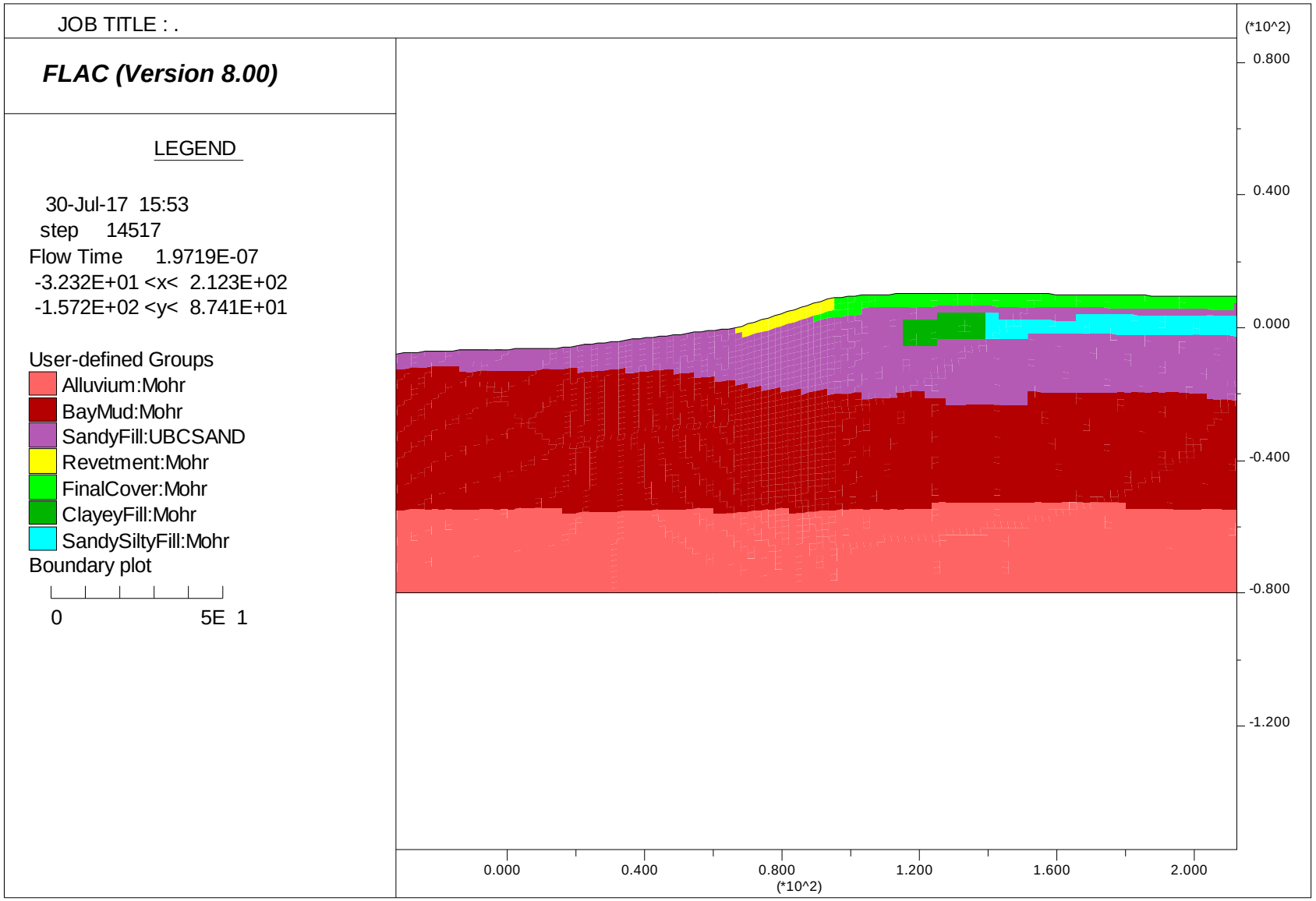
0 5E 1



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
FLAC Model for Initial Static Equilibrium

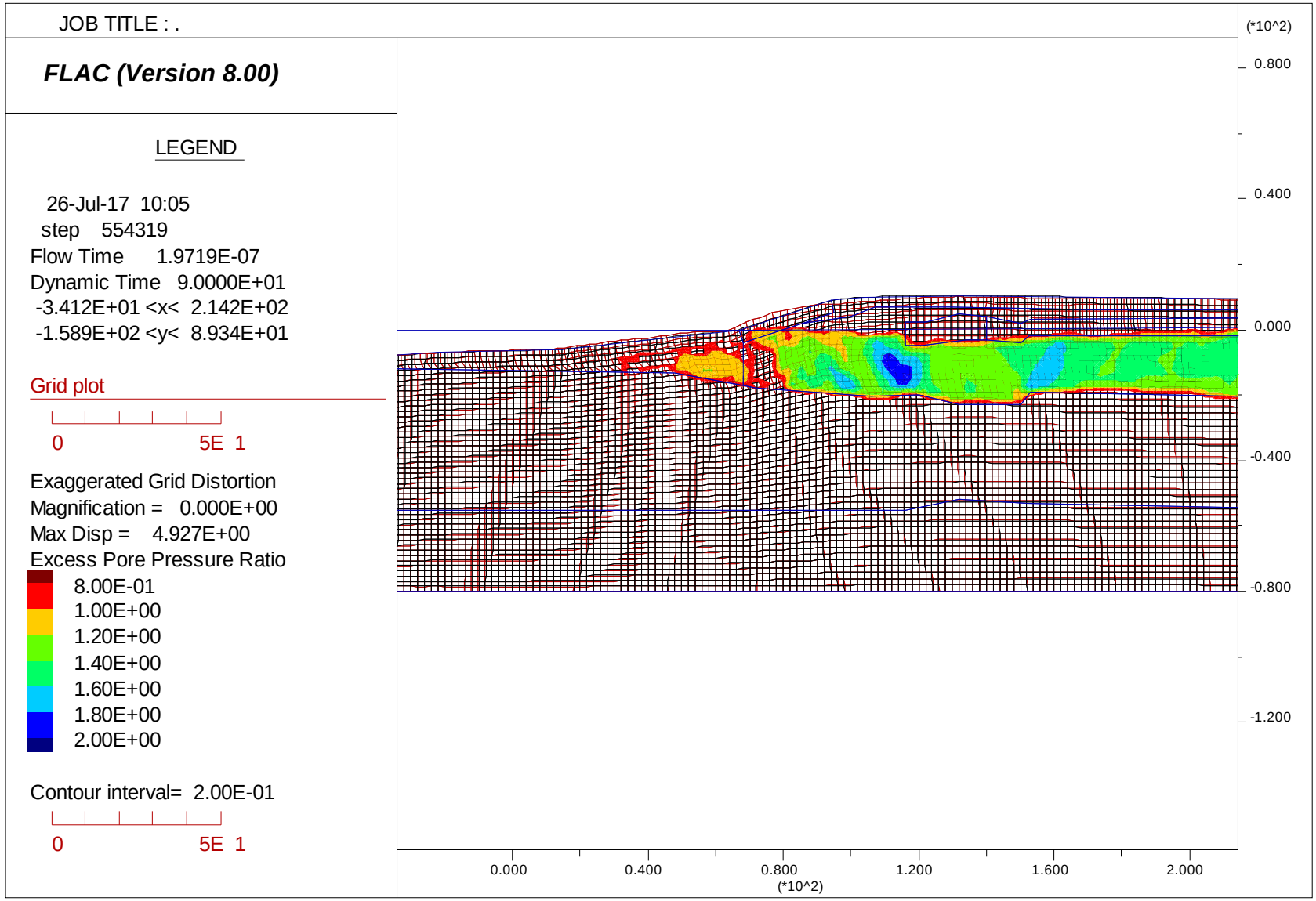
Project No.: **1402317** | Date: **August 2017** | Figure: **2**



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
FLAC Model for Dynamic Analysis

Project No.: **1402317** | Date: **August 2017** | Figure: **3**



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU076.acc
Computed Liquefaction Zone

Project No.: **1402317** | Date: **August 2017** | Figure: **4**

JOB TITLE : .

FLAC (Version 8.00)

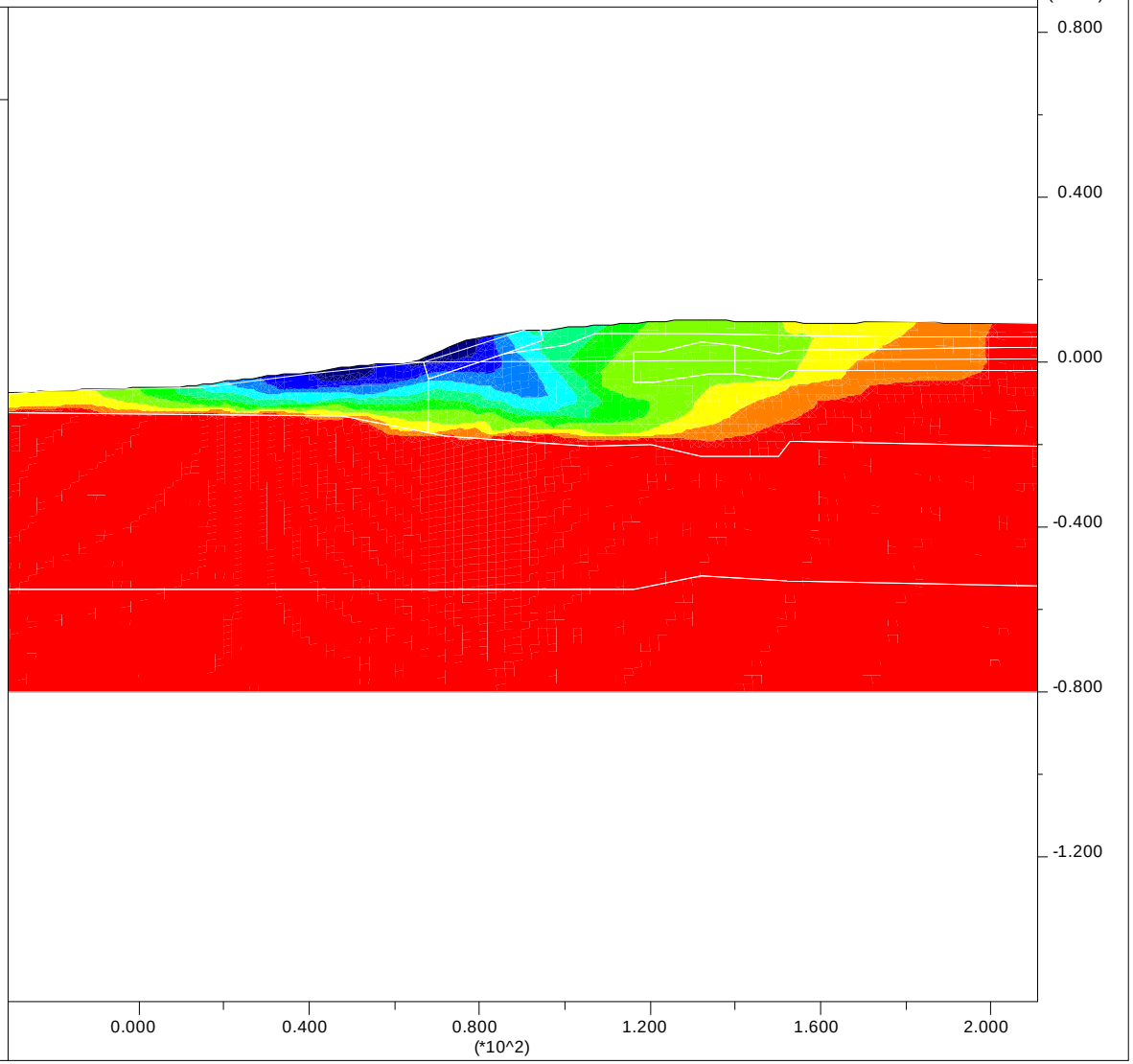
LEGEND

26-Jul-17 10:07
step 554319
Flow Time 1.9719E-07
Dynamic Time 9.0000E+01
-3.056E+01 <x< 2.107E+02
-1.551E+02 <y< 8.617E+01

Displacement contours
- 0.00E+00
- 5.00E-01
- 1.00E+00
- 1.50E+00
- 2.00E+00
- 2.50E+00
- 3.00E+00
- 3.50E+00
- 4.00E+00
- 4.50E+00

Contour interval= 5.00E-01
Boundary plot

0 5E 1



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU076.acc
Contours of Computed Displacements

Project No.: **1402317** | Date: **August 2017** | Figure: **5**

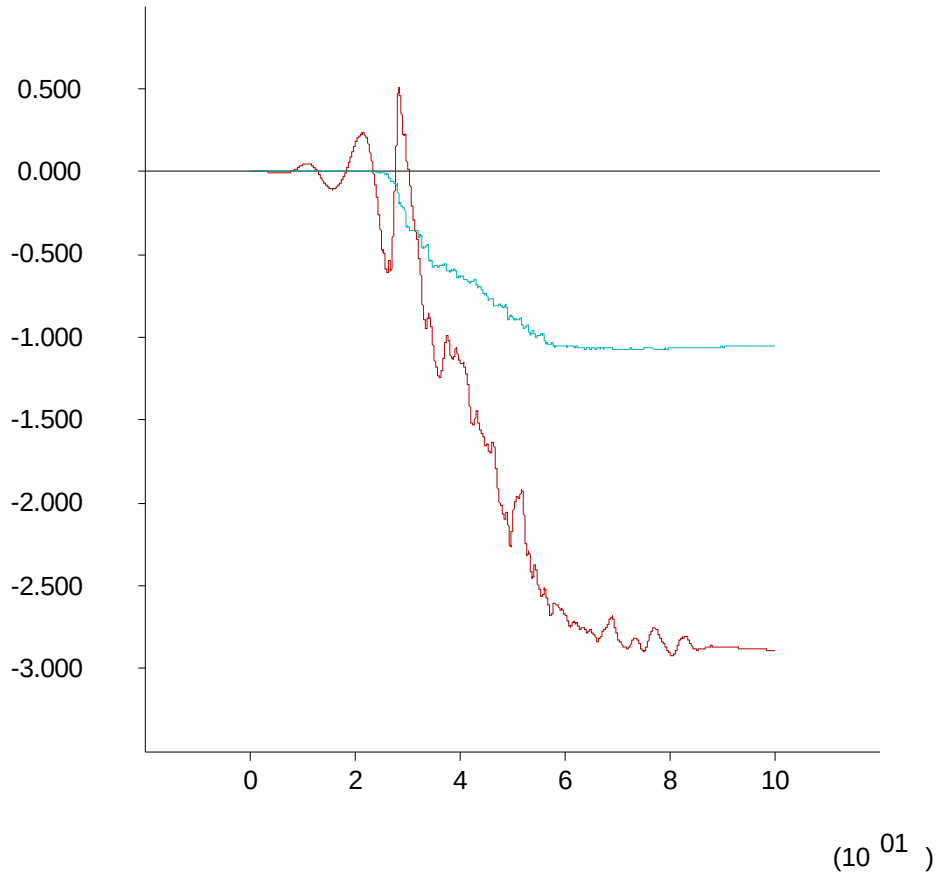
JOB TITLE : .

FLAC (Version 8.00)

LEGEND

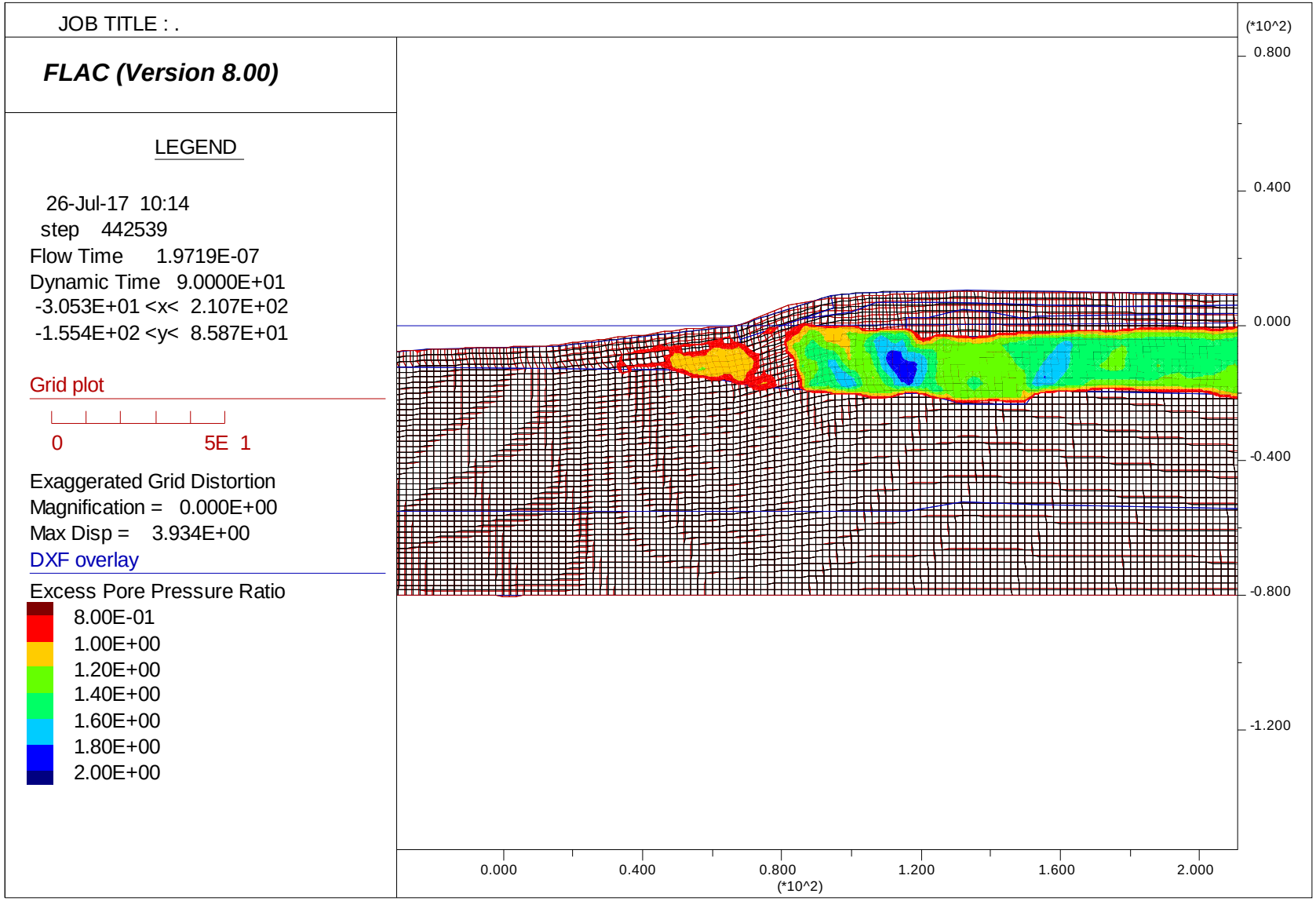
26-Jul-17 10:09
step 614295
Flow Time 1.9719E-07
Dynamic Time 1.0000E+02
-7.689E+01 <x< 2.569E+02
-2.023E+02 <y< 1.314E+02

HISTORY PLOT
Y-axis :
237 X displacement(78, 47)
238 Y displacement(78, 47)
X-axis :
99 Dynamic time



Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU076.acc
Horizontal/Vertical Displacements of the Slope Crest

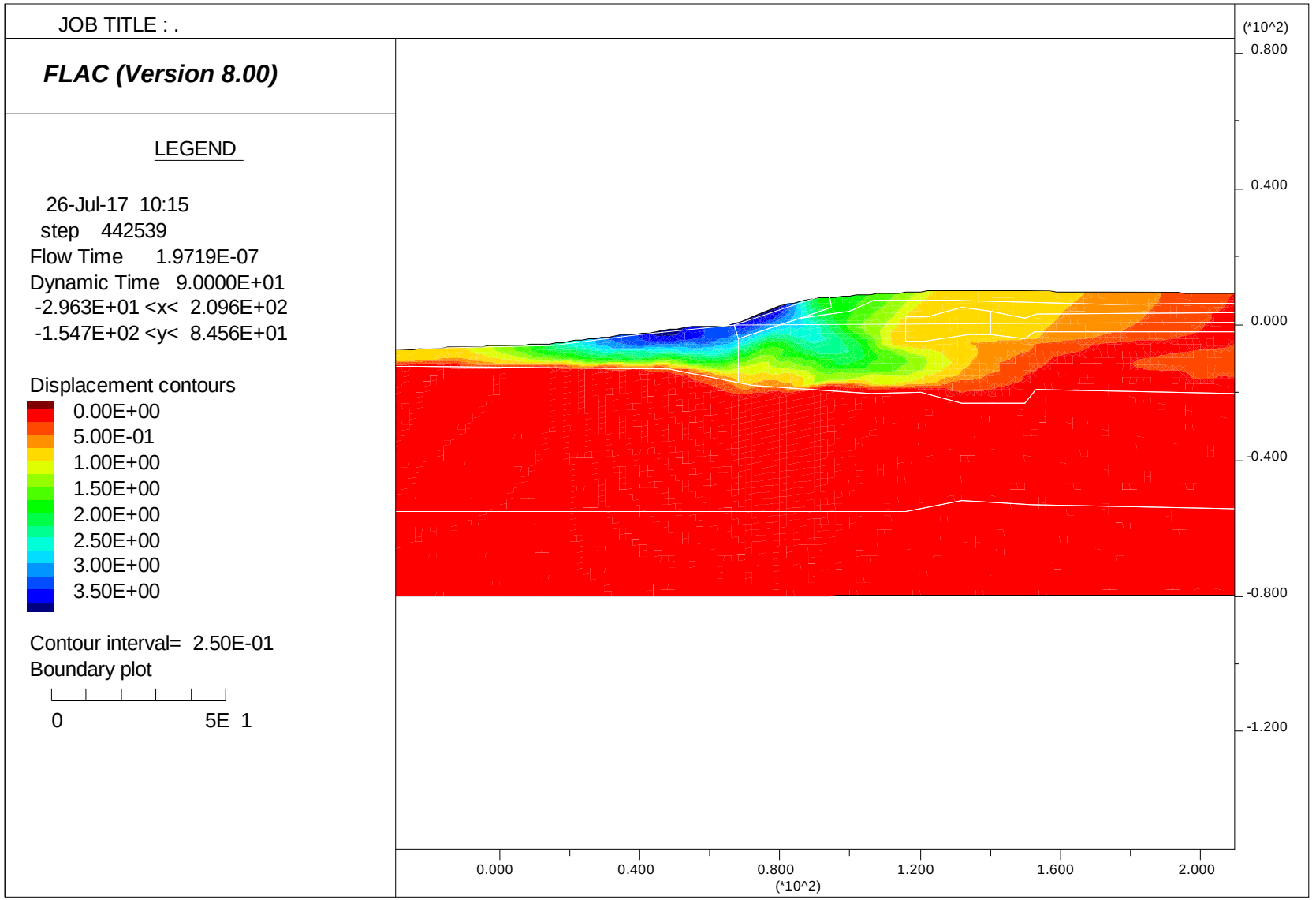
Project No.: **1402317** | Date: **August 2017** | Figure: **6**



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU051.acc
Computed Liquefaction Zone

Project No.: **1402317** | Date: **August 2017** | Figure: **7**



Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU051.acc
Contours of Computed Displacements

Project No.: **1402317** | Date: **August 2017** | Figure: **8**

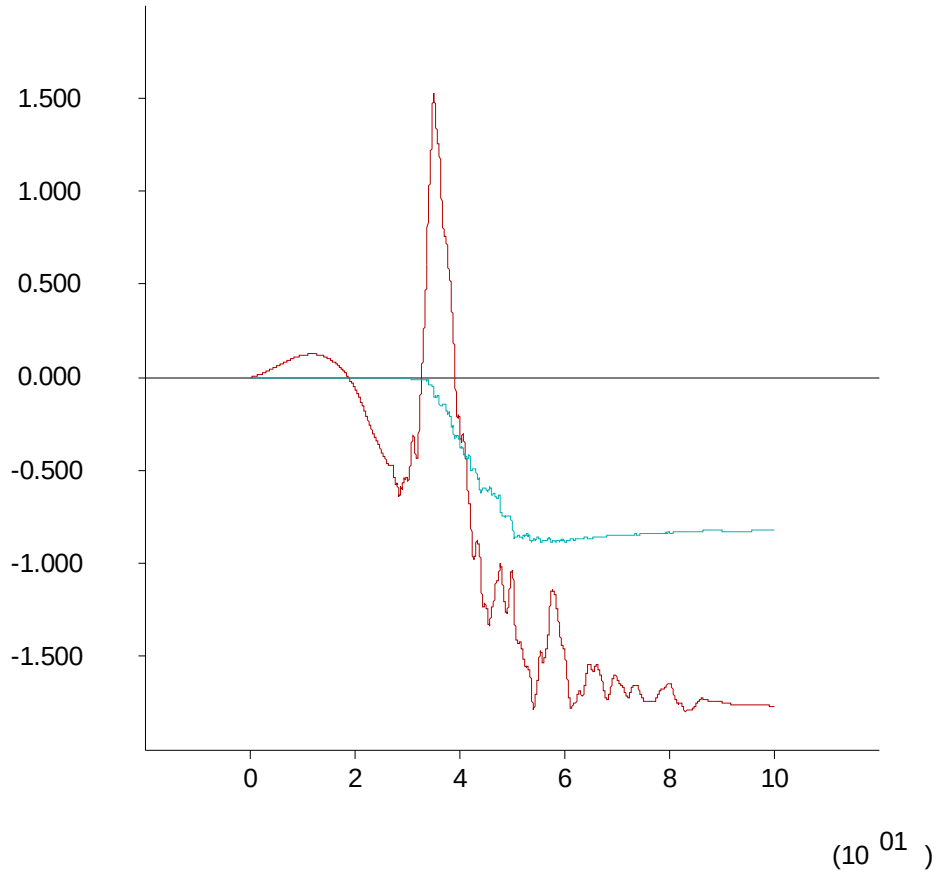
JOB TITLE : .

FLAC (Version 8.00)

LEGEND

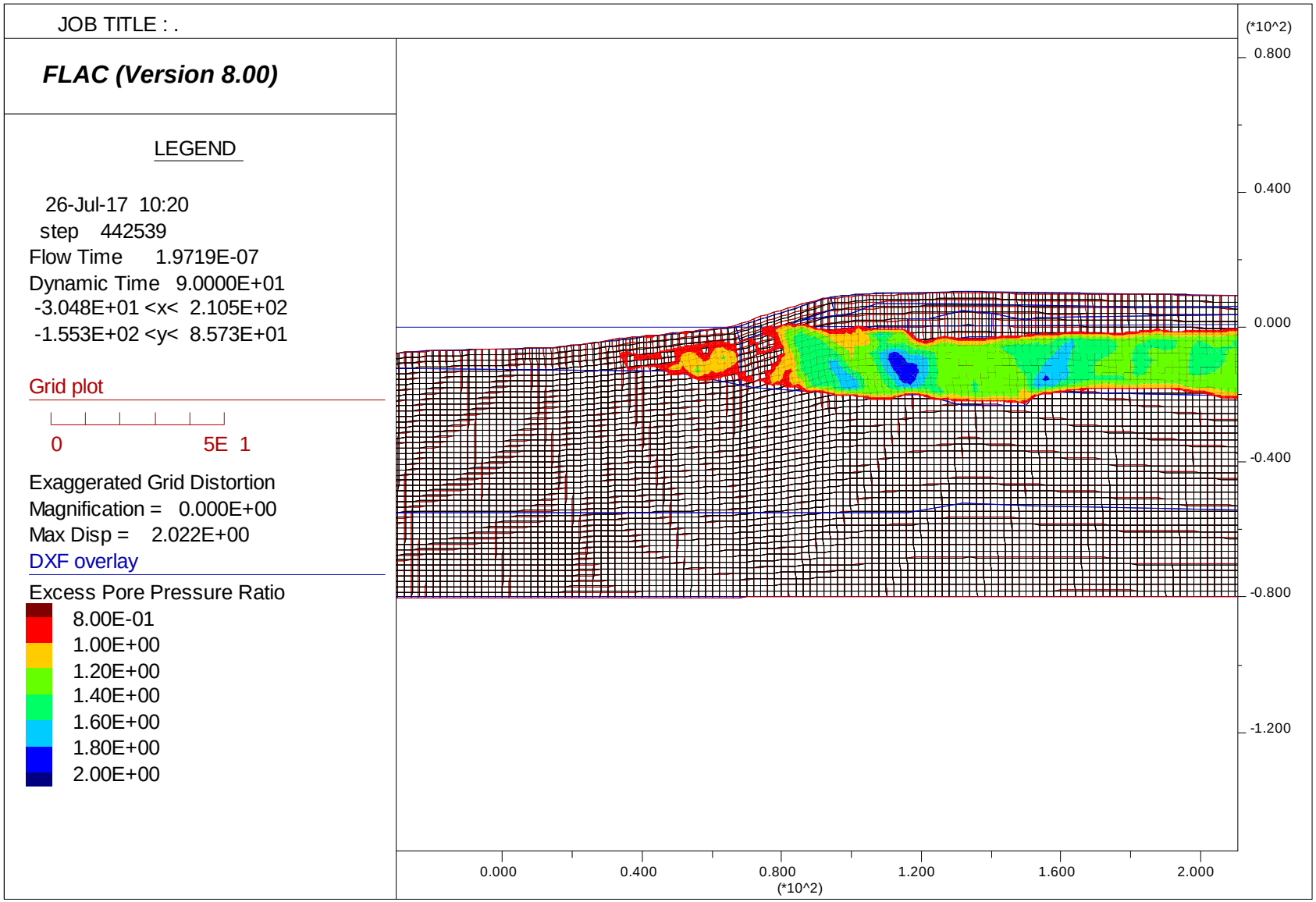
26-Jul-17 10:17
step 490096
Flow Time 1.9719E-07
Dynamic Time 1.0000E+02
-7.690E+01 <x< 2.570E+02
-2.023E+02 <y< 1.317E+02

HISTORY PLOT
Y-axis :
237 X displacement(78, 47)
238 Y displacement(78, 47)
X-axis :
99 Dynamic time



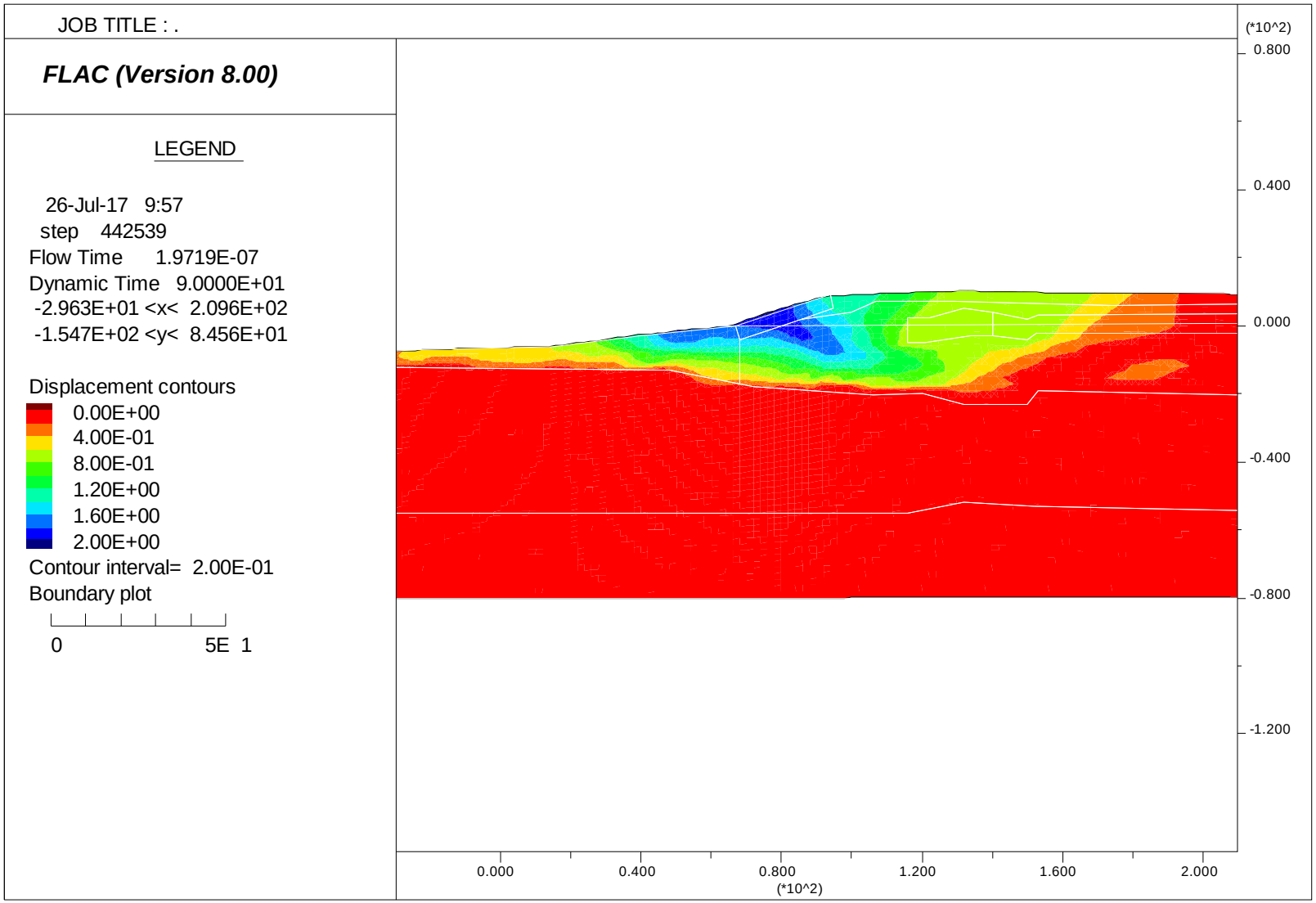
Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = TCU051.acc
Horizontal/Vertical Displacements of the Slope Crest

Project No.: **1402317** | Date: **August 2017** | Figure: **9**



Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = PS-10.acc
Computed Liquefaction Zone

Project No.: **1402317** | Date: **August 2017** | Figure: **10**



Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = PS-10.acc
Contours of Computed Displacements

Project No.: **1402317** | Date: **August 2017** | Figure: **11**

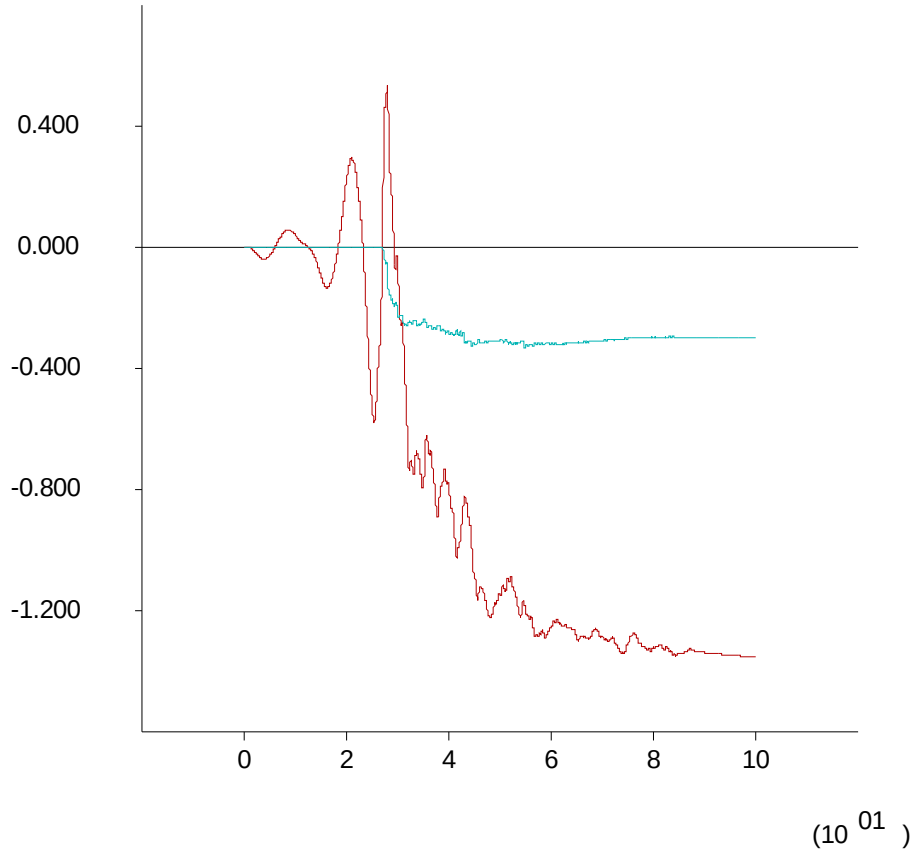
JOB TITLE : .

FLAC (Version 8.00)

LEGEND

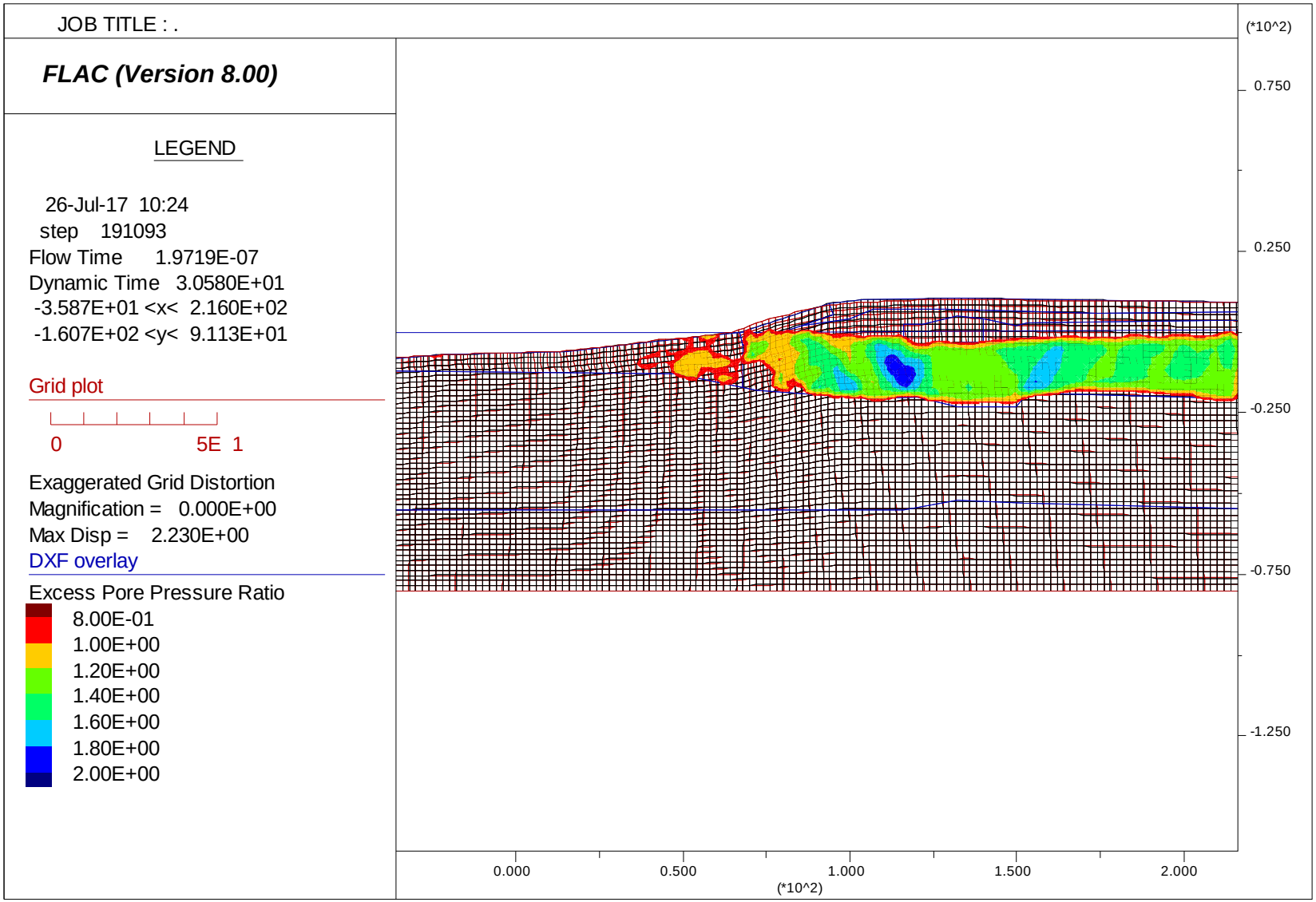
26-Jul-17 10:00
step 490096
Flow Time 1.9719E-07
Dynamic Time 1.0000E+02
-7.678E+01 <x< 2.568E+02
-2.020E+02 <y< 1.316E+02

HISTORY PLOT
Y-axis :
237 X displacement(78, 47)
238 Y displacement(78, 47)
X-axis :
99 Dynamic time



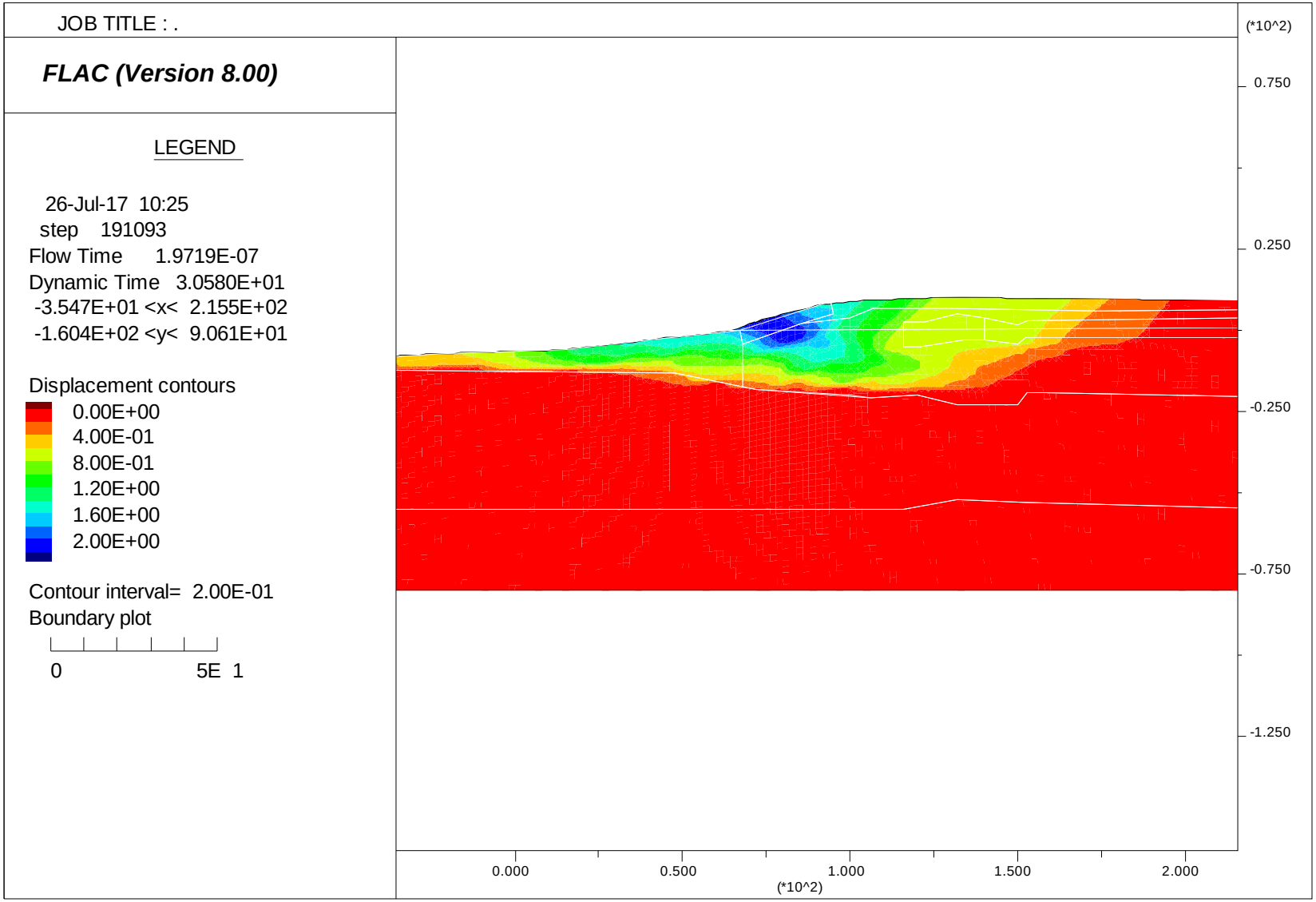
Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = PS-10.acc
Horizontal/Vertical Displacements of the Slope Crest

Project No.: **1402317** | Date: **August 2017** | Figure: **12**



Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = Izmit.acc
Computed Liquefaction Zone

Project No.: **1402317** | Date: **August 2017** | Figure: **13**



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = Izmit.acc
Contours of Computed Displacements

Project No.: **1402317** | Date: **August 2017** | Figure: **14**

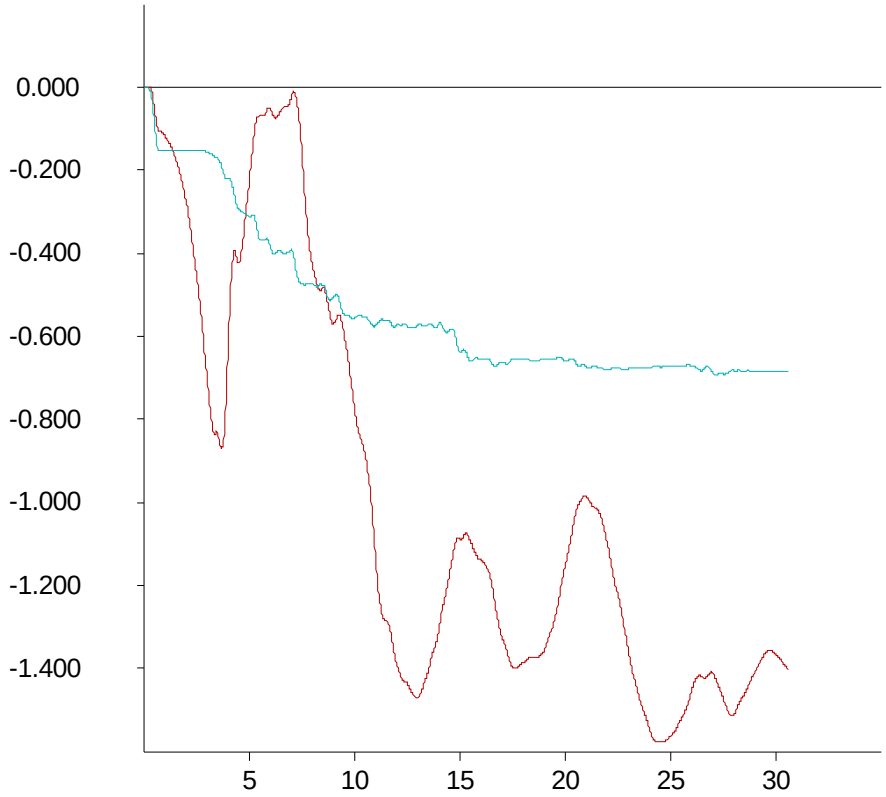
JOB TITLE : .

FLAC (Version 8.00)

LEGEND

30-Jul-17 16:26
step 191093
Flow Time 1.9719E-07
Dynamic Time 3.0580E+01
-7.674E+01 <x< 2.568E+02
-2.019E+02 <y< 1.317E+02

HISTORY PLOT
Y-axis :
237 X displacement(78, 47)
238 Y displacement(78, 47)
X-axis :
99 Dynamic time



Golder Associates

Hunters Point Naval Shipyard
Parcel E Remedial Design
FLAC Modeling for Cross Section D-D′
Acceleration Time History = Izmit.acc
Horizontal/Vertical Displacements of the Slope Crest

Project No.: **1402317** | Date: **August 2017** | Figure: **15**

Attachment F8
Results of D-MOD2000 Analyses

(This attachment is provided on CD only)

Input Parameters for D-MOD2000
Cross Section A-A'
Parcel E Remedial Design
Hunters Point Naval Shipyard

Elevation of the ground surface at the DMOD-2000 Column = 4.4 ft.
Water table elevation = 0.4 ft.

Layer	Soil Description	Thickness (ft.)	Mid-Depth Elevation (ft.)	V_s (ft./sec)	Unit Weight (pcf)	G_{max} (psf)	γ_r	τ_{m0} (psf)	G/G_{max} Curve	β	s
1	Revetment	4	2.4	1000	130	4037267	0.000722	2915	Shibuya	0.36	0.4
2	Sand	3	-1.1	500	120	931677	0.0002	186	Sand	1.1	0.9
3	Bay Mud	3	-4.1	229	100	162473	0.00099	161	Bay Mud Crust	0.5	1.2
4	Bay Mud	4	-7.6	235	100	171901	0.00099	170	Bay Mud Crust	0.5	1.2
5	Bay Mud	4	-11.6	242	100	181638	0.00099	180	Bay Mud	0.5	1.2
6	Bay Mud	5	-16.1	259	100	209067	0.00099	207	Bay Mud	0.5	1.2
7	Bay Mud	6	-21.6	283	100	249485	0.00099	247	Bay Mud	0.5	1.2
8	Bay Mud	6	-27.6	312	100	301360	0.00099	298	Bay Mud	0.5	1.2
9	Bay Mud	9	-35.1	350	100	381430	0.00099	378	Bay Mud	0.5	1.2
10	Alluvium	20	-49.6	900	130	3270186	0.0004	1308	Sand	1.1	0.9
11	Alluvium	20	-69.6	950	130	3643634	0.0004	1457	Sand	1.1	0.9
12	Alluvium	20	-89.6	1000	130	4037267	0.0004	1615	Sand	1.1	0.9
13	Alluvium	20	-109.6	1050	130	4451087	0.0004	1780	Sand	1.1	0.9
14	Alluvium	20	-129.6	1100	130	4885093	0.0004	1954	Sand	1.1	0.9
15	Alluvium	30	-154.6	1150	130	5339286	0.0004	2136	Sand	1.1	0.9
16	Alluvium	30	-184.6	1200	130	5813665	0.0004	2325	Sand	1.1	0.9
17	Alluvium	30	-214.6	1250	130	6308230	0.0004	2523	Sand	1.1	0.9

H = **234** ft. $(V_s)_{avg}$ = **958** ft./sec T = **0.977** sec

n	ξ (%)	α_R	β_R
5	0.5	**0.05358**	**0.000259**

σ_v at the failure surface = 3680 psf

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º  D - MOD2000  º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
        ³
   ³    ³³ ³
   ³  ³³O³O³ ³ ³
V1.03      ÀÄÄÅ×××××××ÅÅÅÄÄ┼
GeoMotions, LLC   ³³O³O³ ³ ³
        ³³ ³
        ³
```

A Computer Program for Seismic
Response Analyses of Horizontally
Layered Soil Deposits, Earthfill
Dams and Solid Waste Landfills
by
Neven Matasovic, 1993;`06

The following models are incorporated in this computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic (1993); Cyclic Degradation - PWP Generation Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for Composite Soil Deposits by Matasovic (1993).

ÄÄ
Input file name = C:\D-MOD2\Parcel-E\A-A'\TCU076\A-A_TCU076.inp
Output file name = C:\D-MOD2\Parcel-E\A-A'\TCU076\A-A_TCU076.out
ÄÄ

****
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****

Hunters Point Section A-A' * Dt: 0.005

```
NPTYPE =  1 ;   NLINEL =  1 ;   NMAT   = 17 ;   NLAYER = 17 ;   NDAMP  =  2
ITMBY  =  1 ;   NBT    =  0 ;   NBB    =  1 ;   ITERRV =  1 ;   ICKFB  =  1
```

****
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
****

************* STRESS - STRAIN MODEL *************

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	932430.	186.49	1.10	.92
3	162992.	161.36	.50	1.20
4	171645.	169.93	.50	1.20
5	182023.	180.20	.50	1.20
6	208494.	206.41	.50	1.20
7	248925.	246.44	.50	1.20
8	302555.	299.53	.50	1.20
9	380742.	376.93	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	120.00	120.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	2		3.00	1.00	0
3	3	2		3.00	1.00	0
4	4	2		4.00	1.00	0
5	5	2		4.00	1.00	0
6	6	2		5.00	1.00	0
7	7	3		6.00	1.00	0
8	8	3		6.00	1.00	0
9	9	4		9.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: .977 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 234.0 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 957.7 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
5.50	606.35	500.00	.00020	.08
8.50	749.07	229.00	.00099	.08
12.00	880.56	235.00	.00099	.08
16.00	1030.84	242.00	.00099	.08
20.50	1199.91	259.00	.00099	.08
26.00	1406.54	283.00	.00099	.08
32.00	1631.96	312.00	.00099	.08
39.50	1913.74	350.00	.00099	.08
54.00	2758.50	900.00	.00040	.08
74.00	4109.90	950.00	.00040	.08
94.00	5461.30	1000.00	.00040	.08
114.00	6812.70	1050.00	.00040	.08
134.00	8164.10	1100.00	.00040	.08

159.00	9853.35	1150.00	.00040	.08
189.00	11880.45	1200.00	.00040	.08
219.00	13907.55	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+00
2	5.359E-02	2.592E-04	9.324E+05	2.416E+02	1.37E+01
3	5.359E-02	2.592E-04	1.630E+05	4.224E+01	1.03E+01
4	5.359E-02	2.592E-04	1.716E+05	4.448E+01	1.09E+01
5	5.359E-02	2.592E-04	1.820E+05	4.717E+01	1.24E+01
6	5.359E-02	2.592E-04	2.085E+05	5.403E+01	1.40E+01
7	5.359E-02	2.592E-04	2.489E+05	6.451E+01	1.71E+01
8	5.359E-02	2.592E-04	3.026E+05	7.841E+01	1.86E+01
9	5.359E-02	2.592E-04	3.807E+05	9.867E+01	2.33E+01
10	5.359E-02	2.592E-04	3.273E+06	8.482E+02	5.44E+01
11	5.359E-02	2.592E-04	3.647E+06	9.450E+02	8.08E+01
12	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+01
13	5.359E-02	2.592E-04	4.455E+06	1.154E+03	8.08E+01
14	5.359E-02	2.592E-04	4.889E+06	1.267E+03	8.08E+01
15	5.359E-02	2.592E-04	5.344E+06	1.385E+03	1.01E+02
16	5.359E-02	2.592E-04	5.818E+06	1.508E+03	1.21E+02
17	5.359E-02	2.592E-04	6.313E+06	1.636E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.321E+06 3.651E+05 9.724E+04 8.842E+04 8.720E+04
8.319E+04 9.191E+04 9.273E+04 2.059E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -3.108E+05 -5.433E+04 -4.291E+04 -4.551E+04 -4.170E+04
-4.149E+04 -5.043E+04 -4.230E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.622E+02 3.431E+02 9.518E+01 2.578E+01 2.358E+01 2.335E+01
2.247E+01 2.482E+01 2.528E+01 5.629E+01
9.399E+01 1.039E+02 1.144E+02 1.254E+02 1.149E+02 1.029E+02
1.113E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.618E+02 -8.055E+01 -1.408E+01 -1.112E+01 -1.179E+01 -1.081E+01
-1.075E+01 -1.307E+01 -1.096E+01 -4.241E+01
-4.725E+01 -5.236E+01 -5.772E+01 -6.335E+01 -4.616E+01 -5.026E+01
-5.454E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\A-
    A'\TCU076\TCU076-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\TCU076-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\TCU076\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   8  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000003 (g)

    LAYER   ACCEL.      VELOCITY     DISPL.       STRAIN       STRESS
             (g)        (ft/sec)     (ft)          (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	49.88	.145584	49.88	.000990	49.88	.14447	.00	.00000
2	49.90	.145499	49.90	.025901	49.90	.16628	.00	.00000
3	49.88	.134364	49.89	.170258	49.88	.18900	.00	.00000
4	26.85	.225269	25.43	.245157	25.43	.19232	.00	.00000
5	49.82	.230797	34.19	.524383	34.19	.19716	.00	.00000
6	49.79	.230549	34.27	.951290	29.79	.19533	.00	.00000
7	49.72	.345732	49.16	.978010	34.23	.20706	.00	.00000
8	49.72	.497418	28.57	.820609	28.49	.20841	.00	.00000
9	35.26	.202223	28.48	.472214	28.48	.22055	.00	.00000
10	35.22	.150819	49.63	.035598	49.63	.21219	.00	.00000
11	25.66	.118036	49.61	.060505	49.61	.20676	.00	.00000
12	43.23	.117253	49.58	.080608	49.58	.19447	.00	.00000
13	34.96	.138090	49.56	.086872	49.56	.17692	.00	.00000
14	31.48	.159332	28.39	.096450	28.39	.16845	.00	.00000
15	28.49	.156848	28.36	.104022	28.36	.15671	.00	.00000
16	32.82	.173669	28.34	.110988	28.34	.14471	.00	.00000
17	34.61	.167424	28.30	.129078	28.30	.14095	.00	.00000
18	28.24	.486465	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .311199 (g) AT TIME = 34.595 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
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º D - MOD2000 º
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V1.03
GeoMotions, LLC

A Computer Program for Seismic Response Analyses of Horizontally Layered Soil Deposits, Earthfill Dams and Solid Waste Landfills

by

Neven Matasovic, 1993;`06

The following models are incorporated in this computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic (1993); Cyclic Degradation - PWP Generation Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for Composite Soil Deposits by Matasovic (1993).

Input file name = C:\D-MOD2\Parcel-E\A-A'\TCU051\A-A_TCU051.inp
Output file name = C:\D-MOD2\Parcel-E\A-A'\TCU051\A-A_TCU051.out

****
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****

Hunters Point Section A-A' * Dt: 0.005

NPTYPE = 1 ; NLINEL = 1 ; NMAT = 17 ; NLAYER = 17 ; NDAMP = 2
ITMBY = 1 ; NBT = 0 ; NBB = 1 ; ITERRV = 1 ; ICKFB = 1

****
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
****

********** STRESS - STRAIN MODEL **********

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	932430.	186.49	1.10	.92
3	162992.	161.36	.50	1.20
4	171645.	169.93	.50	1.20
5	182023.	180.20	.50	1.20
6	208494.	206.41	.50	1.20
7	248925.	246.44	.50	1.20
8	302555.	299.53	.50	1.20
9	380742.	376.93	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	120.00	120.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	2		3.00	1.00	0
3	3	2		3.00	1.00	0
4	4	2		4.00	1.00	0
5	5	2		4.00	1.00	0
6	6	2		5.00	1.00	0
7	7	3		6.00	1.00	0
8	8	3		6.00	1.00	0
9	9	4		9.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: .977 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 234.0 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 957.7 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
5.50	606.35	500.00	.00020	.08
8.50	749.07	229.00	.00099	.08
12.00	880.56	235.00	.00099	.08
16.00	1030.84	242.00	.00099	.08
20.50	1199.91	259.00	.00099	.08
26.00	1406.54	283.00	.00099	.08
32.00	1631.96	312.00	.00099	.08
39.50	1913.74	350.00	.00099	.08
54.00	2758.50	900.00	.00040	.08
74.00	4109.90	950.00	.00040	.08
94.00	5461.30	1000.00	.00040	.08
114.00	6812.70	1050.00	.00040	.08
134.00	8164.10	1100.00	.00040	.08

159.00	9853.35	1150.00	.00040	.08
189.00	11880.45	1200.00	.00040	.08
219.00	13907.55	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+00
2	5.359E-02	2.592E-04	9.324E+05	2.416E+02	1.37E+01
3	5.359E-02	2.592E-04	1.630E+05	4.224E+01	1.03E+01
4	5.359E-02	2.592E-04	1.716E+05	4.448E+01	1.09E+01
5	5.359E-02	2.592E-04	1.820E+05	4.717E+01	1.24E+01
6	5.359E-02	2.592E-04	2.085E+05	5.403E+01	1.40E+01
7	5.359E-02	2.592E-04	2.489E+05	6.451E+01	1.71E+01
8	5.359E-02	2.592E-04	3.026E+05	7.841E+01	1.86E+01
9	5.359E-02	2.592E-04	3.807E+05	9.867E+01	2.33E+01
10	5.359E-02	2.592E-04	3.273E+06	8.482E+02	5.44E+01
11	5.359E-02	2.592E-04	3.647E+06	9.450E+02	8.08E+01
12	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+01
13	5.359E-02	2.592E-04	4.455E+06	1.154E+03	8.08E+01
14	5.359E-02	2.592E-04	4.889E+06	1.267E+03	8.08E+01
15	5.359E-02	2.592E-04	5.344E+06	1.385E+03	1.01E+02
16	5.359E-02	2.592E-04	5.818E+06	1.508E+03	1.21E+02
17	5.359E-02	2.592E-04	6.313E+06	1.636E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.321E+06 3.651E+05 9.724E+04 8.842E+04 8.720E+04
8.319E+04 9.191E+04 9.273E+04 2.059E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -3.108E+05 -5.433E+04 -4.291E+04 -4.551E+04 -4.170E+04
-4.149E+04 -5.043E+04 -4.230E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.622E+02 3.431E+02 9.518E+01 2.578E+01 2.358E+01 2.335E+01
2.247E+01 2.482E+01 2.528E+01 5.629E+01
9.399E+01 1.039E+02 1.144E+02 1.254E+02 1.149E+02 1.029E+02
1.113E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.618E+02 -8.055E+01 -1.408E+01 -1.112E+01 -1.179E+01 -1.081E+01
-1.075E+01 -1.307E+01 -1.096E+01 -4.241E+01
-4.725E+01 -5.236E+01 -5.772E+01 -6.335E+01 -4.616E+01 -5.026E+01
-5.454E+01

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 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\A-
    A'\TCU051\TCU051-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\TCU051-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\TCU051\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   8  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. =  .000825 (g)

    LAYER   ACCEL.      VELOCITY     DISPL.       STRAIN       STRESS
             (g)        (ft/sec)     (ft)          (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
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6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	44.58	.196359	44.58	.001357	44.58	.19638	.00	.00000
2	44.58	.196480	44.58	.057600	44.58	.22648	.00	.00000
3	44.59	.210102	44.60	.473101	44.59	.24125	.00	.00000
4	36.94	.429038	37.07	.348365	37.07	.20812	.00	.00000
5	36.92	.666928	47.92	.591201	47.92	.19814	.00	.00000
6	36.83	.900402	35.50	1.927733	35.19	.19533	.00	.00000
7	44.38	.905653	42.22	1.313653	44.47	.19894	.00	.00000
8	44.38	.985292	35.40	.598282	35.40	.20810	.00	.00000
9	44.47	.533453	35.26	.341602	35.26	.21171	.00	.00000
10	44.50	.197636	35.17	.029635	35.17	.19111	.00	.00000
11	38.18	.130778	32.09	.047570	32.09	.18464	.00	.00000
12	36.78	.143465	32.13	.064237	32.13	.17702	.00	.00000
13	36.76	.149993	32.15	.074452	32.15	.16649	.00	.00000
14	36.66	.164630	50.16	.086248	50.16	.16159	.00	.00000
15	36.63	.171791	50.13	.098381	50.13	.15364	.00	.00000
16	36.60	.191761	50.09	.104633	50.09	.14178	.00	.00000
17	36.57	.196910	50.05	.098675	50.05	.12874	.00	.00000
18	55.85	13.932270	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .319920 (g) AT TIME = 36.455 (sec) **

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* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
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        V1.03      ÀÄÄÅÅ×××××××ÅÅÅÄÄ┼
  GeoMotions, LLC      33O3O3  3  3
                        33  3
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Response Analyses of Horizontally
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Input file name = C:\D-MOD2\Parcel-E\A-A'\PS-10\A-A_PS-10.inp
Output file name = C:\D-MOD2\Parcel-E\A-A'\PS-10\A-A_PS-10.out
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Hunters Point Section A-A' * Dt: 0.005

NPTYPE =  1 ;   NLINEL =  1 ;   NMAT   = 17 ;   NLAYER = 17 ;   NDAMP  =  2
ITMBY  =  1 ;   NBT    =  0 ;   NBB    =  1 ;   ITERRV =  1 ;   ICKFB  =  1

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11	3646578.	1458.63	1.10	.90
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16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	120.00	120.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	2		3.00	1.00	0
3	3	2		3.00	1.00	0
4	4	2		4.00	1.00	0
5	5	2		4.00	1.00	0
6	6	2		5.00	1.00	0
7	7	3		6.00	1.00	0
8	8	3		6.00	1.00	0
9	9	4		9.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: .977 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 234.0 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 957.7 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
5.50	606.35	500.00	.00020	.08
8.50	749.07	229.00	.00099	.08
12.00	880.56	235.00	.00099	.08
16.00	1030.84	242.00	.00099	.08
20.50	1199.91	259.00	.00099	.08
26.00	1406.54	283.00	.00099	.08
32.00	1631.96	312.00	.00099	.08
39.50	1913.74	350.00	.00099	.08
54.00	2758.50	900.00	.00040	.08
74.00	4109.90	950.00	.00040	.08
94.00	5461.30	1000.00	.00040	.08
114.00	6812.70	1050.00	.00040	.08
134.00	8164.10	1100.00	.00040	.08

159.00	9853.35	1150.00	.00040	.08
189.00	11880.45	1200.00	.00040	.08
219.00	13907.55	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+00
2	5.359E-02	2.592E-04	9.324E+05	2.416E+02	1.37E+01
3	5.359E-02	2.592E-04	1.630E+05	4.224E+01	1.03E+01
4	5.359E-02	2.592E-04	1.716E+05	4.448E+01	1.09E+01
5	5.359E-02	2.592E-04	1.820E+05	4.717E+01	1.24E+01
6	5.359E-02	2.592E-04	2.085E+05	5.403E+01	1.40E+01
7	5.359E-02	2.592E-04	2.489E+05	6.451E+01	1.71E+01
8	5.359E-02	2.592E-04	3.026E+05	7.841E+01	1.86E+01
9	5.359E-02	2.592E-04	3.807E+05	9.867E+01	2.33E+01
10	5.359E-02	2.592E-04	3.273E+06	8.482E+02	5.44E+01
11	5.359E-02	2.592E-04	3.647E+06	9.450E+02	8.08E+01
12	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+01
13	5.359E-02	2.592E-04	4.455E+06	1.154E+03	8.08E+01
14	5.359E-02	2.592E-04	4.889E+06	1.267E+03	8.08E+01
15	5.359E-02	2.592E-04	5.344E+06	1.385E+03	1.01E+02
16	5.359E-02	2.592E-04	5.818E+06	1.508E+03	1.21E+02
17	5.359E-02	2.592E-04	6.313E+06	1.636E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.321E+06 3.651E+05 9.724E+04 8.842E+04 8.720E+04
8.319E+04 9.191E+04 9.273E+04 2.059E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -3.108E+05 -5.433E+04 -4.291E+04 -4.551E+04 -4.170E+04
-4.149E+04 -5.043E+04 -4.230E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.622E+02 3.431E+02 9.518E+01 2.578E+01 2.358E+01 2.335E+01
2.247E+01 2.482E+01 2.528E+01 5.629E+01
9.399E+01 1.039E+02 1.144E+02 1.254E+02 1.149E+02 1.029E+02
1.113E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.618E+02 -8.055E+01 -1.408E+01 -1.112E+01 -1.179E+01 -1.081E+01
-1.075E+01 -1.307E+01 -1.096E+01 -4.241E+01
-4.725E+01 -5.236E+01 -5.772E+01 -6.335E+01 -4.616E+01 -5.026E+01
-5.454E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\A-
    A'\PS-10\PS10-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\PS10-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\Denali\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   8  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000015 (g)

    LAYER   ACCEL.      VELOCITY     DISPL.       STRAIN       STRESS
             (g)        (ft/sec)     (ft)          (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	27.45	.148340	27.45	.001016	27.45	.14813	.00	.00000
2	27.44	.147391	27.45	.027310	27.45	.17036	.00	.00000
3	29.26	.126074	27.45	.160437	27.45	.18447	.00	.00000
4	27.48	.217049	29.27	.239219	29.26	.19097	.00	.00000
5	27.57	.205348	29.73	.436606	29.73	.19434	.00	.00000
6	27.60	.165244	30.30	.582562	30.30	.19489	.00	.00000
7	29.73	.192732	27.95	1.131265	27.72	.19894	.00	.00000
8	29.69	.192277	27.85	.702642	27.73	.20841	.00	.00000
9	29.66	.169926	27.81	.332107	27.79	.21200	.00	.00000
10	27.26	.223879	27.67	.032831	27.67	.20278	.00	.00000
11	27.61	.152120	27.53	.048001	27.53	.18548	.00	.00000
12	27.58	.141199	27.15	.068470	27.15	.18193	.00	.00000
13	27.38	.127651	27.14	.086899	27.14	.17694	.00	.00000
14	27.14	.153733	27.11	.095627	27.11	.16792	.00	.00000
15	27.12	.150964	27.07	.113297	27.07	.16137	.00	.00000
16	27.08	.197397	27.03	.140266	27.03	.15604	.00	.00000
17	27.04	.212512	26.98	.178527	26.98	.15503	.00	.00000
18	73.51	.516801	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .312270 (g) AT TIME = 27.175 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
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                    ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
                    º  D - MOD2000  º
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                     3    33  3
                     3   33O3O3  3  3
           V1.03      ÀÄÄÅÅ×××××××ÅÅÅÄÄ┼
       GeoMotions, LLC   33O3O3  3  3
                          33  3
                            3
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A Computer Program for Seismic
Response Analyses of Horizontally
Layered Soil Deposits, Earthfill
Dams and Solid Waste Landfills
by
Neven Matasovic, 1993;`06

The following models are incorporated in this
computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic
(1993); Cyclic Degradation - PWP Generation
Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for
Composite Soil Deposits by Matasovic (1993).

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Input file name = C:\D-MOD2\Parcel-E\A-A'\Izmit\A-A_Izmit.inp
Output file name = C:\D-MOD2\Parcel-E\A-A'\Izmit\A-A_Izmit.out
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

****************************************************
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****************************************************

Hunters Point Section A-A' * Dt: 0.005

NPTYPE =  1 ;   NLINEL =  1 ;   NMAT   = 17 ;   NLAYER = 17 ;   NDAMP  =  2
ITMBY  =  1 ;   NBT    =  0 ;   NBB    =  1 ;   ITERRV =  1 ;   ICKFB  =  1

***********************************************************
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
***********************************************************

************* STRESS - STRAIN MODEL *************
```

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	932430.	186.49	1.10	.92
3	162992.	161.36	.50	1.20
4	171645.	169.93	.50	1.20
5	182023.	180.20	.50	1.20
6	208494.	206.41	.50	1.20
7	248925.	246.44	.50	1.20
8	302555.	299.53	.50	1.20
9	380742.	376.93	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	120.00	120.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	2		3.00	1.00	0
3	3	2		3.00	1.00	0
4	4	2		4.00	1.00	0
5	5	2		4.00	1.00	0
6	6	2		5.00	1.00	0
7	7	3		6.00	1.00	0
8	8	3		6.00	1.00	0
9	9	4		9.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: .977 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 234.0 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 957.7 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
5.50	606.35	500.00	.00020	.08
8.50	749.07	229.00	.00099	.08
12.00	880.56	235.00	.00099	.08
16.00	1030.84	242.00	.00099	.08
20.50	1199.91	259.00	.00099	.08
26.00	1406.54	283.00	.00099	.08
32.00	1631.96	312.00	.00099	.08
39.50	1913.74	350.00	.00099	.08
54.00	2758.50	900.00	.00040	.08
74.00	4109.90	950.00	.00040	.08
94.00	5461.30	1000.00	.00040	.08
114.00	6812.70	1050.00	.00040	.08
134.00	8164.10	1100.00	.00040	.08

159.00	9853.35	1150.00	.00040	.08
189.00	11880.45	1200.00	.00040	.08
219.00	13907.55	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+00
2	5.359E-02	2.592E-04	9.324E+05	2.416E+02	1.37E+01
3	5.359E-02	2.592E-04	1.630E+05	4.224E+01	1.03E+01
4	5.359E-02	2.592E-04	1.716E+05	4.448E+01	1.09E+01
5	5.359E-02	2.592E-04	1.820E+05	4.717E+01	1.24E+01
6	5.359E-02	2.592E-04	2.085E+05	5.403E+01	1.40E+01
7	5.359E-02	2.592E-04	2.489E+05	6.451E+01	1.71E+01
8	5.359E-02	2.592E-04	3.026E+05	7.841E+01	1.86E+01
9	5.359E-02	2.592E-04	3.807E+05	9.867E+01	2.33E+01
10	5.359E-02	2.592E-04	3.273E+06	8.482E+02	5.44E+01
11	5.359E-02	2.592E-04	3.647E+06	9.450E+02	8.08E+01
12	5.359E-02	2.592E-04	4.041E+06	1.047E+03	8.08E+01
13	5.359E-02	2.592E-04	4.455E+06	1.154E+03	8.08E+01
14	5.359E-02	2.592E-04	4.889E+06	1.267E+03	8.08E+01
15	5.359E-02	2.592E-04	5.344E+06	1.385E+03	1.01E+02
16	5.359E-02	2.592E-04	5.818E+06	1.508E+03	1.21E+02
17	5.359E-02	2.592E-04	6.313E+06	1.636E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.321E+06 3.651E+05 9.724E+04 8.842E+04 8.720E+04
8.319E+04 9.191E+04 9.273E+04 2.059E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -3.108E+05 -5.433E+04 -4.291E+04 -4.551E+04 -4.170E+04
-4.149E+04 -5.043E+04 -4.230E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.622E+02 3.431E+02 9.518E+01 2.578E+01 2.358E+01 2.335E+01
2.247E+01 2.482E+01 2.528E+01 5.629E+01
9.399E+01 1.039E+02 1.144E+02 1.254E+02 1.149E+02 1.029E+02
1.113E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.618E+02 -8.055E+01 -1.408E+01 -1.112E+01 -1.179E+01 -1.081E+01
-1.075E+01 -1.307E+01 -1.096E+01 -4.241E+01
-4.725E+01 -5.236E+01 -5.772E+01 -6.335E+01 -4.616E+01 -5.026E+01
-5.454E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     = 6112
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  =  764 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\A-
    A'\Izmit\Izmit-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\Izmit-4.acc
    SHAKE2000 Conversion:    6112      .005      6         8         9
    8f
    Acceleration Units: (g's) - No. Values: 6112 - Time Step: .005 (secs)
    Data Format: 8f9.6 - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-E\Izmit\setarget.tgt
     6116      0.0050     116


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   8  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000100 (g)

    LAYER   ACCEL.      VELOCITY     DISPL.       STRAIN       STRESS
             (g)        (ft/sec)     (ft)          (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      6    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 30.565 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	3.83	.150250	3.83	.001031	3.83	.15035	.00	.00000
2	3.83	.150443	3.83	.028475	3.83	.17359	.00	.00000
3	3.85	.148213	3.85	.202223	3.85	.20202	.00	.00000
4	3.94	.184944	3.88	.314635	3.88	.20426	.00	.00000
5	3.41	.224440	3.93	.501333	3.93	.19662	.00	.00000
6	3.44	.235432	9.52	.804191	7.44	.19533	.00	.00000
7	5.88	.254629	4.14	.607605	4.14	.19872	.00	.00000
8	3.67	.226515	4.11	.523426	4.68	.21536	.00	.00000
9	3.64	.174181	4.06	.354611	4.06	.21304	.00	.00000
10	3.63	.141367	4.00	.034294	4.00	.20783	.00	.00000
11	3.61	.139282	3.97	.053306	3.97	.19508	.00	.00000
12	3.58	.114880	3.93	.072160	3.93	.18597	.00	.00000
13	3.87	.116021	3.89	.099963	3.89	.18631	.00	.00000
14	3.51	.149909	3.87	.130801	3.87	.18672	.00	.00000
15	3.52	.154279	3.83	.181212	3.83	.18596	.00	.00000
16	3.48	.195462	3.88	.208426	3.88	.17420	.00	.00000
17	3.44	.172232	3.71	.261573	3.71	.17056	.00	.00000
18	4.46	.400249	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .313140 (g) AT TIME = 3.580 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS: 6112 *
****

Input Parameters for D-MOD2000
Cross Section B-B'
Parcel E Remedial Design
Hunters Point Naval Shipyard

Elevation of the ground surface at the DMOD-2000 Column = 6.3 ft.
Water table elevation = 1.1 ft.

Layer	Soil Description	Thickness (ft.)	Mid-Depth Elevation (ft.)	V_s (ft./sec)	Unit Weight (pcf)	G_{max} (psf)	γ_r	τ_{m0} (psf)	G/G_{max} Curve	β	s
1	Revetment	4	4.3	1000	130	4037267	0.000722	2915	Shibuya	0.36	0.4
2	Bay Mud Crust	6	-0.7	206	100	132009	0.001	132	Bay Mud	0.5	1.2
3	Bay Mud Crust	6	-6.7	226	100	159241	0.001	159	Bay Mud	0.5	1.2
4	Bay Mud	5	-12.2	244	100	185233	0.001	185	Bay Mud	0.5	1.2
5	Bay Mud	5	-17.2	265	100	218730	0.001	219	Bay Mud	0.5	1.2
6	Bay Mud	5.8	-22.6	288	100	258329	0.001	258	Bay Mud	0.5	1.2
7	Bay Mud	8	-29.5	317	100	312686	0.001	313	Bay Mud	0.5	1.2
8	Bay Mud	9.6	-38.3	354	100	388261	0.001	388	Bay Mud	0.5	1.2
9	Bay Mud	10	-48.1	397	100	489972	0.001	490	Bay Mud	0.5	1.2
10	Alluvium	20	-63.1	900	130	3270186	0.0004	1308	Sand	1.1	0.9
11	Alluvium	20	-83.1	950	130	3643634	0.0004	1457	Sand	1.1	0.9
12	Alluvium	20	-103.1	1000	130	4037267	0.0004	1615	Sand	1.1	0.9
13	Alluvium	20	-123.1	1050	130	4451087	0.0004	1780	Sand	1.1	0.9
14	Alluvium	20	-143.1	1100	130	4885093	0.0004	1954	Sand	1.1	0.9
15	Alluvium	30	-168.1	1150	130	5339286	0.0004	2136	Sand	1.1	0.9
16	Alluvium	30	-198.1	1200	130	5813665	0.0004	2325	Sand	1.1	0.9
17	Alluvium	30	-228.1	1250	130	6308230	0.0004	2523	Sand	1.1	0.9

H = **249.4** ft. $(V_s)_{avg}$ = **917** ft./sec T = **1.088** sec

n	ξ (%)	α_R	β_R
5	0.5	**0.04813**	**0.000289**

σ_v at the failure surface = 3300 psf

```
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º  D - MOD2000  º
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V1.03      ÀÄÄÅÅ×××××××ÅÅÅÄÄ┼
GeoMotions, LLC   ³³O³O³  ³  ³
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A Computer Program for Seismic
Response Analyses of Horizontally
Layered Soil Deposits, Earthfill
Dams and Solid Waste Landfills
by
Neven Matasovic, 1993;`06

The following models are incorporated in this
computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic
(1993); Cyclic Degradation - PWP Generation
Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for
Composite Soil Deposits by Matasovic (1993).

ÄÄÄ
Input file name = C:\D-MOD2\Parcel-E\B-B'\TCU076\B-B_TCU076.inp
Output file name = C:\D-MOD2\Parcel-E\B-B'\TCU076\B-B_TCU076.out
ÄÄÄ

****
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****

Hunters Point Section B-B' * Dt: 0.005

```
NPTYPE =  1 ;   NLINEL =  1 ;   NMAT   = 17 ;   NLAYER = 17 ;   NDAMP  =  2
ITMBY  =  1 ;   NBT    =  0 ;   NBB    =  1 ;   ITERRV =  1 ;   ICKFB  =  1
```

****
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
****

************* STRESS - STRAIN MODEL *************

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	131895.	130.58	.50	1.20
3	158749.	157.16	.50	1.20
4	185044.	183.19	.50	1.20
5	218266.	216.08	.50	1.20
6	257798.	255.22	.50	1.20
7	312330.	309.21	.50	1.20
8	389495.	385.60	.50	1.20
9	489865.	484.97	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	3		6.00	1.00	0
3	3	3		6.00	1.00	0
4	4	4		5.00	1.00	0
5	5	4		5.00	1.00	0
6	6	3		5.80	1.00	0
7	7	3		8.00	1.00	0
8	8	4		9.60	1.00	0
9	9	4		10.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: 1.088 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 249.4 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 917.0 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
7.00	632.71	206.00	.00099	.08
13.00	858.13	226.00	.00099	.08
18.50	1064.77	244.00	.00099	.08
23.50	1252.61	265.00	.00099	.08
28.90	1455.49	288.00	.00099	.08
35.80	1714.73	317.00	.00099	.08
44.60	2045.34	354.00	.00099	.08
54.40	2413.53	397.00	.00099	.08
69.40	3277.08	900.00	.00040	.08
89.40	4628.48	950.00	.00040	.08
109.40	5979.88	1000.00	.00040	.08
129.40	7331.28	1050.00	.00040	.08
149.40	8682.68	1100.00	.00040	.08

174.40	10371.93	1150.00	.00040	.08
204.40	12399.03	1200.00	.00040	.08
234.40	14426.13	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+00
2	4.812E-02	2.886E-04	1.319E+05	3.807E+01	1.74E+01
3	4.812E-02	2.886E-04	1.587E+05	4.582E+01	1.86E+01
4	4.812E-02	2.886E-04	1.850E+05	5.340E+01	1.71E+01
5	4.812E-02	2.886E-04	2.183E+05	6.299E+01	1.55E+01
6	4.812E-02	2.886E-04	2.578E+05	7.440E+01	1.68E+01
7	4.812E-02	2.886E-04	3.123E+05	9.014E+01	2.14E+01
8	4.812E-02	2.886E-04	3.895E+05	1.124E+02	2.74E+01
9	4.812E-02	2.886E-04	4.899E+05	1.414E+02	3.05E+01
10	4.812E-02	2.886E-04	3.273E+06	9.445E+02	5.59E+01
11	4.812E-02	2.886E-04	3.647E+06	1.052E+03	8.08E+01
12	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+01
13	4.812E-02	2.886E-04	4.455E+06	1.286E+03	8.08E+01
14	4.812E-02	2.886E-04	4.889E+06	1.411E+03	8.08E+01
15	4.812E-02	2.886E-04	5.344E+06	1.542E+03	1.01E+02
16	4.812E-02	2.886E-04	5.818E+06	1.679E+03	1.21E+02
17	4.812E-02	2.886E-04	6.313E+06	1.822E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.032E+06 4.844E+04 6.347E+04 8.066E+04 8.810E+04
8.349E+04 7.961E+04 8.956E+04 2.126E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -2.198E+04 -2.646E+04 -3.701E+04 -4.365E+04 -4.445E+04
-3.904E+04 -4.057E+04 -4.899E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.919E+02 2.987E+02 1.488E+01 1.914E+01 2.403E+01 2.623E+01
2.513E+01 2.429E+01 2.731E+01 6.406E+01
1.037E+02 1.148E+02 1.265E+02 1.387E+02 1.268E+02 1.132E+02
1.225E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.915E+02 -6.344E+00 -7.636E+00 -1.068E+01 -1.260E+01 -1.283E+01
-1.127E+01 -1.171E+01 -1.414E+01 -4.723E+01
-5.262E+01 -5.831E+01 -6.428E+01 -7.055E+01 -5.141E+01 -5.597E+01
-6.073E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\B-
    B'\TCU076\TCU076-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\TCU076-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\TCU076\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   5  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000003 (g)

    LAYER   ACCEL.     VELOCITY     DISPL.      STRAIN      STRESS
             (g)       (ft/sec)     (ft)         (%)        (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	31.89	.147126	31.89	.001009	31.89	.14715	.00	.00000
2	31.89	.146261	31.89	.190271	31.89	.18932	.00	.00000
3	33.06	.167774	29.88	.327141	29.88	.19532	.00	.00000
4	28.88	.216407	34.35	.711975	34.29	.19536	.00	.00000
5	29.88	.221225	49.24	.620817	49.24	.19574	.00	.00000
6	29.84	.229394	53.95	.620276	53.95	.19896	.00	.00000
7	33.08	.181046	28.62	.697045	28.59	.20476	.00	.00000
8	25.70	.181642	28.56	.539669	28.56	.21294	.00	.00000
9	31.62	.170546	28.50	.358248	28.50	.21770	.00	.00000
10	44.06	.165475	28.40	.043745	28.40	.19928	.00	.00000
11	44.10	.117194	28.37	.065421	28.37	.19000	.00	.00000
12	29.43	.110567	28.33	.085610	28.33	.18180	.00	.00000
13	29.40	.133428	28.37	.095076	28.37	.17003	.00	.00000
14	31.48	.144941	28.34	.102081	28.34	.16163	.00	.00000
15	29.35	.127170	28.37	.111923	28.36	.15370	.00	.00000
16	32.83	.174667	28.35	.117094	28.35	.14118	.00	.00000
17	34.61	.171507	28.30	.152069	28.30	.14284	.00	.00000
18	43.02	1.176362	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .311199 (g) AT TIME = 34.595 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
****

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º D - MOD2000 º
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V1.03
GeoMotions, LLC

A Computer Program for Seismic Response Analyses of Horizontally Layered Soil Deposits, Earthfill Dams and Solid Waste Landfills

by

Neven Matasovic, 1993;`06

The following models are incorporated in this computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic (1993); Cyclic Degradation - PWP Generation Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for Composite Soil Deposits by Matasovic (1993).

Input file name = C:\D-MOD2\Parcel-E\B-B'\TCU051\B-B_TCU051.inp
Output file name = C:\D-MOD2\Parcel-E\B-B'\TCU051\B-B_TCU051.out

****
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****

Hunters Point Section B-B' * Dt: 0.005

NPTYPE = 1 ; NLINEL = 1 ; NMAT = 17 ; NLAYER = 17 ; NDAMP = 2
ITMBY = 1 ; NBT = 0 ; NBB = 1 ; ITERRV = 1 ; ICKFB = 1

****
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
****

********** STRESS - STRAIN MODEL **********

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	131895.	130.58	.50	1.20
3	158749.	157.16	.50	1.20
4	185044.	183.19	.50	1.20
5	218266.	216.08	.50	1.20
6	257798.	255.22	.50	1.20
7	312330.	309.21	.50	1.20
8	389495.	385.60	.50	1.20
9	489865.	484.97	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	3		6.00	1.00	0
3	3	3		6.00	1.00	0
4	4	4		5.00	1.00	0
5	5	4		5.00	1.00	0
6	6	3		5.80	1.00	0
7	7	3		8.00	1.00	0
8	8	4		9.60	1.00	0
9	9	4		10.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: 1.088 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 249.4 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 917.0 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
7.00	632.71	206.00	.00099	.08
13.00	858.13	226.00	.00099	.08
18.50	1064.77	244.00	.00099	.08
23.50	1252.61	265.00	.00099	.08
28.90	1455.49	288.00	.00099	.08
35.80	1714.73	317.00	.00099	.08
44.60	2045.34	354.00	.00099	.08
54.40	2413.53	397.00	.00099	.08
69.40	3277.08	900.00	.00040	.08
89.40	4628.48	950.00	.00040	.08
109.40	5979.88	1000.00	.00040	.08
129.40	7331.28	1050.00	.00040	.08
149.40	8682.68	1100.00	.00040	.08

174.40	10371.93	1150.00	.00040	.08
204.40	12399.03	1200.00	.00040	.08
234.40	14426.13	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+00
2	4.812E-02	2.886E-04	1.319E+05	3.807E+01	1.74E+01
3	4.812E-02	2.886E-04	1.587E+05	4.582E+01	1.86E+01
4	4.812E-02	2.886E-04	1.850E+05	5.340E+01	1.71E+01
5	4.812E-02	2.886E-04	2.183E+05	6.299E+01	1.55E+01
6	4.812E-02	2.886E-04	2.578E+05	7.440E+01	1.68E+01
7	4.812E-02	2.886E-04	3.123E+05	9.014E+01	2.14E+01
8	4.812E-02	2.886E-04	3.895E+05	1.124E+02	2.74E+01
9	4.812E-02	2.886E-04	4.899E+05	1.414E+02	3.05E+01
10	4.812E-02	2.886E-04	3.273E+06	9.445E+02	5.59E+01
11	4.812E-02	2.886E-04	3.647E+06	1.052E+03	8.08E+01
12	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+01
13	4.812E-02	2.886E-04	4.455E+06	1.286E+03	8.08E+01
14	4.812E-02	2.886E-04	4.889E+06	1.411E+03	8.08E+01
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16	4.812E-02	2.886E-04	5.818E+06	1.679E+03	1.21E+02
17	4.812E-02	2.886E-04	6.313E+06	1.822E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.032E+06 4.844E+04 6.347E+04 8.066E+04 8.810E+04
8.349E+04 7.961E+04 8.956E+04 2.126E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -2.198E+04 -2.646E+04 -3.701E+04 -4.365E+04 -4.445E+04
-3.904E+04 -4.057E+04 -4.899E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.919E+02 2.987E+02 1.488E+01 1.914E+01 2.403E+01 2.623E+01
2.513E+01 2.429E+01 2.731E+01 6.406E+01
1.037E+02 1.148E+02 1.265E+02 1.387E+02 1.268E+02 1.132E+02
1.225E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.915E+02 -6.344E+00 -7.636E+00 -1.068E+01 -1.260E+01 -1.283E+01
-1.127E+01 -1.171E+01 -1.414E+01 -4.723E+01
-5.262E+01 -5.831E+01 -6.428E+01 -7.055E+01 -5.141E+01 -5.597E+01
-6.073E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\B-
    B'\TCU051\TCU051-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\TCU051-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\TCU051\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   5  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. =  .000825 (g)

    LAYER   ACCEL.      VELOCITY     DISPL.       STRAIN       STRESS
             (g)        (ft/sec)     (ft)          (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	36.24	.175858	36.24	.001210	36.24	.17571	.00	.00000
2	36.24	.174145	36.24	.365801	36.24	.22432	.00	.00000
3	36.26	.263306	47.94	.486728	47.94	.20556	.00	.00000
4	36.22	.501406	48.00	1.167016	36.17	.19636	.00	.00000
5	36.18	.857668	35.58	2.642956	34.44	.19588	.00	.00000
6	36.18	.899581	35.46	.966409	35.17	.19941	.00	.00000
7	36.22	.596258	35.43	.547248	35.43	.20381	.00	.00000
8	36.26	.440196	35.38	.417766	35.38	.20859	.00	.00000
9	36.30	.309301	35.33	.297904	35.33	.21028	.00	.00000
10	36.77	.175740	32.20	.041969	32.20	.19508	.00	.00000
11	34.92	.124542	32.15	.059025	32.15	.18157	.00	.00000
12	36.78	.125989	32.17	.077227	32.17	.17461	.00	.00000
13	36.76	.163545	50.19	.089409	50.19	.16620	.00	.00000
14	36.66	.171801	50.17	.092344	50.17	.15588	.00	.00000
15	36.63	.168074	50.13	.101258	50.13	.14747	.00	.00000
16	36.61	.202376	50.10	.117547	50.10	.14136	.00	.00000
17	36.57	.233619	50.06	.120873	50.06	.13304	.00	.00000
18	51.77	4.875661	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .319920 (g) AT TIME = 36.455 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
****

D - MOD2000

V1.03

GeoMotions, LLC

A Computer Program for Seismic Response Analyses of Horizontally Layered Soil Deposits, Earthfill Dams and Solid Waste Landfills

by

Neven Matasovic, 1993;`06

The following models are incorporated in this computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic (1993); Cyclic Degradation - PWP Generation Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for Composite Soil Deposits by Matasovic (1993).

Input file name = C:\D-MOD2\Parcel-E\B-B'\PS-10\B-B_PS-10.inp
Output file name = C:\D-MOD2\Parcel-E\B-B'\PS-10\B-B_PS-10.out

****
* PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES *
****

Hunters Point Section B-B' * Dt: 0.005

NPTYPE = 1 ; NLINEL = 1 ; NMAT = 17 ; NLAYER = 17 ; NDAMP = 2
ITMBY = 1 ; NBT = 0 ; NBB = 1 ; ITERRV = 1 ; ICKFB = 1

****
* MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS *
****

********** STRESS - STRAIN MODEL **********

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	131895.	130.58	.50	1.20
3	158749.	157.16	.50	1.20
4	185044.	183.19	.50	1.20
5	218266.	216.08	.50	1.20
6	257798.	255.22	.50	1.20
7	312330.	309.21	.50	1.20
8	389495.	385.60	.50	1.20
9	489865.	484.97	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	3		6.00	1.00	0
3	3	3		6.00	1.00	0
4	4	4		5.00	1.00	0
5	5	4		5.00	1.00	0
6	6	3		5.80	1.00	0
7	7	3		8.00	1.00	0
8	8	4		9.60	1.00	0
9	9	4		10.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: 1.088 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 249.4 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 917.0 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
7.00	632.71	206.00	.00099	.08
13.00	858.13	226.00	.00099	.08
18.50	1064.77	244.00	.00099	.08
23.50	1252.61	265.00	.00099	.08
28.90	1455.49	288.00	.00099	.08
35.80	1714.73	317.00	.00099	.08
44.60	2045.34	354.00	.00099	.08
54.40	2413.53	397.00	.00099	.08
69.40	3277.08	900.00	.00040	.08
89.40	4628.48	950.00	.00040	.08
109.40	5979.88	1000.00	.00040	.08
129.40	7331.28	1050.00	.00040	.08
149.40	8682.68	1100.00	.00040	.08

174.40	10371.93	1150.00	.00040	.08
204.40	12399.03	1200.00	.00040	.08
234.40	14426.13	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
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SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

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(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

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8.349E+04 7.961E+04 8.956E+04 2.126E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -2.198E+04 -2.646E+04 -3.701E+04 -4.365E+04 -4.445E+04
-3.904E+04 -4.057E+04 -4.899E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.919E+02 2.987E+02 1.488E+01 1.914E+01 2.403E+01 2.623E+01
2.513E+01 2.429E+01 2.731E+01 6.406E+01
1.037E+02 1.148E+02 1.265E+02 1.387E+02 1.268E+02 1.132E+02
1.225E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.915E+02 -6.344E+00 -7.636E+00 -1.068E+01 -1.260E+01 -1.283E+01
-1.127E+01 -1.171E+01 -1.414E+01 -4.723E+01
-5.262E+01 -5.831E+01 -6.428E+01 -7.055E+01 -5.141E+01 -5.597E+01
-6.073E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     =18000
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  = 2250 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\B-
    B'\PS-10\PS10-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\PS10-4.acc
    SHAKE2000 Conversion:    18000     .005      6         8         9
    (8
    Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
    Data Format: (8f9.6) - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-
      E\Denali\setarget.tgt
    18000      0.0050       0


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   5  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000015 (g)

    LAYER   ACCEL.     VELOCITY     DISPL.      STRAIN      STRESS
             (g)       (ft/sec)     (ft)         (%)        (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

6	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 90.005 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	27.76	.145598	27.76	.000995	27.76	.14527	.00	.00000
2	27.77	.144450	27.77	.181958	27.77	.18612	.00	.00000
3	29.41	.140957	29.74	.266216	29.74	.18664	.00	.00000
4	29.37	.178475	30.38	.543988	30.38	.19441	.00	.00000
5	29.28	.177823	30.33	.797050	30.27	.19626	.00	.00000
6	29.75	.160279	30.32	1.510032	27.80	.19911	.00	.00000
7	27.37	.151266	27.95	.662138	27.95	.20475	.00	.00000
8	27.34	.160280	27.91	.333294	27.91	.20175	.00	.00000
9	27.31	.189122	27.85	.236448	27.85	.19820	.00	.00000
10	27.28	.236589	27.20	.041494	27.20	.19393	.00	.00000
11	27.42	.119277	27.18	.064399	27.18	.18871	.00	.00000
12	27.57	.161698	27.16	.084305	27.16	.18073	.00	.00000
13	27.55	.144467	27.14	.094027	27.14	.16934	.00	.00000
14	27.15	.167337	27.11	.099716	27.11	.16029	.00	.00000
15	27.12	.150084	27.07	.115490	27.07	.15429	.00	.00000
16	27.08	.193872	27.03	.142211	27.03	.15014	.00	.00000
17	27.04	.211214	27.96	.174978	27.96	.14864	.00	.00000
18	53.63	.607463	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .312270 (g) AT TIME = 27.175 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS:18000 *
****

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                    º  D - MOD2000  º
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                          3
                       3    33 3
                       3   33o3o3 3 3
              V1.03        ÀÄÅÅ××××××ÅÅÄÄ┼
        GeoMotions, LLC    33o3o3 3 3
                             33 3
                              3
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A Computer Program for Seismic Response Analyses of Horizontally Layered Soil Deposits, Earthfill Dams and Solid Waste Landfills

by

Neven Matasovic, 1993;`06

The following models are incorporated in this computer program:
Dynamic Response Model by Lee & Finn (1978);
Stress-Strain Model by Matasovic and Vucetic (1993); Cyclic Degradation - PWP Generation Model for Clay by Matasovic & Vucetic (1995);
PWP Model for Sand by Vucetic & Dobry (1988);
PWP Dissipation-PWP Redistribution Model for Composite Soil Deposits by Matasovic (1993).

Input file name = C:\D-MOD2\Parcel-E\B-B'\Izmit\B-B_Izmit.inp
Output file name = C:\D-MOD2\Parcel-E\B-B'\Izmit\B-B_Izmit.out

****
*** PROBLEM DESCRIPTION & ANALYSIS CONTROL VARIABLES ***
****

Hunters Point Section B-B' * Dt: 0.005

NPTYPE = 1 ; NLINEL = 1 ; NMAT = 17 ; NLAYER = 17 ; NDAMP = 2
ITMBY = 1 ; NBT = 0 ; NBB = 1 ; ITERRV = 1 ; ICKFB = 1

****
*** MATERIAL PROPERTIES & PARAMETERS OF CONSTITUTIVE MODELS ***
****

*************** STRESS - STRAIN MODEL **************

LAYER	G_mo (psf)	T_mo (psf)	á (-)	s (-)
1	4040530.	2917.26	.36	.40
2	131895.	130.58	.50	1.20
3	158749.	157.16	.50	1.20
4	185044.	183.19	.50	1.20
5	218266.	216.08	.50	1.20
6	257798.	255.22	.50	1.20
7	312330.	309.21	.50	1.20
8	389495.	385.60	.50	1.20
9	489865.	484.97	.50	1.20
10	3272829.	1309.13	1.10	.90
11	3646578.	1458.63	1.10	.90
12	4040530.	1616.21	1.10	.90

13	4454684.	1781.87	1.10	.90
14	4889041.	1955.62	1.10	.90
15	5343601.	2137.44	1.10	.90
16	5818362.	2327.34	1.10	.90
17	6313328.	2525.33	1.10	.90

****** PWP DISSIPATION MODEL ****** *** PHYSICAL PROPERTIES OF SOIL ***

LAYER	E_r (psf)	K_2 (-)	m (-)	n (-)	UW_sat (pcf)	UW_wet (pcf)	k (ft/sec)
1	0.000E+00	.0000	.00	.00	130.00	130.00	1.000E+01
2	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
3	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
4	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
5	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
6	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
7	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
8	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
9	0.000E+00	.0000	.00	.00	100.00	100.00	0.000E+00
10	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
11	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
12	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
13	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
14	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
15	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
16	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00
17	0.000E+00	.0000	.00	.00	130.00	130.00	0.000E+00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 1 ****

LAYER	ç_tv (%)	f (-)	p (-)	F (-)	s (-)	v (-)
1	.000	.000	.000	.000	.000	1.00
2	.000	.000	.000	.000	.000	.00
3	.000	.000	.000	.000	.000	.00
4	.000	.000	.000	.000	.000	.00
5	.000	.000	.000	.000	.000	.00
6	.000	.000	.000	.000	.000	.00
7	.000	.000	.000	.000	.000	.00
8	.000	.000	.000	.000	.000	.00
9	.000	.000	.000	.000	.000	1.00
10	.000	.000	.000	.000	.000	.00
11	.000	.000	.000	.000	.000	.00
12	.000	.000	.000	.000	.000	.00
13	.000	.000	.000	.000	.000	.00
14	.000	.000	.000	.000	.000	.00
15	.000	.000	.000	.000	.000	.00
16	.000	.000	.000	.000	.000	.00
17	.000	.000	.000	.000	.000	.00

**** PORE WATER PRESSURE (DEGRADATION) MODEL 2 ****

LAYER	OCR (-)	s_t (-)	r_t (-)	A (-)	B (-)	C (-)	D (-)
1	.00	.000	.000	.0000	.0000	.0000	.0000
2	.00	.000	.000	.0000	.0000	.0000	.0000
3	.00	.000	.000	.0000	.0000	.0000	.0000
4	.00	.000	.000	.0000	.0000	.0000	.0000
5	.00	.000	.000	.0000	.0000	.0000	.0000
6	.00	.000	.000	.0000	.0000	.0000	.0000
7	.00	.000	.000	.0000	.0000	.0000	.0000
8	.00	.000	.000	.0000	.0000	.0000	.0000
9	.00	.000	.000	.0000	.0000	.0000	.0000

10	.00	.000	.000	.0000	.0000	.0000	.0000
11	.00	.000	.000	.0000	.0000	.0000	.0000
12	.00	.000	.000	.0000	.0000	.0000	.0000
13	.00	.000	.000	.0000	.0000	.0000	.0000
14	.00	.000	.000	.0000	.0000	.0000	.0000
15	.00	.000	.000	.0000	.0000	.0000	.0000
16	.00	.000	.000	.0000	.0000	.0000	.0000
17	.00	.000	.000	.0000	.0000	.0000	.0000

****
* PROFILE GEOMETRY & FLAGS ON PWP (DEGRADATION) MODEL(S) TO BE ACTIVATED *
****

LAYER	MAT.	TYPE	NSUBDIV	THICK (ft)	WIDTH (ft)	MODEL(S)
1	1	2		4.00	1.00	0
2	2	3		6.00	1.00	0
3	3	3		6.00	1.00	0
4	4	4		5.00	1.00	0
5	5	4		5.00	1.00	0
6	6	3		5.80	1.00	0
7	7	3		8.00	1.00	0
8	8	4		9.60	1.00	0
9	9	4		10.00	1.00	0
10	10	8		20.00	1.00	0
11	11	8		20.00	1.00	0
12	12	8		20.00	1.00	0
13	13	8		20.00	1.00	0
14	14	10		20.00	1.00	0
15	15	10		30.00	1.00	0
16	16	10		30.00	1.00	0
17	17	10		30.00	1.00	0

** PROPERTIES OF THE VISCO-ELASTIC HALF-SPACE **
UNIT WEIGHT OF BASE, UW = 145. (pcf)
SHEAR WAVE VELOCITY, V_s = 3500. (ft/sec)

****
* INITIAL CONDITIONS *
****

** FUNDAMENTAL PERIOD OF THE DEPOSIT IS: 1.088 sec
TOTAL THICKNESS OF THE DEPOSIT IS: 249.4 ft
WT. AVERAGE SHEAR WAVE VELOCITY IS: 917.0 ft/sec)

DEPTH (ft)	å`vo (psf)	V_s (ft/sec)	REF. STRAIN (-)	c (%)
2.00	260.00	1000.00	.00072	.08
7.00	632.71	206.00	.00099	.08
13.00	858.13	226.00	.00099	.08
18.50	1064.77	244.00	.00099	.08
23.50	1252.61	265.00	.00099	.08
28.90	1455.49	288.00	.00099	.08
35.80	1714.73	317.00	.00099	.08
44.60	2045.34	354.00	.00099	.08
54.40	2413.53	397.00	.00099	.08
69.40	3277.08	900.00	.00040	.08
89.40	4628.48	950.00	.00040	.08
109.40	5979.88	1000.00	.00040	.08
129.40	7331.28	1050.00	.00040	.08
149.40	8682.68	1100.00	.00040	.08

174.40	10371.93	1150.00	.00040	.08
204.40	12399.03	1200.00	.00040	.08
234.40	14426.13	1250.00	.00040	.08

** NORMAL EFFECTIVE STRESS (å`vo) IS CALCULATED IN LAYER MIDHEIGHTS
VISCOUS DAMPING COEFFICIENT (c) IS CALCULATED FROM á_R ONLY
SHEAR WAVE VELOCITY (V_s) IS CALCUALTED FROM G_mo AND UW_sat

****
* INITIAL PROPERTIES OF THE DYNAMIC RESPONSE MODEL *
****

LAYER	à_R (-)	á_R (-)	{k} (psf)	{c} (-)	{m} (lb sý/ftýft)
1	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+00
2	4.812E-02	2.886E-04	1.319E+05	3.807E+01	1.74E+01
3	4.812E-02	2.886E-04	1.587E+05	4.582E+01	1.86E+01
4	4.812E-02	2.886E-04	1.850E+05	5.340E+01	1.71E+01
5	4.812E-02	2.886E-04	2.183E+05	6.299E+01	1.55E+01
6	4.812E-02	2.886E-04	2.578E+05	7.440E+01	1.68E+01
7	4.812E-02	2.886E-04	3.123E+05	9.014E+01	2.14E+01
8	4.812E-02	2.886E-04	3.895E+05	1.124E+02	2.74E+01
9	4.812E-02	2.886E-04	4.899E+05	1.414E+02	3.05E+01
10	4.812E-02	2.886E-04	3.273E+06	9.445E+02	5.59E+01
11	4.812E-02	2.886E-04	3.647E+06	1.052E+03	8.08E+01
12	4.812E-02	2.886E-04	4.041E+06	1.166E+03	8.08E+01
13	4.812E-02	2.886E-04	4.455E+06	1.286E+03	8.08E+01
14	4.812E-02	2.886E-04	4.889E+06	1.411E+03	8.08E+01
15	4.812E-02	2.886E-04	5.344E+06	1.542E+03	1.01E+02
16	4.812E-02	2.886E-04	5.818E+06	1.679E+03	1.21E+02
17	4.812E-02	2.886E-04	6.313E+06	1.822E+03	1.21E+02

(N+1)TH MASS FOR TRANSMITTING BOUNDARY = 6.061E+01

** INITIAL STIFFNESS MATRIX, [K] **

DIAGONAL TERMS:
1.010E+06 1.032E+06 4.844E+04 6.347E+04 8.066E+04 8.810E+04
8.349E+04 7.961E+04 8.956E+04 2.126E+05
3.460E+05 3.844E+05 4.248E+05 4.672E+05 4.226E+05 3.721E+05
4.044E+05 2.104E+05

OFF-DIAGONAL TERMS:
-1.010E+06 -2.198E+04 -2.646E+04 -3.701E+04 -4.365E+04 -4.445E+04
-3.904E+04 -4.057E+04 -4.899E+04 -1.636E+05
-1.823E+05 -2.020E+05 -2.227E+05 -2.445E+05 -1.781E+05 -1.939E+05
-2.104E+05

** INITIAL DAMPING MATRIX, [C] **

DIAGONAL TERMS:
2.919E+02 2.987E+02 1.488E+01 1.914E+01 2.403E+01 2.623E+01
2.513E+01 2.429E+01 2.731E+01 6.406E+01
1.037E+02 1.148E+02 1.265E+02 1.387E+02 1.268E+02 1.132E+02
1.225E+02 1.583E+04

OFF-DIAGONAL TERMS:
-2.915E+02 -6.344E+00 -7.636E+00 -1.068E+01 -1.260E+01 -1.283E+01
-1.127E+01 -1.171E+01 -1.414E+01 -4.723E+01
-5.262E+01 -5.831E+01 -6.428E+01 -7.055E+01 -5.141E+01 -5.597E+01
-6.073E+01

```
 ****************************************************
 * DYNAMIC EXCITATION INPUT - FLAGS AND CONTROL  DATA *
 ****************************************************

 ** CONTROL FLAGS FOR DYNAMIC RESPONSE CALCULATION **
    NEQ    =    1 ;   INTYP  =    1 ;   NC     = 6112
    NCPR   =    1 ;   NCPRM  =    1 ;   NPLD   =    2

 ** CONTROL  DATA OF THE ACCELERATION TIME HISTORY **
    NCARD  =  764 ;   NREC   =    8 ;   NFTS   =    0

    INPUT ACC. VALUES ARE MULTIPLIED BY:     1.000000
    ACCELERATION VALUES ARE DIGITIZED @:   .005 (sec)
    ACCELERATION VALUES  ARE  READ FROM: C:\D-MOD2\Parcel-E\B-
    B'\Izmit\Izmit-4.eq

 ** ACCELEROGRAM HEADER:

    Source File: C:\D-MOD2\Parcel-E\Time Histories\Izmit-4.acc
    SHAKE2000 Conversion:    6112      .005      6         8         9
    8f
    Acceleration Units: (g's) - No. Values: 6112 - Time Step: .005 (secs)
    Data Format: 8f9.6 - No. Header Lines:  6
      Time history matched to spectrum:C:\RspMatch\Parcel-E\Izmit\setarget.tgt
     6116      0.0050     116


 ****************************************************
 * DYNAMIC RESPONSE OF THE MODEL - SELECTED RESULTS *
 ****************************************************


 ** TIME-DEPENDANT RESULTS FOR LAYER i =   6  ARE STORED IN THE FOLLOWING
 FILES:

    FILE NAME:     CONTENTS:                                UNITS:

    i-plot1.prn    Time axis                                 (sec)
                   Acceleration in layer "i"                   (g)
                   Shear strain in layer "i"                   (%)
                   Norm. shear stress in layer "i"             (-)
                   Norm. PWP in layer "i"                      (-)
                   Degrad. index in layer "i" (clay only)      (-)

    i-plot2.prn    Time axis                                 (sec)
                   (Scaled) base (input) acceleration          (g)
                   Surface accel. (same as in layer i = 1)     (g)
                   Velocity in layer "i"                  (ft/sec)
                   Displacement in layer "i"                  (ft)
                   Shear stress in layer "i"                 (psf)


 ** RESULTS AT TIME =   .005 (sec), WHEN INPUT ACC. = -.000100 (g)

    LAYER   ACCEL.     VELOCITY     DISPL.      STRAIN      STRESS
             (g)       (ft/sec)     (ft)         (%)         (psf)

      1    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      2    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      3    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      4    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      5    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
      6    .000000    0.000E+00   0.000E+00   0.000E+00   0.000E+00
```

7	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
11	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
13	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
14	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
15	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
17	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
18	.000000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

** DISPLACEMENTS ARE REFERRED TO THE TOP OF THE LAYER
EVERYTHING ELSE IS REF. TO THE CENTER OF THE LAYER

** "STRAIN" & "STRESS" REFER TO THE SHEAR STRAIN & SHEAR STRESS, RESPECTIVELY
"NORM." REFERS TO NORMALIZATION BY INITIAL VERTICAL EFFECTIVE STRESS, å`vo
NOTE THAT "NORM. STRESS" EQUALS TO THE AVERAGE ACCELERATION (IN g UNITS)
IN A TOTAL STRESS ANALYSIS.

****
* MAXIMUM VALUES OCCURRED FROM .000 TO 30.565 sec *
****

LAYER	TIME (sec)	³ACC.³ (g)	TIME (sec)	STRAIN (%)	TIME (sec)	NORM. STRESS (-)	TIME (sec)	NORM. PWP (-)
1	3.92	.164006	3.92	.001127	3.92	.16390	.00	.00000
2	3.93	.163763	3.93	.276009	3.93	.21222	.00	.00000
3	5.68	.196795	3.98	.397800	3.98	.20143	.00	.00000
4	8.23	.233592	7.49	.621157	7.49	.19523	.00	.00000
5	8.20	.218723	7.53	.776719	7.34	.19624	.00	.00000
6	3.72	.197898	7.55	.632089	7.52	.20137	.00	.00000
7	3.69	.152559	4.77	.408863	4.77	.19901	.00	.00000
8	8.13	.179695	4.11	.313126	4.11	.19936	.00	.00000
9	5.64	.164509	4.07	.261967	4.07	.20393	.00	.00000
10	3.63	.156493	4.02	.044350	4.02	.20068	.00	.00000
11	3.60	.114770	4.01	.070967	4.00	.19665	.00	.00000
12	3.25	.116818	3.98	.102203	3.98	.19404	.00	.00000
13	3.54	.137026	3.94	.123923	3.94	.18622	.00	.00000
14	3.52	.132680	3.88	.148989	3.88	.18268	.00	.00000
15	3.51	.141446	3.84	.186251	3.84	.17797	.00	.00000
16	3.48	.168352	3.88	.218301	3.88	.16887	.00	.00000
17	7.38	.162670	3.71	.278424	3.71	.16677	.00	.00000
18	8.18	.581072	.00	.000000	.00	.00000	.00	.00000

** MAX ³VALUE³ OF BASE (input) ACC = .313140 (g) AT TIME = 3.580 (sec) **

****
* N O R M A L T E R M I N A T I O N *
* NUMBER OF INCREMENTAL CALCULATIONS: 6112 *
****

Attachment F9
Results of DISPLMT Analyses

(This attachment is provided on CD only)

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section A-A', Perm. Displ., TCU076.acc

 YIELD ACCELERATION =  0.0530

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000
  A max =  0.09242    Acc Factor =  1.00000         Static F.S.=  1.520


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.42264 Ft/S      Dfinal =  0.65588 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.37379 Ft/S      Dfinal =  0.56298 Ft

 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.42264                 0.65588
                      0.39821                      0.60943
  2       0.37379                 0.56298


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section A-A', Perm. Displ., TCU051.acc

 YIELD ACCELERATION =  0.0530

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000

  A max =  0.09228    Acc Factor =  1.00000         Static F.S.=  1.520


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.44844 Ft/S      Dfinal =  0.58385 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.31132 Ft/S      Dfinal =  0.57634 Ft


 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.44844                 0.58385
                      0.37988                     0.58009
  2       0.31132                 0.57634


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section A-A', Perm. Displ., PS-10.acc

 YIELD ACCELERATION =  0.0530

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000
  A max =  0.09242    Acc Factor =  1.00000         Static F.S.=  1.520


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.61978 Ft/S      Dfinal =  0.63858 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.18488 Ft/S      Dfinal =  0.24495 Ft

 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.61978                 0.63858
                      0.40233                     0.44177
  2       0.18488                 0.24495


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********
```

HPNS, Parcel E Remedial Deign, Section A-A', Perm. Displ., Izmit.acc

YIELD ACCELERATION = 0.0530

DT = 0.0050 ACCN DUE GRAVITY = 32.200 NLINES = 6112

A max = 0.09550 Acc Factor = 1.00000 Static F.S.= 1.520

*** COMPUTATION WITH ORIGINAL RECORD ***

Vmax = 0.35795 Ft/S Dfinal = 0.30667 Ft

*** COMPUTATION WITH REVERSED RECORD ***

Vmax = 0.31794 Ft/S Dfinal = 0.20950 Ft

** SUMMARY OF RESULTS **

RUN	V max Ft/S	V ave Ft/S	D final Ft	D final ave Ft
1	0.35795	0.33794	0.30667	0.25809
2	0.31794		0.20950	

*** PROGRAM TERMINATED ***

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section B-B', Perm. Displ., TCU076.acc

 YIELD ACCELERATION =  0.0500

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000
  A max =  0.07430    Acc Factor =  1.00000         Static F.S.=  1.500


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.28746 Ft/S      Dfinal =  0.40415 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.23914 Ft/S      Dfinal =  0.35954 Ft

 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.28746                 0.40415
                      0.26330                     0.38185
  2       0.23914                 0.35954


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section B-B', Perm. Displ., TCU051.acc

 YIELD ACCELERATION =  0.0500

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000
  A max =  0.07435    Acc Factor =  1.00000         Static F.S.=  1.500


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.30810 Ft/S      Dfinal =  0.41490 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.22332 Ft/S      Dfinal =  0.40859 Ft

 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.30810                 0.41490
                      0.26571                     0.41174
  2       0.22332                 0.40859


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********


HPNS, Parcel E Remedial Deign, Section B-B', Perm. Displ., PS-10.acc

 YIELD ACCELERATION =  0.0500

 DT = 0.0050    ACCN DUE GRAVITY =   32.200    NLINES =18000

  A max =  0.07449    Acc Factor =  1.00000         Static F.S.=  1.500


 *** COMPUTATION WITH ORIGINAL RECORD ***

Vmax =  0.45813 Ft/S      Dfinal =  0.41346 Ft


 *** COMPUTATION WITH REVERSED RECORD ***

Vmax =  0.12871 Ft/S      Dfinal =  0.15753 Ft

 ** SUMMARY OF RESULTS **

 RUN       V max       V ave       D final      D final ave
             Ft/S        Ft/S         Ft             Ft

  1       0.45813                 0.41346
                      0.29342                     0.28550
  2       0.12871                 0.15753


***  PROGRAM TERMINATED  ***
```

```
          ***********
    **                    **
    **   D I S P L M T    **
          ***********
```

HPNS, Parcel E Remedial Deign, Section B-B', Perm. Displ., Izmit.acc

YIELD ACCELERATION = 0.0500

DT = 0.0050 ACCN DUE GRAVITY = 32.200 NLINES = 6112

A max = 0.08882 Acc Factor = 1.00000 Static F.S.= 1.500

*** COMPUTATION WITH ORIGINAL RECORD ***

Vmax = 0.39435 Ft/S Dfinal = 0.35718 Ft

*** COMPUTATION WITH REVERSED RECORD ***

Vmax = 0.35376 Ft/S Dfinal = 0.26541 Ft

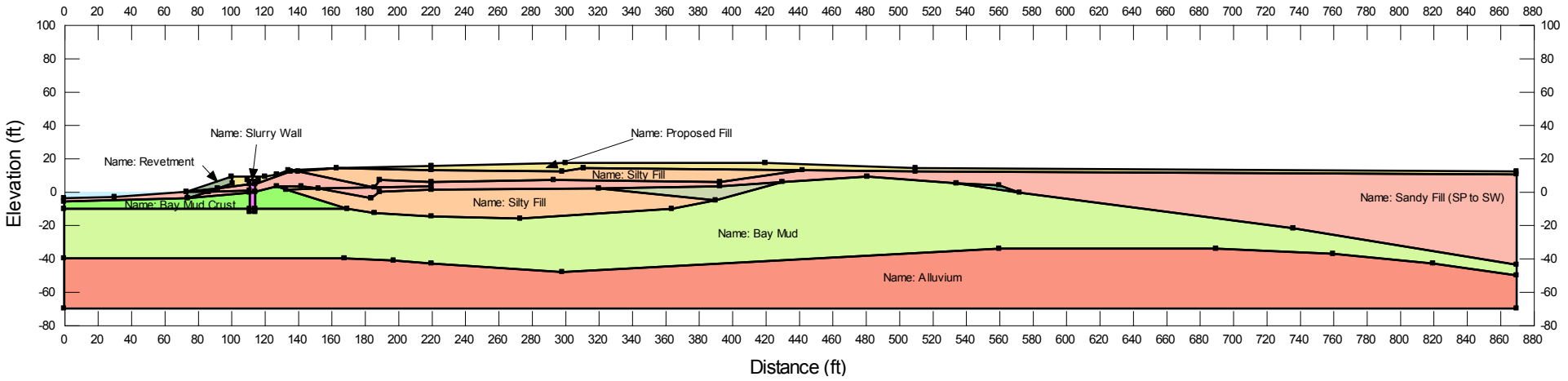
** SUMMARY OF RESULTS **

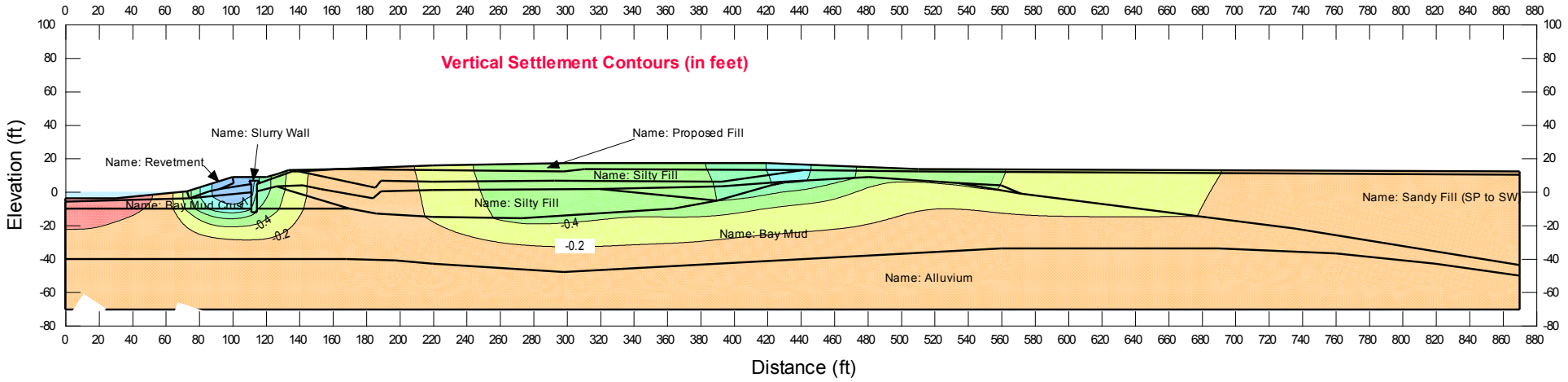
RUN	V max Ft/S	V ave Ft/S	D final Ft	D final ave Ft
1	0.39435		0.35718	
		0.37405		0.31129
2	0.35376		0.26541	

*** PROGRAM TERMINATED ***

Attachment F10
Results of Settlement Analyses

(This attachment is provided on CD only)


Name: Slurry Wall
Name: Proposed Fill
Name: Revetment
Name: Silty Fill
Name: Bay Mud Crust
Name: Silty Fill
Name: Sandy Fill (SP to SW)
Name: Bay Mud
Name: Alluvium
Elevation (ft)
Distance (ft)


Vertical Settlement Contours (in feet)
Name: Slurry Wall
Name: Proposed Fill
Name: Revetment
Name: Silty Fill
Name: Bay Mud (Crust)
Name: Silty Fill
Name: Sandy Fill (SP to SW
-0.4
-0.2
-0.4
Name: Bay Mud
-0.2
Name: Alluvium
Elevation (ft)
Distance (ft)

Settlement 30-Year after Construction

Report generated using GeoStudio 2012. Copyright © 1991-2015 GEO-SLOPE International Ltd.

File Information

Tool Version: 8.15.1.11236
File Name: A-A'.gsz
Directory: C:\PROJECTS\Hunters Point\Parcel E\Settlement\A-A'\
Last Solved Date: 10/26/2015
Last Solved Time: 8:22:20 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Days
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Stiffness Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

30-Year Consolidation after Construction

Description: HPNS, Parcel E Remedial Design, Settlement Analysis, Cross Section A-A'
Kind: SIGMA/W
Parent: Place New Fill and Revetment
Method: Coupled Stress/PWP
Settings
    Initial Stress: Parent Analysis
    Initial PWP: Parent Analysis
    Exclude cumulative values: No
Control
    Apply Body Force in All Steps: No
    Saturated Zone Only: No
Convergence
    Maximum Number of Iterations: 50
    Minimum Pressure Head Difference: 0.001
    Minimum Displacement Difference: 0.001
    Significant Digits: 3
    Hydraulic Under-Relaxation Criteria
        Under-Relaxation Initial Rate: 1

Under-Relaxation Min. Rate: 0.1
Under-Relaxation Reduction Rate: 0.65
Under-Relaxation Iterations: 10
Equation Solver: Parallel Direct
Time
Starting Time: 14 days
Duration: 10,950 days
# of Steps: 300
Step Generation Method: Exponential
Initial Increment Size: 4 days
Save Steps Every: 300
Fixed Elapsed Times: 365; 1,825; 3,650; 7,300;

Materials

Revetment

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 135 pcf
Poisson's Ratio: 0.334
Activation PWP: -20 psf

Proposed Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334
Activation PWP: -200 psf

Sandy Fill (SP to SW)

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Clayey Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 0.5
Rotation: 0 °
K-Modifier Function: Bay Mud K Modifier Funtion
Load Response Ratio: 1

Alluvium

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 200,000 psf
Unit Weight: 130 pcf
Poisson's Ratio: 0.334

Silty Fill

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 150,000 psf
Unit Weight: 120 pcf
Poisson's Ratio: 0.334

Bay Mud Crust

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 3
Poisson's Ratio: 0.26
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 2
Unit Weight: 100 pcf
Phi': 30 °
Hydraulic
Vol. WC. Function: Bay Mud Crust
K-Function: Bay Mud Crust
Ky'/Kx' Ratio: 0.5
Rotation: 0 °

K-Modifier Function: Bay Mus Crust K Modifier Function
Load Response Ratio: 1

Slurry Wall

Model: Soft Clay (MCC w/ PWP Change)
Stress Strain
O.C. Ratio: 1
Poisson's Ratio: 0.3
Lambda: 0.61
Kappa: 0.122
Initial Void Ratio: 3
Unit Weight: 90 pcf
Phi': 20 °
Hydraulic
Vol. WC. Function: Bay Mud
K-Function: Bay Mud
Ky'/Kx' Ratio: 1
Rotation: 0 °
Load Response Ratio: 1

Gravel

Model: Linear Elastic (Effective)
Stress Strain
Effective Young's Modulus (E'): 300,000 psf
Unit Weight: 125 pcf
Poisson's Ratio: 0.334

Boundary Conditions

Fixed X

X: X-Displacement 0

Fixed X/Y

X: X-Displacement 0
Y: Y-Displacement 0

Bay Water Level

Type: Head (H) 0
Review: No

Initial Water Tables

Initial Water Table 1

Max. negative head: 5
Coordinates

Coordinate 1: (0, 0) ft
Coordinate 2: (94, 0) ft
Coordinate 3: (106, 0.5) ft
Coordinate 4: (118.5, 0.5) ft
Coordinate 5: (200, 1) ft

K Functions

Bay Mud Crust

Model: Hyd K Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Vol. Water Content Function 3
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Hyd K Data Point Function

Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Saturated Kx: 0.0004
Data Points: Matric Suction (psf), X-Conductivity (ft/days)
Data Point: (0.01, 0.0004)
Data Point: (0.018329807, 0.00038967277)
Data Point: (0.033598183, 0.00037792234)
Data Point: (0.061584821, 0.00036462391)
Data Point: (0.11288379, 0.00034960021)
Data Point: (0.20691381, 0.00033268641)
Data Point: (0.37926902, 0.00031372429)
Data Point: (0.6951928, 0.00029257292)
Data Point: (1.274275, 0.00026912696)
Data Point: (2.3357215, 0.0002433421)
Data Point: (4.2813324, 0.00021527057)
Data Point: (7.8475997, 0.00018511983)
Data Point: (14.384499, 0.00015333266)
Data Point: (26.366509, 0.000120709)
Data Point: (48.329302, 8.8567249e-005)
Data Point: (88.586679, 5.8869341e-005)
Data Point: (162.37767, 3.4104101e-005)
Data Point: (297.63514, 1.6474635e-005)
Data Point: (545.55948, 6.422923e-006)
Data Point: (1,000, 2.0258119e-006)
Estimation Properties
Hyd. K-Function Estimation Method: Van Genuchten Function
Volume Water Content Function: Bay Mud
Saturated Kx: 0.0004 ft/days
Residual Water Content: 0.2 ft^3/ft^3
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Hydraulic K Modifier Functions

Bay Mud K Modifier Funtion

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 100 %
Y-Intercept: 0.96838408
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (750, 1)
Data Point: (1,300, 0.6)
Data Point: (2,200, 0.3)

Data Point: (2,750, 0.2)

Bay Mus Crust K Modifier Function

Model: Spline Data Point Function (Y Log)
Function: K-Modifier vs. Y-Effective Stress
Curve Fit to Data: 0 %
Segment Curvature: 0 %
Y-Intercept: 0.9677369
Data Points: Y-Effective Stress (psf), K-Modifier
Data Point: (150, 1)
Data Point: (800, 0.55)
Data Point: (1,300, 0.375)
Data Point: (2,200, 0.1875)

Vol. Water Content Functions

Bay Mud Crust

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft^3/ft^3
Residual Water Content: 0.074073295 ft^3/ft^3
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft^3/ft^3)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)

Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0
Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Bay Mud

Model: Vol WC Data Point Function
Function: Vol. Water Content vs. Pore-Water Pressure
Mv: 0.00012 /psf
Saturated Water Content: 0.74073295 ft³/ft³
Residual Water Content: 0.074073295 ft³/ft³
Curve Fit to Data: 100 %
Segment Curvature: 100 %
Porosity: 0.74073295
Data Points: Matric Suction (psf), Vol. Water Content (ft³/ft³)
Data Point: (0.01, 0.72999997)
Data Point: (0.018329807, 0.72999995)
Data Point: (0.033598183, 0.7299999)
Data Point: (0.061584821, 0.72999979)
Data Point: (0.11288379, 0.72999957)
Data Point: (0.20691381, 0.72999907)
Data Point: (0.37926902, 0.72999797)
Data Point: (0.6951928, 0.72999548)
Data Point: (1.274275, 0.72998974)
Data Point: (2.3357215, 0.7299763)
Data Point: (4.2813324, 0.72994451)
Data Point: (7.8475997, 0.72986859)
Data Point: (14.384499, 0.72968594)
Data Point: (26.366509, 0.72924431)
Data Point: (48.329302, 0.7281738)
Data Point: (88.586679, 0.72558263)
Data Point: (162.37767, 0.71936939)
Data Point: (297.63514, 0.7048642)
Data Point: (545.55948, 0.67310241)
Data Point: (1,000, 0.612308)
Estimation Properties
Vol. WC Estimation Method: Sample functions
Saturated Water Content: 0.73 ft³/ft³
Sample Material: Clay
Liquid Limit: 0 %
Diameter at 10% passing: 0
Diameter at 60% passing: 0

Maximum: 1,000
Minimum: 0.01
Num. Points: 20

Points

	X (ft)	Y (ft)
Point 1	0	-4
Point 2	30	-3.5
Point 3	73	0
Point 4	100	9
Point 5	120	9
Point 6	127.5	10.5
Point 7	134	13
Point 8	163	14
Point 9	220	15.5
Point 10	220	13
Point 11	140	12.2
Point 12	185.65	2.55
Point 13	189	7
Point 14	220	6
Point 15	74	-4
Point 16	92	2
Point 17	101	5
Point 18	111.5	4.5
Point 19	110	7
Point 20	114.5	4.5
Point 21	116	7
Point 22	135.5	12
Point 23	111.5	-0.5
Point 24	114.5	0
Point 25	127	3
Point 26	142	3.5
Point 27	184	-4
Point 28	189	0
Point 29	220	1
Point 30	170	-10

Point 31	186	-13
Point 32	220	-15
Point 33	0	-6
Point 34	111.5	-12.5
Point 35	114.5	-12.5
Point 36	0	-40
Point 37	168	-40
Point 38	197.5	-41
Point 39	220	-43
Point 40	0	-70
Point 41	870	-70
Point 42	0	-10
Point 43	111.5	-10
Point 44	114.5	-10
Point 45	111.5	0.7
Point 46	133.15	1.15
Point 47	152.45	1.55
Point 48	86.4	0.2
Point 49	220	3
Point 50	300	17
Point 51	420	17
Point 52	510	14
Point 53	870	12
Point 54	298	12
Point 55	311	14
Point 56	442	13
Point 57	870	10
Point 58	293	7
Point 59	393	6
Point 60	320	1.5
Point 61	393	3
Point 62	364	-10
Point 63	390	-5
Point 64	430	6
Point 65	481	9
Point 66	534	5

Point 67	560	4
Point 68	572	-1
Point 69	736	-22
Point 70	870	-44
Point 71	298	-48
Point 72	560	-34
Point 73	690	-34
Point 74	760	-37
Point 75	820	-43
Point 76	870	-50
Point 77	273	-16
Point 78	509.95	12

Lines

	Start Point	End Point	Stress/Strain Boundary	Length (ft)	Angle (°)	Hydraulic Boundary
Line 1	40	36	Fixed X	30	90	
Line 2	36	37		168	0	Bay Water Level
Line 3	37	38		29.517	-1.94	Bay Water Level
Line 4	38	39		22.589	-5.08	Bay Water Level
Line 5	41	40	Fixed X/Y	870	0	
Line 6	33	15		74.027	1.55	
Line 7	15	23		37.663	5.33	
Line 8	34	35		3	0	
Line 9	30	31		16.279	-10.6	
Line 10	31	32		34.059	-3.37	
Line 11	23	24		3.0414	9.46	
Line 12	33	1	Fixed X	2	90	
Line 13	1	2		30.004	0.955	Bay Water Level
Line 14	2	3		43.142	4.65	Bay Water Level
Line 15	3	15		4.1231	-76	
Line 16	3	16		19.105	6.01	
Line 17	16	18		19.66	7.31	
Line 18	18	20		3	0	
Line 19	20	24		4.5	90	

Line 20	24	25		12.855	13.5	
Line 21	20	22		22.299	19.7	
Line 22	12	13		5.57	53	
Line 23	13	14		31.016	-1.85	
Line 24	29	28		31.016	1.85	
Line 25	28	27		6.4031	38.7	
Line 26	26	25		15.008	1.91	
Line 27	22	11		4.5044	2.54	
Line 28	11	12		46.659	-11.9	
Line 29	3	4		28.46	18.4	
Line 30	4	17		4.1231	-76	
Line 31	17	16		9.4868	18.4	
Line 32	18	19		2.9155	-59	
Line 33	19	21		6	0	
Line 34	21	20		2.9155	59	
Line 35	4	5		20	0	
Line 36	5	6		7.6485	11.3	
Line 37	6	7		6.9642	21	
Line 38	7	8		29.017	1.97	
Line 39	8	11		23.07	4.47	
Line 40	8	10		57.009	-1.01	
Line 41	8	9		57.02	1.51	
Line 42	36	42	Fixed X	30	90	
Line 43	43	34		2.5	90	
Line 44	35	44		2.5	90	
Line 45	42	43		111.5	0	
Line 46	44	30		55.5	0	
Line 47	43	44		3	0	
Line 48	42	33	Fixed X	4	90	
Line 49	23	43		9.5	90	
Line 50	24	44		10	90	
Line 51	18	45		3.8	90	
Line 52	45	23		1.2	90	
Line 53	25	46		6.4222	-16.7	
Line 54	46	30		38.5	-16.8	
Line 55	27	47		32.034	-9.98	

Line 56	47	26		10.63	-10.6	
Line 57	46	47		19.304	1.19	
Line 58	16	48		5.8822	17.8	
Line 59	48	15		13.092	18.7	
Line 60	3	48		13.401	0.855	
Line 61	48	45		25.105	1.14	
Line 62	14	49		3	90	
Line 63	49	47		67.566	1.23	
Line 64	49	29		2	90	
Line 65	39	71		78.16	-3.67	Bay Water Level
Line 66	71	72		262.37	3.06	Bay Water Level
Line 67	72	73		130	0	Bay Water Level
Line 68	73	74		70.064	-2.45	Bay Water Level
Line 69	74	75		60.299	-5.71	Bay Water Level
Line 70	75	76		50.488	-7.97	Bay Water Level
Line 71	76	41	Fixed X	20	90	
Line 72	32	77		53.009	-1.08	
Line 73	77	62		91.198	3.77	
Line 74	62	63		26.476	10.9	
Line 75	63	64		41.485	15.4	
Line 76	64	65		51.088	3.37	
Line 77	65	66		53.151	-4.32	
Line 78	66	68		38.471	-8.97	
Line 79	68	69		165.34	-7.3	
Line 80	69	70		135.79	-9.32	
Line 81	70	76	Fixed X	6	90	
Line 82	66	67		26.019	-2.2	
Line 83	67	68		13	-22.6	
Line 84	29	60		100	0.286	
Line 85	60	63		70.301	-5.31	
Line 86	60	61		73.015	1.18	
Line 87	61	64		37.121	4.64	
Line 88	14	58		73.007	0.785	
Line 89	58	59		100	-0.573	
Line 90	57	70	Fixed X	54	90	
Line 91	10	54		78.006	-0.735	

Line 92	54	55		13.153	8.75	
Line 93	55	56		131	-0.437	
Line 94	56	59		49.497	8.13	
Line 95	9	50		80.014	1.07	
Line 96	50	51		120	0	
Line 97	51	52		90.05	-1.91	
Line 98	52	53		360.01	-0.318	
Line 99	53	57	Fixed X	2	90	
Line 100	57	78		360.06	-0.318	
Line 101	78	56		67.957	-0.843	

Regions

	Material	Points	Area (ft^2)
Region 1	Alluvium	40,36,37,38,39,71,72,73,74,75,76,41	26,119
Region 2	Bay Mud	36,42,43,34,35,44,30,31,32,77,62,63,64,65,66,68,69,70, 76,75,74,73,72,71,39,38,37	24,755
Region 3	Slurry Wall	44,35,34,43	7.5
Region 4	Sandy Fill (SP to SW)	33,1,2,3,15	180.25
Region 5	Revetment	3,48,15	26.9
Region 6	Sandy Fill (SP to SW)	15,48,45,23	72.11
Region 7	Slurry Wall	18,20,24,23,45	14.25
Region 8	Sandy Fill (SP to SW)	20,22,11,12,13,14,49,47,26,25,24	534.3
Region 9	Silty Fill	47,27,28,29,60,63,62,77,32,31,30,46	3,018
Region 10	Revetment	3,4,17,16	78
Region 11	Slurry Wall	18,19,21,20	11.25
Region 12	Proposed Fill	16,17,4,5,6,7,8,11,22,20,21,19,18	128.38
Region 13	Silty Fill	11,8,10,54,55,56,59,58,14,13,12	1,839.1
Region 14	Proposed Fill	8,9,50,51,52,53,57,78,56,55,54,10	1,763.8
Region 15	Bay Mud Crust	42,33,15,23,43	660.63
Region 16	Slurry Wall	43,23,24,44	29.25
Region 17	Bay Mud Crust	24,25,46,30,44	423.45
Region 18	Silty Fill	25,26,47,46	36.32
Region 19	Sandy Fill (SP to SW)	47,49,29,28,27	186.83
Region 20	Revetment	3,16,48	11.5

Region 21	Sandy Fill (SP to SW)	48,16,18,45	58.24
Region 22	Clayey Fill	66,67,68	59
Region 23	Gravel	60,61,64,63	433.25
Region 24	Sandy Fill (SP to SW)	14,58,59,56,78,57,70,69,68,67,66,65,64,61,60,29,49	11,364

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Appendix G NAPL Treatment Technology Evaluation and Selection for IR-03

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Attachments

Attachment G1. Sitewise™ Output Results

Abbreviations and Acronyms

bgs	below ground surface
COPECs	chemicals of potential ecological concern
DBR	design basis report
FPM	free product mobility
GAC	granular activated carbon
GHG	greenhouse gases
GSR	green and sustainable remediation
IR	installation restoration
ISS	in-situ solidification/stabilization
ISTR	in-situ thermal remediation
MPE	multi-phase extraction
NAPL	non-aqueous phase liquid
NOx	nitrogen oxides
PCBs	polychlorinated biphenyls
PM	particular matter
RAOs	remedial action objectives
RD	remedial design
ROCs	radionuclides of concern
S/S	solidification/stabilization
SDL	semi dynamic leaching
SOx	sulfur oxides
SVOCs	semivolatile organic compounds
TCH	thermal conduction heater
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TTZs	target treatment zones

Section 1. NAPL Treatability Study Summary

This report summarizes the results from a treatability study that was implemented at Installation Restoration (IR)-03 in 2013 and 2014 to evaluate nonaqueous phase liquid (NAPL) treatment using in situ thermal remediation (ISTR) and in situ solidification/stabilization (ISS) technologies. The ISTR and ISS pilot studies were conducted within the IR-03 NAPL zone (see Figure 34 in the Design Basis Report [DBR]) to assess the ability of each technology to achieve the remedial action objectives (RAOs) and provide the information necessary for the full-scale remedial design (RD) (CIJV and CDM Smith, 2016a). The full-scale RD for IR-03 is presented in the DBR to which this report is appended. This introductory section describes the treatability study activities. Following this introduction, this appendix provides the following information:

- Section 2 describes the pilot study objectives.
- Section 3 summarizes the evaluation of the two NAPL treatment technologies (ISTR and ISS) and the basis for selecting ISS.
- Section 4 identifies the reference documents used to prepare this appendix.

Supporting figures and tables are presented at the end of this report. Attachment G1 provides supporting information from the sustainability analysis of the ISTR and ISS technologies.

1.1. SUMMARY OF TREATABILITY STUDY ACTIVITIES

Prior to pilot testing, a characterization was performed in 2013 to:

- Characterize soil properties in the target treatment zones (TTZs)
- Measure properties of the A-aquifer
- Evaluate the integrity of the existing sheetpile wall
- Collect ISTR and ISS performance monitoring data
- Collect soil for ISS bench study testing
- Characterize the composition of NAPL at IR-03

The 2013 characterization and ISS bench study testing were used to update the conceptual site model and finalize the design of ISTR and ISS pilot studies (CIJV and CDM Smith, 2016a). One objective of the 2013-2014 treatability study (and the 2015 post-pilot study characterization) was to evaluate the extent of mobile NAPL. Mobile NAPL is defined as NAPL entrained in the aquifer sediment pore volume above the residual saturation, and is important because it defines the NAPL with potential to migrate. The mobile NAPL extent is the basis for the NAPL treatment zone used during the evaluation of the two NAPL remediation technologies in the RD.

1.2. ISTR PILOT STUDY

The ISTR pilot study was implemented within a portion of the footprint of the western former oily waste pond (see Figure 34 in the DBR). The TTZ for ISTR was approximately 1,900 square feet, with an upper depth of 5 feet below ground surface (bgs) and extended to 25 feet bgs for a total estimated treatment volume of approximately 1,400 cubic yards. The ISTR system comprised 46 thermal conduction heater (TCH) wells, 14 multi-phase extraction (MPE) wells, 46 vacuum extraction wells, horizontal vacuum extraction wells, 7 reinjection wells, and pressure and temperature monitoring wells. The subsurface ISTR system was connected to an aboveground treatment system, which extracted and treated the water, NAPL, and vapor from the TTZ. Water extracted by the MPE wells and condensate was treated by a liquid granular activated carbon (GAC)-based treatment system and injected into wells positioned around the northern, southern, and eastern perimeters of the TTZ. The existing sheetpile wall provided a hydraulic boundary on the western perimeter of the TTZ. Prior to injection, treated water was heated using a heat exchanger, wherein the hot off-gas from the TCH wells was used as the source of heat. This generally resulted in injection of water that was approximately 60°C. The heat conducted from the heating system increased temperatures of the subsurface soil, NAPL, and groundwater to an average temperature of 95 to 100°C. Following 153 days of operation of the ISTR pilot treatment system, soil samples were collected from within the ISTR TTZ immediately after the heater wells were turned off. ISTR operation and maintenance data and pre- and post-treatment soil sample data were used in assessing the performance of the ISTR system.

The primary performance metric for evaluating the ability of the ISTR system to remove mobile NAPL was collection of samples from soil cores for total, leachable, and residual NAPL using free product mobility (FPM) testing (ASTM Method D425/Dean-Stark extraction). Additionally, soil samples were collected to quantify the concentrations of total petroleum hydrocarbons (TPH), metals, and polychlorinated biphenyls (PCBs), along with other chemicals (e.g., volatile organic compounds [VOCs] and semivolatile organic compounds [SVOCs]) present at IR-03, total organic carbon (TOC), and radionuclides of concern (ROCs) (CIJV and CDM Smith, 2016a). The ISTR system did not target reductions of metals or ROCs, but these parameters were monitored to assess whether ISTR would impact their concentrations and distribution and provide the information necessary for health and safety monitoring and the full-scale RD.

In addition to performance monitoring, process monitoring was conducted to evaluate the functional parameters of the ISTR heating and treatment systems. The operation of the ISTR system was evaluated using several direct measurements, including soil temperature, vapor treatment controls (i.e., flowrate, temperature, pressure, and chemical parameters), and liquid treatment controls (i.e., flowrate, temperature, pH, and chemical parameters). In addition, parameters affecting efficiency and cost were collected, and measurements and observations of the ISTR system were collected for compliance with pertinent regulations. Details of the performance evaluation are provided in the Pilot Study Completion Report (CIJV and CDM Smith, 2016a).

Approximately 2,453 gallons of NAPL was mobilized and recovered during operation of the ISTR system. The pilot study demonstrated that ISTR technology was able to significantly remove NAPL, reducing both NAPL saturation (by approximately 40%), and mobile NAPL (by approximately 96%). The ISTR system reduced concentrations of TPH in soil from 64 percent for diesel-range hydrocarbons and 43 percent for motor oil-range hydrocarbons. Performance monitoring concluded that the ISTR system had a significant influence on reducing NAPL mobility within the ISTR TTZ. However, the pilot study also identified inefficiencies of the ISTR system that would need to be accounted for during full-scale RD. The Pilot Study Completion Report (CIJV and CDM Smith, 2016a) described these inefficiencies, which informed the technology evaluation (presented in Section 3).

1.3. ISS BENCH STUDY AND FIELD PILOT STUDY

The ISS pilot study was implemented at IR-03 using a two-phased approach—bench-scale testing and field pilot-scale testing. For the bench-scale testing, soil was collected from the ISS pilot TTZ on the Bay side of the sheetpile wall (see Figures 33 and 34 in the DBR) during the pre-pilot study characterization. Bench study testing was conducted in the three phases discussed below.

- **Phase 1 – Initial Screening.** As part of the Phase 1 testing, a representative baseline soil-reagent mixture was developed for use in all subsequent testing during Phase 2 and Phase 3. Reagent mixes during the Phase 1 testing included Portland cement, fly-ash, and lime at various mix percentages.
- **Phase 2 – Synthetic Precipitation Leaching Procedure.** Phase 2 testing used the recommended baseline mix from Phase 1 and evaluated the effect of the addition of activated carbon and Organoclay in reducing leachability of contaminants from the soil mixes.
- **Phase 3 – Semi-Dynamic Leaching (SDL) Testing.** Phase 3 testing was conducted to identify the mix that would be used for the ISS pilot study. This test used a modified EPA Method 1315M (EPA SW-846).

Results of the bench-scale testing were used to develop the design for the reagent mix for the ISS pilot study. Based on the bench-scale testing, the reagent mix design consisted of 30% Bay Mud by weight based on the weight of the treatment zone soil (TZS) (weight to weight [w/w]), 18% (w/w) bentonite slurry[1], and 20% (w/w) Portland cement.

The TTZ selected for the ISS pilot study (see Figure 34 in the DBR) was in an area with high NAPL saturation and exposure to tidal influence to better test the treatment technology. The ISS pilot study consisted of injecting reagents and homogenizing the subsurface soil to create five overlapping columns. Each column was 36 inches in diameter and spaced 30 inches center-to-center to create a 6-inch overlap. Three overlapping columns were installed adjacent to the existing sheetpile wall and two additional

[1] Bentonite slurry constitutes 18% of the design mix by total weight of TZS. Slurry is prepared by adding 6% bentonite by weight to water. Therefore, bentonite constitutes approximately 1.08% of the design mix by weight of TZS.

columns were installed overlapping the three previously installed columns. The ISS columns were mixed from approximately 4 to 42 feet bgs, which included approximately 18 vertical feet of TTZ soil and 20 vertical feet of the underlying Bay Mud. Approximately 1,350 cubic feet of TTZ soil and Bay Mud were mixed as part of the ISS pilot study. Each column was mixed with three passes, and each pass consisted of a penetration stroke and withdrawal stroke of the rotating mixing tool. The mixing tool rotation rate was approximately 60 revolutions per minute. The mixing tool penetration rate ranged from 1.5 to 2 feet per minute under typical drilling conditions. Soil-reagent mix samples were collected during the ISS mixing operation to evaluate the mix consistency, material strength, and permeability using molded cylinders. The cylinder samples were collected immediately after completion of three mixing passes. The ISS pilot area was allowed to cure for approximately 84 to 90 days after installation of the ISS columns before core samples were collected for performance monitoring.

Physical testing was performed to evaluate whether the ISS field pilot study was capable of reducing permeability in treated soil to 10^{-6} cm/sec. Semi-dynamic leaching (SDL, modified ASTM Method C1308-0) testing was conducted to evaluate leaching of COPECs and TPH from the solidified mass. In addition, diffusion modeling was conducted to obtain diffusion coefficients of COPECs from the solidified core and cylinders obtained during and after the installation of the ISS columns. ISS reduced leaching of COPEC concentrations to less than surface water quality criteria for aquatic wildlife and total TPH concentrations to less than 1,400 µg/L (CIJV and CDM Smith, 2016b). These data demonstrated that ISS was capable of significantly reducing the mobility and leaching of NAPL from the highly-saturated mobile NAPL zone.

Section 2. NAPL Pilot Study Objectives

The following technology-specific performance objectives were developed for ISTR and ISS to specify how each technology would address NAPL:

- ISTR performance objective is to extract and treat all mobile NAPL within the treatment volume
- ISS performance objective is to reduce NAPL mobility by reducing soil permeability to 10^{-6} or lower and contaminant leachability to prevent discharge that would result in COPEC concentrations greater than the surface water quality criteria for aquatic wildlife or TPH concentrations greater than 1,400 μg/L

Section 3. NAPL Treatment Technology Evaluation and Selection

As discussed in Section 3.8.2 of the DBR, NAPL treatment zones were delineated based on area and volume estimated to contain mobile NAPL and/or residual NAPL. To treat the mobile NAPL zone, an evaluation was conducted to determine the approach for using ISTR and/or ISS at IR-03. Information from the pilot study was used to evaluate multiple combinations of ISTR and ISS for the mobile NAPL zone supplemented with a slurry wall to address the total NAPL zone in order to contain contaminated groundwater (as discussed in Section 3.9 of the DBR). Based on the results of this preliminary evaluation, two approaches warranted a more detailed evaluation to address the IR-03 NAPL: (1) ISTR with a slurry wall and (2) ISS with a slurry wall. The two full-scale NAPL treatment options were evaluated relative to the following decision criteria: implementability and effectiveness, sustainability, and capital cost. The following sections describe the results of the detailed evaluation relative to these criteria.

3.1. IMPLEMENTABILITY AND EFFECTIVENESS

The evaluation of implementability considered remedial technology sequencing, feasibility, logistics, and coordination required to implement the technology full-scale. The evaluation of effectiveness considered the ability of each technology to achieve the RAOs. Neither ISS nor ISTR would likely achieve RAOs alone, but both were considered as part of a multi-technology strategy for IR-03. Accordingly, the evaluation considered multiple scenarios of ISTR and ISS to treat NAPL in combination with technologies to address remaining contamination. The paragraphs below summarize key conclusions regarding the implementability of each technology and briefly describe their effectiveness (CIJV and CDM Smith, 2016a).

3.1.1. ISTR

The pilot study demonstrated that ISTR technology was able to significantly remove NAPL, reducing both NAPL saturation (by approximately 40%), and mobile NAPL (by approximately 96%). At elevated temperatures, enhanced dissolution of the NAPL constituents resulted in elevated chemical concentrations in groundwater, as demonstrated by the significant increases in TPH and phenolic chemical concentrations observed post-ISTR during the pilot study (CIJV and CDM Smith, 2016a). In addition, ISTR was highly effective for reducing mobile NAPL, but only moderately effective for total NAPL. Therefore, this technology will not remove all of the NAPL, and groundwater COPEC concentrations would likely not be reduced sufficiently to achieve the RAOs. Key conclusions on the implementability and effectiveness of ISTR are presented below.

- ISTR implementation requires hydraulic isolation from tidal influence to achieve target treatment temperatures. Therefore, full-scale implementation of ISTR would require additional hydraulic control (e.g., a slurry wall).
- NAPL outside of the hydraulic containment (e.g., NAPL on the bay-side of the future slurry wall) would require removal (via excavation) and offsite disposal.
- Full-scale implementation of ISTR would require a complicated sequence of operations to treat the large area with mobile NAPL in up to four separate zones. This sequencing would require hydraulic isolation of treatment zones and moving the process treatment equipment (used to segregate waste streams) when transitioning from one treatment zone to the next.
- Full-scale implementation of ISTR would require significant infrastructure, including a source of energy (electricity and/or fuel), staging and waste management areas, process treatment equipment, and operations facilities.
- Full-scale implementation of ISTR would require robust treatment of the liquid effluent (prior to reinjection) to comply with regulatory requirements. Therefore, full-scale implementation could require multiple treatment processes, including GAC, chemical oxidation, and/or thermal oxidation.
- ISTR treatment temperatures should be kept at or below 100°C, unless additional detailed studies are conducted to evaluate thermal decomposition of the NAPL. The composition of the NAPL may generate toxic chemicals at high temperatures that would have to be addressed by the treatment system. The generation and necessary treatment for such toxic byproducts would require further study to ensure compliance with regulatory requirements.
- ISTR implementation generates multiple waste streams that have to be managed and disposed of. Full-scale implementation is estimated to produce 28,000 gallons of NAPL, 750 tons of soil, 600 tons of GAC, and oxidant wastes from advanced treatment processes.
- ISTR implementation would require a highly adaptable system design to address significant variability in the NAPL composition across IR-03, which could result in less efficient NAPL removal.
- ISTR is estimated to take 3 years to implement (e.g., for construction, operation and demobilization).
- ISTR would remove mobile NAPL, but leave in place residual NAPL that could be a source of groundwater contamination. Therefore, hydraulic containment (e.g., slurry wall with soil cover and protective liner) would be required to ensure that the RAOs are met.

3.1.2. ISS

Pilot testing confirmed that ISS could meet the RAOs by reducing the permeability and leachability of NAPL-impacted soil. The ISS pilot study successfully emplaced an S/S monolith with an average permeability of less than 10^{-6} cm/sec and adequately reduced the leachability of NAPL-impacted soil. Key conclusions on the implementability and effectiveness of ISS are presented below.

- ISS implementation would require use of a hydraulic barrier (such as a slurry wall) to provide an additional level of protection (from potential leaching and discharge of contaminated groundwater to the Bay).
- ISS implementation would generate excess soil volume that must be managed and, if needed, disposed of off site.
- ISS implementation would require additional characterization to locate and/or remove large subsurface obstructions.
- ISS is estimated to take 2 years to implement (e.g., for construction and demobilization).
- ISS would treat mobile NAPL but, unless implemented over a much larger area, would leave in place residual NAPL that could be a source of groundwater contamination. Therefore, hydraulic containment (e.g., slurry wall with soil cover and protective liner) would be required to ensure that the RAOs are met.

3.2. SUSTAINABILITY

The criteria for the overall design include green and sustainable remediation (GSR) principles identified in Navy guidance (Battelle, 2012). Accordingly, the evaluation of NAPL remediation technologies included an assessment of GSR principles. GSR is the "site-specific employment of products, processes, technologies, and procedures that mitigate contaminant risk to receptors while making decisions that are cognizant of balancing community goals, economic impacts, and environmental effects" (Interstate Technology and Regulatory Council, 2011). The GSR assessment evaluated the environmental, economic, and social impacts (i.e., "triple bottom line") associated with full-scale implementation of ISTR and ISS, in accordance with pertinent guidance (ASTM International, 2013; Battelle, 2012; EPA, 2012; Interstate Technology and Regulatory Council, 2011). The GSR assessment comprises the following impacts and corresponding evaluation methods:

- Environmental impacts were evaluated quantitatively using the SiteWise™ footprint evaluation tool
- Socio-economic impacts were evaluated quantitatively by estimating both project implementation costs and global monetized impacts associated with the environmental footprint
- Community impacts were evaluated qualitatively by assessing the potential detrimental and beneficial impacts

The paragraphs below summarize the environmental, socio-economic, and community impacts for ISTR and ISS.

3.2.1. Environmental Impacts

The SiteWise™ tool evaluated the following sustainability metrics: likelihood of accident risk fatality/injury; total energy and water resources used; and emissions of greenhouse gases (GHG), nitrogen

oxides (NOx), sulfur oxides (SOx), and coarse particulate matter (PM10; i.e., diameter of 10 micrometers or less). Table 1 identifies the input parameters used in the SiteWise™ footprint evaluation for implementation of ISTR and ISS.

Table 2 presents the results of the environmental footprint analysis (both quantitative and relative impact). The Addendum also presents the SiteWise™ footprint output results. The analysis indicated that ISS has the lower overall environmental footprint in comparison to ISTR. Consumption of raw materials (e.g., stabilization and well materials) and equipment use (e.g., drill rig and electricity usage) are the primary contributors to the environmental footprints of both ISTR and ISS. In addition, handling and transportation of waste generated during ISTR implementation had a greater impact on the environmental footprint in comparison to ISS. The likelihood of accident risk fatality/injury for both alternatives was comparable.

3.2.2. Socio-Economic Impacts

Global monetized impacts were quantified by integrating the social cost of environmental metrics (i.e., emissions and energy consumption) into the footprint analysis using a cost benefit methodology. The social cost of the environmental metrics represent financial implications to society due to an incremental increase in emissions and resource consumption, as presented in the Table 3 on the Global monetized impacts for implementation of ISTR and ISS is presented in Table 4 and shown in Figure 1.

The analysis indicated that ISS has fewer long-term global impacts in comparison to ISTR. The estimated monetized impacts of ISS implementation is about 76 percent lower than ISTR implementation. The increased monetized impacts of ISTR implementation is primarily attributed to the increased GHG emissions and energy consumption (when compared to ISS implementation).

3.2.3. Community Impacts

The primary detrimental impacts to the surrounding community during implementation of ISTR and ISS are attributed to transporting remediation waste to a licensed offsite disposal facility. Notable factors include traffic congestion in the community and incidental impacts to local businesses due to increased truck traffic. ISS implementation would generate less waste in comparison to ISTR. As a result, ISS implementation would have a less detrimental impact on the surrounding community in comparison to ISTR.

The primary beneficial impacts to the surrounding community during ISTR and ISS implementation are attributed to using local vendors and subcontractors (potentially including local waste haulers). A long term beneficial impact for the community from remedy implementation is subsequent redevelopment of the property into open space, thereby improving access to the property and increasing its aesthetic value. Redevelopment activities will be commenced once the remediation of the entire Parcel E is complete. Therefore, the differences between the timeframes for implementing each alternative does not directly

expedite redevelopment of the property. Thus beneficial impacts to the surrounding community are comparable among each proposed alternative.

3.2.4. Overall GSR Assessment

Based on the results of the GSR assessment, ISS implementation has fewer triple bottom-line impacts in comparison to ISTR implementation.

3.3. CAPITAL COSTS

The capital costs for full-scale implementation of ISTR and ISS were estimated to support the technology evaluation. The estimated capital cost for full-scale ISTR implementation is $14.6 million, which is slightly higher than the estimated capital cost for full-scale ISS implementation ($13.8 million). Table 5 provides a summary of the capital costs for the full-scale implementation of ISTR and ISS.

Although the estimated costs for ISTR and ISS implementation are generally comparable, the estimated costs for ISTR have a greater uncertainty because of the following factors:

- Volumes of waste requiring disposal, particularly the NAPL
- Cost of energy
- Duration of operation required to remove mobile NAPL

For instance, due to high variability in NAPL composition across the site, as well as hydraulic and hydrogeologic variability in the heterogeneous fill geology, significant variability in the ISTR treatment operation and duration is likely during the full scale implementation. This uncertainty results in significant variability in estimate costs, which are considered rough order of magnitude. As an example, at the pilot scale, operational costs increased by 30% as a result in variability in NAPL removal efficiency over time from the initial estimate.

3.4. TECHNOLOGY SELECTION FOR FULL-SCALE IMPLEMENTATION

Table 6 summarizes the evaluation of ISTR and ISS combined with the slurry wall for treatment of the IR-03 NAPL. Based on this assessment, ISS was selected to treat mobile, highly-saturated NAPL at IR-03 for the full-scale RD because of its improved performance relative to ISTR. Physical testing during the ISS field pilot study demonstrated the technology was capable of 1) reducing permeability in treated soil to 10^{-6} cm/sec and 2) reducing leaching of COPEC concentrations to less than surface water quality criteria for aquatic wildlife and total TPH concentrations to less than 1,400 µg/L (CIJV and CDM Smith, 2016b). To address migration of COPECs for the entire NAPL-impacted area, ISS is augmented with a slurry wall that surrounds the entire NAPL-impacted area. Using this design, ISS will immobilize NAPL and reduce leaching from the highly mobile NAPL-saturated interior of the treatment volume, where the potential for COPEC leaching to groundwater is greatest. Further leaching reduction is expected with full-scale design

due the containment achieved with the installation of a slurry wall to prevent groundwater discharge from residual NAPL outside and from the ISS-treated zone to the Bay. In addition, shoreline protection will include excavation to remove NAPL between the slurry wall and San Francisco Bay, which will further reduce leaching. Collectively, the multi-technology strategy is intended to provide a robust means to achieve RAOs. Figure 35 in the DBR presents an overview of the NAPL remediation approach.

Section 4. References

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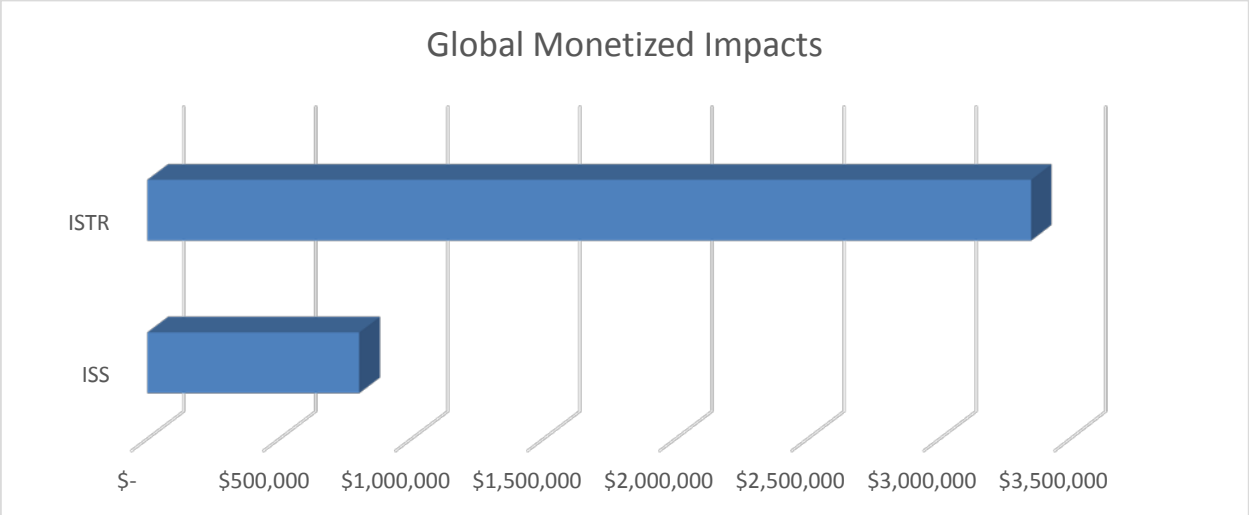
Figures

Figure 1. Global Monetized Impacts



Tables

Table 1. Environmental Footprint Input Parameters

ISTR	ISS
1. Fuel and raw material usage to install extraction wells	1. Fuel usage to operate drill rig
2. Energy usage for thermal treatment	2. Raw material usage for stabilization (e.g., concrete and bentonite)
3. Required virgin GAC	3. Water consumption to mix stabilization materials
4. Water consumption for steam generation	4. Volume of waste transported off site
5. Volume of waste transported for offsite disposal	

Table 2. Environmental Footprint Metrics and Relative Impact Categories

GSR Metric Categories	GHG Emissions (metric ton)	Total Energy Used (MMBTU)	Water Consumption (gallons)	Electricity Usage (MWH)	Onsite NOx Emissions (metric ton)	Onsite SOx Emissions (metric ton)	Onsite PM10 Emissions (metric ton)	Total NOx Emissions (metric ton)	Total SOx Emissions (metric ton)	Total PM10 Emissions (metric ton)	Accident Risk* Fatality	Accident Risk* Injury	Community Impacts	Resources Lost
Remedial Alternative: *in situ* Solidification/Stabilization (ISS)														
Footprint Metric	2458.64	2.09E+04	2.50E+04	0.00E+00	2.56E+00	2.61E-01	2.30E-01	7.08E+00	9.09E+00	2.00E+00	2.96E-04	7.30E-02	NA	NA
Relative Impact	Medium	Low	Low	Low	High	High	High	High	High	High	Low	Low	Low	Low
Remedial Alternative: *in situ* Thermal Remediation (ISTR)														
Footprint Metric	7941.16	1.34E+05	8.65E+06	1.32E+04	2.69E+00	2.75E-01	2.42E-01	8.61E+00	6.31E+00	1.58E+00	3.91E-04	8.33E-02	NA	NA
Relative Impact	High	High	High	High	High	High	High	High	Medium	High	Low	Low	High	High

Notes:

*Accident Risk is an estimate of how many accidents may occur. This risk is not the same as Cancer Risk, which is the probability (for a single person) of getting cancer. Accident risk is not comparable to Cancer Risk due to inherent fundamental differences.

GHG = greenhouse gas

MMBTU = one million British Thermal Units

MWH = megawatt hour

NA = not applicable

NO_x = nitrogen oxides

PM_{10} = coarse particulate matter

SO_x = sulfur oxides

Table 3. Social Cost of the Environmental Metrics

Environmental Metric	Social Cost per Metric Ton (2015 US$)	Financial Implications to Society
Carbon Dioxide	$64.01	Long-term global impacts of climate change, including changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services (Interagency Working Group on Social Cost of Carbon, United States Government, 2013)
Methane, Nitrous Oxide	$1,616.57	Long-term global impacts of climate change, including changes in agriculture, energy production, water availability, human health, coastal communities, and biodiversity (Marten and Newbold, 2012)
Energy (non-carbon social cost)	$22,227.75	Long-term societal impacts, including health costs, shortened life spans, environmental mitigation, and broad impacts of climate change (Greenstone et al., 2011)
NOx, SOx, PM10	$13.76	Long-term societal impacts, including health effects, reduced crop and timber yields, materials depreciation, lost recreation services, and reduced visibility (Muller and Mendelsohn, 2010)

Table 4. Cost for Environmental Impact Metrics

Remedial Alternatives	GHG Emissions[1] (metric tons)	Total energy Used (MMBTU)	Total NOx Emissions (metric tons)	Total SOx Emissions (metric tons)	Total PM10 Emissions (metric tons)
Environmental Impact Metrics under Each Alternative[2]					
ISS	2,458.6	2.09E+04	7.08E+00	9.09E+00	2.00E+00
ISTR	7,941.2	1.34E+05	8.61E+00	6.31E+00	1.58E+00
Unit Social Cost for Environmental Impact Metrics[3]					
Social Cost in 2015 US$	$182.59	$13.76	$1,449.24	$5,441.25	$2,582.29

Social Cost of Environmental Impact Metrics for Each Alternative 2015 US$						Total Social Cost
ISS	$448,927	$288,130	$10,263	$49,463	$5,172	$801,954
ISTR	$1,449,988	$1,847,496	$12,484	$34,339	$4,081	$3,348,389

Notes:

[1] Greenhouse gas emissions (GHG) are generally comprised of 99% carbon dioxide (CO_2), 0.5% methane (CH_4), and 0.5% nitrous oxide (N_2O).

[2] Based on results from footprint analysis using Sitewise™.

[3] Social cost of environmental metrics are based on:

- CO_2 (2007 US$, 2.5% discount rate): United States Government, Interagency Working Group on Social Cost of Carbon. (2013). Technical support document: "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866." Revised July 2015.
- CH_4 and N_2O (2020 US$, 2.5% discount rate): Marten, A.L., E.A. Kopits, C.W. Griffiths, S.C. Newbold, and A. Wolverton, 2015. "Incremental CH_4 and N_2O Mitigation Benefits Consistent with the US Government's SC-CO_2 Estimates." *Climate Policy.* Volume 15, No. 2. Pages 272–298.
- Energy (2000 US$): Greenstone, M. and A. Looney, (2011). "A Strategy for America's Energy Future: Illuminating Energy's Full Costs." *The Hamilton Project Strategy Paper.* Washington, DC: Brookings.
- Total Nitrogen Oxides (NO_x), Sulfur Oxides (SO_x), and Particulate Matter (PM_{10}) (2002 US$, 99th Quantile, based on site location within San Francisco): Muller, N.Z., and R. Mendelsohn, 2010. "Weighing the Value of a Ton of Pollution." *Regulation.* Volume 33, No. 2. Pages 20–24.

[4] Methodology used to quantify social cost of environmental impacts metrics based on:

- Harclerode, M.A., P. Lal, and M.E. Miller, 2015. "Quantifying Global Impacts to Society from the Consumption of Natural Resources during Environmental Remediation Activities." *Journal of Industrial Ecology*, Special Issue: Linking Local Consumption to Global Impacts.
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Table 5. Capital Cost Comparison for Full-Scale ISTR and ISS

Item	Slurry Wall/ISTR ($M)	Slurry Wall/ISS ($M)
Slurry Wall[1]	$1.7	$1.7
In-Situ Solidification/Stabilization[2]	--	$10.3
In-Situ Thermal Remediation[2]	$7.6	--
Waste Transportation and Disposal[3]	$4.0	$1.2
Radiological Control	$1.3	$0.6
Capital Cost ($M)	$14.6	$13.8

Notes:

1 = Slurry wall is estimated to be 1,810 linear feet and extends 2 feet into the Bay Mud.

2 = Cost for treating approximately 60,000 square feet to the Bay Mud, approximately 50,000 cubic yards, includes radiological control.

3 = Includes slurry wall and ISS (soil, bentonite, equipment decontamination) or ISTR (soil cuttings, NAPL, GAC, equipment decontamination) remediation waste.

GAC = granular activated carbon

ISS = in-situ solidification/stabilization

ISTR = in-situ thermal remediation

NAPL = nonaqueous-phase liquid

-- = Indicates that the cost item is not applicable.

Table 6. Summary of Technology Evaluation

Criteria	Metric	Rating	
		ISTR	ISS
Implementability	Qualitative rating that measures the complexity of implementation	Difficult	Moderately Difficult
Sustainability	Qualitative rating based on quantitative environmental impact analysis (using Sitewise™)	High	Moderate
Capital Cost	Capital cost ($M)	$14.7	$13.8

Notes:

ISS = in-situ solidification/stabilization

ISTR = in-situ thermal remediation

Attachment G1. Sitewise™ Output Results

Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Stabilization/Solidification

Sustainable Remediation Summary

Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NO_x Emissions	Percent Total	Onsite SO_x Emissions	Percent Total
	metric ton	%	MMBTU	%	gallons	%	Mwh	%	metric ton	%	metric ton	%
Consumables	11,713.57	97.74	6.5E+04	95.19	NA	NA	NA	NA	NA	-	NA	-
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-
Equipment Use and Miscellaneous	267.67	2.23	3.2E+03	4.75	2.5E+04	100.00	0.0E+00	0.00	2.6E+00	100.00	2.6E-01	100.00
Residual Handling	2.84	0.02	3.9E+01	0.06	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-
Total	11,984.08	100.0	6.80E+04	100.0	2.50E+04	100.0	0.00E+00	0.0	2.56E+00	100.0	2.61E-01	100.0

Acronyms:

% - percent
GHG - greenhouse gases
MMBTU - one million British Thermal Units
Mwh - megawatt hour
NA - not applicable
NO_x - nitrogen oxides
PM_{10} - coarse particulate matter
SO_X - sulfur oxides

Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Stabilization/Solidification

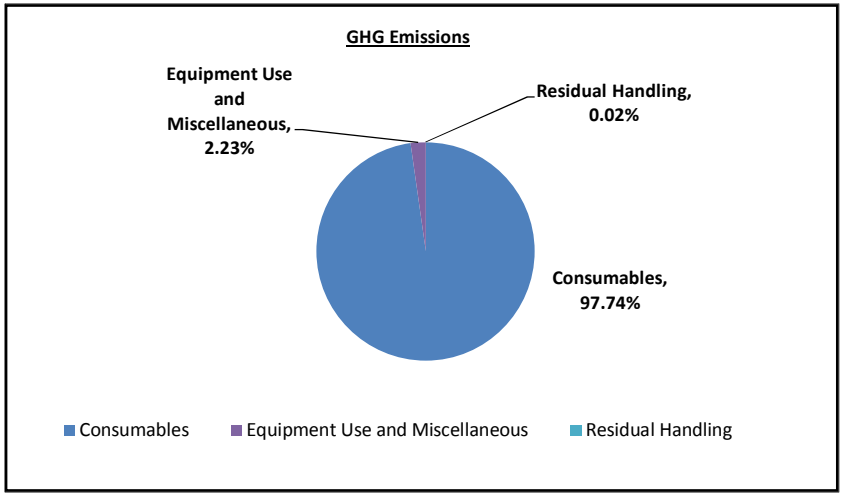
Sustainable Remediation Summary

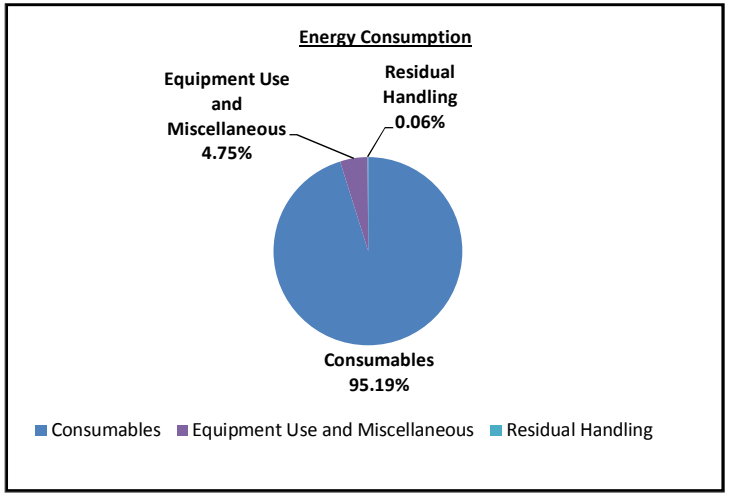
Activities	Onsite PM_{10} Emissions	Percent Total	Total NO_x Emissions	Percent Total	Total SO_x Emissions	Percent Total	Total PM_{10} Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	NA	-	2.3E+01	89.65	4.7E+01	99.28	9.4E+00	97.38	NA	NA	NA	NA
Transportation-Personnel	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Miscellaneous	2.3E-01	100.00	2.7E+00	10.35	3.4E-01	0.72	2.5E-01	2.62	2.9E-04	97.49	7.2E-02	99.18
Residual Handling	0.0E+00	-	9.1E-04	0.004	3.7E-05	0.0001	7.4E-05	0.0008	7.4E-06	2.51	6.0E-04	0.82
Total	2.30E-01	100.0	2.61E+01	100.0	4.72E+01	100.0	9.62E+00	100.0	2.96E-04	100.0	7.30E-02	100.0

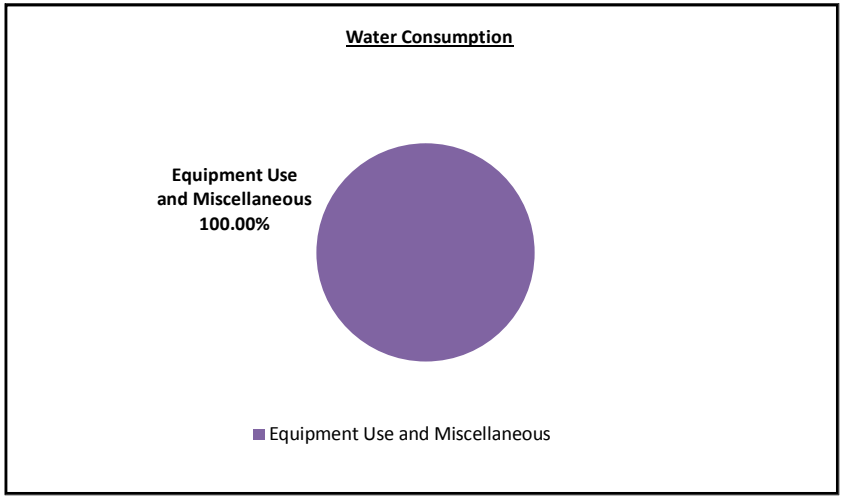
Acronyms:

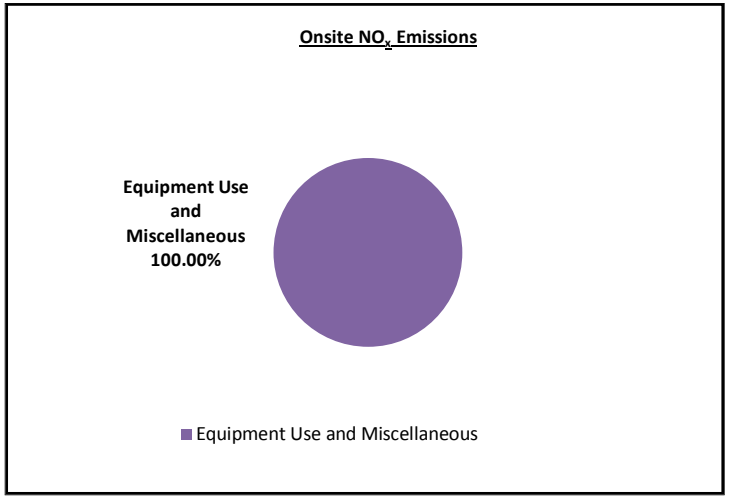
% - percent
GHG - greenhouse gases
MMBTU - one million British Thermal Units
Mwh - megawatt hour
NA - not applicable
NO_x - nitrogen oxides
PM_{10} - coarse particulate matter
SO_X - sulfur oxides

Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Stabilization/Solidification

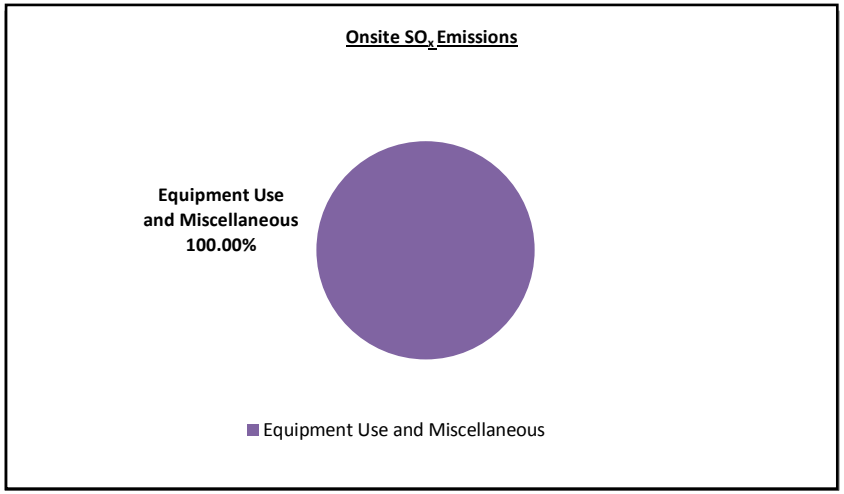


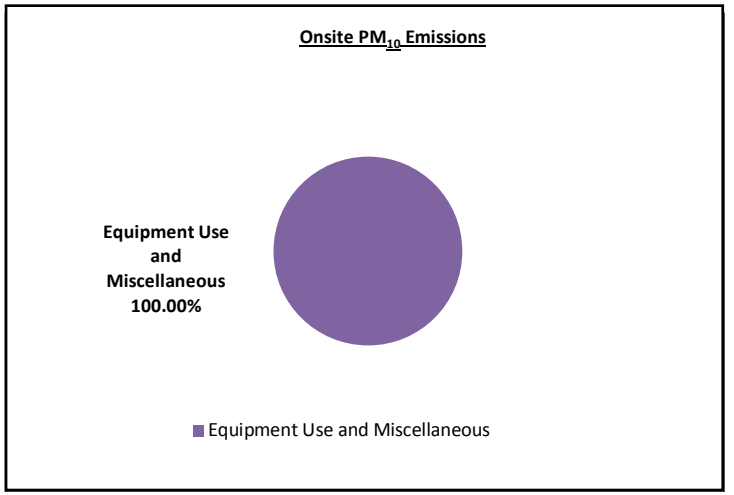


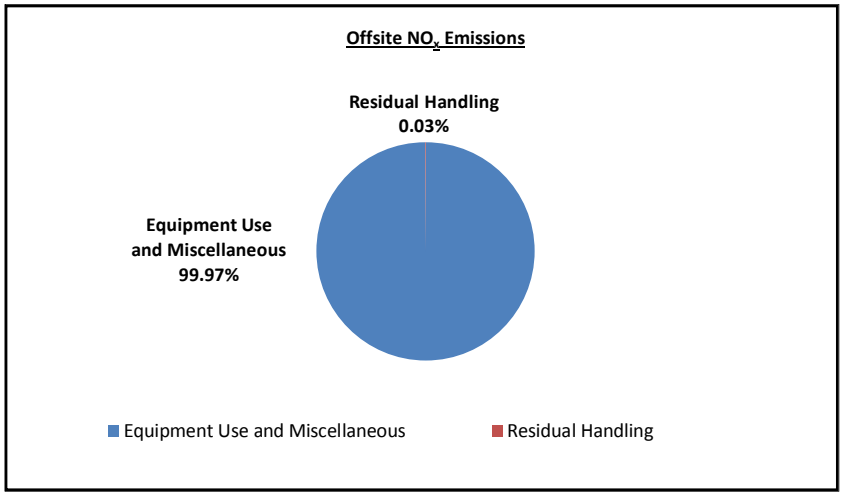


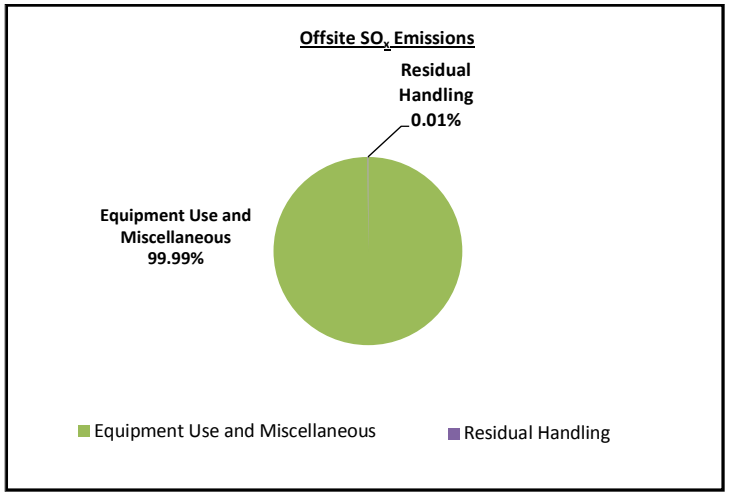


Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Stabilization/Solidification

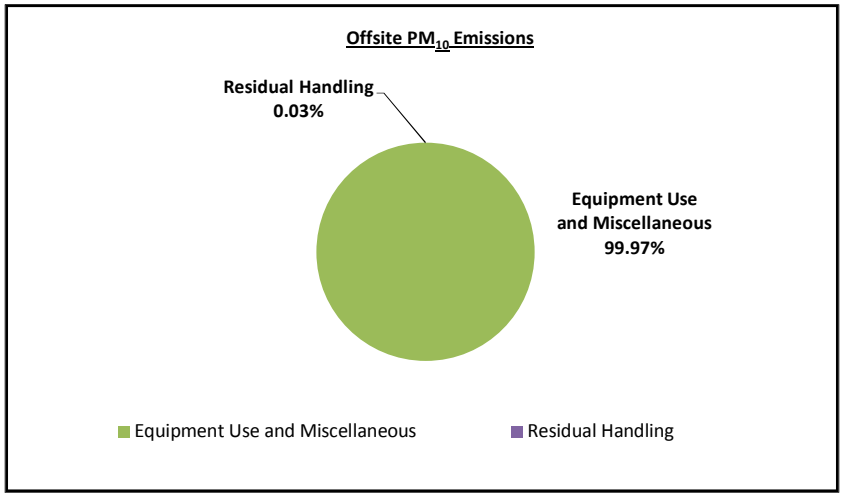


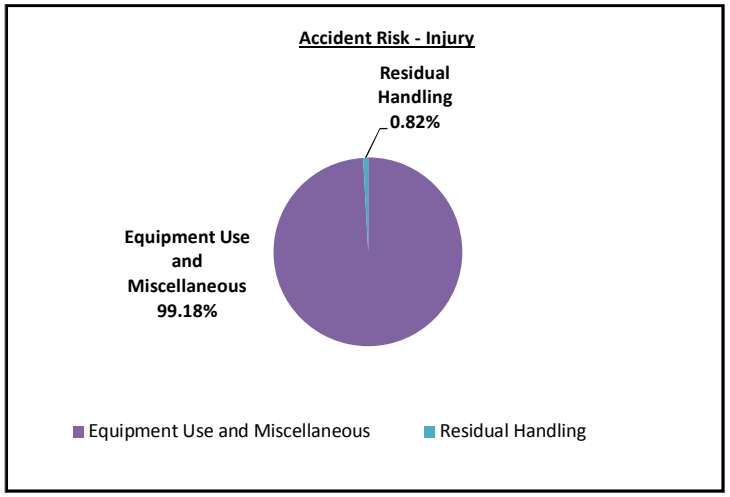


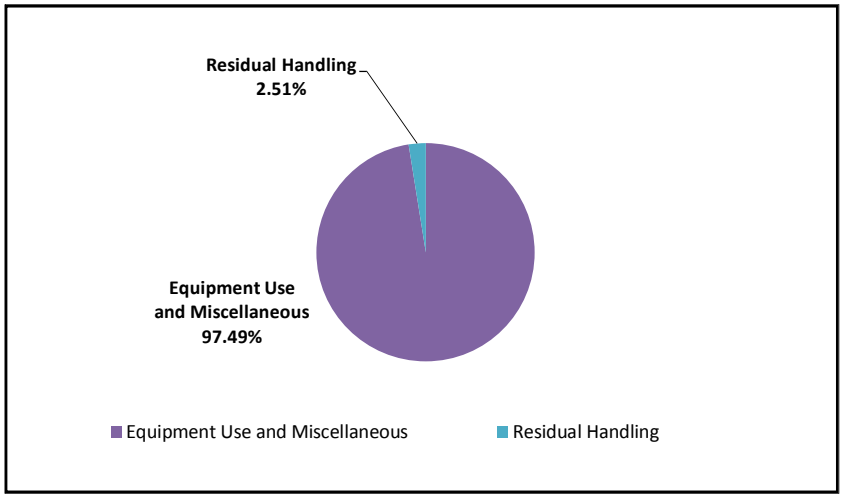




Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Stabilization/Solidification







Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Thermal Remediation

Sustainable Remediation Summary

Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NO_x Emissions	Percent Total	Onsite SO_x Emissions	Percent Total
	metric ton	%	MMBTU	%	gallons	%	Mwh	%	metric ton	%	metric ton	%
Consumables	3,248.33	43.11	2.4E+04	23.47	NA	NA	NA	NA	NA	-	NA	-
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-
Equipment Use and Misc	4,252.84	56.45	7.9E+04	76.10	5.3E+06	100.00	6.7E+03	100.00	1.2E+01	100.00	3.0E-01	100.00
Residual Handling	33.03	0.44	4.5E+02	0.44	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-
Total	7,534.21	100.0	1.04E+05	100.0	5.31E+06	100.0	6.68E+03	100.0	1.16E+01	100.0	2.98E-01	100.0

Acronyms:

% - percent
GHG - greenhouse gases
MMBTU - one million British Thermal Units
Mwh - megawatt hour
NA - not applicable
NO_x - nitrogen oxides
PM_{10} - coarse particulate matter
SO_x - sulfur oxides

Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Thermal Remediation

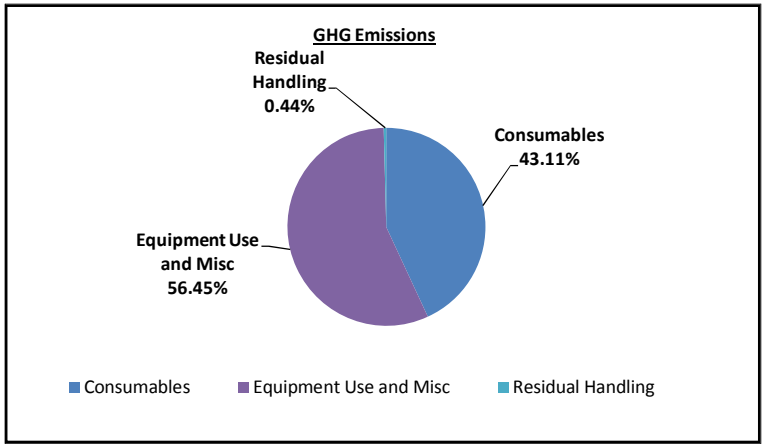
Sustainable Remediation Summary

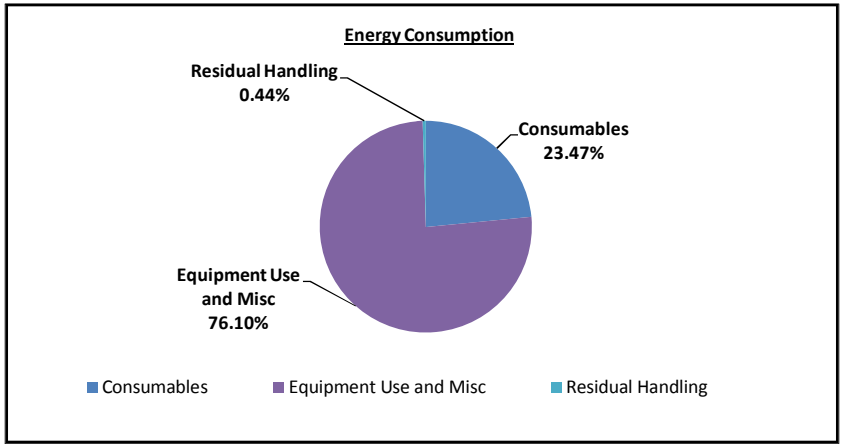
Activities	Onsite PM_{10} Emissions metric ton	Percent Total %	Total NO_x Emissions metric ton	Percent Total %	Total SO_x Emissions metric ton	Percent Total %	Total PM_{10} Emissions metric ton	Percent Total %	Accident Risk Fatality	Percent Total %	Accident Risk Injury	Percent Total %
Consumables	NA	-	2.5E+00	14.68	4.1E+00	69.05	8.3E-01	41.87	NA	NA	NA	NA
Transportation-Personnel	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	7.0E-01	100.00	1.4E+01	85.26	1.9E+00	30.94	1.1E+00	58.09	3.0E-04	77.62	7.6E-02	91.55
Residual Handling	0.0E+00	-	1.1E-02	0.06	4.3E-04	0.01	8.6E-04	0.04	8.7E-05	22.38	7.0E-03	8.45
Total	7.04E-01	100.0	1.69E+01	100.0	5.99E+00	100.0	1.97E+00	100.0	3.91E-04	100.0	8.33E-02	100.0

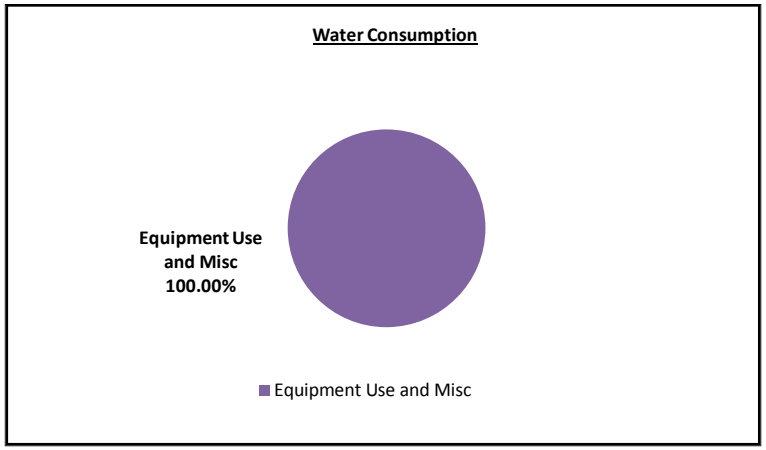
Acronyms:

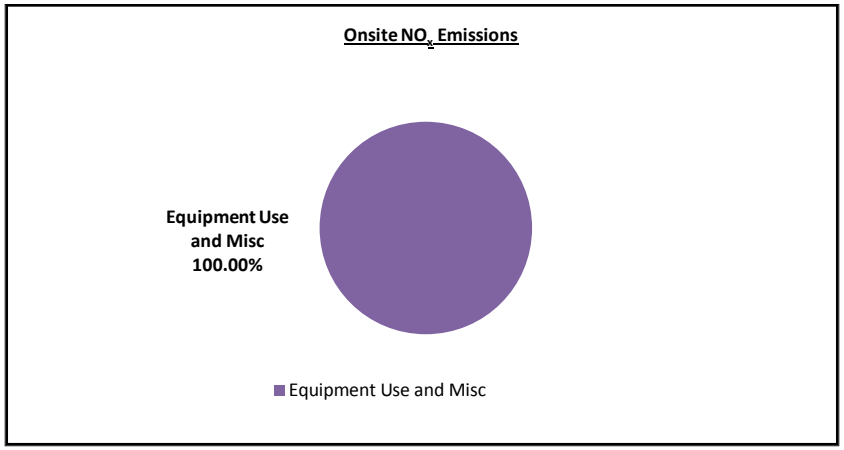
% - percent
GHG - greenhouse gases
MMBTU - one million British Thermal Units
Mwh - megawatt hour
NA - not applicable
NO_x - nitrogen oxides
PM_{10} - coarse particulate matter
SO_X - sulfur oxides

Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Thermal Remediation

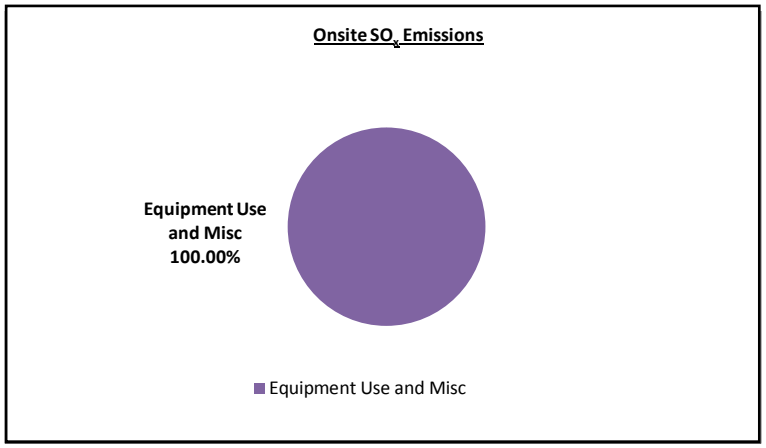


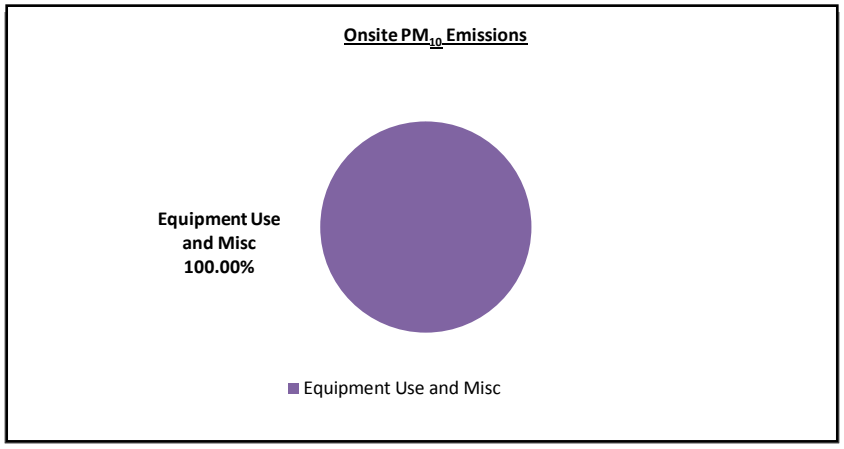


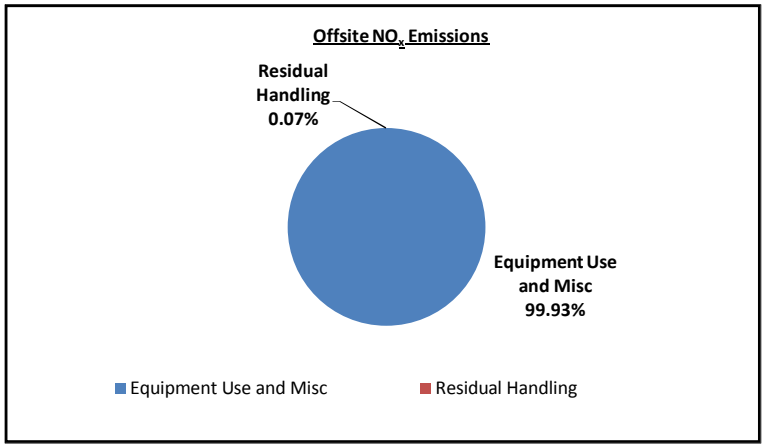


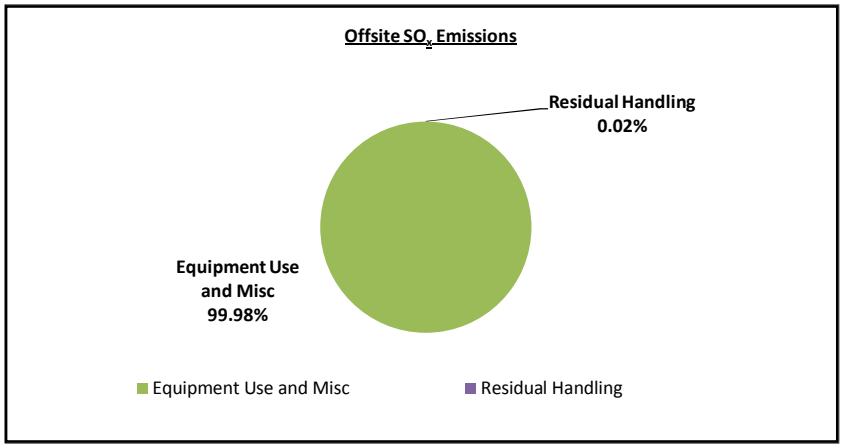


Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Thermal Remediation

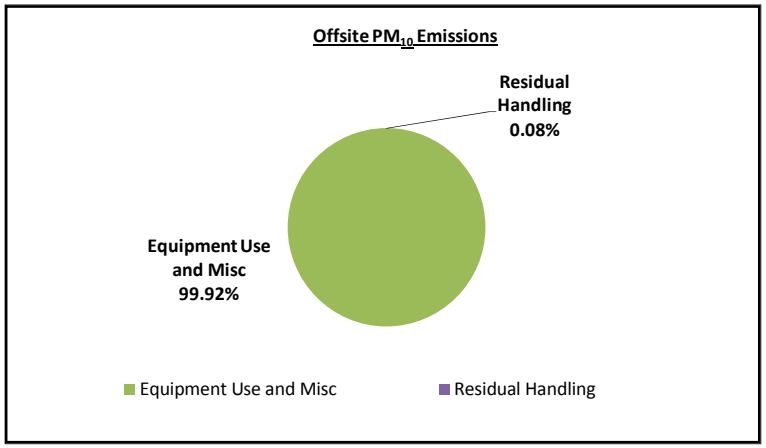


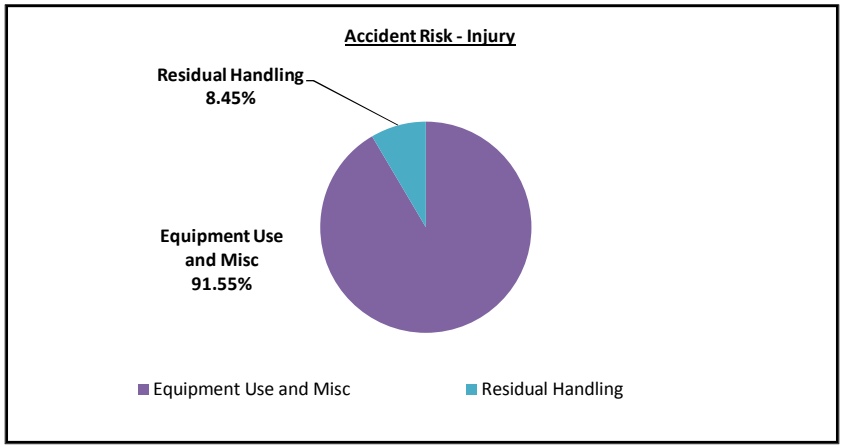


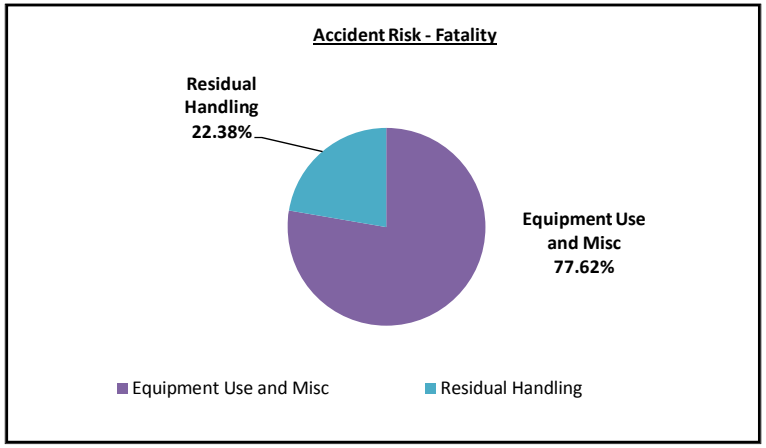




Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results: In-Situ Thermal Remediation







Attachment G1 - Green and Sustainable Remediation Assessment
SiteWise™ Results

Remedial Alternatives	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NO_x Emissions	Onsite SO_x Emissions	Onsite PM_{10} Emissions	Total NO_x Emissions	Total SO_x Emissions	Total PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	Mwh	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
ISS	2458.64	2.09E+04	2.50E+04	0.00E+00	2.56E+00	2.61E-01	2.30E-01	7.08E+00	9.09E+00	2.00E+00	2.96E-04	7.30E-02
ISTR	7941.16	1.34E+05	8.65E+06	1.32E+04	2.69E+00	2.75E-01	2.42E-01	8.61E+00	6.31E+00	1.58E+00	3.91E-04	8.33E-02

Relative Impact

Remedial Alternatives	GHG Emissions	Energy Usage	Water Usage	Electricity Usage	Onsite NO_x Emissions	Onsite SO_x Emissions	Onsite PM_{10} Emissions	Total NO_x emissions	Total SO_x Emissions	Total PM10 Emissions	*Accident Risk Fatality	*Accident Risk Injury	Community Impacts	Resources Lost
ISS	Medium	Low	Low	Low	High	High	High	High	High	High	Low	Low	Low	Low
ISTR	High	High	High	High	High	High	High	High	Medium	High	Low	Low	High	High

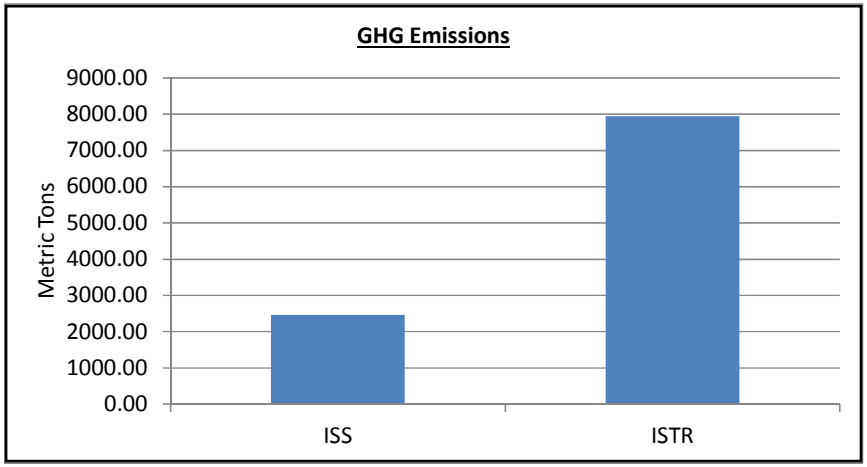
*Accident Risk is an estimate of how many accidents may occur. This risk is not the same as Cancer Risk, which is the probability (for a single person) of getting cancer. Accident risk is not comparable to Cancer Risk due to inherent fundamental differences.

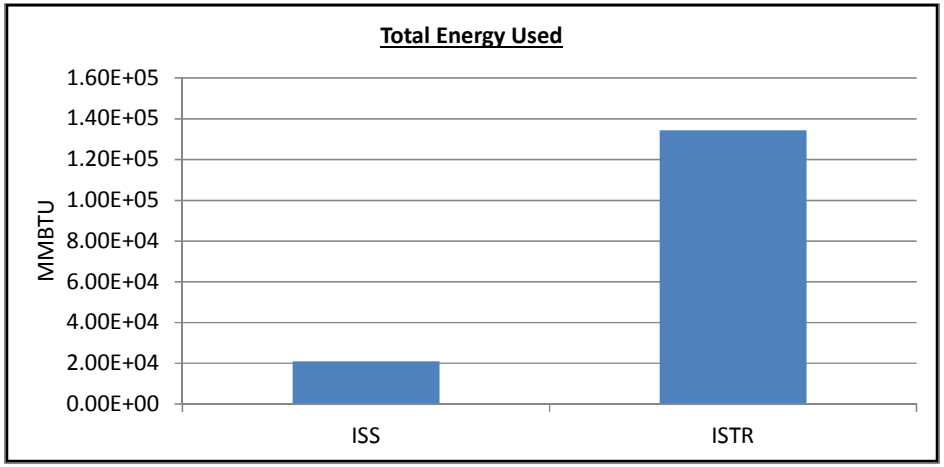
Acronyms:

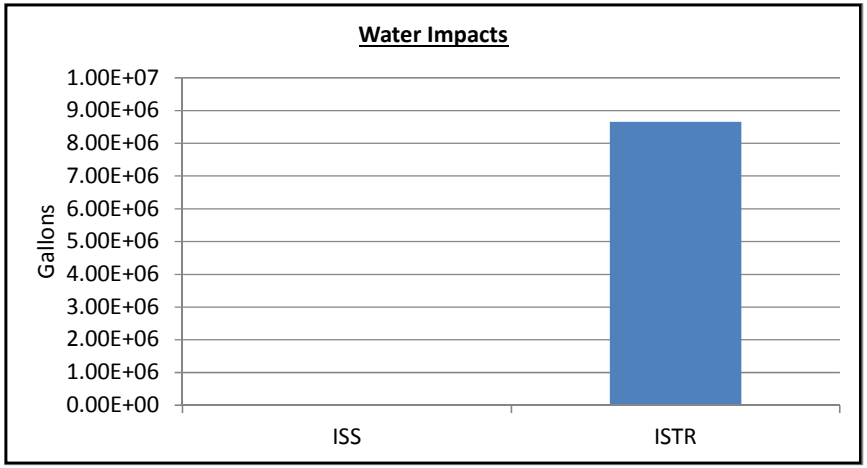
GHG - greenhouse gases
ISS - in-situ stabilization/solidification
ISTR - in-situ thermal remediation ISTR
MMBTU - one million British Thermal Units
Mwh - megawatt hour
NO_x - nitrogen oxides
PM_{10} - coarse particulate matter
SO_x - sulfur oxides

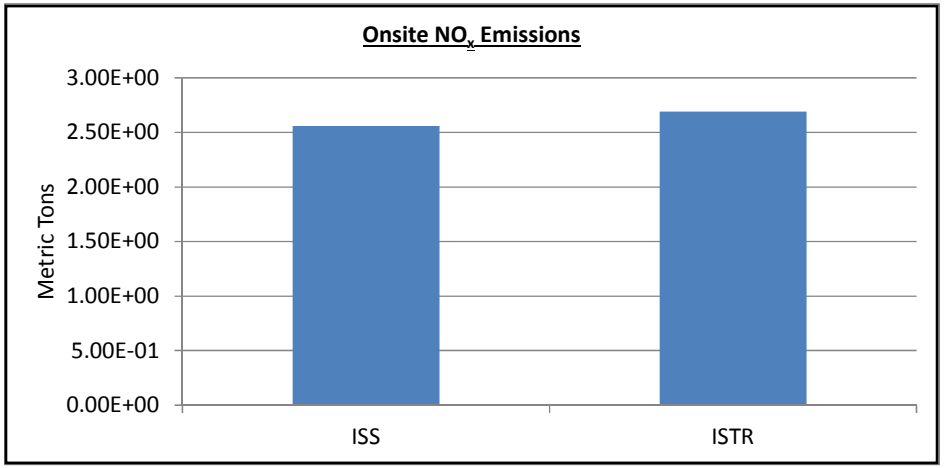
Attachment G1 - Green and Sustainable Remediation Assessment

SiteWise™ Results



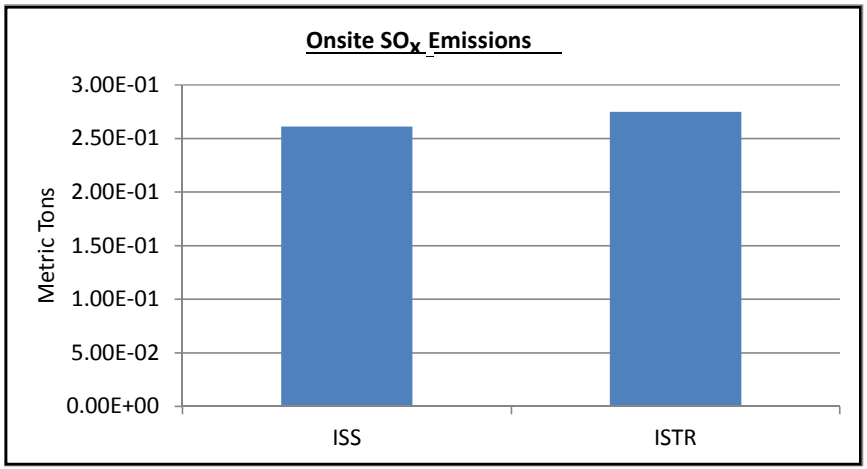


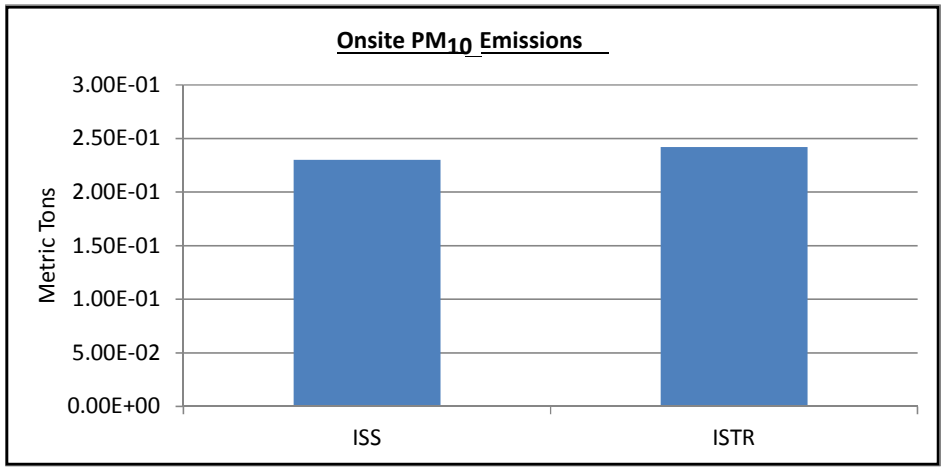


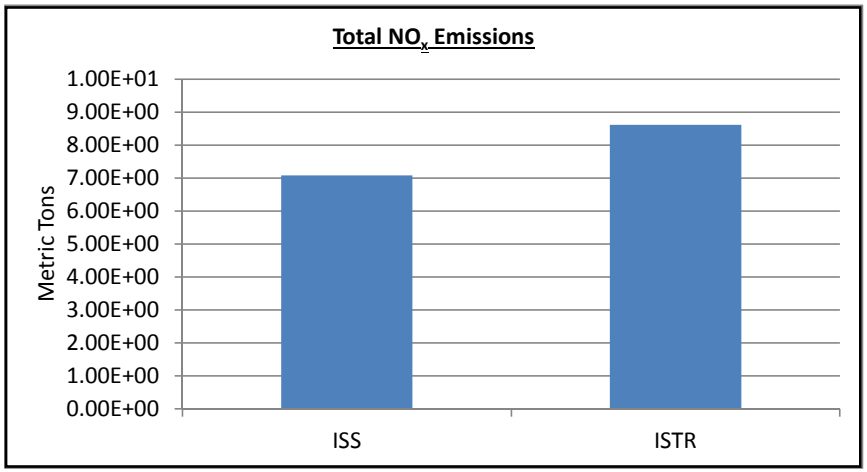


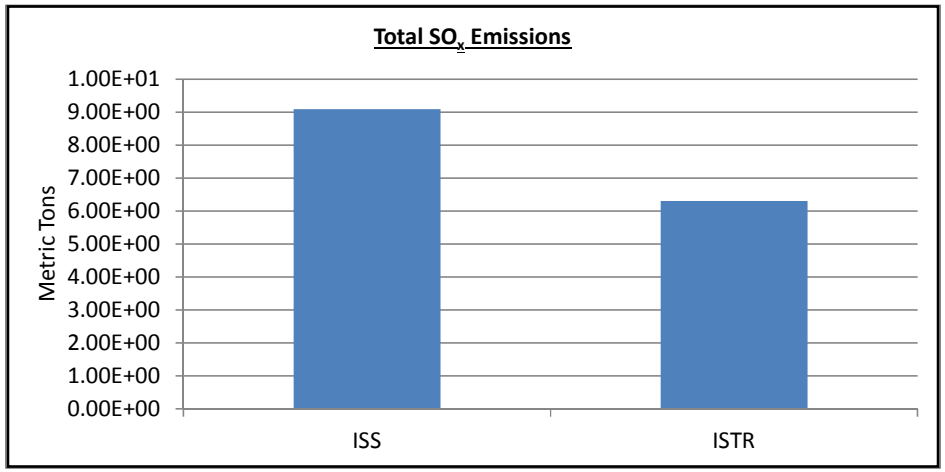
Attachment G1- Green and Sustainable Remediation Assessment

SiteWise™ Results



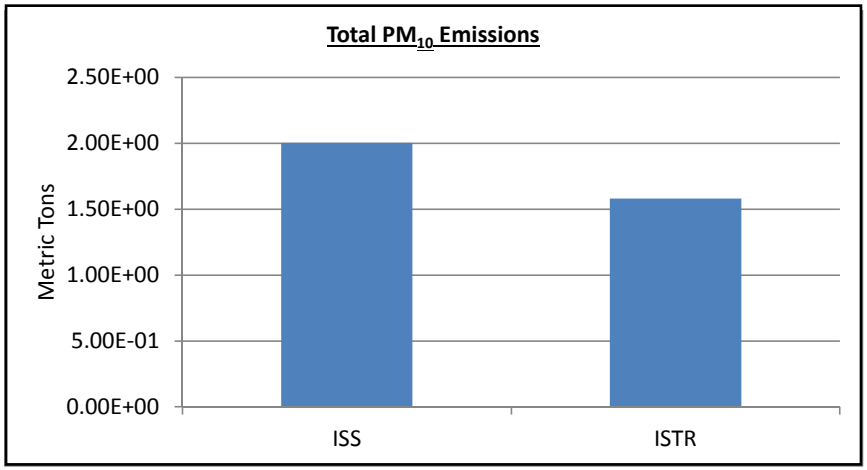


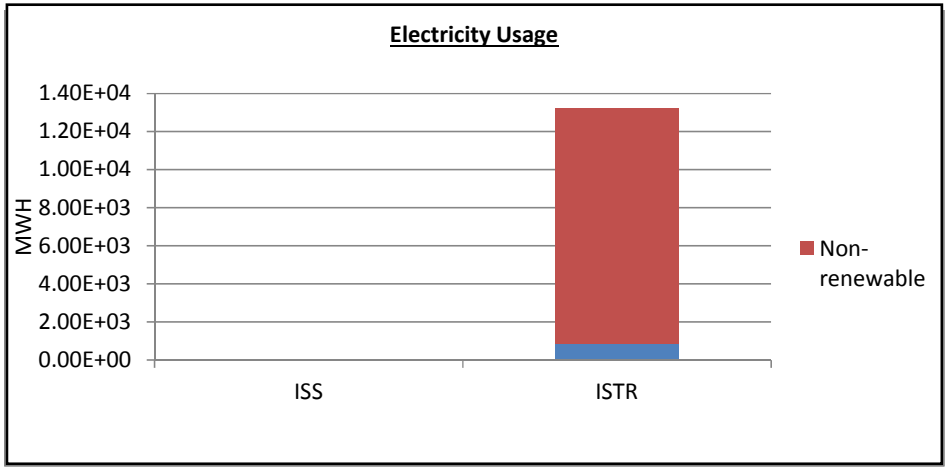


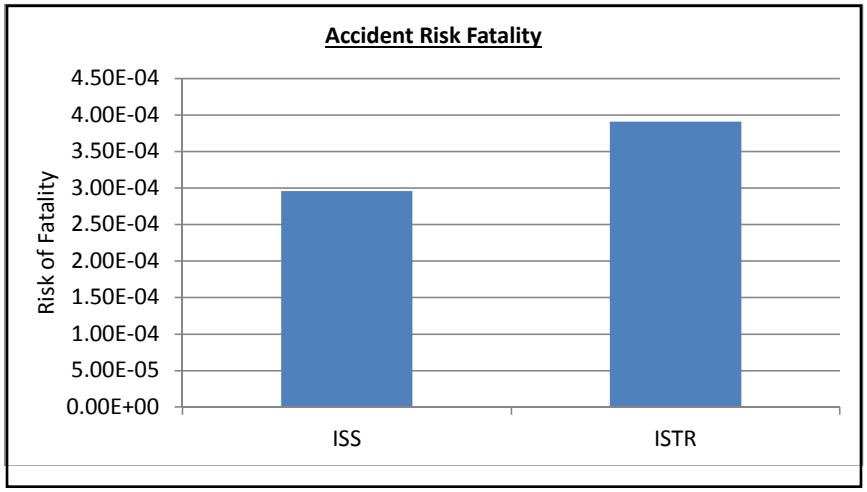


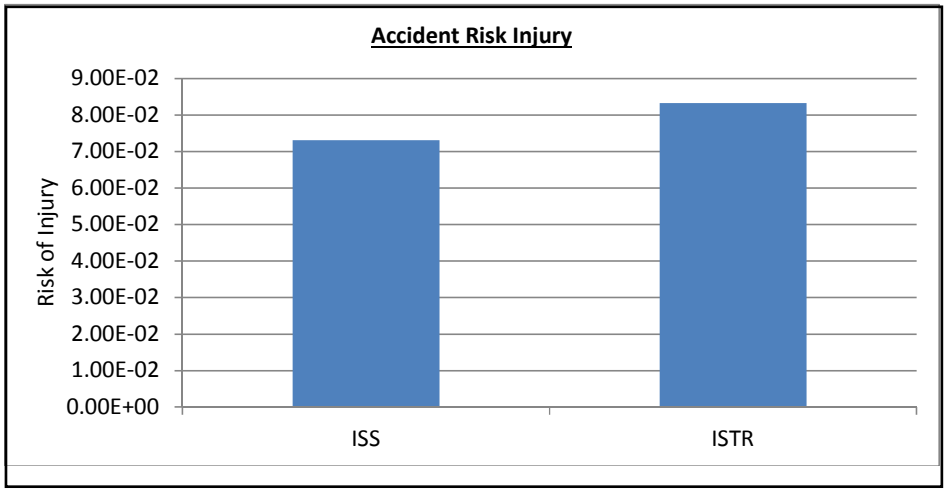
Attachment G1 - Green and Sustainable Remediation Assessment

SiteWise™ Results



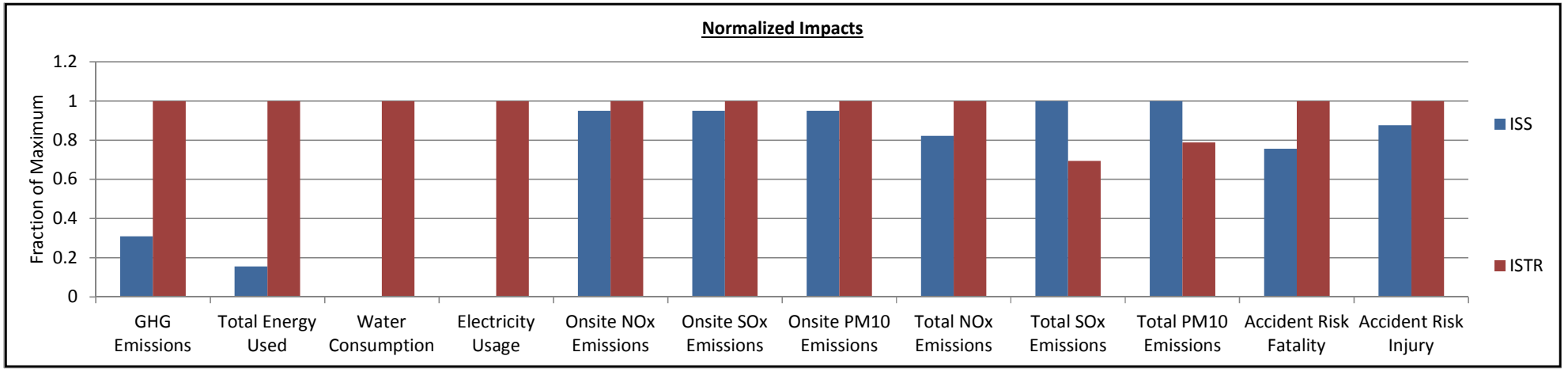






Attachment G1 - Green and Sustainable Remediation Assessment

SiteWise™ Results



Appendix H. Preliminary Radiological Risk Modeling

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Table 2. Radiological Risk Results, 3-Foot Cover
Table 3. Radionuclide Soil Data Summary

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Attachment H1. RESRAD Modeling and Risk Calculations *(provided on CD only)*

Acronyms and Abbreviations

ERRG	Engineering/Remediation Resources Group, Inc.
FS	Feasibility Study
ICs	institutional controls
IR	Installation Restoration
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRDL	Naval Radiological Defense Laboratory
RESRAD	Residual Radioactivity (Model)
RI	Remedial Investigation
ROCs	radionuclides of concern
RSRS	Radiological Survey and Remedial Services, LLC

Section 1. Purpose

Two general sources of potential radioactive contamination exist at Parcel E: research activities at various buildings formerly occupied by the Naval Radiological Defense Laboratory (NRDL) and historical waste disposal activities that occurred along the shoreline (referred to as Installation Restoration [IR] Sites IR-02 and IR-03). Historical activities in IR-02 and IR-03 included the disposal of radioluminescent commodity items (such as dials, gauges, and deck markers) in conjunction with the disposal of other construction debris and industrial wastes. In developing the response actions for radiologically impacted media, the Department of the Navy (Navy) considered the historical operations and the available data on the distribution of radioactivity. At most radiologically impacted sites at Parcel E, radioactive contamination is present in shallow soil and is the result of historical operations at buildings or open storage areas. At these types of sites, removal by excavation is considered a practical and cost-effective means of preventing unacceptable exposure to humans. However, the operational history at IR-02 and IR-03 involved historical filling with soil and construction debris and intermittent disposal of various shipyard wastes, including radiological devices, and required an evaluation of a combination of removal and containment. The Navy focused the removal of radionuclides of concern (ROCs) to the surface of IR-02 and IR-03 because these areas posed the most significant risk to future recreational users. Following cleanup of ROCs within 1 foot of the existing ground surface, a cover (comprising clean imported soil and geosynthetic material) and institutional controls (ICs) would effectively prevent unacceptable exposures to remaining concentrations of ROCs.

As described in the Record of Decision for Parcel E (Navy, 2013), the selected remedy for Parcel E includes the following actions to address radiologically impacted media in IR-02 and IR-03: (1) scanning the entire area for radioactivity to a depth of at least 1 foot; (2) removing residual radiological contamination to a depth of 1 foot (the maximum effective depth of the surface survey) and disposing of it at an approved landfill; (3) constructing a 2-foot-thick soil cover (as provided by the selected remedy for soil) to prevent exposure to remaining contaminants and installing a demarcation layer to mark the boundary between the existing surface and the soil cover; (4) conducting regular inspections and maintenance (as provided by the selected remedy for soil) of the soil cover and adjoining shoreline protection features to ensure their integrity; and (5) implementing ICs to limit the use of land or restrict activities that take place within the area. Prior to constructing the soil cover, the Navy will perform a final radiological surface survey throughout IR-02 and IR-03 to identify and remove radiological contamination to a depth of 1 foot (the maximum effective depth of the surface survey). Deeper soil excavation will be performed at IR-02 and IR-03, if necessary, to ensure that the residual radiological risk (i.e., the incremental excess cancer risks from exposure to radionuclides in soil) at the final ground surface (following installation of a demarcation layer and soil cover) is

acceptable. The residual radiological risk at the final ground surface (based on residential exposure) will be within the risk management range (i.e., 10^{-6} to 10^{-4}) specified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The survey and risk modeling procedures will be outlined in the Remedial Action Work Plan. However, as described in Section 3.11.3 of the Design Basis Report, the Navy performed preliminary radiological risk modeling to help inform the design process and guide future radiological remediation activities at IR-02 and IR-03. Specifically, preliminary risk modeling was performed to identify an upper bound of acceptable radiological contamination that can remain below the soil cover and demarcation layer without posing a future risk that exceeds the risk management range (10^{-6} to 10^{-4}) specified in the NCP. The preliminary risk modeling was performed using procedures initially developed in the radiological addendum to the Feasibility Study (FS) Report (Engineering/Remediation Resources Group, Inc. [ERRG] and Radiological Survey and Remedial Services, LLC [RSRS], 2012).

This appendix presents the methodology and evaluations used to estimate the potential radiological risk to humans from exposure to remaining radioactivity under the final 2-foot-thick soil cover and demarcation layer. When combined with the minimum 1-foot-thick foundation[1] that will be free of radioactive contamination exceeding the remediation goals, the total thickness of the radiologically cleared surface soil will be 3 feet. Accordingly, this preliminary risk modeling evaluates the shielding provided by a 3-foot-thick soil cover.

The remainder of this appendix is organized as follows:

- Section 2 presents an overview of the methodology used for the radiological risk modeling.
- Section 3 discusses the results of the radiological risk modeling.
- Section 4 presents the references cited in this appendix.

Tables and attachments are presented after Section 4.

[1] This statement refers to the upper 1 foot of soil that will be surveyed and, if necessary, remediated prior to placement of the final cover (see Section 3.11.3 of the Design Basis Report). As described in Section 3.12.5 of the Design Basis Report, the foundation soil layer will be no less than 2 feet thick.

Section 2. Methodology for Radiological Risk Modeling

The computer code Residual Radioactive (RESRAD) Model (Argonne National Laboratory, 2009) was used to perform the preliminary risk modeling. The site-specific RESRAD modeling uses the isotopes specified as ROCs in IR-02 and IR-03 (radium-226, cesium-137, and strontium-90) and includes the long-lived daughter products of these isotopes; specifically, lead-210, which is a daughter product of radium-226.

RESRAD was used to analyze a residential exposure scenario. Although the residential exposure scenario does not align with the planned open space reuse of IR-02 and IR-03 (City and County of San Francisco, 2010), it represents an upper-bound estimation of risk from exposure to ROCs at IR-02 and IR-03 and is a conservative basis for the design.

Table 1 summarizes the changes to RESRAD default parameters that were previously used in the risk analysis presented in the radiological addendum to the FS Report (ERRG and RSRS, 2012). These parameters, which were repeated in this preliminary risk modeling, were developed to make the receptor scenarios closely match the nonradiological human health risk assessment scenarios (as provided in the Revised Remedial Investigation (RI) Report for Parcel E [Barajas & Associates, Inc., 2008]). All other RESRAD parameters were left at default values. The methodology for the radiological risk analysis is detailed in the radiological addendum to the FS Report (ERRG and RSRS, 2012).

Section 3. Results of Radiological Risk Modeling

Radiological dose and risk were estimated for three different scenarios of residual radioactivity that could be present under the 3-foot-thick cover; which, as described in Section 1, represents the final 2-foot-thick soil cover underlain by a demarcation layer and at least 1 foot of radiologically cleared soil. The following three scenarios include a lower and upper bound of potential residual radioactivity:

- Scenario 1, residual radioactivity equal to the remediation goals (below the 3-foot cover)
- Scenario 2, residual radioactivity equal to 100 times the remediation goals (below the 3-foot cover)
- Scenario 3, residual radioactivity equal to the highest reported activity at Parcels E and E-2 (below the 3-foot cover); these activity levels were associated with radiological anomalies (i.e., devices) that were previously removed

Table 2 summarizes the total radiological risk (including risk attributed to background activity levels) for each of the above three scenarios. The total radiological risk associated with Scenario 1 is well below the risk management range (10^{-6} to 10^{-4}) specified in the NCP. The total radiological risk associated with Scenario 2 is at the lower end of the risk management range, while the total radiological risk associated with Scenario 3 is at the upper end of the risk management range. The dose and risk calculations, detailing the contribution from each ROC and each individual exposure pathway, are presented in Attachment H1.

Table 3 provides the soil data for radionuclides at IR-02, as excerpted from the radiological addendum to the FS Report (ERRG and RSRS, 2012). Table 3 also summarizes the soil data for radionuclides at Parcel E-2, as excerpted from the radiological addendum to the RI/FS Report for Parcel E-2 (ERRG and RSRS, 2011). Previous radiological data at Parcel E-2 was considered in this evaluation because of similar operational histories with IR-02 (i.e., historical waste disposal activities that may have included radiological devices). In addition, previous radiological surveys have collected significantly more data at Parcel E-2 (more than 1,000 soil samples analyzed for ROCs) as compared to Parcel E (fewer than 100 soil samples analyzed for ROCs at IR-02). Table 3 shows that the mean activity levels for ROCs at Parcels E and E-2 (excluding elevated activity levels associated with anomalously high samples that were physically removed) are within the same order of magnitude of the corresponding remediation goals. Accordingly, the estimated total risk from the mean activity levels, if found below the 3-foot-thick cover, is expected to be comparable with the estimated total risk for Scenario 1 (i.e., well below the risk management range specified in the NCP).

The results of the preliminary risk modeling also indicate that the highest reported activity at Parcels E and E-2 represents an upper bound of acceptable radiological contamination that can remain below the soil cover and demarcation layer without posing a future risk that exceeds risk management range (10^{-6} to 10^{-4}) specified in the NCP. This finding indicates that a 3-foot cover would provide effective shielding from residual radioactivity at depth. This finding is attributed to the fact that the external radiation pathway is the critical pathway contributing to potential risk and can be effectively controlled by a soil cover. As the cover depth increases, the resulting risk to the receptor is reduced.

The radiological risk modeling approach will be refined in the Remedial Action Work Plan and provided to the regulatory agencies for review and concurrence prior to implementing final radiological surveys.

Section 4. References

Argonne National Laboratory (ANL), 2009. "RESRAD Version 6.5 Computer Code." Environmental Science Division. October. Available Online at: <http://web.ead.anl.gov/resrad/home2/>.

Barajas & Associates, Inc., 2008. "Final Revised Remedial Investigation Report for Parcel E, Hunters Point Shipyard, San Francisco, California." May 2.

City and County of San Francisco, 2010. "Amended Redevelopment Plan, Hunters Point Shipyard Redevelopment Plan." Map 2, titled "Land Use Districts Map." August 3, 2010 (amendment to July 14, 1997 plan). Available Online at: <http://sfocii.org/sites/default/files/FileCenter/Documents/2429-HPS%20Redevelopment%20Plan%202010_recorded.pdf>.

Department of the Navy (Navy), 2013. "Final Record of Decision for Parcel E, Hunters Point Naval Shipyard, San Francisco, California." December.

Engineering/Remediation Resources Group, Inc. (ERRG) and Radiological Survey and Remedial Services, LLC (RSRS), 2011. "Final Radiological Addendum to the Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard, San Francisco, California." March.

ERRG and RSRS, 2012. "Final Radiological Addendum to the Feasibility Study Report for Parcel E, Hunters Point Shipyard, San Francisco, California." August.

Tables

Table 1. Default and Modified RESRAD Input Parameters

Parameter	RESRAD Default	Resident	
		Adult	Child
Exposure duration (years)	30	24	6
Fraction of time spent indoors (unitless)	0.5	0	0
Fraction of time spent outdors (unitless)	0.25	0.959	0.959
Inhalation rate (m^3/yr)	8,400	7,000	3,500
Soil ingestion rate (g/yr)	36.5	35	70

Notes:

g/yr = grams per year

m^3/yr = cubic meters per year

RESRAD = Residual Radioactivity (Model)

Table 2. Radiological Risk Results, 3-Foot Cover

Modeled Scenario	Total Radiological Risk (Residential Exposure)[a, b]
Scenario 1, Radioactivity Level Equal to Remediation Goals (below 3-foot cover)[c]	1.065E-08
Scenario 2, Radioactivity Levels Equal to 100 Times Remediation Goals (below 3-foot cover)	1.044E-06
Scenario 3, Radioactivity Levels Equal to Historic Maximum Detection (below 3-foot cover)[d]	1.368E-04

Notes:

a = As indicated in Section 2, residential reuse of the site is not anticipated.

b = Risk values are highest estimates for the sum of adult and child receptors, and include contribution of background radioactivity.

c = Remediation goals are as follows:

Radionuclide of Concern	Remediation Goal (pCi/g)
Cesium-137 (^{137}Cs)	0.113
Strontium-90 (^{90}Sr)	0.331
Lead-210 (^{210}Pb)	1.633
Radium-226 (^{226}Ra)	1.633

d = Maximum historical detection for each radionuclide of concern are as follows (these detections were associated with radiological surface anomalies (e.g., devices) at Parcel E-2 that were subsequently removed; ^{210}Pb activity levels are conservatively assumed to be equal to ^{226}Ra activity levels

Radionuclide of Concern	Maximum Historic Activity Level (pCi/g)
^{137}Cs	234
^{90}Sr	849
^{210}Pb	20,953
^{226}Ra	20,953

pCi/g = picocuries per gram

Table 3. Radionuclide Soil Data Summary

Study Area	Radionuclide of Concern	Sample Size	Minimum Activity	Maximum Activity	Mean Activity
Parcel E, IR-02					
IR-02 Northwest	Cesium-137	25	0.026	0.319	0.119
	Radium-226	25	0.230	1.180	0.455
IR-02 Central	Cesium-137	20	0.040	0.400	0.173
	Radium-226	20	0.300	2.00	0.718
IR-02 Southeast	Cesium-137	6	0.051	0.376	0.161
	Radium-226[a]	6	0.390	412	75.6
Parcel E-2, IR-01/21 and 02 [b]					
IR-01/21 and 02 (complete)[c]	Cesium-137	1,215	0.002	234	0.254
	Radium-226	1,215	0.080	20,953	17.3
	Strontium-90	1,192	0.007	849	0.845
IR-01/21 and 02 (filtered)[c]	Cesium-137	1,150	0.002	0.988	0.084
	Radium-226	1,150	0.080	28.5	2.19
	Strontium-90	1,129	0.007	3.58	0.305

Notes: All activities are presented in picocuries per gram (pCi/g)

a = Maximum Radium-226 activity was reported at the ground surface adjacent to an anomaly that was physically removed.

b = Previous radiological data at Parcel E-2 were considered in this evaluation because of similar operational histories with IR-02 (i.e., historical waste disposal activities that may have included radiological devices). In addition, previous radiological surveys have collected significantly more data at Parcel E-2 as compared to Parcel E.

c = Two sets of statistics were calculated for the radiological data at Parcel E-2. The first set includes all data collected, including locations adjacent to radiological anomalies that were subsequently removed. The second set excludes samples that were physically removed (either during the Phase V study or during subsequent removal actions).

IR = Installation Restoration

Attachment H1. RESRAD Modeling and Risk Calculations

(RESRAD modeling and risk calculations provided on CD only.)

Summary : Residential Adult 3 Ft Cover
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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Residential Adult 3 Ft Cover
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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.130E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.633E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	3.310E-01	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	7.000E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.400E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.500E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Adult 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	1.130E-01
Thickness:	2.00 meters	Ra-226	1.633E+00
Cover Depth:	0.91 meters	Sr-90	3.310E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.784E-04	4.770E-04	4.743E-04	4.650E-04	4.394E-04	3.608E-04	2.058E-04	2.884E-05
M(t):	1.914E-05	1.908E-05	1.897E-05	1.860E-05	1.758E-05	1.443E-05	8.231E-06	1.154E-06

Maximum TDOSE(t): 4.784E-04 mrem/yr at t = 0.000E+00 years

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.437E-07	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.776E-04	0.9984	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.346E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.784E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.437E-07	0.0016
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.776E-04	0.9984
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.346E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.784E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.267E-07	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.763E-04	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.162E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.770E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.267E-07	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.763E-04	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.162E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.770E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.938E-07	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.736E-04	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.812E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.743E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.938E-07	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.736E-04	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.812E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.743E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.901E-07	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.644E-04	0.9987	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.733E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.650E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.901E-07	0.0013
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.644E-04	0.9987
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.733E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.650E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	3.715E-07	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.391E-04	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.633E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.394E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.715E-07	0.0008
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.391E-04	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.633E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.394E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.352E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.607E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.382E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.608E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.352E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.607E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.382E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.608E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.184E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.058E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.605E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.058E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.184E-10	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.058E-04	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.605E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.058E-04	1.0000

*Sum of all water independent and dependent pathways.

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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.627E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.884E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.173E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.884E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.627E-17	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.173E-22	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-05	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin) (pCi/g)	G(i,tmin)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.130E-01	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	1.633E+00	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	3.310E-01	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	7.437E-07	7.267E-07	6.938E-07	5.901E-07	3.715E-07	7.352E-08	7.184E-10	6.627E-17
Ra-226	Ra-226	1.000E+00	4.776E-04	4.763E-04	4.736E-04	4.644E-04	4.391E-04	3.607E-04	2.058E-04	2.884E-05
Pb-210	Ra-226	1.000E+00	5.978E-12	1.765E-11	3.979E-11	1.058E-10	2.221E-10	2.897E-10	1.738E-10	2.437E-11
Sr-90	Sr-90	1.000E+00	6.346E-10	6.162E-10	5.812E-10	4.733E-10	2.633E-10	3.382E-11	9.605E-14	1.173E-22

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.130E-01	1.104E-01	1.054E-01	8.966E-02	5.644E-02	1.117E-02	1.092E-04	1.007E-11
Ra-226	Ra-226	1.000E+00	1.633E+00	1.628E+00	1.619E+00	1.588E+00	1.501E+00	1.233E+00	7.035E-01	9.862E-02
Pb-210	Ra-226	1.000E+00	0.000E+00	4.987E-02	1.444E-01	4.265E-01	9.237E-01	1.216E+00	7.303E-01	1.024E-01
Sr-90	Sr-90	1.000E+00	3.310E-01	3.214E-01	3.031E-01	2.469E-01	1.374E-01	1.764E-02	5.010E-05	6.118E-14

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.30 seconds

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Time= 1.000E+01 13
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Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.034E-11	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.014E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.466E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.864E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.476E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.034E-11	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.014E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.466E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.864E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.476E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.034E-11	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.466E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.864E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.476E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.034E-11	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.466E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.864E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.476E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.010E-11	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.158E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.442E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.608E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.452E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.010E-11	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.158E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.442E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.608E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.452E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.010E-11	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.442E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.608E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.452E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.010E-11	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.442E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.608E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.452E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.642E-12	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.430E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.395E-09	0.9989	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.118E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.405E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.642E-12	0.0011
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.430E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.395E-09	0.9989
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.118E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.642E-12	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.395E-09	0.9989	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.118E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.405E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.642E-12	0.0011
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.395E-09	0.9989
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.118E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	8.200E-12	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.237E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.232E-09	0.9990	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.611E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.240E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.200E-12	0.0010
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.237E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.232E-09	0.9990
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.611E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.240E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	8.200E-12	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.232E-09	0.9990	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.611E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.240E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.200E-12	0.0010
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.232E-09	0.9990
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.611E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.240E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.162E-12	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	4.621E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	7.782E-09	0.9993	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.678E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.787E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.162E-12	0.0007
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.621E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.782E-09	0.9993
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.678E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.787E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.162E-12	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	7.782E-09	0.9993	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.678E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.787E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.162E-12	0.0007
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.782E-09	0.9993
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.678E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.787E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.022E-12	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.168E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.394E-09	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.724E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.395E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.022E-12	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.168E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.394E-09	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.724E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.395E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.022E-12	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.394E-09	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.724E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.395E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.022E-12	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.394E-09	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.724E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.395E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.984E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.057E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.647E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.342E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.647E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.984E-15	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.057E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.647E-09	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.342E-18	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.647E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.984E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.647E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.342E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.647E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.984E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.647E-09	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.342E-18	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.647E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.210E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	4.286E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.113E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.638E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.113E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.210E-22	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.286E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.113E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.638E-27	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.113E-10	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.210E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.113E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.638E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.113E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.210E-22	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.113E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.638E-27	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.113E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

Summary : Residential Child 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\C3.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Residential Child 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\C3.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.130E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.633E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	3.310E-01	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	3.500E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	7.000E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Child 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	1.130E-01
Thickness:	2.00 meters	Ra-226	1.633E+00
Cover Depth:	0.91 meters	Sr-90	3.310E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.784E-04	4.770E-04	4.743E-04	4.650E-04	4.394E-04	3.608E-04	2.058E-04	2.884E-05
M(t):	1.914E-05	1.908E-05	1.897E-05	1.860E-05	1.758E-05	1.443E-05	8.231E-06	1.154E-06

Maximum TDOSE(t): 4.784E-04 mrem/yr at t = 0.000E+00 years

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.437E-07	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.776E-04	0.9984	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.346E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.784E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.437E-07	0.0016
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.776E-04	0.9984
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.346E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.784E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.267E-07	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.763E-04	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.162E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.770E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.267E-07	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.763E-04	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.162E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.770E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.938E-07	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.736E-04	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.812E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.743E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.938E-07	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.736E-04	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.812E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.743E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.901E-07	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.644E-04	0.9987	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.733E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.650E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.901E-07	0.0013
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.644E-04	0.9987
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.733E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.650E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	3.715E-07	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.391E-04	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.633E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.394E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.715E-07	0.0008
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.391E-04	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.633E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.394E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.352E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.607E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.382E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.608E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.352E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.607E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.382E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.608E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.184E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.058E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.605E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.058E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.184E-10	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.058E-04	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.605E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.058E-04	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.627E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.884E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.173E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.884E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.627E-17	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.173E-22	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-05	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.130E-01	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	1.633E+00	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	3.310E-01	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	7.437E-07	7.267E-07	6.938E-07	5.901E-07	3.715E-07	7.352E-08	7.184E-10	6.627E-17
Ra-226	Ra-226	1.000E+00	4.776E-04	4.763E-04	4.736E-04	4.644E-04	4.391E-04	3.607E-04	2.058E-04	2.884E-05
Pb-210	Ra-226	1.000E+00	5.978E-12	1.765E-11	3.979E-11	1.058E-10	2.221E-10	2.897E-10	1.738E-10	2.437E-11
Sr-90	Sr-90	1.000E+00	6.346E-10	6.162E-10	5.812E-10	4.733E-10	2.633E-10	3.382E-11	9.605E-14	1.173E-22

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.130E-01	1.104E-01	1.054E-01	8.966E-02	5.644E-02	1.117E-02	1.092E-04	1.007E-11
Ra-226	Ra-226	1.000E+00	1.633E+00	1.628E+00	1.619E+00	1.588E+00	1.501E+00	1.233E+00	7.035E-01	9.862E-02
Pb-210	Ra-226	1.000E+00	0.000E+00	4.987E-02	1.444E-01	4.265E-01	9.237E-01	1.216E+00	7.303E-01	1.024E-01
Sr-90	Sr-90	1.000E+00	3.310E-01	3.214E-01	3.031E-01	2.469E-01	1.374E-01	1.764E-02	5.010E-05	6.118E-14

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.29 seconds

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Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.144E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.536E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.170E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.830E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.173E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.144E-12	0.0014
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.536E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.170E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.830E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.173E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.144E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.170E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.830E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.173E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.144E-12	0.0014
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.170E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.830E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.173E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.072E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.022E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.164E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.748E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.167E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.072E-12	0.0014
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.022E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.164E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.748E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.167E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.072E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.164E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.748E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.167E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.072E-12	0.0014
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.164E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.748E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.167E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.933E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.942E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.152E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.592E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.155E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.933E-12	0.0014
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.942E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.152E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.592E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.155E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.933E-12	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.152E-09	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.592E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.155E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.933E-12	0.0014
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.152E-09	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.592E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.155E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.495E-12	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.684E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.110E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.111E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.113E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.495E-12	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.684E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.110E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.113E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.495E-12	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.110E-09	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.111E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.113E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.495E-12	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.110E-09	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.113E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.570E-12	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.049E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.995E-09	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.174E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.997E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.570E-12	0.0008
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.049E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.995E-09	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.174E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.997E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.570E-12	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.995E-09	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.174E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.997E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.570E-12	0.0008
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.995E-09	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.174E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.997E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.108E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.311E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.639E-09	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.508E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.639E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.108E-13	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-09	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.508E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.108E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.639E-09	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.508E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.639E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.108E-13	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-09	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.508E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.037E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	7.837E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	9.350E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.284E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.350E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.037E-15	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.837E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.350E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.284E-19	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.350E-10	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.037E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	9.350E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.284E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.350E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.037E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.350E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.284E-19	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.350E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.802E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.099E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.311E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.231E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.311E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.802E-22	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.099E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.231E-28	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-10	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.802E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.311E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.231E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.311E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.802E-22	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.231E-28	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.125E+01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.600E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	3.292E+01	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	7.000E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.400E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.500E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Summary : Residential Adult 3 Ft Cover
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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Adult 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	1.125E+01
Thickness:	2.00 meters	Ra-226	1.600E+02
Cover Depth:	0.91 meters	Sr-90	3.292E+01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.687E-02	4.674E-02	4.648E-02	4.556E-02	4.306E-02	3.535E-02	2.016E-02	2.826E-03
M(t):	1.875E-03	1.870E-03	1.859E-03	1.822E-03	1.722E-03	1.414E-03	8.065E-04	1.130E-04

Maximum TDOSE(t): 4.687E-02 mrem/yr at t = 0.000E+00 years

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.405E-05	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.680E-02	0.9984	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.312E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.687E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.405E-05	0.0016
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.680E-02	0.9984
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.312E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.687E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.235E-05	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.667E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.130E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.674E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.235E-05	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.667E-02	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.130E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.674E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.908E-05	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.641E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.781E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.648E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.908E-05	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.641E-02	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.781E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.648E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.875E-05	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.550E-02	0.9987	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.708E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.556E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.875E-05	0.0013
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.550E-02	0.9987
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.708E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.556E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	3.698E-05	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.302E-02	0.9991	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.619E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.306E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.698E-05	0.0009
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.302E-02	0.9991
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.619E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.306E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.320E-06	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.535E-02	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.364E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.535E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.320E-06	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.535E-02	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.364E-09	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.535E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.153E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.016E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.554E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.016E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.153E-08	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.016E-02	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.554E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.016E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.599E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.826E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.167E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.826E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.599E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.826E-03	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.167E-20	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.826E-03	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.125E+01	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	1.600E+02	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	3.292E+01	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	7.405E-05	7.235E-05	6.908E-05	5.875E-05	3.698E-05	7.320E-06	7.153E-08	6.599E-15
Ra-226	Ra-226	1.000E+00	4.680E-02	4.667E-02	4.641E-02	4.550E-02	4.302E-02	3.535E-02	2.016E-02	2.826E-03
Pb-210	Ra-226	1.000E+00	5.857E-10	1.730E-09	3.899E-09	1.037E-08	2.176E-08	2.839E-08	1.703E-08	2.388E-09
Sr-90	Sr-90	1.000E+00	6.312E-08	6.130E-08	5.781E-08	4.708E-08	2.619E-08	3.364E-09	9.554E-12	1.167E-20

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.125E+01	1.099E+01	1.050E+01	8.927E+00	5.619E+00	1.112E+00	1.087E-02	1.003E-09
Ra-226	Ra-226	1.000E+00	1.600E+02	1.596E+02	1.587E+02	1.556E+02	1.471E+02	1.208E+02	6.893E+01	9.663E+00
Pb-210	Ra-226	1.000E+00	0.000E+00	4.886E+00	1.415E+01	4.179E+01	9.050E+01	1.192E+02	7.156E+01	1.003E+01
Sr-90	Sr-90	1.000E+00	3.292E+01	3.197E+01	3.015E+01	2.456E+01	1.366E+01	1.755E+00	4.984E-03	6.085E-12

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 1.41 seconds

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Time= 3.000E+01 16
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Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.029E-09	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.974E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.295E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.817E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.305E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.029E-09	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.974E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.295E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.817E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.305E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.029E-09	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.295E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.817E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.305E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.029E-09	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.295E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.817E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.305E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.006E-09	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.115E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.272E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.562E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.282E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.006E-09	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.115E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.272E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.562E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.282E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.006E-09	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.272E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.562E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.282E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.006E-09	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.272E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.562E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.282E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.600E-10	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.381E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.225E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.074E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.235E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.600E-10	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.381E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.225E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.074E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.235E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.600E-10	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.225E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.074E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.235E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.600E-10	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.225E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.074E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.235E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	8.165E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.172E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.065E-07	0.9990	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.576E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.073E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.165E-10	0.0010
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.172E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.065E-07	0.9990
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.576E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.073E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	8.165E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.065E-07	0.9990	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.576E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.073E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.165E-10	0.0010
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.065E-07	0.9990
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.576E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.073E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.140E-10	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	4.527E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	7.625E-07	0.9993	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.659E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.630E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.140E-10	0.0007
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.527E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.625E-07	0.9993
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.659E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.630E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.140E-10	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	7.625E-07	0.9993	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.659E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.630E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.140E-10	0.0007
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.625E-07	0.9993
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.659E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.630E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total Ingestion*
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.017E-10	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.063E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.265E-07	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.699E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.266E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.017E-10	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.063E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.265E-07	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.699E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.266E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.017E-10	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.265E-07	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.699E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.266E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.017E-10	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.265E-07	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.699E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.266E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.941E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.995E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.574E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.335E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.574E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.941E-13	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.995E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.574E-07	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.335E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.574E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.941E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.574E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.335E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.574E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.941E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.574E-07	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.335E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.574E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.170E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	4.199E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.009E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.630E-25	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.009E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.170E-20	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.199E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.009E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.630E-25	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.009E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	9.170E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.009E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.630E-25	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.009E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.170E-20	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.009E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.630E-25	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.009E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.125E+01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.600E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	3.292E+01	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	3.500E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	7.000E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Summary : Residential Child 3 Ft Cover
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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Child 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	1.125E+01
Thickness:	2.00 meters	Ra-226	1.600E+02
Cover Depth:	0.91 meters	Sr-90	3.292E+01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.687E-02	4.674E-02	4.648E-02	4.556E-02	4.306E-02	3.535E-02	2.016E-02	2.826E-03
M(t):	1.875E-03	1.870E-03	1.859E-03	1.822E-03	1.722E-03	1.414E-03	8.065E-04	1.130E-04

Maximum TDOSE(t): 4.687E-02 mrem/yr at t = 0.000E+00 years

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.405E-05	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.680E-02	0.9984	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.312E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.687E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.405E-05	0.0016
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.680E-02	0.9984
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.312E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.687E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.235E-05	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.667E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.130E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.674E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.235E-05	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.667E-02	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.130E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.674E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.908E-05	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.641E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.781E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.648E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.908E-05	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.641E-02	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.781E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.648E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	5.875E-05	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.550E-02	0.9987	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.708E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.556E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.875E-05	0.0013
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.550E-02	0.9987
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.708E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.556E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	3.698E-05	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.302E-02	0.9991	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.619E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.306E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.698E-05	0.0009
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.302E-02	0.9991
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.619E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.306E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.320E-06	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.535E-02	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.364E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.535E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.320E-06	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.535E-02	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.364E-09	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.535E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.153E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.016E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.554E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.016E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.153E-08	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.016E-02	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.554E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.016E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	6.599E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.826E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.167E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.826E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.599E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.826E-03	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.167E-20	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.826E-03	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.125E+01	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	1.600E+02	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	3.292E+01	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	7.405E-05	7.235E-05	6.908E-05	5.875E-05	3.698E-05	7.320E-06	7.153E-08	6.599E-15
Ra-226	Ra-226	1.000E+00	4.680E-02	4.667E-02	4.641E-02	4.550E-02	4.302E-02	3.535E-02	2.016E-02	2.826E-03
Pb-210	Ra-226	1.000E+00	5.857E-10	1.730E-09	3.899E-09	1.037E-08	2.176E-08	2.839E-08	1.703E-08	2.388E-09
Sr-90	Sr-90	1.000E+00	6.312E-08	6.130E-08	5.781E-08	4.708E-08	2.619E-08	3.364E-09	9.554E-12	1.167E-20

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.125E+01	1.099E+01	1.050E+01	8.927E+00	5.619E+00	1.112E+00	1.087E-02	1.003E-09
Ra-226	Ra-226	1.000E+00	1.600E+02	1.596E+02	1.587E+02	1.556E+02	1.471E+02	1.208E+02	6.893E+01	9.663E+00
Pb-210	Ra-226	1.000E+00	0.000E+00	4.886E+00	1.415E+01	4.179E+01	9.050E+01	1.192E+02	7.156E+01	1.003E+01
Sr-90	Sr-90	1.000E+00	3.292E+01	3.197E+01	3.015E+01	2.456E+01	1.366E+01	1.755E+00	4.984E-03	6.085E-12

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.28 seconds

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Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.130E-10	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.505E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.126E-07	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.815E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.130E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.130E-10	0.0015
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.505E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.126E-07	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.815E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.130E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.130E-10	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.126E-07	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.815E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.130E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.130E-10	0.0015
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.126E-07	0.9985
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.815E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.130E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.059E-10	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.981E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.120E-07	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.734E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.123E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.059E-10	0.0014
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.981E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.120E-07	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.734E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.123E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.059E-10	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.120E-07	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.734E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.123E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.059E-10	0.0014
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.120E-07	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.734E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.123E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.920E-10	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.883E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.109E-07	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.578E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.111E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.920E-10	0.0014
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.883E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.109E-07	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.578E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.920E-10	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.109E-07	0.9986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.578E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.111E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.920E-10	0.0014
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.109E-07	0.9986
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.578E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.111E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.484E-10	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.569E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.068E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.100E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.070E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.484E-10	0.0012
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.569E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.068E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.100E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.070E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.484E-10	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.068E-07	0.9988	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.100E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.070E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.484E-10	0.0012
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.068E-07	0.9988
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.100E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.070E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.564E-10	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.028E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.955E-07	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.168E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.956E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.564E-10	0.0008
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.028E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.955E-07	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.168E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.956E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.564E-10	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.955E-07	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.168E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.956E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.564E-10	0.0008
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.955E-07	0.9992
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.168E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.956E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.095E-11	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.285E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.606E-07	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.500E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.606E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.095E-11	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.285E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.606E-07	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.500E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.606E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.095E-11	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.606E-07	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.500E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.606E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.095E-11	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.606E-07	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.500E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.606E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.024E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	7.678E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	9.161E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.261E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.161E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.024E-13	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.678E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.161E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.261E-17	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.161E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.024E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	9.161E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.261E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.161E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.024E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.161E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.261E-17	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.161E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.790E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.076E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.284E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.203E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.284E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.790E-20	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.076E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.203E-26	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.790E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.284E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.203E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.284E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.790E-20	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-08	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.203E-26	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.300E+02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	2.100E+04	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	8.500E+02	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	7.000E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.400E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.500E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Adult 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	2.300E+02
Thickness:	2.00 meters	Ra-226	2.100E+04
Cover Depth:	0.91 meters	Sr-90	8.500E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	6.144E+00	6.127E+00	6.092E+00	5.973E+00	5.647E+00	4.639E+00	2.646E+00	3.709E-01
M(t):	2.458E-01	2.451E-01	2.437E-01	2.389E-01	2.259E-01	1.856E-01	1.058E-01	1.484E-02

Maximum TDOSE(t): 6.144E+00 mrem/yr at t = 0.000E+00 years

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.514E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.142E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.630E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.144E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.514E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.142E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.630E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.144E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.479E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.125E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.583E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.127E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.479E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.125E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.583E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.127E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.412E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.091E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.492E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.092E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.091E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.492E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.092E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.201E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.972E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.215E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.973E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.201E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.972E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.215E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.973E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\AT3A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.560E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.646E+00	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.762E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.647E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.560E-04	0.0001
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.646E+00	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.762E-07	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.647E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.496E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.639E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.685E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.639E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.496E-04	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.639E+00	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.685E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.639E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.462E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.646E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.467E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.646E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.462E-06	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E+00	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.467E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.349E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.709E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.012E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.709E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.349E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.709E-01	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.012E-19	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.709E-01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Adult 3 Ft Cover
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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	2.300E+02	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	2.100E+04	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	8.500E+02	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.514E-03	1.479E-03	1.412E-03	1.201E-03	7.560E-04	1.496E-04	1.462E-06	1.349E-13
Ra-226	Ra-226	1.000E+00	6.142E+00	6.125E+00	6.091E+00	5.972E+00	5.646E+00	4.639E+00	2.646E+00	3.709E-01
Pb-210	Ra-226	1.000E+00	7.688E-08	2.270E-07	5.117E-07	1.361E-06	2.856E-06	3.726E-06	2.235E-06	3.134E-07
Sr-90	Sr-90	1.000E+00	1.630E-06	1.583E-06	1.492E-06	1.215E-06	6.762E-07	8.685E-08	2.467E-10	3.012E-19

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.300E+02	2.247E+02	2.146E+02	1.825E+02	1.149E+02	2.274E+01	2.222E-01	2.050E-08
Ra-226	Ra-226	1.000E+00	2.100E+04	2.094E+04	2.082E+04	2.042E+04	1.930E+04	1.586E+04	9.047E+03	1.268E+03
Pb-210	Ra-226	1.000E+00	0.000E+00	6.413E+02	1.857E+03	5.485E+03	1.188E+04	1.564E+04	9.392E+03	1.317E+03
Sr-90	Sr-90	1.000E+00	8.500E+02	8.254E+02	7.784E+02	6.340E+02	3.527E+02	4.530E+01	1.287E-01	1.571E-10

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.33 seconds

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Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.104E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.590E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.089E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.276E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.089E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.104E-08	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.590E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.089E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.276E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.089E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.104E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.089E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.276E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.089E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.104E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.089E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.276E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.089E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total Ingestion*
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.056E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.775E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.086E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.210E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.086E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.056E-08	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.775E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.210E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.056E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.086E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.210E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.086E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.056E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.210E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.963E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.125E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.080E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.085E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.080E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.963E-08	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.125E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.085E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.963E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.080E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.085E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.080E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.963E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.085E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.669E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	4.163E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.059E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.698E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.059E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-08	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.163E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.698E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.669E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.059E-04	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.698E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.059E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-08	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-04	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.698E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.051E-08	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.942E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.001E-04	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.445E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.001E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.051E-08	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.001E-04	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.445E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.001E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.051E-08	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.001E-04	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	9.445E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.001E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.051E-08	0.0001
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.001E-04	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.445E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.001E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.080E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	6.646E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.223E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.213E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.223E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.080E-09	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.646E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.223E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.213E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.223E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.080E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.223E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.213E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.223E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.080E-09	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.223E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.213E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.223E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.032E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.931E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.690E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.445E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.690E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.032E-11	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.931E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.690E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.445E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.690E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	2.032E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.690E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.445E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.690E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.032E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.690E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.445E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.690E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.875E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	5.511E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.575E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.207E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.575E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.875E-18	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.511E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-06	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.207E-24	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	1.875E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.575E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.207E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.575E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.875E-18	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-06	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.207E-24	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.575E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(4)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(13)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(14)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(15)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(4,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(4,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	2.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.300E+02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	2.100E+04	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Sr-90	8.500E+02	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(4)
R013	Cover depth (m)	9.144E-01	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.623E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.516E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	3.500E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	9.590E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	7.000E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Summary : Residential Child 3 Ft Cover
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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Residential Child 3 Ft Cover
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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	2000.00 square meters	Cs-137	2.300E+02
Thickness:	2.00 meters	Ra-226	2.100E+04
Cover Depth:	0.91 meters	Sr-90	8.500E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	6.144E+00	6.127E+00	6.092E+00	5.973E+00	5.647E+00	4.639E+00	2.646E+00	3.709E-01
M(t):	2.458E-01	2.451E-01	2.437E-01	2.389E-01	2.259E-01	1.856E-01	1.058E-01	1.484E-02

Maximum TDOSE(t): 6.144E+00 mrem/yr at t = 0.000E+00 years

Summary : Residential Child 3 Ft Cover
File : N:\PROJECTS\2005 PROJECTS\25-049_NAVY_HPS_E-2_RI-FS\F_CALCULATIONS\RAD\CT3B.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.514E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.142E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.630E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.144E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.514E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.142E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.630E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.144E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.479E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.125E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.583E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.127E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.479E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.125E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.583E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.127E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.412E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.091E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.492E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.092E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.091E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.492E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.092E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.201E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.972E+00	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.215E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.973E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.201E-03	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.972E+00	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.215E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.973E+00	1.0000

*Sum of all water independent and dependent pathways.

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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	7.560E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.646E+00	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.762E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.647E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.560E-04	0.0001
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.646E+00	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.762E-07	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.647E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.496E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.639E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.685E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.639E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.496E-04	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.639E+00	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.685E-08	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.639E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Residential Child 3 Ft Cover
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.462E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.646E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.467E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.646E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.462E-06	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E+00	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.467E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E+00	1.0000

*Sum of all water independent and dependent pathways.

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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.349E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.709E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.012E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.709E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.349E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.709E-01	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.012E-19	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.709E-01	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137+D	Cs-137+D	1.000E+00	6.581E-06	6.431E-06	6.140E-06	5.222E-06	3.287E-06	6.506E-07	6.358E-09	5.865E-16
Ra-226+D	Ra-226+D	1.000E+00	2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Ra-226+D	Pb-210+D	1.000E+00	3.661E-12	1.081E-11	2.437E-11	6.481E-11	1.360E-10	1.774E-10	1.064E-10	1.492E-11
Ra-226+D	∑DSR(j)		2.925E-04	2.917E-04	2.900E-04	2.844E-04	2.689E-04	2.209E-04	1.260E-04	1.766E-05
Sr-90+D	Sr-90+D	1.000E+00	1.917E-09	1.862E-09	1.756E-09	1.430E-09	7.955E-10	1.022E-10	2.902E-13	3.543E-22

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	3.799E+06	3.887E+06	4.072E+06	4.788E+06	7.605E+06	3.843E+07	3.932E+09	*8.704E+13
Ra-226	8.547E+04	8.571E+04	8.620E+04	8.791E+04	9.298E+04	1.132E+05	1.984E+05	1.415E+06
Sr-90	1.304E+10	1.343E+10	1.424E+10	1.748E+10	3.143E+10	2.447E+11	8.615E+13	*1.365E+14

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	2.300E+02	0.000E+00	6.581E-06	3.799E+06	6.581E-06	3.799E+06
Ra-226	2.100E+04	0.000E+00	2.925E-04	8.547E+04	2.925E-04	8.547E+04
Sr-90	8.500E+02	0.000E+00	1.917E-09	1.304E+10	1.917E-09	1.304E+10

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.514E-03	1.479E-03	1.412E-03	1.201E-03	7.560E-04	1.496E-04	1.462E-06	1.349E-13
Ra-226	Ra-226	1.000E+00	6.142E+00	6.125E+00	6.091E+00	5.972E+00	5.646E+00	4.639E+00	2.646E+00	3.709E-01
Pb-210	Ra-226	1.000E+00	7.688E-08	2.270E-07	5.117E-07	1.361E-06	2.856E-06	3.726E-06	2.235E-06	3.134E-07
Sr-90	Sr-90	1.000E+00	1.630E-06	1.583E-06	1.492E-06	1.215E-06	6.762E-07	8.685E-08	2.467E-10	3.012E-19

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.300E+02	2.247E+02	2.146E+02	1.825E+02	1.149E+02	2.274E+01	2.222E-01	2.050E-08
Ra-226	Ra-226	1.000E+00	2.100E+04	2.094E+04	2.082E+04	2.042E+04	1.930E+04	1.586E+04	9.047E+03	1.268E+03
Pb-210	Ra-226	1.000E+00	0.000E+00	6.413E+02	1.857E+03	5.485E+03	1.188E+04	1.564E+04	9.392E+03	1.317E+03
Sr-90	Sr-90	1.000E+00	8.500E+02	8.254E+02	7.784E+02	6.340E+02	3.527E+02	4.530E+01	1.287E-01	1.571E-10

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 0.30 seconds

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Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors 2
Risk Slope and ETFG for the Ground Pathway 3
Amount of Intake Quantities and Excess Cancer Risks
Time= 0.000E+00 4
Time= 1.000E+00 7
Time= 3.000E+00 10
Time= 1.000E+01 13
Time= 3.000E+01 16
Time= 1.000E+02 19
Time= 3.000E+02 22
Time= 1.000E+03 25

Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(1,1)
Sf-1	Pb-210+D	4.21E-09	1.41E-09	SLPF(2,1)
Sf-1	Ra-226+D	8.49E-06	2.29E-08	SLPF(3,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(4,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Cs-137+D	1.12E-10	1.12E-10	SLPF(1,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(2,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(3,2)
Sf-2	Sr-90+D	4.33E-10	4.25E-10	SLPF(4,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,3)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,3)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(1,4)
Sf-3	Pb-210+D	2.66E-09	8.81E-10	SLPF(2,4)
Sf-3	Ra-226+D	3.86E-10	3.85E-10	SLPF(3,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(4,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(1,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(2,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(3,5)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(4,5)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02	KFACTR(1,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

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Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)							
	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
At-218	3.570E-09	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23	6.206E-23
Ba-137m	2.690E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06	1.952E-06
Bi-210	2.760E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09	9.950E-09
Bi-214	7.480E-06	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05	2.983E-05
Cs-137	5.320E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10	3.615E-10
Pb-210	1.410E-09	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30	3.312E-30
Pb-214	9.820E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07	2.158E-07
Po-210	3.950E-11	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06	3.871E-06
Po-214	3.860E-10	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06	5.032E-06
Po-218	4.260E-11	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06	5.043E-06
Ra-226	2.290E-08	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09	8.120E-09
Rn-222	1.740E-09	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06	1.285E-06
Sr-90	4.820E-10	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11	6.077E-11
Tl-210	0.000E+00	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01	9.590E-01
Y-90	1.910E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08	8.136E-08

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.399E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.976E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.791E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.268E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.792E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.399E-09	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.976E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.791E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.268E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.792E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.399E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.791E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.268E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.792E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.399E-09	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.791E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.268E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.792E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.253E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	2.600E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.783E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.058E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.784E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.253E-09	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.600E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.783E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.058E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.784E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.253E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.783E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.058E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.784E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.253E-09	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.783E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.058E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.784E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.970E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	3.784E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.767E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.656E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.768E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.970E-09	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.784E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.767E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.656E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.768E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.970E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.767E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.656E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.768E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.970E-09	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.767E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.656E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.768E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.077E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	7.309E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.714E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.421E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.714E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.077E-09	0.0002
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.309E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.714E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.421E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.714E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.077E-09	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.714E-05	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.421E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.714E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.077E-09	0.0002
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.714E-05	0.9998
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.421E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.714E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.196E-09	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.349E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.566E-05	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.016E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.566E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.196E-09	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.349E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.566E-05	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.016E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.566E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	3.196E-09	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.566E-05	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.016E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.566E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.196E-09	0.0001
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.566E-05	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.016E-12	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.566E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.326E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.686E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.108E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.873E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.108E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.326E-10	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.686E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.108E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.873E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.108E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.326E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.108E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.873E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.108E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.326E-10	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.108E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.873E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.108E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.182E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.008E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.202E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.100E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.202E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.008E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.100E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	6.182E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.202E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.100E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.202E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-05	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.100E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.703E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	1.413E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.685E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.343E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.685E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.703E-19	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.413E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.685E-06	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.343E-24	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.685E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	5.703E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.685E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.343E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.685E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.703E-19	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.685E-06	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.343E-24	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.685E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Appendix I. Responses to Comments on Draft, Revised Draft, and Draft Final Remedial Design Package

Appendix IA. Responses to Comments on Draft Remedial Design Package

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Remedial Design Package				
1	--	--	Details regarding numerous remedial action (RA) components and implementation procedures are not included in the Draft Remedial Design Package, Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated January 2017 (Draft RDP). Instead, these components and procedures have been deferred to other documents. As a result, it is unclear if the remedy will meet the requirements of the record of decision (ROD). The following are several examples of information that has been deferred: a. Table 9 (Actions to be Addressed in Remedial Action Work Plan) of the Draft Design Basis Report for Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated January 2017 (Draft DBR) provides a list of the information that will be provided later by the RA contractor. b. Section 3.3.1 (Proposed Area for Treatment) of the Draft DBR states, "The RAMP [Remedial Action Monitoring Plan], which is provided under separate cover, describes soil gas monitoring that will be performed in and around Building 406 to guide SVE system operation and verify that the source control measures are adequately mitigating the inhalation risk." c. Section 3.4.3.2 (Post-Injection Monitoring) of the Draft DBR indicates that inspections for biofouling will be performed as part of the monitoring program; however, further details regarding biofouling and the inspections are not provided and/or referenced.	The RDP[1] was revised, as appropriate, to briefly describe the objectives of future activities that will be provided in future planning documents. The following items briefly describe the revisions for each of the items identified in this comment. However, the Navy wishes to clarify that the organization of the RDP for Parcel E is similar to previous RDPs that were prepared for other HPNS parcels and approved by the regulatory agencies. For many portions of the RA, these previous RDPs deferred specific information regarding RA implementation to the RAWP(s). a. Table 9 describes specific actions (and their associated objectives) that will be further described in the RAWP(s). The Navy believes that this information is sufficiently detailed to inform the RAWP development and, as a result, Table 9 was not further revised based on this comment. b. The subject paragraph in Section 3.3.1 was revised to refer to Section 3.3.5, which provides preliminary information regarding the soil gas monitoring proposed at Building 406. Also, the revised draft RDP includes the RAMP that further details the proposed monitoring. c. The revised draft RDP includes the RAMP that further details the proposed monitoring, including biofouling inspections. As a result, DBR Section 3.4.3.2 was not revised to include further information.

[1] Abbreviations and acronyms are defined in a list presented at the end of this document.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Remedial Design Package (continued)				
1 *(cont.)*	--	--	d. Section 3.4.4 (Treatment Design for IR-04 CVOC Plume) of the Draft DBR states, "The RAWP(s) [remedial action work plans] will further refine this contingency treatment action." The statement suggests that there will be multiple RAWPs but there is no clarity regarding how many RAWPs are planned. e. Section 3.1.3 (Environmental Protection Measures) of the Draft DBR indicates that the RAWP will include a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Stormwater Plan, a Dust Monitoring and Control Plan, and a San Francisco Bay Water Quality Monitoring and Protection Plan. f. Section 3.2.3 (Pre-Excavation Characterization Sampling) of the Draft DBR indicates that the RA contractor will develop a pre-excavation characterization sampling plan designed to refine the limits of the excavations. Section 3.2.4 (Excavation Methods) of the Draft DBR states, "The RA contractor will be required to prepare a wastewater management plan that identifies the methods and procedures for management and/or discharge of waste waters that are directly derived from construction activities. Please revise the Draft RDP to summarize the information requested in the above, including goals and objectives for each document to provide a comprehensive remedial design package that allows for assessment of the remedy to meet the requirements of the ROD.	d. The following text was provided in the introductory paragraphs of Section 3: *"The RA will need to be implemented in phases because of the large scope of proposed actions. Multiple RAWPs may be prepared if the RA construction phases are implemented by different contractors."* The Navy currently plans on implementing the RA in at least three phases, but this plan is subject to change based on multiple factors (e.g., available funding) that cannot be predicted at this time. Accordingly, the DBR was not revised to further clarify the number of RAWPs that may be prepared and submitted. e. The documents identified in Section 3.1.3 will be similar to plans that have been prepared as part of RAWPs for other HPNS parcels. In addition, Table 9 identifies each of these documents and briefly describes their primary objective. Accordingly, the DBR was not revised to further explain the objective of these documents. f. Section 3.2.3 was revised to include additional information regarding the pre-excavation characterization. Please refer to the Navy's response to general comment 1 on the DBR.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Remedial Design Package (continued)				
2	--	--	The text of the RDP indicates that some new material will be included in the Draft Final RDP (e.g., techniques to improve liquefiable soil at IR-02 Southeast), so it is recommended that a list identifying new text, tables, figures, and appendix material be provided. Please ensure that all new material is labeled such that it can be identified easily for review.	The revised draft RDP includes the following new information that was not presented in the draft RDP: • DBR Section 3.3 – discussion of contingency to address VOCs in soil under Building 406 via excavation instead of SVE • DBR Section 3.5.5 – placement and number of monitoring/extraction wells behind the IR-02 Northwest slurry wall • DBR Section 3.10.9 and Appendix F – revised numeric modeling of potentially liquefiable soils at IR-02 Southeast • DBR Section 3.12.6 – stormwater management at proposed catch basin near Building 505 and at proposed channel adjacent to Parcel D-1 (at Hussey Street). • RAMP • Pre-construction cost opinion In addition, the RDP content was revised based on regulatory agency comments, as described within these responses.
General Comments on Design Basis Report				
1	--	--	Insufficient detail was provided regarding pre-excavation characterization sampling. Section 3.2.3 (Pre-Excavation Characterization Sampling) indicates that the contractor will develop a pre-excavation characterization sampling plan to refine the limits of the excavation. However, the Draft DBR should identify areas where uncertainties exist to provide the RA contractor with a starting point for drafting the pre-excavation characterization plan. For example, the following areas of uncertainty should be discussed and/or highlighted in the Draft DBR:	Section 3.2.3 was revised to discuss specific areas of uncertainty, as detailed in this comment, that require resolution during the pre-excavation characterization. In addition, Figures 10 through 26 (now re-numbered as Figures 11 through 27) were revised, as appropriate, to identify specific locations where pre-excavation sampling is necessary. The RA contractor will develop a sampling and analysis plan that details the pre-excavation characterization sampling that will sufficiently define all of the proposed excavation areas.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Design Basis Report (continued)				
1 *(cont.)*			a. Based on Figure 10 (Excavations at Redevelopment Block EOS-1 North), Excavation Area IR02B416 was not sufficiently delineated to the east or south. Specifically, there are no sample locations that provide a delineating point of compliance to the east and south of the area. Similarly, there are no sample locations that provide a delineating point of compliance to the east of Excavation Area IR02B524. b. Figure 11 (Excavations at Redevelopment Block EOS-1 South) shows that the excavation area near IR02B256 was not delineated to the east. In addition, the excavation area does not address the hotspots shown on the figure. c. The excavation area near IR03SH012 on Figure 15 (Excavations at Redevelopment Block EOS-3) was not delineated to the north or east. d. Based on Figure 16 (Excavations at Redevelopment Block EOS-4 North), the excavation area near IR14B026 was not delineated to the northwest or southeast. Similarly, the excavation area near IR15B027 was not delineated to the north or south. e. Figure 17 (Excavations at Redevelopment Block EOS-4 Central) shows that the excavation area near IR02B355 was not sufficiently defined to the west or south. f. Based on Figure 18 (Excavations at Redevelopment Block EOS-4 South), additional sampling is needed to define the excavation areas near Grid 99-1, 100, 105, 114, and 115, as these grids are only defined in one or two directions. g. Figure 24 (Excavations at Redevelopment Block MU-2 South) shows that the excavation area near IR14MW10A was only delineated to the east and west.	Regarding the excavations at Redevelopment Block EOS-4 South, please note that the elevated chemical concentrations were reported in post-excavation samples collected following the TCRA at the former Metal Debris Reef. The areas adjacent to these proposed excavations were previously characterized by both pre- and post-excavation samples (collected as part of the TCRA). In addition, the proposed excavation areas are located in intertidal areas that were backfilled with a combination of rock and sand to prevent erosion of the backfill material. Based on this information, the Navy does not believe that additional pre-excavation characterization in these areas is either practical or necessary. The RAWP will detail the excavation approach for these intertidal areas, and explain how post-excavation samples will be collected to verify that remaining chemical concentrations area less than the Tier 2 action levels.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Design Basis Report (continued)				
1 *(cont.)*			h. Figure 26 (Excavations at Redevelopment Block MU-3 South) shows that excavation areas near IR04B015, IR04B030, and IR01SS350 are not delineated in any direction. In addition, Excavation Area IR12SS02 was not delineated to the south. Please revise the text to propose pre-excavation sampling, at a very minimum, for the above mentioned excavation areas to sufficiently delineate the excavation areas.	*(see above)*
2	--	--	The groundwater flow direction was not shown on a number of Draft DBR figures. The groundwater flow direction is an important piece of information especially on figures pertinent to groundwater contamination or light non-aqueous phase liquid (NAPL) contamination. Also, a figure showing the groundwater contour elevations at Parcel E was not provided to support the text in Section 2.4 (Hydrogeology). Please show the groundwater flow direction on all pertinent figures for groundwater contamination and NAPL, and provide a figure that depicts the groundwater elevation contours at Parcel E.	A new figure (Figure 7) was added to depict representative A-aquifer groundwater flow patterns, and support the text in Section 2.4. In addition, Figures 29 through 33 (now re-numbered as Figures 30 through 34) were revised to include approximate groundwater flow directions (based on recent potentiometric surface maps).
3	--	--	Insufficient detail was provided regarding injection procedures for groundwater treatment. The text describes the number of injection points, but does not provide sufficient detail regarding important injection details such as the depth of the injection screens, whether top-down or bottom-up methods will be used, the drill rig to install the injection points, and anticipated time frames for injection. While Table 9 (Actions to be Addressed in Remedial Action Work Plan) indicates that this information will be developed and addressed in the RAWP, please revise the text pertinent to groundwater treatment to provide sufficient detail regarding injection procedures.	Section 3.4 was revised to include additional information regarding the in-situ groundwater treatment, including preliminary information regarding the injection procedures (that will be expanded upon in the RAWP). Please refer to the Navy's response to general comment 7 on the DBR for additional clarifications that were made to Section 3.4.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Design Basis Report (continued)				
4	--	--	Excavation areas overlap fixed features such as rail lines on many figures showing excavation areas, but the Draft DBR does not clarify if the rail line will be excavated, or the excavation will be performed around it. Figures 30 (VOC Groundwater Concentrations and Proposed Groundwater Treatment at IR-04) and 31 (VOC Groundwater Concentrations and Proposed Groundwater Treatment at IR-12A), for example, show the excavation areas as overlapping the rail line. Please clarify the excavation procedures that will be used when the proposed excavation area overlaps a fixed feature such as rail lines.	In general, railroad lines that overlap proposed excavations will be removed. To clarify this requirement, Section 3.2.4 was revised to include the following statement: "*Existing surface features, such as asphalt paving and railroad tracks, will be removed where they overlap proposed excavations*." However, select excavations (e.g., EX56B021 in Redevelopment Block MU-3 North [see Figure 26]) were adjusted when the proposed limits did not significantly overlap with the railroad lines.
5	--	--	The Draft DBR does not specify the need for a dewatering work plan. Per the specifications provided in Section 3.3.1.2 (Dewatering) of 31 00 00 (Earthwork) in Appendix D (Project Specifications), a dewatering work plan should be submitted for approval 15 days prior to starting earthwork. Since the need for dewatering is anticipated per Sections 3.2.4 (Excavation Methods) and 3.2.6 (Backfilling of Soil Excavations), it is unclear why the submittal of a dewatering work plan in addition to the wastewater management plan is not included in Table 9 (Actions to be Addressed in Remedial Action Work Plan). Please revise the Draft DBR to include a dewatering work plan along with a wastewater management plan for the RA contractor.	DBR Section 3.2.4 accurately describes the requirement for dewatering and specifies that a wastewater management plan will be developed to describe the management and discharge of wastewater derived from construction activities (e.g., dewatering). Specification Section 01 57 20 (Paragraph 1.6.2) identifies the required content of the Environmental Protection Plan, including a wastewater management plan. For clarity, Specification Section 31 00 00 will be revised to delete reference to a dewatering plan and instead refer to a wastewater management plan that will be part of the Environmental Protection Plan (and will refer to Specification Section 01 57 20).

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Design Basis Report (continued)				
6	--	--	The basis for calculating the groundwater treatment design concentrations (GWTDC) is not viable. Based on Section 3.4.1 (Calculation of GWTDCs from Preliminary SGALs), the GWTDCs were back calculated using the U.S. Environmental Protection Agency's (USEPA's) vapor intrusion screening level (VISL) calculator which is used to identify whether groundwater concentrations can pose an indoor air risk that warrants further investigation of the vapor intrusion pathway. This approach is not an accepted use of the VISL calculator and using this approach might underestimate the risk posed by volatile organic compounds (VOCs) from indoor air. A better site-specific approach to establish GWTDCs would be to collect soil gas data from the sites and correlate it with actual groundwater concentrations. Please revise the text to propose a more defensible approach to establish GWTDCs.	The first paragraph in Section 3.4.1 describes the basis for the GWTDCs and their limited focus in the design process. Section 3.4.1 acknowledges the preference for using soil gas data to evaluate the vapor intrusion pathway, but clarifies that no permanent soil gas network is available to develop and refine the groundwater treatment design. In addition, DBR Figure 27 (now re-numbered as Figure 28) identifies a vadose zone source at the Building 406 VOC plume that does not align very well with the residual saturated zone contamination (see DBR Figure 29, now re-numbered as Figure 30), and would likely invalidate any direct correlation of soil gas and groundwater data. The Navy will perform soil gas characterization as part of the RA, but does not believe that it is either practical or necessary to delay the RDP to collect and evaluate soil gas data for the groundwater treatment design. Also, Section 3.4.1 clarifies that GWTDCs "*were developed to evaluate the current extent of the VOC plumes and provide a basis for the recommended treatment design*." The Navy believes this is a reasonable approach that accounts for site-specific conditions and helps expedite the RA implementation. Also, DBR Section 2.6 (including Exhibit 1 located at the end of that section) describes how soil gas and groundwater data will be evaluated during RA implementation to ensure that the vapor intrusion pathway is adequately remediated.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Design Basis Report (continued)				
7	--	--	The specifics regarding in-situ groundwater treatment are not sufficiently detailed to allow the RA contractor to design a RAWP. For example: a. In Section 3.4.3 (Treatment Design for Building 406 CVOC Plume), the treatment areas are not fully explained. The last paragraph of Section 3.4.3 states that a total of 85 injection points covering an area of 160 feet by 120 feet is planned around well IR36MW239A. However, Figure 29 (VOC Groundwater Concentrations and Proposed Groundwater Treatment at Building 406) shows a total of three proposed treatment areas. Also, a figure showing the proposed injection locations is not provided and/or referenced. b. In Section 3.4.4 (Treatment Design for IR-04 CVOC Plume), the last paragraph on Page 3-30 states that a total of 120 injection points are planned but the area is not specified. Also, a figure showing the proposed injection locations is not provided and/or referenced. c. In Section 3.4.5 (Treatment Design for IR-12A CVOC Plume), the last paragraph on Page 3-32 states that a total of 92 injection points are planned but the area is not specified. Also, a figure showing the proposed injection locations is not provided and/or referenced. Please clarify the proposed treatment areas and provide a figure that shows the proposed injection locations to allow the RA contractor to develop a comprehensive RAWP.	The level of detail presented in the RDP is generally consistent with previously approved RDPs for other HPNS parcels. For most groundwater plumes, additional characterization is needed to develop a more detailed in-situ treatment design. Section 3.4.2 describes the current extent of each VOC plume, and this section was revised to more clearly identify the areas requiring additional characterization. In addition, Sections 3.4.3 through 3.4.6 describe the proposed pre-treatment characterization, including identifying new groundwater monitoring wells in areas where additional delineation is required. These sections were revised to describe the objectives of the pre-treatment characterization at each plume. The Navy's RA contractor is in the process of planning this additional characterization and more detailed information will be presented in the RAWP. The RAWP will also describe how the resulting data will be used to refine the in-situ treatment design, and provide more specific information regarding the treatment products and injection methods. The Navy's RA contractor will work with qualified third-party vendors to evaluate the pre-treatment characterization data, and identify the optimal treatment product and injection method. In the interim, the DBR presents an initial treatment design based on consultation with a third-party vendor. Sections 3.4.3 through 3.4.6 describe the treatment areas (which are shown in Figures 29 through 31, now re-numbered as Figures 30 through 32) and identify the number and spacing of injection points (which would be installed in a grid pattern). The Navy believes that this level of information is sufficient to describe the initial treatment design.

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General Comments on Design Basis Report (continued)				
8	--	--	The Geotechnical Analysis Report is listed as a 60% Completion Report, but it is not clear when subsequent reports including the 100% report will be submitted. Please revise the Draft DBR to include a schedule indicating when the subsequent versions of the Geotechnical Analysis Report will be provided including the final version.	The title of the geotechnical analysis report was revised to eliminate reference to the 60% completion level. The report provided in the draft DBR analyzed all elements of the proposed design, and exceeded the level of information typically provided in a 60% design. The updated report (to be provided as part of the revised draft DBR) provides refined analysis at IR-02 Southeast and IR-03 based on additional information.
9	--	--	Based on the information presented in Appendix B (Design Calculations), all the design calculations were performed in 2015. As a result, it is unclear if the calculations remain relevant. Please ensure that calculations, if necessary, are updated and represent current information.	The date of the design calculations were reviewed and updated, where appropriate. The majority of the engineering design was completed in 2015 and the technical information that informed many design elements remains unchanged. Please refer to the Navy's responses to specific comments 46 and 47 for clarification regarding several calculations related to the shoreline protection.
10	--	--	Section 3 of Appendix G (NAPL Treatment Technology Evaluation and Selection for IR-03) only summarizes the evaluation of the two NAPL treatment technologies and the basis for selecting in situ solidification/stabilization (ISS). While the actual pilot test report [Draft Post-Pilot Study Site-Wide Characterization Technical Memorandum for Installation Restoration Site 03, Former Oily Waste Ponds, Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated December 2016] provides additional details regarding the pilot test, additional details from the pilot test should be provided such as the size of the pilot test, the estimated treatment volumes, and duration of pilot tests. Also, figures from the pilot tests showing the area of implementation would also be helpful to support the conclusions in the Draft DBR. Please revise Appendix G to provide additional details regarding the pilot tests for NAPL that were performed.	Section 1.1 of Appendix G summarizes the two treatability studies conducted to evaluate NAPL treatment at IR-03. Section 1.2 of Appendix G summarizes the in-situ thermal remediation (ISTR) pilot study, including the area and vertical treatment depths of implementation (which references Figure 33 of the DBR [now re-numbered as Figure 34] that shows the pilot study areas), and duration of the treatment. Section 1.2 of Appendix G was revised to provide the estimated treatment volume for the ISTR pilot study. Section 1.3 of Appendix G summarizes the ISS pilot study including area (which references Figure 33 of the DBR, now re-numbered as Figure 34, that shows the pilot study areas). Section 1.3 of Appendix G was revised to provide additional detail regarding the duration of the ISS column mixing, the duration of the curing before sampling, and the estimated treatment volume for the ISS pilot study.

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Specific Comments on Design Basis Report				
1	Sec 2.5.4	Pages 2-7 and 2-8	This section does not discuss the presence of aryl phosphates in the NAPL. Since aryl phosphates are present at percentage concentrations and are toxic, the text should acknowledge the presence of these compounds. Please revise Section 2.5.4 to provide a more complete description of the NAPL constituents, including aryl phosphates.	Section 2.5.4 was revised to summarize the NAPL composition characterization, including the presence of aryl phosphates.
2	Exhibit 1	Page 2-15	The exhibit for the soil and soil gas process does not contain an action item that evaluates when the soil vapor extraction (SVE) treatment for source removal should be discontinued. There is a decision box provided in the flow chart to determine the next course of action based on when concentrations exceed soil gas action levels; however, the decision diagram does not describe when the SVE treatment will be discontinued. Please revise Exhibit 1 to include a decision box that describes when the SVE treatment for source removal will be deemed successful or terminated.	Exhibit 1 includes a note indicating that treatment via SVE will be implemented that allows for regular optimization in order to meet the RAOs in a timely, cost-effective manner while minimizing negative environmental effects. There are many factors that will inform this decision which cannot be succinctly summarized in Exhibit 1. As described in Section 3.3.1, the RAMP will describe the exit strategy for SVE system operations. Accordingly, Exhibit 1 was not revised in response to this comment. In addition, Sections 3.2.2.6 and 3.3 were revised to describe a contingency excavation to address VOCs in soil under Building 406. The contingency excavation would be implemented in the event that Building 406 is demolished as part of redevelopment activities that may occur within the next 2 years. If implemented, the contingency excavation would be intended to remove the vadose zone source and eliminate the need to install and operate an SVE system.

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Specific Comments on Design Basis Report (continued)				
3	Section 3.1.1	Pages 3-6 and 3-7	The existing site fencing should be scanned for radioactive contamination before it is reused, recycled, returned to the vendor, or sent to a landfill for disposal. Fencing in other areas has been found to have radioactive contamination. In addition, the text states that temporary fencing is not needed along the shoreline, but people have been observed to land boats along the Hunters Point Shoreline to mine copper from buildings or to steal tools or other equipment. Site access must be restricted as long as exposure can occur. To ensure that no one is able to access the site, perimeter fencing should be installed along or near the shoreline. Please revise the text to require scanning fencing for radioactive contamination before it is reused, recycle, returned to the vendor or disposed. In addition, please revise the text to require fencing along or near the shoreline.	Section 3.1.1 was revised to include the following statement: "*Fencing and materials from radiologically controlled areas (RCAs) will be screened for radionuclides and handled as described in Section 3.2.7.*" Section 3.1.1 was not revised to specify fencing along or near the shoreline because the Navy does believe that it will be effective in achieving the objective cited in this comment (i.e., "ensure that no one is able to access the site"). The perimeter fencing and associated signs restrict access to members of the public and local community, but the fencing does not prevent access from unauthorized persons (e.g., scavengers) who are sufficiently motivated and armed with tools to cut the fence. Pedestrian access to the shoreline is severely limited, and therefore unauthorized access requires use of a boat or other floatation device, which would suggest that the unauthorized persons would also likely to be armed with tools to cut the fence.
4	Section 3.1.2	Page 3-44	The text in Section 3.1.2 states, "Inactive former Navy utilities, if encountered, should be removed or cut and capped in place with cement grout;" however, a specific standard operation procedure (SOP) is not provided. Similarly, Section 3.7.1 indicates that sections of the steam lines "will be permanently isolated from further use and the environment by sealing the ends with a 24-inch-long concrete plug." Yet, a specific SOP is not provided. Further, it is unclear how capping in place with cement grout is appropriate in areas where soil gas is an issue, as these inactive utilities may represent a preferential pathway. Please revise the text to specify the SOPs that will be used for cutting or capping inactive utilities and discuss how the preferential pathway concerns that could result from leaving utilities in place will be addressed.	The level of detail presented in the RDP is generally consistent with previously approved RDPs for other HPNS parcels. The RAWPs will identify specific procedures for capping utilities (including backfill material that may serve as a preferential pathway) and will, as appropriate, incorporate SOPs. Section 3.1.2 was not revised in response to this comment.

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5	Section 3.1.4	Page 3-6	It is unclear how RA activities will be sequenced to work with and around the radiological screening pads. Section 3.1.4 states, "Parcel E contains several areas (within IR-02 Northwest, IR-05, and IR-12) with existing radiological screening pads that have been (and in some cases continue to be) used to support remediation work at HPNS [Hunters Point Naval Shipyard]. The existing screening pads may be used to support select RA activities, but the pads will need to be properly characterized and removed to allow for other RA activities (e.g., Tier 1/Tier 2 excavation, and durable cover installation) to be completed." The sequencing of RA activities will need to work around and with these pads, yet there is no discussion regarding them, their capacity, work sequencing, etc. Please revise the text to clearly specify the sequence of activities and provide additional information with respect to the existing radiological screening pads.	The level of detail presented in the RDP is generally consistent with previously approved RDPs for other HPNS parcels. The RAWPs will identify the sequencing of RA activities. In addition, the Navy and its contractors meet regularly to coordinate the multiple projects that are performed concurrently at HPNS. This coordination process is dynamic and is not practical to summarize in the RDP. Section 3.1.4 was not revised in response to this comment.
6	Section 3.1.5	Page 3-6 and Table 11	Table 11 specifies a number of monitoring wells for destruction, but does not provide rationale explaining why these wells will be destroyed. It should be noted that these recommendations cannot be reviewed without this information. Further, the text references Drawing C1 for the location of these wells, but this drawing was not published at a scale that allows it to easily be read and does not include the location of groundwater plumes, the IR-03 ISS area, or other features that should be monitored for remedy effectiveness such as the slurry walls. In order to understand whether the recommendations for well destruction, preservation, and replacement or for new wells are appropriate, rationale for these decisions should be added to Table 11 and detailed figures depicting monitoring wells and features that require monitoring at scales that can be read should be provided. Please revise Table	Table 11 was revised to include notes describing why individual wells are not required for monitoring and can be decommissioned. In addition, Figure 9 (this figure is now re-numbered as Figure 10) and Design Drawing C3, both of which are printed as 22″ x 34″ drawings, identify wells proposed for decommissioning. The RAMP, which will be provided in the revised draft RDP, further describes to rationale for the proposed groundwater monitoring.

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6 *(cont.)*	Section 3.1.5	Page 3-6 and	11 to include the rationale for the monitoring well recommendations. In addition, please provide one or more figures or drawings that depict all of the monitoring wells and the recommended actions for the wells along with features that require monitoring such as groundwater treatment areas, contaminant plumes, the ISS area, and slurry walls.	*(see above)*
7	Section 3.1.6 and Appendix C,	Page 3-7; Drawing C-3	Section 3.1.6 states, "[S]oil stockpiles (some of which may be from an unknown source) will need to be inventoried, characterized, and removed prior to constructing the durable cover;" however, these stockpile locations are not shown on Drawing C-3. Please revise Drawing C-3 in Appendix C to show the soil stockpile locations.	Section 3.1.6 was revised to refer to design drawing C1, which identifies existing conditions (including numerous stockpiles) from a topographic survey performed in 2014.
8	Section 3.2.1	Page 3-9	The excavation depth assumptions should be clarified. The first bullet point on Page 3-9 states that the excavation depths are "generally assumed to extend 2 feet below the depth of the sample location of concern;" however, the two-foot depth assumption was decreased if results of a subsequent sample, collected within two feet below the sample depth of concern, was less than the soil action level. The text does not specify if the excavation depth will extend to the depth of the subsequent sample that was below the cleanup goals. Please revise the text to clarify if the excavation depth will extend to the depth of the less-contaminated sample or to provide the assumption(s) that will be utilized to determine excavation depth in this case.	Section 3.2.1 was revised to include the following clarification: *"For excavations driven by multiple samples, the excavation depth was extended to the deepest sample that exceeded the soil action level."* No further clarification was made to Section 3.2.1 regarding the planned excavation depth. Please note that pre-excavation characterization (described in Section 3.2.3) will refine the limits of excavation and post-excavation confirmation sampling (described in Section 3.2.5) will verify that that chemical concentrations are less than the soil action levels.

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9	Section 3.2.1	Page 3-9	The text states the large excavation along the IR-03 shoreline "will be extended to an estimated depth of 17 feet bgs [below ground surface]," but does not state the basis for this estimated depth. For example, it is unclear if the excavation will be extended to the surface or a foot or more into Bay Mud to ensure that contamination is not left in place. Similarly, it is unclear what will occur if the Bay Mud or surface or contaminated soil are present below 17 feet bgs. Please revise the text to specify the basis for the 17 foot excavation depth and discuss how this depth is related to the Bay Mud surface and whether contaminated soil below 17 feet bgs will be left in place.	The subject bullet item (in Section 3.2.1) refers to Section 3.2.2 for further information. Section 3.2.2.2 was revised to better clarify the proposed excavation at IR-03 as follows: *"Excavation depths within the shoreline area ~~may~~ will extend to the Bay Mud (estimated at up to 17 feet bgs) and, based on previous characterization data, this excavation depth will be sufficient to remove residual NAPL (i.e., total TPH exceeding the source criterion of 3,500 mg/kg). ~~a~~Additional post-excavation characterization will be performed in this area to ~~define~~ verify the ~~limits~~ adequacy of ~~contamination~~ the removal. Section 3.2.5 describes the post-excavation confirmation sampling approach and potential contingency excavation."* Please note that Section 3.2.2.2 also refers to Section 3.9 for further information, which references Figure 35 (now re-numbered as Figure 36) to depict a representative cross-section of the IR-03 shoreline excavation and slurry wall. The conclusion that the Bay Mud serves as an effective boundary to limit the vertical migration of NAPL is supported by the extensive characterization work done within the IR-03 NAPL-impacted area during the pilot study and post-pilot study investigation; these studies advanced soil borings beneath the NAPL zone into the Bay Mud, and identified little to no contamination within this lower zone.

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10	Section 3.2.1 and Table 12	Page 3-9	The assumptions for calculating the volumes of excavated soil was not sufficiently explained. Section 3.2.1 states, "Additional excavation will be required for sloping and benching (required to maintain the sidewall stability of excavations greater than three feet deep). The additional excavation volume (for sloping and benching) is estimated at 12,500 cubic yards, but this quantity will be refined in the RAWP." Similarly, Table 12 provides the areas and depths of individual excavation areas. However, the assumptions for the additional excavation volumes obtained from sloping and benching excavations greater than three feet are not provided. Please revise Section 3.2.1 and Table 12 to provide the assumptions and volumes for individual areas where benching and sloping will need to be performed. Further, it is unclear if the data from individual sample locations where contamination is not present to the full proposed excavation depth will be used to adjust the excavation depths in the vicinity of those borings. For example, according to Table 12 for EX02B122B, there are three locations where the 8.5 to 9 foot bgs sample was below action levels. It is unclear to what depth the excavation will extend in the vicinity of these samples. Please revise the text to clarify how the data in Table 12 that indicates that contamination may not extend to the full proposed excavation depth will be used.	The draft DBR included a preliminary estimate of the additional excavation required for sloping and benching, but this estimate was not intended to prescribe specific dimensions for the sloping and benching. As described in Section 3.2.4, the RA contractor will be responsible for designing and implementing slope stability measures such as sloping, benching, or shoring, and to have an onsite representative who qualifies as a Competent Person during excavation activities, when appropriate. The Navy's RA contractor is in the process of planning the excavation work and more detailed information will be presented in the RAWP. As described in the response to specific comment 8, the depth for excavations driven by multiple samples was extended to the depth of the deepest sample that exceeded the soil action level. In the case of Excavation EX02B122B, the samples that contained only shallow contamination exceeding the soil action levels were located in close proximity to samples with deeper contamination (up to 9 feet bgs). Therefore, Excavation EX02B122B was conservatively extended to a total depth of 10 feet bgs. Table 12 and the associated excavation figures provide sufficient information to support the proposed excavation depth, and no clarifications were made in response to this comment.

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11	Section 3.2.2.5; and Appendix A-	Sec 6.3, Page 3-11 and App A Page 6-3	Section 6-3 of Appendix A clearly identifies explosive risk from methane at Site IR-12, but it is unclear what actions are being undertaken to mitigate this risk beyond excavation. Section 3.2.2.5 states that additional excavation will be performed to remove the debris or contamination causing methane generation, if needed, but does not identify the measures that will be taken to protect workers from potentially explosive methane conditions, containerize and/or dispose of the debris/contamination. Please clarify the protective measures that will be used during remedial activities to mitigate the explosive risk from methane.	Section 3.2.4 describes general requirements that need to be incorporated into the RAWPs with regard to excavation methods, and was revised as follows: "*Air monitoring for dust, ~~and VOCs~~ site-specific chemicals (e.g., lead and PCBs), asbestos, and other hazardous constituents (e.g., explosive gases during excavation of methane-generating debris at IR-12) will be performed during the excavations. A description of air monitoring methodology that will be implemented during excavation activities, along with associated protective equipment and control procedures, will be included in the RAWP(s).*"
12	Section 3.2.4	Pages 3-12 to 3-13	The excavation methods explained in Section 3.2.4 are insufficiently detailed. Additional detail should be provided regarding excavation procedures such as the type of machinery and waste management procedures that will be used, including details regarding stockpiling, traffic plans, and transportation. Please revise Section 3.2.4 to provide a more detailed summary of activities and procedures.	The level of detail presented in the RDP is generally consistent with previously approved RDPs for other HPNS parcels. The RAWPs will detail the required equipment and procedures, and will include supplemental plans that describe procedures for waste management, traffic control, and other pertinent topics (as described in DBR Table 9). RAWPs prepared for other HPNS parcels have included similar information, and will be used as a basis for developing the RAWPs for Parcel E.
13	Section 3.2.5	Page 3-13	The requirement to collect a minimum of one confirmation sample per sidewall should be moved into the bullet point discussing sidewall confirmation sampling frequency so that this requirement is not missed. Similarly, the requirement for a minimum of one excavation floor sample per excavation should be moved into the bullet point discussing floor sampling frequency. Please make these changes.	Section 3.2.5 was revised as requested.

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14	Section 3.2.5	Page 3-14	The text confirmation sampling requirements should include collection of an additional excavation floor sample when a sidewall confirmation sample result collected within 2 feet of the bottom of the excavation results in extending the excavation or if the excavation is extended two times in the same direction (i.e., a 10-foot extension). Please require collection of an additional floor confirmation sample under these conditions. Similarly, if the excavation depth is extended by two feet, an additional sidewall confirmation sample from each sidewall should be collected. Please revise the text to require collection of additional sidewall confirmation samples (one from each sidewall) if the excavation depth is extended by two feet.	The confirmation sampling frequency described in the two bullet items in Section 3.2.5 is consistent with RAs implemented at other HPNS parcels, and the Navy does not agree that the requested changes are needed to characterize post-excavation conditions. However, the last paragraph of Section 3.2.5 was clarified to better explain that an adequate number confirmation samples will be collected: *"Following completion of contingency excavation at any location, the RA contractor will ensure that the final confirmation sampling density on the final sidewalls and floor meets the requirements described in this section (i.e., one sample per 50 feet of horizontal sidewall exposed, with two confirmation samples from a given sidewall for excavations deeper than 5 feet, and one sample for each 2,500 square feet of excavation floor)."*
15	Section 3.2.7	Page 3-15	It is unclear if the RA contractor or the prime contractor will perform the radiological related excavation activities. While Section 3.2 (Excavation and Offsite Disposal of Tier 1, Tier 2, and TPH Locations) clearly identifies the activities that the RA contractor will perform, Section 3.2.7 does not clarify whether an independent contractor will be performing the radiological related excavation activities. Please clarify in the text if an independent RA contractor will be performing the radiological related excavation activities.	Section 3.2.7 was revised for clarity as follows: *"All excavated soil and sediment from radiologically impacted areas (most notably, all of IR-02 and IR-03) will be managed by an appropriately licensed contractor (i.e., the RA contractor or an appropriately licensed subcontractor) who meets the requirements identified in the HPNS memorandum of understanding (TtEC et al., 2016)~~identifies the radiological licensing requirements)~~."* The RAWPs will provide a radioactive material management plan that identifies the responsible parties and provides information regarding their licensing. For the first phase of the Parcel E RA, the Navy's RA contractor maintains the appropriate licensing to directly fulfill the requirements.

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16	Section 3.3.2	Page 3-18	The spacing that will be used for the SVE wells has not been adequately explained and/or supported. While Section 3.3.2 indicates that the estimated radius of influence (ROI) for the SVE wells from the treatability study is 30 feet at an applied vacuum of 3.5 inches of mercury, the text also indicates that the actual ROI will be evaluated during startup testing to ensure that the SVE wells adequately capture the treatment area. This implies that the actual ROI may be different from the estimated ROI. Please revise Section 3.3.2 to explain how the expected variability in ROI will be addressed to ensure coverage of the entire area requiring SVE.	The estimated ROI provides a reasonable basis upon which to design and install the SVE system at Building 406. If startup test results identify areas that are not influenced by the SVE wells, then appropriate contingency measures (e.g., increasing extraction rate, adding SVE wells, etc.) will be implemented. The RAWP will identify the startup testing procedures and potential contingency measures to optimize SVE system performance. However, as described in the response to specific comment 2 on the DBR, a contingency excavation may be implemented that would be intended to remove the vadose zone source and eliminate the need to install and operate an SVE system.
17	Section 3.3.2	Page 3-18	Section 3.3.2 indicates that performance of the SVE system may need to be reevaluated to identify whether an additional means of passively introducing air to the subsurface is required to optimize system operation; however, details regarding this reevaluation are not provided. The triggers for this reevaluation should be discussed in the Draft DBR. Please revise the text to discuss the triggers for reevaluating the SVE system and provide specific details about this reevaluation.	As described in the response to comment 16 above, the RAWP will identify the potential contingency measures to optimize SVE system performance, which may includes the passive introduction of air into the subsurface. However, as described in the response to specific comment 2 on the DBR, a contingency excavation may be implemented that would be intended to remove the vadose zone source and eliminate the need to install and operate an SVE system.
18	Section 3.3.4	Page 3-21	The last sentence on Page 3-21 states that the preliminary design maximum system flow rates and contaminant loading indicates breakthrough from the second granular activated carbon (GAC) unit at approximately 39 days of continuous operation; however, the calculations used to estimate the breakthrough have not been provided. Please provide the calculations to support the estimate for GAC breakthrough.	Appendix B was revised to include a new calculation brief for the SVE system's GAC usage. However, as described in the response to specific comment 2 on the DBR, a contingency excavation may be implemented that would be intended to remove the vadose zone source and eliminate the need to install and operate an SVE system.

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19	Section 3.3.4	Page 3-21	Monitoring information for the treatment system is not provided and/or referenced. Specifically, the monitoring frequency for the SVE wells and the granular activated carbon (GAC) vessels are not specified. Please revise Section 3.3.4 to specify the monitoring frequency and protocols for the SVE treatment system.	Section 3.3.4 was revised to include the following statement: "*Information regarding monitoring the SVE treatment system is provided in the RAMP.*" As noted previously, the RAMP will be provided in the revised draft RDP.
20	Section 3.3.5	Page 3-23	The text indicates that the soil gas monitoring probes (GMP) will be constructed of 2-inch Schedule 40 PVC pipe; however, Drawing C5 (SVE Well and Soil Gas Monitoring Probe Details) of Appendix C (Design Drawings) shows the GMP as 0.5-inch Schedule 40 PVC. Please revise Section 3.3.5 and Drawing C5 of Appendix C to address this discrepancy.	Drawing C5 was revised to indicate that the GMPs will be constructed of 2-inch Schedule 40 PVC pipe.
21	Section 3.3.5	Page 3-23	The monitoring frequency and sampling protocols for the GMPs are not specified. In addition, Section 3.3.5 states, "[T]he RAWP may propose additional GMPs if needed to monitor additional locations surrounding Building 406;" however, the decision criteria that will be used to determine that additional locations are needed are not provided and/or referenced. Please revise Section 3.3.5 to specify the monitoring frequency and sampling protocols for the GMPs. In addition, please revise Section 3.3.5 to provide the decision criteria that will be used to determine that additional locations are needed.	The first paragraph of Section 3.3.5 was revised to include the following statement: "*The RAMP identifies decision criteria that will be used to determine if additional GMPs are needed.*" In addition, the last sentence of Section 3.3.5 was revised as follows: "*The RAMP, provided under separate cover, describes the monitoring frequency and sampling protocols for the GMPs, as well as the exit strategy for SVE system operations.*"

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22	Section 3.3.5	Page 3-24	The text states that "field adjustments [may] eliminate a given shallow GMP if it is screened only within low permeability soil," but care should be taken to ensure that sufficient shallow GMPs are installed. Further, the text in Section 3.3 (SVE at Building 406) describe the locations where SVE is needed, stating "the highest VOC concentrations within lower permeability soil layers that would likely limit the ability of SVE to remove VOCs from vadose-zone soil." Since the highest concentrations are present in low-permeability soil layers, it will be important to monitor these areas and not just monitor higher permeability zones. Please revise the text to clarify that it is critical to monitor lower permeability zones where the highest concentrations are present and that shallow GMPs should only be eliminated where high concentrations are not present.	Section 3.3.5 was revised for clarity as follows: "*Accordingly, the geologist or hydrogeologist may make field adjustments that eliminate a given shallow GMP if it is screened only within low-permeability soil; however, it is critical to monitor lower permeability soil layers where the highest VOC concentrations are present and shallow GMPs should only be eliminated where high concentrations are not present.*" The RAWP will present further information on how field decisions will be made regarding potentially eliminating GMPs.
23	Section 3.4.4 Figure 30	Pages 3-30 and 3-31	Two additional monitoring wells are not sufficient to delineate the current extent of contamination because the proposed wells are approximately 100 feet apart. At least one additional well should be installed along the railroad tracks in the vicinity of former boring IR04B065, which was the location with the highest concentration of TCE. Please revise the treatment design and Figure 30 to include an additional groundwater monitoring well in the vicinity of former boring IR04B065.	Section 3.4.4 and Figure 30 (now re-numbered as Figure 31) were revised to include the following changes to the proposed monitoring network at the IR-04 CVOC plume: • Proposed well IR04MW41A was moved slightly to the northeast to be closer to former boring IR04B065. • Proposed well IR04MW42A was moved slightly to the south to be more evenly spaced between existing wells IR04MW37A and IR04MW39A (i.e., less than 100 feet apart). • An additional well (IR04MW43A) is proposed south of the proposed excavation to better delineate the lateral extent of the plume. Based on the proposed changes above, the resulting monitoring network should provide adequate spatial coverage around the plume.

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24	Section 3.4.6	Pages 3-33 and 3-34	The design for the IR-12B benzene plume does not include the potential that treatment will be necessary. The text states that groundwater monitoring data will be used "to support a transition to MNA [monitored natural attenuation] or a no further action determination." However, data from the new wells may indicate a need for treatment. Please revise the text to include the potential need to treat benzene in the IR-12B benzene plume.	The Navy believes that the available groundwater data is sufficient to demonstrate that elevated benzene concentrations are limited in extent and do not warrant groundwater treatment. The proposed groundwater monitoring wells will be installed in previously characterized areas, and the post-excavation conditions can be reasonably expected to be comparable to (or less than) the previously reported benzene concentrations. However, Section 3.4.6 was revised as follows to clarify how future data may prompt re-evaluation of this approach: *"In addition, the proposed excavation at IR-12 will verify the extent of waste that may contribute to the benzene contamination (as described in Section 3.2.2.5). If the future monitoring results or post-excavation characterization identify differing conditions from the assumptions outlined above, then the Navy will consult the regulatory agencies and determine if groundwater treatment is needed to mitigate vapor intrusion risk. If treatment is deemed necessary, a RAWP addendum would be prepared to outline the performance objectives, implementation procedures, and monitoring requirements.*"
25	Section 3.5	Page 3-34	The text in Section 3.4 states, "Groundwater quality (as well as flow direction) will be monitored to ensure that contamination is not discharged into San Francisco Bay at concentrations greater than the corresponding surface water quality criteria for aquatic wildlife;" however, the text does not specify how this will be performed during the RA. Please revise the text to clarify how the monitoring for contamination along the San Francisco Bay will be performed.	The revised draft RDP includes the RAMP that further details the proposed monitoring at IR-02 Northwest. The first paragraph of Section 3.5 was revised to include the following statement: *"The RAMP, which is provided under separate cover, describes the proposed monitoring.*"

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26	Section 3.5.2.1	Page 3-35	Section 3.5.2.1 indicates that a slurry wall overlap of approximately 20 feet is proposed; however, information is not provided and/or referenced to support this overlap. The basis for the 20 feet overlap should be specified in the Draft DBR. Further, it is unclear if the overlap was included in the groundwater modeling, referenced in Section 3.5.2.3 (Wall Thickness), which was conducted to evaluate the slurry wall. Please revise the text to provide information that supports the proposed 20 feet overlap of slurry wall.	Section 3.5.2.1 describes the rationale for the slurry wall overlap as follows: "*The proposed overlap of the two walls is intended to address the potential for the ends of either wall to not terminate at a vertical profile.*" This statement succinctly describes the following logic that was applied to this design element: • Construction methods will allow for the end of the slurry wall to be constructed at a nearly vertical profile, but the potential for slight deviations in this vertical profile cannot be dismissed. • Slight deviations from a vertical profile may result in the slurry wall at the ground surface extending slightly further than the bottom of the slurry wall. For a slurry wall that extends to between 20 and 25 feet bgs (as is proposed for the IR-02 Northwest slurry wall), the potential variation is expected to be less than 5 feet in horizontal distance. • The proposed 20-foot overlap provides additional assurance that the slurry wall will form a continuous low-permeability barrier. The groundwater modeling incorporates this same design objective, and therefore does not need to be further refined. The information above further explains the rationale for the proposed overlap; however, the Navy does not believe that this level of detail needs to be incorporated into Section 3.5.2.1.
27	Section 3.5.2.3	Page 3-36	Section 3.5.2.3 states that, "Groundwater modeling was performed to evaluate the anticipated mound heights and hydraulic gradients associated with the wall under typical groundwater conditions;" however, the groundwater modeling details and results are not provided and/or referenced. Please revise Section 3.5.2.3 to provide or reference details about the groundwater modeling and the model results.	Section 3.5.2.3 was revised to refer to Appendix E, which provides the details and results from the groundwater modeling.

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28	Section 3.5.2.3	Page 3-37	The text refers to potential corrective action to maintain the function of the slurry wall, but it is unclear where this corrective action is discussed. The DBR should include details about the type(s) of corrective action that would be necessary should the groundwater mound height near 6 inches below the top elevation of the wall. For example, one potential corrective action would be pumping groundwater from the upgradient side of the slurry wall, but Drawing C7 does not include sufficient monitoring/extraction wells to monitor potential mounding or to draw down a groundwater mound. Please revise the DBR to specify the corrective action(s) that would be taken in this case and provide details about the components required to monitor groundwater levels upgradient of the wall and to lower the height of a groundwater mound, if it forms.	The last paragraph of Section 3.5.2.3 was revised for clarity as follows: *"Both the maximum allowable hydraulic head difference across the wall and allowable groundwater mound height limits are specified in the RAMP, provided under separate cover, as triggers for initiating corrective actions (e.g., groundwater extraction) to maintain the function of the slurry wall. Section 3.5.5 describes the monitoring/extraction wells and piezometers that will be installed to measure groundwater levels and the hydraulic gradient across the slurry wall, and the potential contingency actions that may be implemented to maintain the function of the slurry wall."* In addition, Section 3.5.5 was revised to refine the number of monitoring/ extraction wells that would be installed and monitored for future contingency actions.
29	Section 3.5.3	Page 3-37	The text in Section 3.5.3 states, "To prevent deformation, the target compressive strength of the slurry wall is a minimum of 30 pounds per square inch;" however, information and calculations to support this value are not provided and/or referenced. Similarly, the target permeability is estimated at 10-5 centimeters per second, but the basis for this value is not provided. Please revise the Draft DBR to provide the calculations and assumptions used to estimate the minimum pressure and target permeability of the slurry wall.	The strength and permeability requirements for the IR-02 Northwest slurry wall are described in Appendices E and F, and are consistent with the previously approved design for the nearshore slurry wall at Parcel E-2. The second paragraph of Section 3.5.3 was revised to clarify the strength requirements as follows: *"Appendix F (Section 6.5.1) provides further information on the design requirements for the slurry wall."* The third paragraph of Section 3.5.3 was revised to clarify the permeability requirements as follows: *"A target permeability of 10^{-5} centimeters per second (cm/sec) (maximum) is specified and, consistent with the modeling results provided in Appendix E, is sufficient to impede the horizontal flow of groundwater at IR-02 Northwest."*

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30	Section 3.5.4	Page 3-38	Section 3.5.4 indicates that the slurry wall will be realigned, if necessary, based on the project specifications in Appendix D (Project Specifications). However, the relevant sections of the specifications have not been cited. In addition, the text references drawing C12, which requires a Slurry Wall Implementation Plan in the notes, but this plan is not discussed in the DBR. Please revise Section 3.5.4 to cite the applicable sections of the project specifications associated with any proposed realignment of the slurry wall. Please also revise the DBR to discuss the contents of the Slurry Wall Implementation Plan.	Section 3.5.4 was revised to delete reference to slurry wall realignment (because the design of the shoreline protection and liner does not provide for that flexibility). In addition, Section 3.5.4 was revised to include the following statement: "*The project specifications (Appendix D, Section 02 35 27, Slurry Trench) also require the RA contractor to prepare and submit a Slurry Wall Implementation Plan that details the implementation procedures and proposed materials.*" Please note that specification Section 02 35 27 (pages 5 through 8) details the specific content the implementation plan, which cannot be concisely summarized in the DBR text.
31	Section 3.5.5	Page 3-39	The monitoring frequency and protocols are not specified for the nearshore slurry wall. From the text in the first paragraph of Section 3.5.5, it appears that only depth-to-water measurements are planned for collection at an unknown frequency. It is not clear whether the groundwater and surface water will be sampled to ensure that the slurry wall is working as intended. Please revise Section 3.5.5 to specify the monitoring frequency and clarify whether groundwater and surface water analytical samples will be collected to confirm that the slurry wall is working as intended.	Consistent with the approved monitoring approach for the nearshore slurry wall at adjacent Parcel E-2, the Navy's monitoring approach relies on water level measurements to ensure that the slurry wall is serving as a hydraulic barrier. Monitoring wells inland of the slurry wall will be sampled for chemical analysis, and those results may prompt sampling of the piezometers on the bay side of the slurry wall. The RAMP, to be provided in Revised Draft RDP, will provide further information.

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32	Section 3.6.1	Page 3-41	Section 3.6.1 states, "The soil gas sampling locations will be based on a review of historic soil data (e.g., soil samples with previous detections of organic chemicals that may volatilize into soil gas) to identify potential areas with residual VOCs in soil gas;" however, the specific decision criteria that will be used to evaluate the historic soil data are not provided and/or referenced. Please revise the text to provide the specific decision criteria that will to evaluate the historic soil data.	The Navy's preliminary approach for the soil gas survey at Parcel E will build upon the methodology for soil gas surveys at other HPNS parcels. However, given that the soil gas survey at Parcel E will not be completed for several years (until after the other RA phases are complete), the Navy wishes to defer more specific details on the soil gas survey to a future work plan. This approach will provide the Navy the necessary flexibility to ensure that future soil gas surveys are implemented consistently across HPNS and in accordance with current regulatory guidance. Section 3.6.1 was revised to include the following statement: "*The RAWP(s) will further detail the evaluation criteria used in selecting the soil gas survey locations, and ensure that the criteria is consistent with the State of California and EPA vapor intrusion guidance (DTSC, 2011 and EPA, 2015, or more recent guidance if available at the time of investigation).*"
33	Section 3.6.4	Page 3-42	It is unclear why this section does not reference the USEPA Vapor Mitigation Guidance, OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, OSWER Publication 9200.2-154, June 2015 (VIP Guidance). Please revise the text describing the contingency for vapor mitigation to cite the VIP Guidance.	The first paragraph of Section 3.6.4 was revised as follows: *"After soil gas data have been evaluated through risk-based screening, areas with unacceptable risk will be further evaluated using location-specific data (i.e., physical characteristics of the soil) to assess potential exposures consistent with the ~~most current~~ State of California and EPA vapor intrusion guidance (DTSC, 2011 and EPA, 2015, or more recent guidance if available at the time of investigation).*" Similar edits were made to Sections 3.6.2 and 3.6.3.
34	Section 3.7.2; Fig 8	Pages 3-45 and 3-46	Section 3.7.2 indicates that Figure 8 shows the approximate locations of the fuel lines on Parcel E; however, Figure 8 does not utilize a suitable scale to show the details for the fuel line locations. Figure 8 is zoomed out to show all the site locations and plans for the site, and is not the appropriate scale to show the details for the fuel lines locations. Please revise the Draft DBR to include a separate figure that shows the relevant details for the fuel lines at a readable scale.	Figure 8 (now re-numbered as Figure 9) was provided as a Standard D-size drawing (22″ x 34″), at which scale all site features (including the fuel lines) are legible.

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35	Section 3.7.2 Table 9	Page 3-45	The text in the partial paragraph at the top of page 3-45 discusses the need to investigate residual petroleum contamination that was not addressed when 150 feet of fuel line were removed adjacent to the D-1 boundary, but this investigation is not specified in the Closure of Steam and Fuel Lines section of Table 9. Please revise Table 9 to include the requirement to investigate this residual petroleum contamination.	Table 9 was revised to include the following requirement: "*Investigate residual petroleum contamination adjacent to the D-1 boundary and shoreline (where fuel lines were previously removed but residual contamination may remain).*"
36	Section 3.8.4 Figure 34	Page 3-49	Section 3.8.4 indicates that the ISS treatment footprint for the full-scale design is shown on Figure 34, but the treatment area is not identified on Figure 34. While the extent of NAPL is shown on the figure, the figure does not specifically identify the treatment area for ISS. It appears that the text should reference Drawing C-14 instead of Figure 34. Please revise Figure 34 to identify the ISS treatment area or revise the text to reference Drawing C-14.	Figure 34 (now re-numbered as Figure 35) identifies the Mobile NAPL Treatment Zone which, as described in Section 3.8.4, is the area that will be treated using ISS. The legend of Figure 34 (now re-numbered as Figure 35) was revised to clarify that this area is the ISS treatment footprint.
37	Section 3.8.4.1	Page 3-50	The text in Section 3.8.4.1 does not specify the procedure that will be used if the tests for the unconfined compressive strengths fail. The procedures that will be used, if the average unconfined compressive strength is not above 100 pounds per square inch (psi) or the unconfined compressive strengths are below 50 psi, are not specified. Similarly, the procedures that will be used if the average hydraulic conductivity on the cured cylinders is not less than 1x10-6 centimeters per second (cm/sec) and the hydraulic conductivities are not below 1x10-5 cm/sec are not specified. Finally, it is not clear that areas with voids that contain liquid NAPL can be solidified to meet the required criteria. Please revise the text to specify the actions that will follow should the above mentioned performance criteria fail to be met. Please also revise the text to discuss how areas with voids filled	QC procedures for ensuring compliance with the design specifications will be detailed in the RA Contractor's RAWP. In case of QC test results that fail to meet the specification requirements, replicate samples will be tested to verify compliance. If the replicate samples fail to meet specification requirements for compressive strength and/or hydraulic conductivity, the RA Contractor shall (1) implement more thorough mixing using additional passes of the auger, or (2) advance an additional ISS column(s) at the location of the failing tests, until the required compressive strengths and hydraulic conductivity are achieved. Steps to be taken in case of failed QC test results shall be addressed in the RAWP. No changes to the DBR were made in response to this comment. The ISS full-scale design addresses mobile NAPL by solidifying the bulk soil mass containing mobile NAPL. The current design

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37 *(cont.)*	Section 3.8.4.1	Page 3-50	with liquid NAPL will be addressed to ensure that the ISS performance criteria are met.	eliminates mobile NAPL through the same mechanisms of reducing permeability and leaching described for the pilot study, but implemented throughout the treatment zone containing mobile NAPL in a manner that reduces groundwater movement to less than $1x10^{-6}$ cm/sec. Some void areas containing NAPL were identified during the pre-design characterization; however, they were very localized and the nature of the column mixing will fill any voids with solidified materials (i.e. bentonite, cement, Bay Mud and fill). Additional auger passes may be required to ensure complete mixing of areas that may contain large voids. Such areas, if present, would be located within the larger ISS treatment zone, and NAPL will be dispersed through the column and surrounded by additional solidified mass. This will address mobile NAPL (the primary objective of ISS) and significantly reduce chemical leaching from the treated NAPL zone. Specific methods for mixing areas with liquid NAPL will be described in the RA Contractor's RAWP. No changes to the DBR were made in response to this comment.
38	Section 3.8.4.2	Page 3-50	The procedures that will be used to confirm the mix percent is unclear. The target mix ratios for the cement-bentonite slurry and soil are specified, but it is unclear how the final mix-ratio will be confirmed. Please revise Section 3.8.4.2 to clarify the procedures which will confirm that the target mix ratio for the ISS is achieved.	The RAWP will describe the procedures for confirming the mix percent for ISS. The procedures are likely to be similar to those implemented during the ISS pilot study, which consisted of the contractor maintaining an installation log for each ISS column that included the diameter and length of the column, total grout volume used, specific gravity of grout, weight of binder used and grout injection rates during the penetration and withdrawal cycles. No changes to the DBR were made in response to this comment.

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39	Section 3.8.4.4	Page 3-52	Section 3.8.4.4 does not discuss the USEPA off-site rule and how it applies to materials excavated or to excess soil from Parcel E. In addition, Section 3.8.4.4 does not include sufficient provisions to ensure the receiving waste management facilities meet USEPA requirements prior to shipment offsite. Periodic verification that the receiving waste management facilities meet USEPA requirements prior to shipment offsite should be incorporated into the Draft RAWP. In addition, verbal notification should also be provided to the off-site rule expert at USEPA Region 9. Please revise the text to discuss the USEPA off-site rule with regard to meeting verification requirements for waste management facilities and notification procedures.	Section 3.8.4.4 was revised for clarity (and consistency with Section 3.2.8) as follows: *"The excavated soil and debris will undergo radiological screening (see Section 3.2.7) and will be properly characterized and disposed of at an appropriate offsite disposal facility that is approved to accept CERCLA wastes in accordance with the "CERCLA Off-Site Rule" (see Section 3.2.8)."*
40	Section 3.9.2.2	Page 3-54	The Wall Thickness subsection of Section 3.9.2.2 states, "Groundwater modeling will be performed as part of the IR-03 slurry wall design to estimate the maximum hydraulic head difference across the IR-03 slurry wall to confirm that the specified wall thickness provides sufficient factors of safety against a blowout failure;" however, this sentence is confusing because groundwater modeling has presumably already been performed and presented in Appendix E (Groundwater Containment System Modeling). If additional groundwater modeling is planned, please provide additional details regarding when this modeling will be performed and who will perform it. Please clarify if additional groundwater modeling is planned to determine hydraulic head difference and details regarding when and who will perform the groundwater modeling.	Section 3.9.2.2 was revised to identify estimated hydraulic head difference across the slurry wall, which supports the selected 3-foot thickness.

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41	Section 3.9.2.3	Page 3-55	Details regarding the field quality control (QC) testing program for the IR-03 slurry wall is not provided. The last paragraph of Section 3.9.2.3 indicates that a field QC testing program is required by the project specification to ensure that the IR-03 slurry wall is constructed in a manner that achieves the specified performance requirements, but details regarding the field QC testing program are not specified. Please revise Section 3.9.2.3 to provide additional details regarding the field QC testing program.	As described in Table 9, the RAWP will describe the CQC program (i.e., organization, processes, and procedures) to ensure compliance with the project specifications. This organization is consistent with previously approved RDPs and RAWP for other HPNS parcels. No changes to the RDP were made in response to this comment.
42	Section 3.9.2.4	Page 3-55	Section 3.9.2.4 states that, "The RA contractor will be responsible for conducting adequate pre-construction subsurface investigations to identify and locate subsurface obstructions along the entire IR-03 slurry wall alignment. The identified obstructions shall be removed by over-excavating prior to construction of the IR-03 slurry wall. If obstructions are deemed too large for removal, the IR-03 slurry wall may be realigned to avoid the obstructions;" however, it is not clear whether the proposed excavation area will be cleared for subsurface utilities prior to digging. The text does not discuss whether there is a need for utilities clearance to be performed prior to initiating digging. Please revise Section 3.9.2.4 to clarify whether subsurface utilities clearance is needed.	Section 3.9.2.4 was revised for clarity as follows: "*<u>In addition to performing preconstruction utility surveys (see Section 3.1.2), </u>~~T~~the RA contractor will be responsible for conducting adequate pre-construction subsurface investigations to identify and locate subsurface obstructions along the entire IR-03 slurry wall alignment.*"

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43	Section 3.9.3	Page 3-56	Sufficient detail has not been provided regarding the monitoring frequency and laboratory analyses. The section refers to the RAMP for the details regarding monitoring, but the Draft DBR should provide a succinct summary that includes the proposed frequency of sampling and the laboratory analyses. It should be noted that the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128, dated September 1998 (Natural Attenuation Protocol) requires an assessment of dissolved oxygen (DO), oxidation reduction potential (ORP), methane, iron, nitrate, ferrous iron, sulfate, sulfide, pH, total organic carbon, temperature, carbon dioxide, alkalinity, chloride, dissolved hydrogen, volatile fatty acids, ethane/ethene to assess if natural attenuation is occurring. Please revise Section 3.9.3 to specify the monitoring frequency and the required laboratory analyses.	Section 3.9.3 was revised to identify the wells proposed for monitoring and summarize the proposed monitoring frequency and laboratory analyses. In addition, Figure 34 (now re-numbered as Figure 35) was revised to identify the new and existing monitoring wells that will be incorporated into the monitoring program. The revisions made to Section 3.9.3 are consistent with the level of information provided in Sections 3.4.3 through 3.4.6 (for monitoring at the VOC plumes).
44	Section 3.9.4	Page 3-57	The areas for potential in-situ bioremediation are not shown on a figure. The second paragraph in the section states, that in-situ bioremediation is planned as a contingency for areas outside the slurry wall. However, these areas are not shown on any figure in the Draft DBR. Please revise Figure 34 (NAPL Remediation Approach at IR-03) to identify the areas where bioremediation is being planned as a contingency.	As described in Section 3.9.4 (and shown on Figure 33, now re-numbered as Figure 34), the concentrations of total TPH and COPECs that exceed trigger levels are located within the areas containing NAPL (or the immediately adjacent shoreline areas) which, as shown on Figure 34 (now re-numbered as Figure 35), will be addressed by a combination of excavation and off-site disposal (within the shoreline zone), ISS (within the mobile NAPL zone), and slurry wall containment (supplemented by a soil cover and liner system). Based on the available data, there is no groundwater contamination outside the IR-03 slurry wall that requires remediation. As a result, the RDP was not revised to identify any areas requiring in-situ treatment. However, as discussed in the response to comment 43, Section 3.9.3 was revised to identify the new and existing wells that will be incorporated into the monitoring program outside of the IR-03 slurry wall. Section 3.9.4 was also revised for clarity as

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44 *(cont.)*	Section 3.9.4	Page 3-57	*(see above)*	follows: "*Currently, it is anticipated that the groundwater plume will reside entirely within the planned barrier wall, so no specific design parameters nor amendment selection is included for this contingency action. However, as described in Section 3.9.3, groundwater monitoring will be performed outside the slurry wall to evaluate the potential presence of total TPH and COPECs. The RAMP summarizes the data evaluation process for the groundwater monitoring program, including the potential implementation of contingency treatment.*"
45	Section 3.9.4	Page 3-57	The criteria for determining when aerobic bioremediation will be used versus when anaerobic bioremediation will be used are not specified. The last paragraph in Section 3.9.4 states that the strategy for determining which amendment to use will be based on local conditions; however, the specific decision criteria that will be utilized should be provided and/or referenced. For example, the groundwater is predominantly anaerobic, so it is unclear what conditions could prompt the use of an aerobic remedy that would have to overcome natural background conditions. Please revise Section 3.9.4 to specify the decision criteria that will be used to determine whether an aerobic remedy or anaerobic remedy will be utilized.	As discussed in the response to comment 44, there is no groundwater contamination outside the IR-03 slurry wall that requires remediation. As a result, the RDP was not revised to identify any areas requiring in-situ treatment, nor to provide specific decision criteria for treatment of contaminants that are not known to be present. The remaining text in Section 3.9.4 (which remains unchanged), provides an overview of possible types of bioremediation technology that could be employed and specifies that a RAWP would be prepared to detail the proposed treatment and any required pre-treatment characterization.
46	Section 3.10.1; Appendix B	Page 3-61; B4 in App B	It is unclear whether current tidal data was used as the basis for design of shoreline protections (e.g., revetment). The two primary data sources per Section 3.10.1 and Calculation Sheet B4 in Appendix B are the National Ocean and Atmospheric Administration tidal data, which ranges from 1960 to 1978 and the National Geodetic Survey which has data until 2012. Please revise Section 3.10.1 to clarify whether these were the most recent data available for tidal ranges.	Section 3.10.1 states that tidal data from the National Oceanic and Atmospheric Administration tidal epoch 1960 to 1978 were used in the design analysis. This is consistent with the tidal data that was used to develop the previously approved design for the shoreline revetment at adjacent Parcel E-2. Calculation brief B4 in Appendix B further explains that tidal data from the 1983 to 2001 tidal epoch was not used because it does not relate the data to the 1929 National Geodetic Vertical Datum. Attachment 2 (within calculation brief B4) provides the mean lower low water and mean high water elevations

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Specific Comments on Design Basis Report (continued)				
46 *(cont.)*	Section 3.10.1; Appendix B	Page		for each epoch relative to established benchmarks, and shows that two epochs are generally comparable (i.e., differences are about 0.3 feet). Section 3.10.6 and calculation brief B10 identifies the parameters that were used to select the revetment height. The design parameters include an extreme high tide (with a 100-year return period) that is 3 feet greater than the mean higher high water level, and is much more significant in selecting the revetment height as compared to minor variations between the two tidal epochs. As a result, no change was made to the design to use data from the more recent 1983 to 2001 tidal epoch.
47	Section 3.10.2; Appendix B	B5 in App B	It is unclear whether current wind data was used to determine wind parameters. Per Calculation Sheet B5 in Appendix B, the wind data from San Francisco International Airport ranging from 1982 to 2011 were used to develop the wind rose. Please revise Section 3.10.2 to clarify whether these were the most recent data available for determining wind parameters.	Calculation brief B5 in Appendix B accurately states that data from 1982-2011 was used to develop the design. This is consistent with the wind data that was used to develop the previously approved design for the shoreline revetment at adjacent Parcel E-2. Section 3.10.2 and calculation brief B5 identify the key design parameters as the sustained peak wind, the direction over which such wind speeds could generate waves (i.e., from the south-southeast), and the fetch distance over which wind-generated waves could develop. Although wind roses can be readily obtained for varying data sets, all the key parameters require a more detailed data analysis (as provided in Attachment 2 of calculation brief B5). During preparation of the design, a wind rose from 2011 to 2016 (from the station at San Francisco International Airport) was reviewed and found to be generally consistent with the wind rose from 1982 to 2011. Specifically, both data sets show that the sustained peak wind that drove the revetment design (over 40 miles per hour from the south-southeast) is a rare occurrence that provides a sufficiently conservative design. As a result, the detailed data analysis was not repeated using a modified (1982-2016) data set.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
48	Section 3.11.3; Section 3.11.4	Pages 3-75 and 3-76; 3-77	The text should specify that the final status survey systematic and biased soil samples will be sent for off-site laboratory analysis of the radionuclides of concern (ROCs), which include cesium-137 (Cs-137), radium-226 (Ra-226), and strontium-90 [Sr-90]). It is important that final status survey samples that are used to demonstrate compliance with the remedial goals, be analyzed according to a defined Quality Assurance Project Plan (QAPP) to ensure the results are defensible and meet the data quality objectives (DQOs) for this remedial action. This should include a requirement for collecting samples being analyzed for Ra-226 by gamma spectroscopy in a sealed container and allowing for a twenty-one ingrowth time prior to analysis. For clarity, please revise these sections to indicate that final status survey samples will be sent for off-site analysis and to require a QAPP for this project.	Section 3.11.3 was revised to include the following statement: *"The gamma spectroscopy analysis will be performed by an appropriately licensed laboratory in accordance with procedures to be specified in the RAWP(s) (which will include a sampling and analysis plan)."* Section 3.11.4 was revised to include a more detailed discussion of the radiological survey approach, consistent with the text provided in Section 3.11.3 (including the additional statement above).
49	Figure 11		Excavation EX02B256 does not appear to include the three locations with exceedences in this area because the three red dots indicating exceedences of Tier I action levels are located northeast of the brown-shaded excavation area. Please resolve this discrepancy.	Figure 11 (now re-numbered as Figure 12) and Table 12 were revised to reflect an expanded excavation footprint that includes the three samples that exceeded the Tier 1 action levels.
50	Figure 21		There is a note for IR36B064 that indicates that Aroclor 1254 "exceeds Tier 2 Action Level," but no excavation is proposed in this area. Also, Aroclor is misspelled. Please resolve these discrepancies.	Figure 21 (now re-numbered as Figure 22) was revised to clarify the note regarding location IR36B064 as follows: *"Aro~~l~~clor-1254 exceeds Tier 2 Action Level and TPH exceeds Source Criterion (3,500 mg/kg); area will be addressed under the TPH corrective action program for Parcel E."*

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
51	Appendix A, Section 2.2; Figures 3 & 4	Page 2-3	The transects used for the cone penetrometer text (CPT) borings are unclear. Section 2.2 states that the CPT borings were installed in transect groups of two borings; however, it is difficult to distinguish which CPT borings form a pair from Figures 3 and 4. Please revise Figures 3 and 4 to show the transect lines to help distinguish the borings that were installed in pairs.	Appendix A, Section 2.2 was revised as follows to more concisely summarize the CPT boring placement: *"For this investigation, as shown on Figures 3 and 4, 21 CPT borings were ~~aligned~~ advanced ~~in groups of two,~~ along ~~transects perpendicular to~~ the shoreline to assist in developing lithologic profiles. Most ~~transects~~ CPT borings were spaced relatively closely (within about 150 feet of each other) along steep and narrow slopes that represent the most critical slopes of the final cover."* The discussion of specific transect locations was originally provided in the work plan, but is not important to the information conveyed in Appendix A. Appendix F (specifically Figures 3 and 4) identify the CPT borings and other soil borings that were used to create lithologic profiles used in the geotechnical analyses. For further clarification, the following statement was added to Appendix A, Section 2.2: *"Lithologic profiles and geotechnical analyses related to the design are provided in Appendix F of the DBR (to which this report is appended)."*
52	Appendix B-B2;	Att 2	The assumptions and formulas used in the calculations for amendment volumes have not been provided. For example, the assumptions for porosity, demand, and factors of safety that have been used are not provided. In addition, the basis of design concentration and distribution volumes have also not been explained. Please provide all the assumptions and formulas used to calculate the quantities of amendments and the distribution volumes.	As described in the response to general comment 7, the level of detail presented in the RDP is generally consistent with previously approved RDPs for other HPNS parcels and additional characterization is needed to develop a more detailed in-situ treatment design. The Navy's RA contractor is in the process of planning this additional characterization and more detailed information will be presented in the RAWP. The RAWP will also describe how the resulting data will be used to refine the in-situ treatment design, and provide more specific information regarding the treatment products and estimated quantities.

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
53	Appendix E1, Section 1	Page 1-4	The last paragraph on Page 1-4 states that, "The results of the modeling work presented herein represent average anticipated groundwater conditions at the site, which are defined by 5 complete years of the most recent consecutive quarterly groundwater monitoring results available for the site from 2010 through 2014;" however, the text does not explain why only data through 2014 is used. Also, it is not clear whether the model accounts for the fact that a slurry wall and a durable cover are being installed at Parcel E-2, which would impact conditions at Parcel E near the Parcel E-2 boundary. Please revise the text in Appendix E to clarify the data range that was used and whether the model accounts for the Parcel E-2 slurry wall and durable cover.	As described in the response to general comment 9, the majority of the engineering design and groundwater modeling was completed in 2015 when only data through 2014 were available. The technical information that informed modeled design elements remains unchanged since that time. The shoreline slurry wall was completed at Parcel E-2 in early 2016, and corresponding water level data was not available during the groundwater modeling. While more recent groundwater level data is now available (through April 2016), the amount of data since the slurry wall was constructed is limited to one quarter. Based on this limited additional data, the Navy does believe that additional modeling with more recent groundwater data is required. Section 2.6 simulates the future conditions at Parcels E and E-2 with the slurry walls and protective liners installed. No revisions were made in response to this comment.
54	Appendix E1, Section 2.2	Page 2-4	The text states, "Reportedly, sanitary sewer lines at the site have already been removed," but in many areas of Parcel E particularly near the shoreline (e.g., in IR-02 and IR-03), sanitary sewer lines and storm drains are still in place. As such, it is not surprising that these lines still have hydraulic influence on groundwater elevations and flow directions. Please revise the text to acknowledge that storm drains and sanitary sewers are still in place near the shoreline.	The subject text in Appendix E1, Section 2.2 already acknowledges that some of the drain lines remain in place. In addition, the subject text focuses on the boundary conditions which, as shown on Figure 4, use modeled drain cells in the inland portion of Parcel E (i.e., outside of IR-02 and IR-03) to replicate observed groundwater conditions. No revisions were made in response to this comment.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
55	Appendix H, Section 3	--	U.S. EPA's "Radiation Risk Assessment at CERCLA Sites: Q & A" states "The PRG calculators (U.S. EPA 2002a, 2007, 2009a), which are used to develop risk-based PRGs for radionuclides, are recommended by EPA for Superfund remedial radiation risk assessments." (Source: https://epa-prgs.ornl.gov/radionuclides/RadRiskQAwithtransmitmemo_June_13_2014.pdf) As one of multiple lines of evidence, please revise Appendix H to show results from the EPA PRG Calculators for soil, buildings, and/or surfaces where relevant. This addition would help demonstrate consistency with U.S. EPA's CERCLA approaches. The software is public and free. The human health PRG calculator is at https://epa-prgs.ornl.gov/radionuclides/ and the ecological risk version is at https://epa-eco.ornl.gov/radionuclides/	As referenced in Section 1 of Appendix H, the risk modeling was performed using procedures initially developed in the radiological addendum to the FS Report (ERRG and RSRS, 2012) and incorporates RGs selected in the Final ROD (Navy, 2013). During review of the radiological addendum to the FS Report, the EPA made a similar comment/request, to which the Navy responded as follows: "*The radiological RGs were originally developed in the action memorandum for the basewide radiological removal action (Navy, 2006), but the backup calculations were not requested for that document. Given the time that has passed since its publication, it is not practical to locate and publish the backup calculations. Further, as noted in the subject comment, the RGs are consistent with EPA's radionuclide PRG calculator except for Ra-226, which is 1 pCi/g above background per an agreement with EPA.*" The Navy's position on this request remains unchanged, and no revision was made in response to this comment.
56	Appendix H, Section 3	--	Page 1-1 sources including research activities at NRDL buildings and waste disposal activities at IR-02 and IR-03. The appendix appears to only address the latter. For clarity to the reader, please explain to a reader where to find information about risk modelling related to buildings. Also please explain the future use at IR-02 and IR-03 is outdoor recreational. Please explain whether or not any occupied buildings would be constructed (e.g. bathroom, interpretive facility, etc.). If so, then please potential risk associated with indoor exposures, e.g. to radon.	As described in DBR Section 3.11.3, the radiological risk modeling provided in Appendix H is related to the final radiological survey at IR-02 and IR-03. DBR Section 2.5.5 states that the radiological remediation at most Parcel E sites, including all NRDL building and former building sites, was completed as part of a removal action involving cleanup to meet remediation goals identical to those in the ROD. Accordingly, the DBR Section 3.11 focuses on radiological remediation of the remaining sites IR-02, IR-03, and the northern portion of IR-12 (the former salvage yard). No revision was made in response to this comment.

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
57	Appendix H, Section 3	--	Radiological contamination has been measured at above release criteria levels in Building 271. Parcel E requires remedial action for soil gas, which will require workers to enter Building 271 to install a Soil Vapor Extraction system. Please discuss any potential risk to these workers from radiological contamination and what measures, if necessary, will protect these workers, e.g. remediation before SVE installation.	Building 271 is located in Parcel C and is not located within the boundaries of this project. Assuming that the reviewer meant to refer to Building 406, work in this building and others within Parcel E will be performed safely by evaluating and implementing, as appropriate, radiological control protocols used in other portions of Parcel E (e.g., IR-02 and IR-03) and other buildings at HPNS.
58	Appendix H	Page 3-1	The description of Scenario 3 is unclear. The third bullet point states that Scenario 3, which was used to estimate radiological dose and risk, included residual radioactivity equal to the highest reported activity at Parcels E and E-2 (below the three-foot cover), and that these activity levels were associated with radiological anomalies that were previously removed. It is unclear if the statement that the activity levels were associated with radiological anomalies that were previously removed indicates that these activities were obtained from soil directly beneath or beside the anomaly, or whether the soil that exhibited these activity levels was removed. Since the results of the risk modeling show that using Scenario 3 results in a risk greater than that allowed by the National Contingency Plan (NCP) of 10E-04-10E-06, it is important to clarify what is meant by the statement that the activity levels were "associated" with radiological anomalies. Appendix H should also clarify whether these areas of elevated activity were previously removed, or are assumed to be addressed by the proposed remedial action at Parcel E and E-2. Please revise the text to clarify how the activity levels were associated with radiological anomalies and whether these areas of elevated activities have been removed.	Table 3 in Appendix H, which is referred to on page 3-1 (two paragraphs below the subject bullet point), provides the requested information. Specifically, Table 3 (titled "Radiological Soil Data Summary") provides two sets of statistics for radionuclides in soil that were previously reported at Parcel E-2. The first soil data set, which was used in the risk modeling under Scenario 3, includes soil data collected adjacent to radiological anomalies at Parcel E-2 that were subsequently removed. As documented in the radiological addendum to the FS Report (ERRG and RSRS, 2012), the radiological anomalies were removed during surveys associated with the Phase V radiological investigation, which did not involve a confirmation sampling program. The ongoing remedial action at Parcel E-2 includes a final radiological survey and associated remediation that is identical to the approach being implemented at IR-02 and IR-03.

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
59	Appendix H	Page 3-2	The text states that the results of the risk modeling indicate that the highest reported activity at Parcels E and E-2 represent an upper bound of acceptable radiological contamination that can remain below the soil cover without posing a future risk that exceeds the risk management range of 10E-06 – 10E-04, but the basis for this statement is not supported by information provided in the Appendix H Table 2, Radiological Risk Results, 3-Foot Cover. Table 2 lists a Scenario 3 (radioactivity equal to historic maximum levels below 3-foot cover) of 1.368 E-04 which exceeds the National Contingency Plan (NCP) acceptable risk range. Please revise this section to address this concern.	The statement in Appendix H was intended to summarize the EPA's guidance regarding the risk management range in the NCP, which is titled "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (1991). This guidance states that "…*the upper boundary of the risk range is not a discrete line at 1 x $10^{(-4)}$, although EPA generally uses 1 x $10^{(-4)}$ in making risk management decisions. A specific risk estimate around $10^{(-4)}$ may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases EPA may consider risk estimates slightly greater than 1 x $10^{(-4)}$ to be protective.*" For example, EPA Guidance titled "Radiation Risk Assessment at CERCLA Sites: Q&A" (June 2014) provides for a dose-based level of 12 mrem/year that achieves a 3 x 10^{-4} cancer risk. Given that the upper bound conditions presented in Scenario 3 are unlikely to be encountered, the preliminary radiological modeling provided in Appendix H demonstrates that the selected remedy is consistent with the NCP requirements. The Navy has consistently made decisions based on these interpretations of the risk management range, including at Parcel E and other HPNS parcels for which radiological remediation incorporating ICs was required (i.e., Parcel E-2 and IR Sites 07/18). No revision was made in response to this comment.

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
60	Appendix H	Page 3-2	The text explains that potential risk at Parcels E and E-2 can be effectively controlled by a soil cover; however, the text does not include any discussion of whether the rate of degradation of land areas at the shoreline areas has been evaluated and whether future planned development activities and whether future planned housing/building locations at Parcels E or E-2 could be impacted by the loss of shoreline which may affect the assumptions (i.e. soil cover) of the risk modeling. Please revise Appendix H to address this concern.	The concerns raised in this comment are addressed in other portions of the DBR, as summarized below: • DBR Section 3.10 describes the design for the shoreline protection at Parcel E, and explains how erosion from tidal and wave action will be controlled. The shoreline protection features are designed to be effective in the long-term and prevent degradation of the soil cover at IR-02 and IR-03. • DBR Section 3.12.6.2 describes the erosion control design for the soil cover at Parcel E, and explains how erosion control practices (including maintenance of the vegetative cover) will effectively control erosion. DBR Section 2.1 and Figure 2 identify the planned reuse at Parcel E, which includes open space reuse throughout IR-02 and IR-03. In accordance with the Parcel E ROD, ICs will be implemented to restrict land disturbing activities throughout Parcel E and to restrict construction of habitable structures in open space areas at Parcel E. During review of the radiological addendum to the FS Report, the EPA made a similar comment, to which the Navy responded as follows: "*Soil covers would be subject to numerous regulatory requirements to ensure proper erosion control and prevent exposure of contaminated material from under the cover (from erosion, digging, etc.). In addition, institutional controls would restrict any land-disturbing activities in covered areas and would effectively prevent exposure to contaminated material. The regulatory requirements, which are described in the FS Report for Parcel E, and institutional controls would maintain the design thickness of the soil cover.*" Based on the information provided above, Appendix H was not revised in response to this comment.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Design Basis Report (continued)				
61	Appendix H	Table 1	This table identifies the exposure duration used in the RESRAD modeling as six years for the child receptor. Please describe why only 6 years was selected and why this is appropriate, versus assuming a longer time such as 10, 12, or 18 years.	Section 2 in Appendix H, which introduces Table 1, briefly summarizes the exposure parameters used in the RESRAD modeling. The text states that exposure parameters were aligned with those used in the nonradiological human health risk assessment, and refers the reader to the radiological addendum to the FS Report for further information. The radiological addendum to the FS Report (specifically Section B2.1.4 in Appendix B) describes the exposure duration as follows: "*The Revised Final Parcel E RI Report uses exposure duration values of 24 years for the adult resident and recreational receptor and 6 years for the child resident and recreational receptor (Barajas & Associates, Inc., 2008); these are the same values used in the RESRAD modeling.*" Appendix H was not revised in response to this comment.
Minor Comments on Design Basis Report				
1	Section 3.1.1	Page 3-3	The first paragraph incorrectly refers to Drawing C1 (Existing Conditions) in Appendix B (Design Calculations), when it is actually in Appendix C (Design Drawings). Please revise Section 3.1.1 to provide the correct reference for design drawing location.	The subject reference in Section 3.1.1 was revised as requested.
2	Appendix A, Section 6.3	Page 6-3	The section incorrectly refers to Section 3.2.2.4 [IR-04 (Redevelopment Block MU-3)] of the Draft DBR instead of Section 3.2.2.5 [IR-12 (Redevelopment Block MU-1)]. Please provide the correct reference for the relevant Draft DBR section.	The subject reference in Appendix A was revised as requested.

Table 1. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
General Comments on Preconstruction Operation and Maintenance Plan				
1	--	--	The operation and maintenance plan does not provide a discussion of sheetpile integrity testing. Section 3.10 (Shoreline Protection) of the Draft DBR on Page 3-61 indicates that the existing sheet pile seawall corroded, which indicates that integrity testing for the proposed sheetpile wall is warranted. Please revise the operation and maintenance plan to discuss integrity testing that is needed for the sheetpile wall.	Integrity testing is not planned for the proposed sheetpile wall because it is not part of the permanent containment for IR-03. New sheetpile will be used solely to provide temporary stabilization during construction, and therefore integrity testing is not warranted. The preconstruction OMP was not revised in response to this comment.
Specific Comments on Preconstruction Operation and Maintenance Plan				
1	Section 2.2	Page 2-5	The operation and maintenance activities described in the section are confusing. The text states, "The SVE system will require regular inspection and maintenance while operational; inspections and maintenance will not be required if the system is turned off temporarily (e.g., for pulsing operations);" however, it is unclear why inspection and maintenance activities will not be necessary during pulsing, which is typically a part of SVE operations when the active system may be shut off. SVE wells are still monitored when SVE operation is not conducted during pulsing. Please specify the operation and maintenance activities that will not be performed with respect to the SVE system during pulsing mode.	The RAMP will provide specific operational information during pulsing operations; as such, the text in question has been removed as follows: *"The SVE system will require regular inspection and maintenance while operational~~; inspections and maintenance will not be required if the system is turned off temporarily (e.g., for pulsing operations).~~"*
2	Section 2.5.1	Page 2-8	No discussion of inspection following an earthquake or other natural event has been provided in Section 2.5.1. While Sections 2 (Inspection, Maintenance, and Repair) and 4.1.1 (Earthquakes) discuss emergency response procedures following an earthquake, please revise the text to provide a discussion regarding activities that will be performed in relation to the shoreline protection features should an earthquake or other natural event occur.	Section 2.5.1 of the preconstruction OMP was revised to include the following text (similar to existing text provided in Section 2.7.1): "*The shoreline protection features will also be inspected following significant earthquake events for settling or other breaches (as described in Section 4).*"

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated March 29, 2017				
Specific Comments on Preconstruction Operation and Maintenance Plan (continued)				
3	Section 3	Page 3-1	Section 3 states, "Additional reporting may be necessary following significant repair of the soil cover or revetment and following inspections triggered by an earthquake or other natural event;" however, reporting should occur if repairs are made following a natural event. Please revise the text to clearly specify that reporting will be done should repairs be made following a natural event.	Section 3 of the preconstruction OMP was revised as follows: "*Additional reporting <u>will</u>~~may~~ be <u>provided</u>~~necessary~~ following significant repair of the soil cover or revetment and following inspections triggered by an earthquake or other natural event.*"

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Project Manager, Nina Bacey, dated March 28, 2017				
Specific Comments on Design Basis Report				
1	Section 2.5.5, Paragraph 4	--	States: *In addition, the removal action fieldwork at the former series 500 buildings and the Building 707 Triangle Area is ongoing.* Please elaborate further on this.	Section 2.5.5 was revised as follows: "*In addition, the radiological removal action at the former series 500 buildings and the Building 707 Triangle Area is ongoing; field work in these areas is complete and interim reports are being prepared.*"
2	Section 3.1.5	--	This section should indicate that replacement of monitoring wells, if necessary, will occur as soon as possible.	Section 3.1.5 was revised to include the following statement: "*Wells will be replaced as soon as possible following construction.*"
3	Section 3.2.6, Bullet 4	--	Please define landscape areas. Are these areas that will not be impacted by vehicles and/or public access in future development?	The subject bullet in Section 3.2.6 was revised as follows: "*All fill will be compacted to a minimum 90 percent of the maximum modified Proctor dry density (ASTM D 1557) at a moisture content within 2 percentage points of optimum. ~~Landscape areas may be compacted to 85 to 88 percent of the maximum modified Proctor dry density.~~*"
4	Section 3.3.1, Paragraph 2	--	Second sentence should reference Section 3.2.2.6 not 3.2.2.5.	The subject reference in Section 3.3.1 was revised as requested.
5	Section 3.4.3.2, Bullets (list of wells)	--	Well IR36MW127A is repeated	The subject bullet list was revised to eliminate the noted duplication.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Project Manager, Nina Bacey, dated March 28, 2017				
Specific Comments on Design Basis Report (continued)				
6	Section 3.10.1	--	This Section refers to the Intergovernmental Panel on Climate Change. It should also refer to the San Francisco Bay authority on climate change, Bay Conservation and Development Commission (BCDC). BCDC is the regulatory agency responsible for oversight of development around the San Francisco Bay. The BCDC San Francisco Bay Plan was developed to deal with the expected impacts of climate change in San Francisco Bay within their jurisdiction. The Plan took into consideration the California Climate Action Team's sea level rise projections which includes the scientific findings from the IPCC and the National Academy of Sciences scientific study on behalf of the states of CA, OR and WA. The latter study focused on the Pacific Coast and is included in the State of California Sea-Level Rise Guidance Document. This is the guidance currently used by BCDC and should be referred to when addressing potential sea level rise along the San Francisco Bay shoreline. I do not believe this will change any of the projections and details presented in the design package.	Section 3.10.1 was revised to include the following statement: "*IPCC estimates of global sea level rise were also incorporated into the San Francisco Bay Plan (2011) which outlines California's approved coastal management program that is administered by the San Francisco Bay Conservation and Development Commission.*"

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Senior Engineering Geologist, Buck King, dated March 24, 2017				
General Comments on Design Basis Report				
1	--	--	The proposed remedy design described in the DBR is consistent with the ROD and meets the applicable or relevant and appropriate requirements (ARARs) listed in Table 1. The GSU recommends that the DBR description of geologic issues and proposed remedial designs be approved.	Comment acknowledged.
2	--	--	Specific comments described below should be addressed in a revised version of the DBR.	See the responses to specific comments below.
Specific Comments on Design Basis Report				
1	Section 1	Page 1.1	The DBR identifies dioxins/furans as chemicals of concern in soil and subsequently indicates in a foot note 6 (page 1-2) that dioxins and furans are not specifically included in soil excavation remedial actions because their chemical concentrations are less than five times the remedial goal. The DBR should be revised to indicate that dioxins/furans are not being targeted for excavation because concentrations are less than five times the remedial goal criteria used for identifying excavation areas. The proposed revision will clarify the report.	Footnote 6 on page 1-2 clarifies that dioxins and furans are not included in the list of chemical groups comprising the Tier 1, Tier 2, and TPH locations because these chemicals are not found at concentrations greater than 5 times the remediation goals. No change was made in response to this comment because the existing clarification provides sufficient information.
2	Section 2.2	Page 2-2, Paragraph 2	The description "*Former Oily Waste Ponds (IR-03) where spent waste oil was stored from 1944 to 1974* " should be revised to "*Former Oily Waste Ponds (IR-03) where spent waste oil was disposed from 1944 to 1974* "	The subject text in Section 2.2 was revised as requested.
3	Figure 7		Previous Removal Actions and Treatability Actions. The figure scale and color selections make it difficult to evaluate and distinguish between Sanitary Sewer/Storm Drain Lines that have been removed and those that remain. The figure should be revised to more clearly show the Sanitary Sewer/Storm Drain Lines and associated soil that have been removed.	Figure 7 (now re-numbered as Figure 8) was revised to more clearly identify the sewer and storm drain lines.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California				
Comment #	**Section #**	**Page #**	**Comment**	**Response**
Comments provided by DTSC Senior Engineering Geologist, Buck King, dated March 24, 2017				
Specific Comments on Design Basis Report (continued)				
4	Appendix A, Section 6.3	Page 6-3, Paragraph 1	The text references DBR Section 3.2.2.4 for information on mitigation measures. The appendix text should be revised to indicate Section 3.2.2.5.	The subject reference in Appendix A was revised as requested.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated March 27, 2017				
Specific Comments on Construction Quality Assurance Plan				
1	CQA Plan Section 1.0	--	The first sentence states that the CQA Plan covers select components of the selected remedy at Parcel E, but does not list what the selected remedy components are. In addition, the basis for not including all the selected remedies at Parcel E is not included. The text should be expanded to include a clear basis for not including all the selected remedy components in the CQA Plan and how CQA for those components will be performed, (and where the CQA plans for those components can be found).	Section 1 was revised for clarity as follows: "*This plan, which was prepared on behalf of the Department of the Navy (Navy), describes the necessary quality assurance (QA) procedures that are to be undertaken during the closure activities (listed in Section 1.1) planned as part of selected remedy. In addition, construction quality control (CQC) procedures will be implemented for all remedial action construction activities (listed in DBR Section 3), in accordance with a CQC Plan that will be part of a remedial action work plan (RAWP) prepared by the construction contractor.*" Please note that the CQA activities consist of periodic inspections and testing by either the Navy or an independent party to ensure the adequacy of the contractor's QC program for remedy components related to waste containment. Similar to other remediation projects completed at HPNS, the CQC Plan to be included in the contractor's RAWP will provide more comprehensive information related to the inspection and testing required for all remedial action construction activities.
2	CQA Plan Section 2.2.1	--	The first sentence in the first paragraph lists expected participants in a preconstruction meeting. This list should be expanded to include DTSC and other regulatory agencies with oversight for the project and should also include at least a two-week notification to the regulatory agencies prior to the meeting.	The subject section indicates that the attendees may be expanded to include "*others as designated by the CQA organization.*" Based on this text, the Navy will evaluate and expand the attendance list, as appropriate, after consulting with the regulatory agencies. Additional information will be included in the contractor's RAWP and associated CQC Plan.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated March 27, 2017				
Specific Comments on Construction Quality Assurance Plan (continued)				
3	CQA Plan Section 2.2.4	--	The text in this section addresses meetings to discuss problems or nonconformance issues, and states that the design engineering firm should be present if a problem requires design modifications and subsequent change orders. The text should be expanded to include notification to regulatory oversight agencies of minor design changes following such meetings. In addition, the regulatory oversight agencies should be included in meetings held to discuss major/significant design modifications.	The subject section refers only to meetings during which design changes are discussed. Section 8.3 discusses the process of approving design changes, and was revised to include the following statement: "*Design and specification changes will also require consultation with the regulatory agencies and, if appropriate, their written agreement.*" In addition, Section 2.2.4 was revised as follows (for consistency with Section 2.2.1): "*These meetings will be attended by parties as directed by the CQA organization~~Manager~~.*"
4	CQA Plan Section 4.9	--	The second bullet states that visual and manual soil classifications (ASTM 02487) should be performed to verify that the material source is suitable for the vegetative layer. The text should be expanded to include import fill testing requirements for chemicals as specified in the Project Specifications (Appendix D).	Section 4.2 describes the activities that pertain to the acceptance of all imported fill used in the project. Section 4.9 describes the activities related to the placement of the vegetative soil layer.
5	CQA Plan Section 4.9	--	The text in the third bullet states that the vegetative layer should be compacted to 80% of the maximum dry density. We note that the table titled Soil Cover Compaction in Section 31 00 00 Earthwork of the Project Specifications (Appendix D) shows a compaction level of 85% for the upper six inches of the cover. In addition, we note that it would be more practical to define a window of compact ion, say 80 to 85 percent to facilitate proper vegetative grown without creating a too loose soil layer which could be more erosion-prone, or too compacted to allow proper root growth.	The subject text was revised as follows: "*The vegetative layer should be compacted as required by the project specifications~~to 80% of the maximum dry density~~.*" The project specifications require that the upper 6 inches be compacted to no greater than 85 percent of the maximum dry density, and all underlying lifts to no less than 90 percent of the maximum dry density.
6	CQA Plan Section 6.1.1	--	The second sentence in the seventh bullet states that damaged rolls may be rejected. However, the remainder of the text in this bullet does not provide any information on when damaged rolls are acceptable, or when damaged rolls have to be rejected. The text should be revised to remove the vagueness. See also the first sentence in the second paragraph in Section 6.2.1 Delivery.	The subject text was revised as follows: "*~~Any d~~Damaged rolls will~~may~~ be rejected.*"

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Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated March 27, 2017				
Specific Comments on Construction Quality Assurance Plan (continued)				
7	CQA Plan Section 6.2.4	--	The text in the first bullet of the second paragraph in the subsect ion titled Destructive Seam Sampling Procedures and Field Testing includes an average frequency of 500 feet of seam length for seam testing for the entire installation. The text should be expanded to require the test locations to be random and dispersed so that they are representative of the entire installation.	The subject text was revised as follows: *"A minimum of one test per 1,500 feet of seam length, which is an average sampling frequency ~~for~~that shall be dispersed in a manner representative of the entire installation; individual samples may be collected at greater or lesser intervals."* Please note that the prior text identified the incorrect sampling frequency, and was revised to be consistent with the project specifications.
Specific Comments on Design Basis Report				
8	Appendix C	--	The final version of the design drawings should be signed and, stamped by an appropriately licensed professional engineer and a signing and stamping date included as required by the California Business and Professions Code for professional engineers.	The final version of the design drawings will be signed and stamped by an appropriately licensed professional engineer.
9	Appendix C	Drawing C12	The slurry wall construction detail shows temporary shoring seaward of the proposed slurry wall. However, it is not clear how the clean fill materials with a vertical face that are retained by the temporary shoring will be supported following removal of the temporary shoring.	The temporary shoring will be left in place until construction begins on the shoreline protection. Design drawings C15 and C17 depict the shoreline protection materials that will be installed bayward of the slurry wall. The subject detail is not drawn to scale and is not intended to depict the shoreline protection features. DBR Section 3.5.4 was revised to include the following statement: *"The temporary shoring will be left in place until the construction begins on the shoreline protection features (see Section 3.10). The RAWP(s) will describe the procedures for either removing or abandoning the temporary shoring in place."*
10	Appendix C	Drawing C19	The drainage geocomposite appears to terminate at the upslope bottom of the sea wall foundation. The effect of terminating the geocomposite underneath the footing could lead to saturation of bearing soils and footing instability should be evaluated.	The drainage geocomposite does terminate at the bottom of the seawall foundation; however, the 6-inch Class II aggregate base layer directly below the seawall footing and the filter rock layer below the riprap armor provide sufficient drainage from the geocomposite layer to prevent oversaturation of the underlying subgrade.

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Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated March 27, 2017				
Specific Comments on Design Basis Report (continued)				
11	Appendix C	Drawing C20	Typical Hybrid Shoreline Stabilization. The detail shows a two-foot thick coarse sand layer underlain by a layer of light riprap. However, no separation fabric between the coarse sand and the underlying riprap is shown. The detail should be revised to include a means of separating the coarse sand from the underlying riprap.	The absence of the filter fabric between the coarse sand and light riprap is an intentional design element. The coarse sand layer was designed to fill in as much of the voids within the rock layer as practicable. This design requirement is detailed in paragraph 3.5 of specification Section 35 31 19 (Coastal Protection). As described in DBR Section 3.10.3, the sand will improve pedestrian access to shoreline areas and provide an additional layer of protection from exposure to potentially contaminated sediment under the rock armor; however, the primary structural component of the hybrid stabilization design is the underlying riprap rock layer, which is sized based on a worst-case scenario of the rock being exposed to wave action. If a fabric was placed between the two layers, this material, if exposed, would be subject to damage from the wave action and ultraviolet degradation.
12	Appendix D. Section 01 57 20.000 10	Subsection 3.5.1	The seventh sentence states that waste materials will be hauled to a Government landfill site. This is confusing and vague, and the text should be revised to provide more information on the referenced Government landfill	The subject sentence has been revised to state: "*Waste materials will be hauled to a Government approved landfill site designated by the Contracting Officer.*" As described in DBR Section 3.2.8, excavated soil and sediment, along with radiologically cleared debris that is not recyclable, will be properly characterized and disposed of at one or more offsite landfills that are approved to accept CERCLA wastes in accordance with the "CERCLA Off-Site Rule."
13	Appendix D. Section 02 35 27	Subsection 2.1.3	The fourth sentence in the first paragraph states that native materials excavated for slurry trenching shall not be used in backfill mix due to radiological contamination. However, the second sentence in the fourth paragraph states that fill material excavated for slurry trench construction may be used in backfill mix(es) provided it is radiologically cleared. The two statements are contradictory, and the text should be revised to remove the contradiction.	Native materials excavated for slurry trenching will not be used in backfill mix due to potential for radiological contamination. The last two paragraphs of this section have been removed.

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Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated March 27, 2017				
Specific Comments on Design Basis Report (continued)				
14	Appendix D. Section 02 56 13	Subsection 3.5.2	The first sentence states that one destructive test sample should be obtained per 1500 feet of field seam. The text should be expanded to state that the test sample locations will be dispersed randomly throughout the entire installation to be representative of the installation.	The subject text has been revised to add the following statement: "*The test sample locations shall be dispersed in a manner representative of the entire installation; individual samples may be collected at greater or lesser intervals.*"

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by Roger Lupo, Chief Radiological Assessment Unit, dated March 1, 2017				
Specific Comments on Design Basis Report				
1	Section 2 .2	page 2-2	History (page 2-2) does not specifically list all of the radioactive isotopes used by the National Radiological Defense Laboratory (NRDL). Please provide a list of all radioisotopes used or disposed of in Parcel E.	Section 2.2 briefly describes the history at all Parcel E sites, including sites with radiological operations. Section 2.5.5 summarizes the ROCs identified at Parcel E, and includes reference to Table 8 (that identifies remediation goals for all ROCs at Parcel E). Section 2.2 was revised to refer to Section 2.5.5 for more specific information related to radionuclides.
2	Section 2 .2	page 2-2	History (page 2-2) states, "deck markers painted with radioactive paint (containing low levels of radium-226 [226Ra] to make the devices glow in the dark) were disposed of along the shoreline (IR-02 and IR-03)." In other areas of HPS and former Navy bases, strontium 90 (Sr-90) deck markers were disposed of in the similar time period and manner as radium 226 (Ra-226) deck markers. Are there any indication of use and/or disposal of Sr-90 deck markers in Parcel E?	As noted in the response to comment 1 above, Section 2.5.5 summarizes the ROCs identified at Parcel E and the text in that section states that strontium-90 has been identified on radiological devices at Parcel E. For clarity and consistency, Section 2.2 was revised to delete reference to radium-226 and refer to Section 2.5.5 for more specific information related to radionuclides.
General Comments on Remedial Design Package				
3	General	--	Of concern is the limited area of demarcation layer installation in radiologically impacted areas that have been denoted as future open space areas and which will not be covered with a durable cover, such as asphaltic concrete. Comparing and contrasting the following figures: • DBR Figure 2 titled "Reuse Areas, Redevelopment Blocks, and IR Sites at Parcel E" (see page 3) • DBR Figure 3 titled "Radiologically Impacted Area" (see page 4) • DBR Figure 38 titled "Areas Requiring Institutional Controls" (see page 6) • DBR- Draft Operations and Maintenance Plan (OMP) titled "Key Remedy Components for Parcel E" (see page 7 and 8)	DBR Sections 1, 3.11.3, and 3.12.5 state that the demarcation layer is to be installed only under the soil cover at IR-02 and IR-03 (which are the only two sites that will require ICs for radionuclides). The noted figures in the DBR and OMP all consistently depict the demarcation layer to be installed at IR-02 and IR-03. No demarcation layer will be needed at other radiologically impacted sites at Parcel E because, as stated in DBR Sections 1 and 2.5.5 (and consistent with the Parcel E ROD), radiological contamination exceeding the RGs will be removed and the adequacy of the remediation verified with final surveys.

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Comment #	Section #	Page #	Comment	Response
Comments provided by Roger Lupo, Chief Radiological Assessment Unit, dated March 1, 2017				
General Comments on Remedial Design Package (continued)				
3 *(cont.)*	General	--	In Installation Restoration (IR) Sites 07 and 18, the entire soil cover area has a demarcation layer. The magnified portion of DBR- Draft Operations and Maintenance Plan (OMP) titled "Key Remedy Components for Parcel E" on page 8 has been marked to highlight the region of concern. Section 2.8 of the Draft Preconstruction Operation and Maintenance Plan for Parcel E specifies controls for digging below the demarcation layer. What assurance is there that digging will not occur in radiologically impacted areas below the soil cap, if no demarcation layer is installed? Explain why the limited areas of the demarcation layer installation in all radiologically impacted areas with soil cover?	*(see above)*
4	General	--	The document specifies plans for final radiological surveys only in the salvage area (p 3-77) and in IR-02 and IR-03(page 3-76) "To conduct the final radiological survey, IR-02 and IR-03 will be divided into an appropriate number of Class 1survey units not to exceed 2,000 square meters in area." These areas are extremely limited relative to the areas denoted in DBR Figure 3 titled "Radiologically Impacted Area". DBR "Figure 7 Previous Removal Actions and Treatability Studies" (see page 5) shows areas of radiological cleanup which are not included in the final radiological surveys. Explain reasoning for why not all radiologically impacted areas in Parcel E will be given a final radiological survey.	DBR Section 2.5.5 states that the radiological cleanup at most Parcel E sites (excluding IR-02, IR-03, and the salvage yard at IR-12) have been addressed by a removal action involving cleanup to meet remediation goals identical to those in the ROD. Section 2.5.5 also states that the cleanup at the removal action sites will be summarized in a final removal action completion report, which will be concurred upon by the FFA signatories (i.e., the Navy, EPA, DTSC, and SFRWQCB) and the California Department of Public Health (CDPH).
5	General	--	This document represents a broad plan and does not specify the instrumentation, instrumentation efficiencies, specific procedures, or quality assurance testing that will be used for the radiological surveys. This information is necessary for RHB to accept any final radiological surveys.	DBR Section 3.11 states that information on the specific methods for radiological surveys and remediation will be provided in the RAWP(s). The RAWP(s) will be subject to review and approval from the FFA signatories and CDPH prior to implementation.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
General Comments on Remedial Design Package				
1	General	--	CDFW-OSPR appreciates the opportunity to provide guidance on the planned cleanup at HPNS. This memorandum will serve to inform the Navy of our continuing interest in coordinating any natural resource issues, as one of the designated State natural resource Trustees.	Comment acknowledged.
2	General	--	The organization of the document is confusing. Different parts of the same procedure are located in different sections of the document. For example, a discussion of general inspection and maintenance measures for burrowing animals is presented on page 3-91 of the Design Basis Report, which then refers to specific measures in the Preconstruction Operation and Maintenance Plan (OMP). Page 2-15 of the OMP refers to Appendix A (Table A-1) of the OMP. Pages A-3 to A-4 of Appendix A refer to Section 2 of Appendix A. Page A-10 of Section 2 refers to Table A-2, which should actually be Table A-1. The complete list of measures for each procedure should be listed in one section of the document, so that it is easy to locate. Cross referencing different parts of the procedure in different sections of the document makes it difficult and time consuming to determine all the measures that are required for each procedure. As a result, some measures may not be implemented based on which section of the document is followed.	The RDP is organized similar to previously approved RDPs for other HPNS parcels. The largest document within the RDP package is the DBR, which describes how the remedy will meet the requirements of the approved ROD. As noted in DBR Section 3, future RAWPs will describe specific implementation procedures for the remedy construction. In contrast, the preconstruction OMP identifies procedures for inspection and maintenance of the various remedy components, and is organized similar to previously approved OMPs for other HPNS parcels. OMP Appendix A summarizes the inspection and maintenance procedures related to various remedy components, including a specific section (Appendix A Section 2) regarding management of invasive plant and animal species (which primarily relate to inspection of the soil cover and shoreline protection). OMP Appendix A, which also includes the general inspection checklist (Appendix A1), provides sufficient detail to guide future inspection and maintenance activities. Accordingly, no changes were made to the RDP in response to this comment. OMP Appendix A (page A-10) was revised to correctly refer to Table A-1 (not Table A-2).

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Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
Specific Comments on Remedial Design Package				
1	DBR Section 3.1.3	Page 3-5	The text states, "*Avoidance measures were developed based on input from the California Department of Fish and Wildlife (CDFW) and are summarized below:*". a. Please add the following measure to the second bullet: New employees will attend a briefing by the qualified biologist prior to participating in work activities. b. Please add the following measure to this section: Equipment and personnel shall be confined to the designated access routes, staging areas, and work areas. c. The text indicates additional avoidance measures may be implemented if intrusive activities are performed during the nesting season or if protected bird species are identified during the focused biological survey, and these additional measures will be specified if needed in the Remedial Action Work Plan (RAWP). Please clarify whether the focused biological survey will be conducted before the Draft RAWP is written, in order to determine whether additional avoidance measures will be specified in the RAWP. CDFW-OSPR recommends that additional avoidance measures, developed in consultation with the regulatory agencies, be included as a contingency in the RAWP in the event work is conducted during nesting season and/or protected bird species are identified during surveys or biological monitoring.	a. The second bullet will be revised[2] to include the following statement: "*<u>The briefing will be repeated daily, as needed, to address new site conditions or orient new site personnel</u>.*" b. The requested text was not added to this section. The existing text describes limitations for locating access routes and staging areas, but does not limit the extent of work areas because, as detailed in the DBR, the remedy involves intrusive construction throughout Parcel E. As a result, a broad restriction of equipment and personnel to remain within select areas of Parcel E is neither practical nor appropriate. c. The focused biological survey may be performed either before or after the Draft RAWP is written. The Navy will develop a specific work sequence that will be discussed with the regulatory agencies prior to implementation. If the Navy decides to perform the focused biological survey after submitting the Draft RAWP, then the findings and recommendations will be documented in a separate technical memorandum that will be reviewed and approved by the regulatory agencies prior to remedy construction. A similar process was previously implemented during the Parcel E-2 remedial action.

[2] Responses to these comments were inadvertently omitted from the Revised Draft RD Package. This response and the associated revisions will be incorporated into the Draft Final RD Package.

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Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
Specific Comments on Remedial Design Package (continued)				
2	DBR Table 1	Page 3	For California Fish & Game Code §5650(a), (b), and (c), under the column "*Design Requirement"*, the text states, "*Prohibits the passage of enumerated substances or materials into waters of the state deleterious to fish, plant life, or birds"*. Please add *"mammals"* to *"fish, plant life, or birds."*	The subject statement in DBR Table 1 will be revised[3] as follows to align with the revised language in that section of the California Fish and Game Code: "*Prohibits the passage of enumerated substances or materials into waters of the state deleterious to fish, plant life, mammals, or birds~~s~~ life*."
3	DBR Table 9	Page 1	The text states, *"Perform focused biological survey and document findings in technical memorandum, which will also identify biological avoidance measures to ensure compliance with the substantive provisions of the Migratory Bird TreatyAct (Title 16 United States Code § 703) and California Fish & Game Code § 3511"*. Please clarify whether the focused biological survey technical memorandum will be completed before the Draft RAWP is written. Please see Specific Comment 1c.	Please see the Navy's response to specific comment 1c.
4	OMP Section 2.7.1	Page 2-12	The text states, *"A site walk will be conducted on* a *quarterly basis for the first year and annually thereafter to check for the formation of rills or gullies on the soil cover"*. Please add that inspections may be more frequent if problems occur such as damage from erosion, burrowing animals, or invasive plants.	The requested change was not made because the existing text adequately describes the process for revising the inspection frequency. Specifically, the second paragraph on page 2-1 states "*The OMP should be revised when or if experience shows a deficiency in the identification, frequency, or adequacy of repair of inspected items.*" In addition, the third paragraph on page 2-1 states "*Changes to the inspection frequency will be documented in annual inspection reports and will be subject to review and approval by the FFA signatories.*"

[3] Responses to these comments were inadvertently omitted from the Revised Draft RD Package. This response and the associated revisions will be incorporated into the Draft Final RD Package.

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Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
Specific Comments on Remedial Design Package (continued)				
5	OMP Appendix A Section 1	Page A-1	The text states, *"Parcel E will be visited at least quarterly for the first year and annually thereafter - or as necessary based on the results of the inspections"*. Please add that inspections may be more frequent if problems occur such as damage from erosion, burrowing animals, or invasive plants.	The requested change was not made because the existing text (in OMP Section 2) adequately describes the process for revising the inspection frequency. Please see the Navy's response to specific comment 4.
6	OMP Appendix A Section 1.4	Pages A-3 to A-4	a. On page A-3, the third bullet states, *"If the damaged areas do not regenerate or are extensive, the seed mix provided in the OMP should be used when reseeding"*. CDFW-OSPR could not locate the seed mix in the OMP. Please reference the page number where the seed mix can be found (e.g., the seed mix is listed on page 3-89 of the Design Basis Report). b. On page A-3, the fourth bullet states, *" The roots of any species outgrowing the predominant grasses could breach the demarcation layer (or underlying protective liner) and must be promptly removed. Exposure of underlying soil beneath trees should be prevented, and herbicide should be applied as necessary"*. Please include in this bullet and in Table A-1 that during nesting season, *"The soil cover should be inspected prior to vegetation removal to identify the potential presence of ground-nesting birds. If evidence of ground-nesting birds is identified during the site inspection, no vegetation removal activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resource trustees) and properly implemented (with oversight from a qualified biologist)."*	a. The seed mix is provided in OMP Table 5, and is referenced in OMP Section 2.7.1.3. OMP Appendix A (pages A-3 and A-4) will be revised[4] to refer to OMP Table 5. b. The requested text, which is similar to existing text in OMP Sections 2.7.1.3 and 2.7.2, will be added[4] as a new bullet item on page A-3.

[4] Responses to these comments were inadvertently omitted from the Revised Draft RD Package. This response and the associated revisions will be incorporated into the Draft Final RD Package.

Table 2. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
Specific Comments on Remedial Design Package (continued)				
6 *(cont.)*	OMP Appendix A Section 1.4	Pages A-3 to A-4	Please revise the second sentence of the bullet to state, *"Exposure of underlying soil beneath trees should be prevented, and herbicide should be applied as necessary in consultation with the FFA signatories and other natural resource trustees (e.g., California Department of Fish and Wildlife)"*, to be consistent with the requirements listed elsewhere in Appendix A. Please include a reference to all sections of the documents that contain additional measures, such as Section 2 (pages A-8 to A-9) and Table A-1 of Appendix A, or list all measures in one section of the document. See General Comment 2. Please note, CDFW-OSPR does not recommend the use of herbicides in special status species habitat such as wetlands and active nesting areas.	Sections 1.4 and 1.6 in OMP Appendix A (that refer to removal of invasive vegetation) will be revised[5] to include the following statement: "*Manage invasive plant species in accordance with the approach described in Section 2.*" Section 2 in OMP Appendix A (as supplemented with Table A-1) summarizes the procedures to be used in managing invasive plant and animals species.
			c. On page A-3, the fifth bullet discusses the procedures for mowing. Please include in this bullet that during nesting season, *"The soil cover should be inspected prior to mowing to identify the potential presence of ground-nesting birds. If evidence of ground-nesting birds is identified during the site inspection, no mowing activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resource trustees) and properly implemented (with oversight from a qualified biologist)"*, to be consistent with the requirements in Section 2 of the OMP (pages 2-14 to 2-16). Please include a reference to all sections of the documents that contain additional measures, such as Section 2, or list all measures in one section of the document. See General Comment 2.	c. The requested text, which is similar to existing text in OMP Sections 2.7.1.3 and 2.7.2, will be added[5] as a new bullet item on page A-3.

[5] Responses to these comments were inadvertently omitted from the Revised Draft RD Package. This response and the associated revisions will be incorporated into the Draft Final RD Package.

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Comment #	Section #	Page #	Comment	Response
Comments provided by Charlie Huang and Tami Nakahara, California Department of Fish and Game, dated March 21, 2017				
Specific Comments on Remedial Design Package (continued)				
6 *(cont.)*	OMP Appendix A Section 1.4	Pages A-3 to A-4	d. On page A-4, the second bullet states, *"For burrows that extend to the demarcation layer (at least 2 feet vertically below the ground surface), the following inspections should be performed:"* Please explain how the Navy will determine whether the burrow extends to the demarcation layer. Please include a reference to all sections of the documents that contain additional measures, such as Section 2 (page A-10) and Table A-1 of Appendix A, or list all measures in one section of the document. See General Comment 2.	d. The last bullet on page A-3 briefly describes the proposed measurements, and will be clarified[6] as follows: *"Evidence of burrowing animals on the soil cover should be noted and monitored over time. The approximate location, diameter, and vertical depth of burrows will be recorded (where the burrow daylights at the ground surface). Pest control measures, to be performed in accordance with the approach described in Section 2, may be necessary if damage to the cover occurs ~~(see Section 2)~~."* The Navy will evaluate the available information regarding the depth of the animal burrows to determine if they have the potential to extend to the demarcation layer. The procedure described in the subject bullet on page A-4 will be implemented if the Navy determines that the animal burrows extend to the demarcation layer.
7	OMP Appendix A Section 2.5	Page A-10	The text states, *"Table A-2 identifies the invasive species management steps to be followed during future inspections"*. It appears the text should be referring to Table A-1 rather than A-2. Please revise the text from *"Table A-2"* to *"Table A-1"*.	OMP Appendix A (page A-10) was revised to correctly refer to Table A-1 (not Table A-2).
8	OMP Appendix A1	Page 4	Under Shoreline Protection, in regards to the Armoring Inspection, please add to the Action/Inspection Items list: *"Note evidence of invasive animals"*.	OMP Appendix A1 will be revised[6] as requested.

[6] Responses to these comments were inadvertently omitted from the Revised Draft RD Package. This response and the associated revisions will be incorporated into the Draft Final RD Package.

Abbreviations and Acronyms

ASTM	ASTM International
bgs	below ground surface
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/s	centimeters per second
COPEC	chemical of potential ecological concern
CPT	cone penetrometer test
CQA	construction quality assurance
CQC	construction quality control
CVOC	chlorinated volatile organic compounds
DBR	design basis report
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ERRG	Engineering/Remediation Resources Group, Inc.
FFA	Federal Facility Agreement
FS	Feasibility Study
GAC	granulated activated carbon
GMPs	gas monitoring probes
GWTDCs	groundwater treatment design concentrations
HPNS	Hunters Point Naval Shipyard
ICs	institutional controls
IR	Installation Restoration
ISS	in-situ solidification/stabilization
ISTR	in-situ thermal remediation
mg/kg	milligrams per kilogram
NAPL	nonaqueous-phase liquid
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRDL	Naval Radiological Defense Laboratory

Abbreviations and Acronyms *(continued)*

OMP	operation and maintenance plan
pCi/g	picocuries per gram
PCBs	polychlorinated biphenyls
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RA	remedial action
Ra-226	radium-226
RAMP	Remedial Action Monitoring Plan
RAWP	Remedial Action Work Plan
RCAs	radiologically controlled areas
RDP	Remedial Design Package
RESRAD	residual radioactivity
RG	remediation goal
RI	Remedial Investigation
ROC	radionuclide of concern
ROD	Record of Decision
ROI	radius of influence
RPM	Remedial Project Manager
RSRS	Radiological Survey and Remedial Services, LLC
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SOP	standard operating procedure
SVE	soil vapor extraction
TCRA	time-critical removal action
TPH	total petroleum hydrocarbons
VOCs	volatile organic compounds

References

Department of the Navy (Navy), 2013. "Final Record of Decision for Parcel E, Hunters Point Naval Shipyard, San Francisco, California." December.

Engineering/Remediation Resources Group, Inc. (ERRG) and Radiological Survey and Remedial Services, LLC, 2012. "Final Radiological Addendum to the Feasibility Study Report for Parcel E, Hunters Point Shipyard, San Francisco, California." August.

Appendix IB. Responses to Comments on Revised Draft Remedial Design Package

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
General Comment on Revised Draft Remedial Design Package				
--	--	--	Several Responses to EPA Comments (RTCs) could not be fully evaluated because the Remedial Action Monitoring Plan and Remedial Action Work Plans (RAWPs) were not provided to confirm that the issues noted in the RTCs were incorporated and addressed in these subsequent documents. This includes but is not limited to the responses to Remedial Design Package - General Comments 1a-1d; Design Basis Report General Comments 3 and 7; and, Design Basis Report Specific Comments 2, 4-6, 10-12, 15-19, 21, 22, 25, 31, 38, 39, 41, 44, 45, and 52. Please provide the RAMP and RAWP in order for EPA to complete its review.	The Draft RAMP[1] and the Draft RAWP (for the first phase of the Parcel E RA) will be submitted for regulatory agency review in 2018 (the planned submittal dates are identified in the most recent FFA schedule).
Comments on Responses to Comments on Draft Design Basis Report				
1	3.1.6	--	Response to EPA Specific Comment 7: The response addresses the comment; however, Section 3.1.6 (Site Demolition, Clearing, and Grubbing) continues to reference Design Drawing C3 (Clearing, Grubbing, Demolition, and Surface Debris Removal) of Appendix C (Design Drawings) rather than Design Drawing C1 (Existing Conditions) of Appendix C, as noted in the response. Please revise Section 3.1.6 to reference Design Drawing C1 of Appendix C.	Section 3.1.6 was revised to refer to Design Drawings C1 and C3, which both depict the existing stockpiles that were identified during the 2014 topographic survey. Although not specifically mentioned in the response to EPA Specific Comment 7, Design Drawing C3 was revised to show the same existing stockpiles that are also depicted on Design Drawing C1. This change was made to clarify the potential features that require demolition during the RA.

[1] Abbreviations and acronyms are defined in a list presented at the end of this document.

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
2	3.2.5	--	Response to EPA Specific Comment 14: The response partially addresses the comment. While Section 3.2.5 (Post-Excavation Confirmation Sampling) was revised to clarify that one sample per 50 feet of horizontal sidewall exposed, with two confirmation samples from a given sidewall for excavations deeper than 5 feet, and one sample for each 2,500 square feet of excavation floor, Section 3.2.5 should ensure that floor samples will be collected in areas where sidewalls are extended, particularly if the contamination identified in the sidewall is near the bottom of the sidewall. This will ensure deeper contamination could be detected in areas where sidewalls are extended. Please revise Section 3.2.5 to ensure that floor samples are collected in areas where sidewalls are extended to ensure deeper contamination is assessed.	Section 3.2.5 was revised in two locations to address this concern. The second bullet (describing the location of post-excavation floor samples) was revised to state: "*Excavation floor samples will be evenly spaced and collected from the center of each 2,500-square-foot grid, unless site-specific observations (e.g., visual cues of stained soil) necessitate biasing the sampling locations*." The second paragraph (describing step-out excavation based on sidewall sample results) was revised to state: "*Following completion of contingency excavation at any location, another confirmation sidewall sample will be collected from the same height as the original sample (i.e., with results exceeding the soil action levels) and from the newly exposed sidewall. If contingency excavation was driven by results from a deep sidewall sample (i.e., deeper than 5 feet), then the location of excavation floor samples should be evaluated to determine if an additional floor sample should be collected and analyzed (to demonstrate that the vertical extent of the excavation is properly characterized).*"
3	3.3.2	--	Response to EPA Specific Comment 16: The response addresses the comment; however, Section 3.3.2 (Extraction Wells) was not revised to clarify that if startup test results identify areas that are not influenced by the SVE wells, then appropriate contingency measures (e.g., increasing extraction rate, adding SVE wells, etc.) will be implemented. Please revise Section 3.3.2 to clarify that if startup test results identify areas that are not influenced by the SVE wells, then appropriate contingency measures (e.g., increasing extraction rate, adding SVE wells, etc.) will be implemented.	Section 3.3.2 was revised to include the following new paragraph: "*During system startup, vacuum readings will be collected at GMPs to evaluate ROI from SVE wells. If startup test results identify areas that are not influenced by the SVE wells, then appropriate contingency measures (e.g., increasing extraction rate, adding SVE wells, etc.) will be implemented. The RAWP will identify the startup testing procedures and potential contingency measures to optimize SVE system performance.*"

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
4	Appendix C, Drawing C5	--	Response to EPA Specific Comment 20: The response addresses the comment; however, Design Drawings C5 (SVE Well and Soil Gas Monitoring Probe Details) of Appendix C (Design Drawings) was not revised to show the soil gas monitoring probes (GMPs) are constructed of 2-inch Schedule 40 PVC pipe, as described in Section 3.3.5 (Soil Gas Monitoring Probes). Please ensure Drawing C5 of Appendix C is revised to address this discrepancy.	The previous response to Specific Comment 20 was incorrect. Drawing C5 accurately depicts the proposed construction for the GMPs (0.5-inch diameter, Schedule 40 PVC pipe), which is consistent with the existing GMP network at other HPNS sites (e.g., Building 123 in Parcel B-1). For the Draft Final DBR, Section 3.3.5 was revised to accurately describe the proposed GMP construction, consistent with the information presented on Drawing C5.
5	3.5.2.1	--	Response to EPA Specific Comment 26: The response addresses the comment; however, the information presented in the response was not incorporated into Section 3.5.2.1 (Wall Lengths) to provide the logic that was applied when overlapping the slurry walls or to clarify that the groundwater modeling accounted for this overlap. Please revise Section 3.5.2.1 to explain the rationale for the proposed slurry wall overlap.	Section 3.5.2.1 was revised to provide the expanded rationale, as documented in the Navy's previous response, regarding the proposed overlap of the IR-02 Northwest slurry wall with the Parcel E-2 nearshore slurry wall.

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
6	--	--	Response to EPA Specific Comment 29: The response does not address the comment. The response includes the revised text, "A target permeability of 10^{-5} centimeters per second (cm/sec) (maximum) is specified and, consistent with the modeling results provided in Appendix E, is sufficient to impede the horizontal flow of groundwater at IR-02 Northwest;" however, the text provided in Section 3.5.3 (Slurry Wall Mix) states, "A target permeability of 10^{-6} centimeters per second (cm/sec) maximum is specified and, consistent with the modeling results provided in Appendix E, is sufficient to impede the horizontal flow of groundwater at IR-02 Northwest." As such, it is unclear if the target permeability is 10^{-5} cm/sec or 10^{-6} cm/sec. It should be noted that Section 2.6.3 (Subsurface Horizontal Flow Barriers) of Appendix E1 (Groundwater Containment System Modeling for Parcel E) indicates that the horizontal flow barriers have been modeled with "a K value of 10^{-5} feet per day." Please update the Revise Draft RDP to address this discrepancy.	Section 3.5.3 correctly identifies the maximum target permeability of 10^{-6} cm/s, which is consistent with the Parcel E-2 nearshore slurry wall (into which the IR-02 Northwest slurry wall will be tied). The response to EPA Specific Comment 29 should have identified this change from the Draft DBR. Appendix E1 used a higher permeability (10^{-5} cm/s) for the slurry wall to conservatively model hydraulic conditions, and the lower permeability (10^{-6} cm/s) specified in the DBR provides an additional factor of safety for the constructed slurry wall.

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
7	--	--	Response to EPA Specific Comment 31: The response partially addresses the comment. Water level measurements alone are insufficient to demonstrate that the slurry wall is functional. The functionality of the slurry wall should be discussed in the Five-Year Review Reports; data from chemical analyses of groundwater as well as hydraulic analysis should be provided to demonstrate that the slurry wall is functioning as designed. Section 3.5.5 (Monitoring/Extraction Wells and Piezometers for Nearshore Slurry Wall) should be revised to include sampling of monitoring wells inland of the slurry wall for chemical analysis. The results from those wells would then prompt sampling of the piezometers on the bay side of the slurry wall (e.g., if concentrations upgradient of the wall increase). Alternatively, Section 3.5.5 could recommend baseline sampling of bay side wells and sampling once every five years (i.e., prior to the Five-Year Review) to demonstrate that the slurry wall remains functional. Please revise Section 3.5.5 to include sampling of monitoring wells inland of the slurry wall for chemical analysis and an approach to determine when bay side well should be sampled. Alternatively, please revise the text to require baseline sampling of bay side wells and sampling once every five years to demonstrate that the slurry wall remains functional. In addition, please revise Section 3.5.5 to clarify that this methodology will be utilized in addition to relying on water level measurements.	Section 3.5.5 was revised in two locations to address this concern. The first paragraph was revised to state: *"The design of the slurry wall includes monitoring/extraction wells and piezometers to measure groundwater levels and the hydraulic gradient across the slurry wall. In addition, existing and new groundwater monitoring wells in and around the contaminant plumes at IR-02 Northwest and Central will be sampled to track COPEC concentration trends. Figure 9 identifies the existing and new groundwater monitoring wells and piezometers in and around the contaminant plumes at IR-02 Northwest and Central."* The second paragraph was revised to state: *"The monitoring approach at IR-02 Northwest and Central will rely upon multiple lines of evidence to verify that the slurry walls are preventing discharge (into San Francisco Bay) that would result in concentrations exceeding corresponding surface water quality criteria for aquatic wildlife. The primary lines of evidence include: (1) sampling and analysis of existing and new groundwater monitoring wells in and around the contaminant plumes at IR-02 Northwest and Central (to track COPEC concentration trends); (2) sampling and analysis of new monitoring/extraction wells (to track attenuation of COPECs behind the slurry wall), (3) depth-to-water measurements from new monitoring/extraction wells and piezometers (to ensure the slurry wall is serving as a hydraulic barrier). Secondary lines of evidence may include: (1) sampling and analysis of new piezometers (to evaluate COPEC concentrations near the surface water/groundwater interface), and (2) sampling and analysis of existing monitoring wells at adjacent Parcel E-2 (to evaluate COPEC concentrations hydraulically upgradient from IR-02 Northwest). The RAMP further describes the proposed sampling and analysis, and the associated data evaluation methodology for ~~the~~ groundwater ~~wells~~ monitoring at IR-02 Northwest and Central."*

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
7 *(cont.)*	--	--	*(see above)*	The RAMP, which will be submitted separately for regulatory review, provides further information on the proposed monitoring. The RAMP is the more appropriate document to describe the monitoring requirements for IR-02 Northwest and Central.
8	--	--	Response to EPA Specific Comment 37: The response partially addresses the comment. The response indicates that quality control (QC) procedures for ensuring compliance with the design specifications will be detailed in the RAWP; however, it is unclear why the steps to be taken in case of failed QC test results were not included in the Revised Draft Construction Quality Assurance Plan for Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated November 2017 (Revised Draft CQAP). Please revise the Revised Draft CQAP of the Revised Draft RDP to include the steps to be taken in case of failed QC test results.	Section 1 of the CQA Plan distinguishes between CQC actions that will be implemented by the construction contractor, and CQA actions that will be implemented by an independent engineering firm. CQC actions will be implemented in accordance with a CQC Plan prepared as part of the RAWP, and will include more comprehensive inspections and testing for all RA construction activities. In contrast, CQA actions are limited to inspections and periodic testing for select RA construction activities at IR-02 Northwest and IR-03 (i.e., slurry walls, shoreline revetment, and soil covers with protective liners). For these reasons, the testing associated with the ISS (which was the subject of EPA Specific Comment 37) is not discussed in the CQA Plan.
9	--	--	Response to EPA Specific Comment 39: The response partially addresses the comment. While Section 3.8.4.4 (Disposal of Excess Soil and Debris) was revised to reference the USEPA off-site rule, the revised text and Section 3.2.8 (Waste Characterization and Disposal of Excavated Soil, Sediment, and Debris), but the text does not specifically discuss the USEPA off-site rule with regard to meeting verification requirements for waste management facilities and notification procedures. Please revise Sections 3.2.8 and 3.8.4.4 to discuss the USEPA off-site rule with regard to meeting verification requirements for waste management facilities and notification procedures.	To clarify, EPA Specific Comment 39 requested the Draft RAWP (not the DBR) address "*periodic verification that the receiving waste management facilities meet USEPA requirements prior to shipment offsite*." Accordingly, the RAWPs will include a waste management plan that describes specific procedures to ensure compliance with the CERCLA Off-Site Rule. These procedures include the RA contractor confirming the "Off-Site Policy" status of the designated disposal facilities by contacting EPA's designated Regional Off-Site Contact (currently Ms. Sharon Lin).

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
10	3.9.2.2	--	Response to EPA Specific Comment 40: The response partially addresses the comment. While the Wall Thickness subsection of Section 3.9.2.2 (IR-03 Slurry Wall Dimensions) was revised to clarify that preliminary water balance calculations indicated that the water level inside the slurry wall would be approximately three feet above mean sea level and the highest hydraulic head difference across the wall would be approximately five feet, the preliminary water balance calculations are not included and/or referenced. As a result, the revised text in Section 3.9.2.2 cannot be verified. Please revise the Wall Thickness subsection of Section 3.9.2.2 to include and/or reference the preliminary water balance calculations to support the revised text.	DBR Appendix E2 was revised to include the preliminary water balance calculations for the IR-03 slurry wall. DBR Section 3.9.2.2 was revised to refer to this supplemental information.
11	--	--	Response to EPA Specific Comment 50: The response does not address the comment. Figure 22 (Excavations at Redevelopment Block MU-1 Central) was not revised to clarify that the area associated with location IR36B064 will be addressed under the total petroleum hydrocarbon (TPH) corrective action program for Parcel E. However, moving excavation of the area associated with location IR36B064 to the TPH corrective action program is not appropriate given the presence of polychlorinated biphenyls (PCBs). Given the fact that the TPH corrective action program only addresses TPH, please revise the Revised Draft RDP to include the excavation of the area associated with location IR36B064.	DBR Figure 22 and Table 12 were revised to include a new Tier 2 location at IR36B064. This boring has an isolated detection of Aroclor-1254 (0.8 mg/kg at 1 foot bgs) that exceeds the Tier 2 action level (0.47 mg/kg), and also contains a total TPH concentration (5,000 mg/kg) that exceeds the source criterion.

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
12	--	--	Response to EPA Specific Comment 55: The response does not address the comment. The current EPA Radiological Preliminary Remedial Goal (PRG) calculator contains the most recent risk and dose coefficients, shielding factors, cancer slope factors and other such information that reflects the newest scientific research and data for use in assessing the protectiveness of site conditions. As such, the PRG calculator can and should be used to ensure that the remedial actions under consideration continue to fall within the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) acceptable risk range and therefore are protective of human health and the environment. Please provide an updated assessment of the total risk resulting from obtaining the remedial goals for the selected scenario.	Based on follow-up communication, the Navy and EPA agreed that the preliminary risk modeling does not need to be revised as requested in this comment. However, as discussed in DBR Section 3.11.3, post-remediation risk modeling will be performed at IR-02 and IR-03 (using data collected during the final radiological survey) to "*demonstrate the radiological risk at the final ground surface (following installation of a demarcation layer and soil cover) is within the risk management range specified in the NCP (10^{-6} to 10^{-4}).*" In addition, DBR Appendix H (Section 3) states that the radiological risk modeling approach will be refined in the Remedial Action Work Plan and provided to the regulatory agencies for review prior to implementing final radiological surveys. The Navy will consult with EPA and evaluate use of the PRG calculator in the post-remediation risk modeling
13	--	--	Response to EPA Specific Comment 56: The response partially addresses the comment. The response does not address whether future use at the IR-02 and IR-03 sites will include any occupied buildings, such as a bathroom or interpretive facility. Please provide a response and/or revisions to the Remedial Design package for Parcel E that addresses this question. If any buildings are planned, please provide an analysis of the potential risk associated with indoor exposures from radon resulting from residual Ra-226 contamination.	As shown on DBR Figure 2, IR-02 and IR-03 are slated for open space reuse. In accordance with the ROD, land use restrictions will apply at open space areas that will restrict construction of enclosed structures for human habitation without controls to mitigate potential vapor inhalation risk. Implementation of ICs, including inspection and reporting requirements, are described in the LUC RD, which will be provided under separate cover.

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Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
Comments on Responses to Comments on Draft Preconstruction Operation and Maintenance Plan				
1	--	--	Response to EPA General Comment 1: The response does not address the comment. The response indicates that integrity testing of the new sheetpile wall is not warranted as it will be used solely to provide temporary stabilization during construction; however, the response does not address the need for integrity testing of the existing sheetpile wall which Section 3.10 (Shoreline Protection) indicates "still provide structural support for the upland soil." Please revise the Revised Draft RDP to discuss the need for integrity testing of the existing sheetpile wall given that it still provides structural support for the upland soil.	The previous response mistakenly referred to the existing and proposed sheetpile walls at IR-03, whereas the EPA comment referred to the existing vertical seawall that extends approximately 475 feet along the southeastern boundary of IR-02 Southeast. The existing seawall, which consists of interlocking steel sheetpiles that are partially corroded but still provide structural support for the upland soil, is not planned to be maintained as a part of the remedy. As described in the DBR Section 3.12.5.6, the design includes installation of drainage rock in place of the 2-foot-thick vegetative soil cover to provide protection of the subsurface soil and adequate drainage of storm water and potential seawater (from wave action that may overtop the existing seawall). In addition, DBR Section 3.10.3 includes the following requirement: "*The RA contractor will verify the integrity of the existing seawall during development of the RAWP(s) and evaluate whether shoreline protection is needed to control erosion from tidal and wave action from San Francisco Bay.*" OMP Section 2.5.2 was revised to include a requirement for the O&M contractor to verify the integrity of the durable cover adjacent to the existing seawall and evaluate whether additional shoreline protection material (e.g., drainage rock) is needed to control erosion from tidal and wave action.

Table 3. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated January 2, 2018				
New General Comment on Draft Opinion of Probable Construction Cost				
1	--	--	Based on Section 1 (Introduction) of the Draft Opinion of Probable Construction Cost for Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated November 2017 (Draft Cost Opinion), "This cost opinion does not include costs for operation and maintenance of the remedy, but does include costs for the first year of post-treatment monitoring at the VOC [volatile organic compound] plumes (to support a demonstration that the remedy is operating properly and successfully." As a result, some costs necessary to implement the remedial design are not included in the Draft Cost Opinion. Section 4.7.6 (Prefinal/Final Design) of the Remedial Design/Remedial Action Handbook, EPA 540/R-95/059, dated June 1995 (RD/RA Handbook) indicates that the final operation and maintenance (O&M) cost estimate information should be "included as part of the materials submitted with the prefinal/final draft O&M manual" and that the prefinal/final remedial action (RA) cost estimate should be accurate within plus 15 percent and minus 5 percent. Given that the Revised Draft Preconstruction Operation and Maintenance Plan for Parcel E, Hunters Point Naval Shipyard, San Francisco, California, dated November 2017 (Revised Draft Preconstruction O&M Plan) is included in the Revise Draft RDP, please revise the Draft Cost Opinion to include costs for O&M of the remedy.	Section 1 states that "*This cost opinion only includes estimates for capital costs associated with construction of the selected remedy for Parcel E and was developed for the Navy to support budgeting and construction contracting.*" The content in the Parcel E cost opinion is consistent with cost opinions developed in support of RAs at other HPNS parcels. This approach focuses on estimating construction costs for RA implementation when necessary and appropriate to support budgeting and construction contracting. EPA's RD/RA Handbook provides useful technical guidance in developing and implementing the RD/RA process. However, certain elements of the handbook, such as those related to construction contracting, are focused on RD/RA projects directly funded and managed by EPA. The recommendations in the RD/RA Handbook regarding preparation of an O&M cost estimate are not relevant to the Navy's management of Parcel E because of their established processes for long-term project planning. Specifically, the Navy maintains a cost estimate for the environmental restoration program at HPNS, which includes projected cost for O&M and LTM. The Navy's programmatic cost estimate uses O&M and LTM costs estimated in the FS reports, which are regularly updated to reflect adjustments in the ongoing O&M and LTM program (i.e., as RAs are completed and O&M/LTM activities are consolidated within multiple parcels to maximize efficiency). For the reasons stated above, the Navy does not agree that the Parcel E cost opinion needs to include O&M/LTM costs, and no change was made in response to this comment.

Table 4. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Project Manager, Nina Bacey, dated January 16, 2018				
Comments on Revised Draft Design Basis Report				
1	3.10.1	--	In December 2017, the San Francisco Bay Conservation and Development Commission, Adapting to Rising Tides Program, provided me with the most recent sea level rise mapping and projections for the San Francisco Bay area. Attached is the Rising Seas in California an Update on Sea-Level Rise Science guidance document. I am requesting that paragraph five and six which detail the Intergovernmental Panel on Climate Change predictions, be replaced with the information specific to the San Francisco Bay area, as indicated in the above document (link provided below). Sections 1.1 and Table 1(b) (2050 and 2100 (RCP8.5) - Likely Range) will provide the necessary information. This will not affect the decisions made in regards to the design plan. The last sentence in Section 3.10.1 will not need to be revised. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf	Section 3.10.1 was revised to include the requested information, including a brief summary of the methodology and the following estimates of sea level rise in 2100 (from the cited guidance document, Griggs et al, 2017): "*The estimated sea-level rise in San Francisco (i.e., the Golden Gate tide gauge location) under three future scenarios (referred to as representative concentration pathways [RCPs]) are summarized as follows:* • *RCP 8.5 is consistent with a future in which there are no significant global efforts to limit or reduce emissions. In 2100, the likely sea-level rise associated with this scenario ranges from 1.6 to 3.4 feet.* • *RCP 4.5 is a moderate emissions reduction scenario and assumes that global greenhouse gas emissions will be curtailed. In 2100, the likely sea-level rise associated with this scenario ranges from 1.2 to 2.7 feet.* • *RCP 2.6 is a stringent emissions reduction scenario and assumes that global greenhouse gas emissions will be significantly curtailed. In 2100, the likely sea-level rise associated with this scenario ranges from 1.0 to 2.4 feet."*

Table 4. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated January 16, 2018				
Comments on Responses to Comments on Draft Construction Quality Assurance Plan				
1	CQA Plan Section 1.0	--	Response to Specific Comment 1: No further comment.	No further change was required.
2	CQA Plan Section 2.2.1	--	Response to Specific Comment 2: Comment not addressed. The text should be revised to state that regulatory agencies providing regulatory oversight for the project will be invited to the preconstruction meeting; the agencies may attend at their discretion. This will allow the agencies to fulfill their regulatory oversight role, and is in keeping with the Federal Facilities Agreement (FFA).	The cited text identifies mandatory attendees for the preconstruction meeting (i.e., Navy and contractor personnel). The Navy agrees that regulatory agency representative may request to attend the meeting, but does not believe that their attendance and participation is mandatory. Accordingly, Section 2.2.1 was revised to state "*Regulatory agency representatives (e.g., U.S. Environmental Protection Agency and California Department of Toxic Substances Control) may request to attend the preconstruction meeting.*"
2 *(cont.)*	CQA Plan Section 2.2.1	--	*Follow-on to comment 2 received March 12, 2018 (based on DTSC review of preliminary Navy response):* ESPO does not concur with the response that regulatory agency representatives, "*May request to attend the preconstruction meeting*". The regulatory agencies should/must be invited to the preconstruction meeting as part of regulatory oversight. However, attendance at the preconstruction meeting is up to the discretion of the regulatory agencies.	In accordance with Sections 7.5 and 18.3 of the FFA, the Navy holds regular progress meetings with project managers from DTSC and other FFA signatories to discuss the status of the restoration program. Meeting topics include progress updates for RA construction, and these updates provide an opportunity for DTSC and other FFA signatories to request attendance at preconstruction meetings. The Navy does not agree that further revisions to the CQA Plan (regarding meeting invitations and attendance) are needed to ensure compliance with the FFA.
3	CQA Plan Section 2.2.4	--	Response to Specific Comment 3: Comment not addressed. The text should be revised to include attendance of regulatory agencies in meetings/discussions pertaining to significant design changes/modification to facilitate fulfillment of regulatory oversight requirements by the agencies.	Section 2.2.4 was revised to state: "*If the problem requires a design modification and subsequent change order, the design engineering firm should also be present. As described in Section 8.3, regulatory agency representatives will be consulted for all design modifications, and they may request to attend meetings that discuss design modifications.*"

Table 4. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated January 16, 2018				
Comments on Responses to Comments on Draft Construction Quality Assurance Plan (continued)				
3 *(cont.)*	CQA Plan Section 2.2.4	--	*Follow-on to comment 3 received March 12, 2018 (based on DTSC review of preliminary Navy response):* ESPO concurs with the response stating that regulatory agency representatives will be consulted for all design modifications, but does not agree with the response that regulatory agency representatives, "May request" to attend meetings. The text should be revised to state that regulatory agency representatives will be notified and invited to meetings, attendance should be left to the discretion of the regulatory agency representatives.	As described in the response to comment 2, the Navy does not agree that not agree that further revisions to the CQA Plan (regarding meeting invitations and attendance) are needed to ensure compliance with the FFA.
4	CQA Plan Section 4.9	--	Response to Specific Comment 4: Comment not addressed. Testing to ensure that contaminated soil is not brought onsite and/or used onsite should be included. The text should be revised to directly include this, or reference the required testing.	The Navy's previous response indicated that the requested information is already identified in Section 4.2 (Acceptance of Imported Fill). This requirement applies to multiple activities described in the CQA Plan, and not just the vegetative layer construction discussed in Section 4.9. Accordingly, the CQA Plan was revised to repeat the information in Section 4.2 in Sections 4.5, 4.9, and 4.10.
5	CQA Plan Section 4.9	--	Response to Specific Comment 5: No further comment.	No further change was required.
6	CQA Plan Section 6.1.1	--	Response to Specific Comment 6: No further comment.	No further change was required.
7	CQA Plan Section 6.2.4	--	Response to Specific Comment 7: The text has been revised, but now shows 1500 lineal feet of geomembrane seams. This is different from the text in the first sentence in the first paragraph which shows 500 lineal feet of geomembrane seams. The text should be revised to remove the discrepancy.	Section 6.2.4 was revised to ensure the two sentences cite the correct testing frequency (1,500 linear feet) as outlined in the project specifications. The previous revision corrected the second sentence, but did not correct the first sentence.

Table 4. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

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Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated January 16, 2018				
Comments on Responses to Comments on Draft Construction Quality Assurance Plan (continued)				
7 *(cont.)*	CQA Plan Section 6.2.4	--	*Follow-on to comment 7 received March 12, 2018 (based on DTSC review of preliminary Navy response):* The response to comment in Table 4 states that the text was revised to cite the correct testing frequency of 1,500 linear feet. However, we note that this is three times the usual industry practice. The testing frequency should be revised to the 500 per linear feet to conform to common industry practice, or a justification should be provided for using 1,500 linear feet.	The DBR and CQA Plan were revised to specify a test frequency of 500 linear feet.
Comments on Responses to Comments on Draft Design Basis Report				
8	Appendix C	--	Response to Specific Comment 8: No further comment.	No further change was required.
9	Appendix C	Drawing C12	Response to Specific Comment 9: No further comment.	No further change was required.
10	Appendix C	Drawing C19	Response to Specific Comment 10: The drawing is renumbered as C23. The arrow next to the label appears to point to an area with similar shading/pattern as that for the vegetative soil layer. The drawing should be revised to use the correct shading/pattern for aggregate base.	Drawing C23 was revised as requested.
11	Appendix C	Drawing C20	Response to Specific Comment 11: No further comment.	No further change was required.
12	Appendix D. Section 01 57 20.000 10	Subsection 3.5.1	Response to Specific Comment 12: No further comment.	No further change was required.

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Comments provided by DTSC Hazardous Substances Engineer, Peter Gathungu, dated January 16, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
13	Appendix D. Section 02 35 27	Subsection 2.1.3	Response to Specific Comment 13: No further comment.	No further change was required.
14	Appendix D. Section 02 56 13	Subsection 3.5.2	Response to Specific Comment 14: No further comment.	No further change was required.

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Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated January 3, 2018				
Comments on Responses to Comments on Draft Design Basis Report				
1	General	--	Response to General Comment 2: CDFW-OSPR previously commented that different parts of the same procedure are located in different sections of the document. We requested the complete list of measures for each procedure be listed in one section of the document, so that it is easy to locate and to ensure all measures for each procedure are implemented (Huang and Nakahara, 2017). The Navy responded, "*The RDP is organized similar to previously approved RDPs for other HPNS parcels ...Accordingly, no changes were made to the RDP in response to this comment.*" If the complete list of measures for each procedure will not be listed in one section of the document, CDFW-OSPR requests the Navy include for each measure, a reference to all sections and page numbers where additional measures for each procedure can be found in the RDP. This will help to ensure all measures for each procedure are implemented.	CDFW's previous comment requested that specific implementation details be included in all portions of the RDP. CDFW's follow-on comment did not acknowledge an important part of the Navy's previous response to this comment, "*The largest document within the RDP package is the DBR, which describes how the remedy will meet the requirements of the approved ROD. As noted in DBR Section 3, future RAWPs will describe specific implementation procedures for the remedy construction.*" Consistent with the implementation of remedial actions at other HPNS parcels, the specific implementation procedures will be detailed in the RAWPs. Given that the Parcel E RDP includes a similar level of detail as compared to previously approved RDPs for other HPNS parcels, the Navy does not believe that further clarifications are needed. The Navy affirms its commitment to include all pertinent implementation procedures (including those related to the protection of biological resources at Parcel E) in the RAWPs that will be prepared by others and submitted for CDFW review and approval prior to field construction.

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Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated January 3, 2018				
Comments on Responses to Comments on Draft Design Basis Report (continued)				
2	DBR Section 3.1.3	Page 3-5	Response to Specific Comment 1b: CDFW-OSPR has previously requested that the Navy add the following measure to this section: Equipment and personnel shall be confined to the designated access routes, staging areas, and work areas (Huang and Nakahara, 2017). The Navy responded, "*The requested text was not added to this section. The existing text describes limitations for locating access routes and staging areas, but does not limit the extent of work areas because, as detailed in the DBR, the remedy involves intrusive construction throughout Parcel E. As a result, a broad restriction of equipment and personnel to remain within selected areas of Parcel E is neither practical or appropriate.*" CDFW-OSPR is again requesting that this measure be added to the DBR. This measure was previously implemented at HPNS for the Hot Spot Delineation and Excavation and Nearshore Slurry Wall Installation Remedial Action at Parcel E-2 (Gilbane, 2014; Gilbane Federal, 2017). Although the existing text describes limitations for locating access routes and staging areas, it does not require personnel and equipment to remain within these designated areas. The purpose of this biological avoidance and minimization measure is to prevent personnel from driving, parking, and staging vehicles and equipment outside of the designated areas, where they may adversely impact protected habitat (i.e., wetlands) or special status species (i.e., nesting birds). If work must be conducted within protected habitat or in the vicinity of protected species, the Navy must implement appropriate biological avoidance, minimization, and mitigation measures under the supervision of a qualified biologist. If work is conducted where avoidance, minimization and mitigation measures are implemented, this would make the Navy's work area a "designated' work area as specified in the measure.	The subject bullet item in DBR Section 3.1.3 was revised to include the following statement: "*Equipment and personnel will be confined to the access routes, staging areas, and work areas that will be designated in the RAWP(s).*" As stated in the original response, the planned work areas will encompass all of Parcel E. Accordingly, the new text should not be interpreted as limiting access to work areas for RA construction, but rather to clarify RA contractor personnel will remain within the designated work areas and the associated access routes and staging areas (that will be identified in their RAWP).

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Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated January 3, 2018				
Specific Comments on Revised Draft Remedial Design Package				
1	DBR Section 3.13	Page 3-100	The text states, "*The ROD requires implementation of ICs, which are legal and administrative mechanisms for the continued protection of human health and the environment.*" Please note, ICs do not prevent exposure of ecological receptors, such as burrowing animals and deep-rooted plants under various pathways (i.e., inhalation, ingestion, dermal, root uptake), to contaminants remaining under the soil cover. ICs also do not prevent burrowing animals from digging up contaminants and creating a complete exposure pathway to human and ecological receptors. Exposed contaminants may also be transported by wind and storm water runoff into surrounding areas, where exposure to both human and ecological receptors may occur.	Comment acknowledged.
2	OMP Table 3	--	Please add a qualified biologist to the table for O&M activities dealing with invasive plants and animals, and special status species.	OMP Table 3 was revised to include the following note (that was placed adjacent to the vegetative cover and shoreline armoring): "*O&M of these remedy components may require consultation with and oversight from a biologist with proficiency with California species of special concern (see Appendix A).*" In addition, Table 3 already includes a row titled "*Wildlife (including invasive species management)*" that notes the required oversight from a qualified biologist.

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Comment #	Section #	Page #	Comment	Response
Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated January 3, 2018				
Specific Comments on Revised Draft Remedial Design Package (continued)				
3	OMP Appendix A, Section 1.4	Pages A-3 and A-4	a. Third bullet. The text states, "*If the damaged areas do not regenerate or are extensive, the seed mix provided in the OMP should be used when reseeding."* Please define what is considered *"extensive"* (e.g., size of the area, percent cover), to determine when damaged areas will be reseeded. b. Sixth bullet. The text states, "*Major settlement could require specialized labor and personnel for repair."* Please define what is considered *"major'* settlement (e.g., 6 inches, 1 foot), to determine when settlement will require specialized labor and personnel. c. Eleventh bullet. The text states, "*If any animal burrow or hole in the soil cover is identified, it should be backfilled using material removed from the hole and compacted manually using a hand tamper.*" Please include in this measure that a qualified biologist will inspect the burrow prior to backfilling to ensure special status species (i.e., Burrowing Owl, San Francisco garter snake, etc.) are not trapped, buried, or killed due to backfilling.	a. The subject sentence was revised to state: *"If the damaged areas do not regenerate or are extensive (i.e., greater than 20 percent of a 400 square-foot subarea), then the damaged areas should be reseeded using seed mix provided in the OMP (see Table 5) ~~should be used when reseeding~~. Reseeding should also occur when erosional damage is observed by the inspector (e.g., visible rills or depressions, and evidence of sediment deposition).*" As described in DBR Section 3.12.6.2, vegetative coverage of at least 80 percent will be sufficient to minimize soil erosion within acceptable limits. b. The subject sentence was revised to state: *"Major settlement or displacement (i.e., a visible slope failure of any size, cracks deeper than 6 inches at a given location, or depressions greater than 6 inches over a 100 square-feet subarea) should be promptly repaired using soil that meets the requirements of the project specifications. ~~could require s~~Specialized labor and equipment~~personnel~~ may be required for these types of major repairs."* c. The subject bullet item was revised to include the following statement (consistent with the requirements for vegetation removal): "*Prior to backfilling activities, the site should be inspected to identify the potential presence of ground-nesting birds (including burrowing owls). If evidence of ground-nesting birds is identified during the site inspection, no backfilling activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resources trustees) and properly implemented (with oversight from a qualified biologist).*" These procedures are sufficient to comply with the pertinent ARARs regarding protection of biological resources (as identified in the ROD and repeated in DBR Table 1).

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Specific Comments on Revised Draft Remedial Design Package (continued)				
3 *(cont.)*	OMP Appendix A, Section 1.4	Pages A-3 and A-4	*Follow-on to comment 3c received March 5, 2018 (based on CDFW review of preliminary Navy response)* CDFW-OSPR appreciates the Navy including the measure for protection of birds during backfilling activities during the nesting season. However, Burrowing Owls and San Francisco garter snake utilize burrows throughout the year, not just during nesting season. Therefore, our concern remains that backfilling burrows, during any time of year, has the potential to trap or kill special status species such as these. CDFW-OSPR is again requesting that a qualified biologist inspect the burrows for special status species prior to backfilling during all times of the year, to prevent impacts to these species. This measure would be similar to that for oversight by a qualified biologist during invasive species control at all times of the year.	As noted in the revised response to comment 3c above, the subject bullet item was revised to remove reference to the nesting season and to specifically mention burrowing owls (that are protected under the Migratory Bird Treaty Act, which is a location-specific ARAR identified in the ROD). The subject bullet item was not revised to discuss protection of the San Francisco garter snake because the regulation that protects this species (California Fish and Game Code Section 5050) was evaluated in the FS Report and determined to not be an ARAR (because the species was not present on site). The subject bullet item was not revised to require that site inspections be performed by a qualified biologist. In accordance with other O&M requirements, the soil covers (including any animal burrows) will be inspected by qualified personnel overseen by an appropriately registered professional. If evidence of ground-nesting birds are identified during this inspection, then appropriate protective measures will be developed and implemented (including oversight from a qualified biologist). Please note that the biological avoidance measures described in DBR Section 3.1.3 (which apply throughout the year) address the RA construction activities. In contrast, the OMP addresses activities that will occur after RA construction is complete. The planned O&M activities are minimally intrusive (in comparison to RA construction) and do not warrant the same degree of biological avoidance measures that are proposed during the RA construction.

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Specific Comments on Revised Draft Remedial Design Package (continued)				
4	OMP Appendix A, Section 1.5	Page A-5	The fifth bullet states, "*Major settlement could require specialized labor and personnel for repair or replacement of the cover materials.*" Please see Specific Comment 3b on the Revised Draft RDP.	The subject sentence was revised to state: "*Major settlement or displacement (that causes surface cracks wider than 0.25 inches) should be promptly repaired using material that meets the requirements of the project specifications. ~~could require s~~Specialized labor and equipment~~personnel~~ may be required for these types of major repairs ~~or replacement of the cover materials~~.*"
5	OMP Appendix A, Table A-1	Page 1	a. First bullet [Program Element "*Develop list of acceptable management strategies*", "*Animal Species*"]. The text states, "*Fill animal burrows and compact soil to limit erosion potential.*" Please include in this measure that a qualified biologist will inspect the burrow prior to backfilling to ensure special status species are not trapped, buried, or killed due to backfilling. b. Second bullet [Program Element "*Develop list of acceptable management strategies*", "*Animal Species*"]. The text states, "*Install raptor perches to encourage predation of burrowing animals.*" Raptor perches should not be installed near wetlands to avoid predation of special status wetland species. The Navy can install raptor perches for the purposes of burrowing animal control in areas where there are no special status species present, as determined through surveys by a qualified biologist prior to the implementation of burrowing animal control measures and as part of monitoring activities.	a. The subject bullet item was revised as follows: "*Fill animal burrows and compact soil to limit erosion potential (with oversight from a qualified biologist, as appropriate; see Section 1.4 for further information)*" b. The subject bullet item was revised as follows: "*Install raptor perches to encourage predation of burrowing animals, in a manner that minimizes impact to nontarget species (including consultation with qualified biologist to perform survey and oversight, as appropriate)*". Also, please note that there are no planned wetlands at Parcel E, and that Parcel E is located over 1,000 feet from the nearest wetland area that will be restored at adjacent Parcel E-2.

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Specific Comments on Revised Draft Remedial Design Package (continued)				
6	OMP Appendix A, Table A-1	Pages 1 and 2	[Program Element "*Develop criteria for selecting invasive species management*"]. Please include the use of a qualified biologist to conduct surveys for special status species prior to implementation of invasive species control measures under "Planned Activities".	The first bullet item on page 2 was revised as follows: *"Ensure that control measures focus on the target invasive species and minimize impact to nontarget species (particularly protected bird species throughout Parcel E); consult with qualified biologist to perform survey and oversight, as appropriate*". In addition, the second bullet item on page 2 was revised as follows: *"Carefully implement mechanical or physical trapping, if needed, to ensure the protection of nontarget species; consult with qualified biologist to perform survey and oversight, as appropriate, of trapping (by an experienced contractor) and coordinate with project stakeholders prior to implementation*".
7	OMP Appendix A, Table A-1	Page 2	[Program Element "*Develop guidelines for herbicide/pesticide use*"]. Please include the following measure in the "Planned Activities": Restricted use pesticides will be applied by a certified pesticide applicator.	The subject bullet item was revised as follows: *"Proceed with application only after receiving and responding to input from project stakeholders, and receiving written authorization from the Navy; in accordance with Title 40 of the Code of Federal Regulations Section 171, restricted use pesticides and herbicides must be applied by a certified applicator."*
8	Cost Opinion	--	Please include the cost estimates for conducting biological surveys and monitoring by the qualified biologist in the appropriate tables of each appendix.	The cost estimates were revised to include support from a qualified biologist. Specifically, the worksheets detailing the labor classifications and rates (the second table within each appendix) were revised to include hours for a biologist to support each activity.

Table 5. Responses to Comments from the California Regional Water Quality Control Board (Water Board) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

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Comments provided by Tina Ures, Engineering Geologist, dated January 16, 2018				
Comments on Revised Draft Design Basis Report				
1	2.5.3	--	Specify in what report the benzene plume in IR-39 will be addressed.	Section 2.5.3 was revised as follows: *"This plume, however, is attributed to past releases from the underground storage tanks at Building 709 (former Navy Exchange gas station), thus it is being addressed under the Navy's TPH corrective action program for Parcel E (ITSI Gilbane Company, 2013b)."*
2	2.6	--	This section describes actions and design criteria to address areas that pose an unacceptable vapor intrusion risk. At Building 406, VOCs including TCE are present in soil and soil gas. In the western section of Building 406, soil gas concentrations of TCE are highly elevated (compared to 1,000 ug/m^3, which is the Water Board trigger level for indoor air sampling) with a soil gas concentration of 81,900 ug/m^3 at soil gas monitoring probe IR36B230. The proposed approach is to treat the site groundwater using biological nutrients and/or zero-valent iron (ZVI), and operate an SVE system until asymptotic conditions are reached or until SGALs are achieved. The design criteria for the treatment of VOCs (especially TCE) should include quantitative, numeric criteria in the media of concern (e.g., percent mass reduction, VOC concentrations, etc.). Asymptotic conditions may be suitable for evaluating SVE performance but it is not suitable for evaluating remedy effectiveness (i.e., reduction of VOC concentrations and risk in the media of concern). Please revise the design criteria to include remedy effectiveness criteria, in addition to SVE performance criteria.	Section 2.6 briefly describes how the components of the selected remedy will address the RAOs, but it is not intended to discuss specific decision criteria related to future soil gas and groundwater monitoring. Sections 3.3 and 3.4 describe design basis for implementing SVE and in-situ groundwater treatment at the CVOC plumes at Building 406, IR-04, and IR-12. The RAMP will describe soil gas and groundwater monitoring program, including how data will be evaluated for the CVOC plumes at Building 406, IR-04, and IR-12. Section 2.6 was revised to more clearly refer to the RAMP for information regarding future soil gas and groundwater monitoring.
3	3.2.1	--	Please clarify whether the estimates of soil excavation extents and volumes include a contingency for additional excavation that may be needed per the results of confirmation sampling.	The volume does not include a contingency for step-out excavation because this quantity will be determined later. The Navy has built an adequate contingency into their RA contract, but that contingency is not directly relevant to the DBR. No change was made to text in response to this comment.

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Comments provided by Tina Ures, Engineering Geologist, dated January 16, 2018				
Comments on Revised Draft Design Basis Report (continued)				
4	3.2.2.2	--	The extent of NAPL between the sheetpile wall and the shoreline was an identified data gap in the Post-Pilot Study Site-Wide Characterization Technical Memorandum. Please describe how this data gap will be addressed before remediation is implemented. How/when will the extent of NAPL be fully characterized?	The entire shoreline area over which the data gap existed will be excavated down to the Bay Mud. Visual observations and post-excavation confirmation sample results will provide sufficient information to fill this data gap.
5	3.3	--	As stated in this section, the effectiveness of SVE treatment can vary depending upon the permeability of vadose-zone soil; SVE is generally less effective in lower permeability soil. We do not concur that this limitation can reliably be addressed by operating the SVE system in a pulsed mode that includes short treatment periods followed by extended rebound periods. How would pulsed mode operation achieve increased mass removal, and what time frames would be required? In some cases, SVE may simply not be the suitable technology for the site conditions. Successful remediation using SVE requires evaluation of VOC concentrations in the media of concern and comparison to appropriate numerical criteria (see Comment #1). If soil gas concentrations of VOCs remain elevated following SVE operation (and optimization) and groundwater treatment, additional source reduction measures may be needed to further reduce the VOC concentrations in soil gas. Please discuss contingency measures that may be implemented in the event VOC soil gas concentrations remain elevated after SVE operations and groundwater treatment.	In accordance with the ROD, both SVE and in-situ groundwater treatment are proposed at Building 406 to reduce CVOC concentrations. In addition, the ROD specifies that "*areas with unacceptable vapor intrusion risk will be subject to institutional controls, and the potential risk will be reduced by engineering controls or other design alternatives that meet the specifications set forth in the ROD, RD reports, and LUC RD report).*" As stated in Section 3.3.1, the RAMP will describe the soil gas monitoring used to guide SVE system operation and verify that the source control measures are adequately mitigating the inhalation risk. In addition, Sections 3.2.2.6 and 3.3 were revised to describe a contingency excavation to address VOCs in soil under Building 406. The contingency excavation would be implemented in the event that Building 406 is demolished as part of redevelopment activities that may occur within the next 2 years. If implemented, the contingency excavation would be intended to remove the vadose zone source and eliminate the need to install and operate an SVE system.

Table 5. Responses to Comments from the California Regional Water Quality Control Board (Water Board) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

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Comments provided by Tina Ures, Engineering Geologist, dated January 16, 2018				
Comments on Revised Draft Design Basis Report (continued)				
6	Figure 28	--	At the western edge of Building 406, areas where the TCE soil gas concentrations are 20,000 - 80,000 ug/m^3 are outside both the SVE treatment area and the excavation area. Treatment measures may be needed in this area to adequately reduce TCE soil gas concentrations. How/when will this be addressed?	The reviewer is referring to the tan-colored area on Figure 28 that identifies the estimated extent of TCE concentrations in soil gas between 20,000 and 80,000 µg/m^3 and extends slightly past the western edge of Building 406. This estimated extent is driven by a single point (former temporary probe IR36B235) that is located under Building 406. In addition, Figure 28 identifies four soil samples in this area (and under Building 406) where elevated VOC concentrations were reported in the vadose zone. Based on this information, the likely VOC source is located under Building 406 and will be addressed by the planned source removal. Please refer to the response to comment 5 for further information regarding the other actions (e.g., monitoring and ICs) proposed to address the inhalation risk at Building 406.
7	3.4.3	--	Clarify if IR36MW237A or IR36MW125A is proposed for treatment.	Section 3.4.3 was revised to clarify that the western-most treatment area encompasses both IR36MW125A and IR36MW237A.
8	3.5.2.2	--	This section states that the slurry wall at IR-02 Northwest will be keyed a minimum of 2 feet into the Bay Mud aquitard. Please revise the text to clarify that the required keyed-in depth is 2 <u>continuous</u> feet into the aquitard, such that if 2 continuous feet of aquitard is not present, the wall must be extended until 2 continuous feet of keyed-in depth is achieved.	No change made because the last two sentences of this paragraph provides adequate explanation: *"However, because it is important that the wall is keyed into the Bay Mud, the project specifications (Appendix D, Specification 02 35 27, Slurry Trench) require that the depth of the Bay Mud and specific material types be verified along the entire alignment of the slurry wall during the pre-construction investigation (at a specified maximum interval of 50 feet). The project specifications (Appendix D, Section 02 35 27, Slurry Trench) also require that the key-in depth be field adjusted, as required, to ensure that the slurry wall is keyed in a minimum of 2 feet into an acceptable material (i.e., Bay Mud).*"

Table 5. Responses to Comments from the California Regional Water Quality Control Board (Water Board) on the Revised Draft Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

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Comments provided by Tina Ures, Engineering Geologist, dated January 16, 2018				
Comments on Revised Draft Design Basis Report (continued)				
9	3.5.3	--	Please clarify how "long-term compatibility" testing of the slurry wall mix will be conducted. What criteria will be used to determine whether the slurry wall mix will maintain its permeability performance over the long-term?	The subject text in Section 3.5.3 refers to the project specifications in Appendix D (Section 02 35 27, Slurry Trench) which provide specific details regarding the compatibility testing program. As described in the project specifications, the testing results will be summarized (along with other implementation procedures) in a detailed plan and provided for regulatory agency review prior to field construction. No change was made to the DBR text because the detailed information in the specifications cannot be concisely summarized.
10	3.5.5	--	If groundwater monitoring results from locations downgradient of the slurry wall (i.e., where the slurry wall is no longer acting as a barrier) indicate an exceedance of aquatic criteria, contingency measures such as extraction or source removal must be implemented in a timely manner to prevent discharge to San Francisco Bay. At nearshore locations, the attenuation factor is assumed to be 1 (no attenuation).	As discussed in the response to EPA comment 7, Section 3.5.5 was revised to briefly summarize the monitoring approach that will verify the slurry walls are preventing discharge (into San Francisco Bay) that would result in concentrations exceeding corresponding surface water quality criteria for aquatic wildlife. The RAMP will provide more specific information regarding the proposed monitoring and contingency extraction.
11	3.8.3	--	Per the Final NAPL Treatment Pilot Study Completion Report (Section 8.2.3.1), 4 out of 45 leaching test samples exceeded the aquatic criteria for PCBs. The Completion Report further states that: "*For full-scale design, the maximum leaching concentrations of PCBs will be used to model fate and transport, accounting for tidal influence, to more accurately evaluate discharge to the Bay and determine if any additional modification to the ISS design is warranted along the treatment zone boundary to the Bay and will be included in the Basis of Design Report.*" Please revise this section to discuss any modifications to the ISS treatment design that may be needed to address exceedances of the aquatic criteria for PCBs.	The noted text from the pilot study completion report referred to the ISS being relied on as the only control measure to prevent unacceptable contamination from migrating to the Bay. However, Section 3.8.3 states that "*ISS will be augmented with a slurry wall that surrounds the entire NAPL-impacted area and will prevent COPEC and TPH discharge at concentrations exceeding aquatic criteria to the Bay*". Section 3.9 further describes the proposed slurry wall at IR-03 and no further modeling is needed to support this design element.

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Comments provided by Tina Ures, Engineering Geologist, dated January 16, 2018				
Comments on Revised Draft Design Basis Report (continued)				
12	3.9	--	This section indicates that contaminated groundwater at IR-03 will be contained within the slurry wall, and that groundwater treatment will only be implemented if future monitoring identifies elevated concentrations of TPH of COPECs in groundwater outside of the slurry wall. This approach does not seem consistent with the remedy selected in the ROD, which specifies groundwater treatment (not only containment). The ROD describes the selected remedy for the oily waste ponds (Alternative O-4): "*Following removal or treatment of the NAPL, biological nutrients would be injected to create conditions where remaining contaminants in groundwater are broken down to less toxic compounds.*" Figure 12 of the ROD also shows IR-03 as a groundwater remediation area. An approach that would be consistent with the ROD would be to monitor the groundwater within IR-03 following NAPL treatment, and implement a bioremediation technology to treat groundwater if concentrations are elevated within IR-03 or outside the slurry wall. Please explain how the proposed groundwater containment approach is consistent with the ROD-selected remedy.	The decision to increase the containment area and revise the groundwater treatment approach is consistent with the ROD (Section 2.9.2.3, 1st paragraph): *"The RD will evaluate the data from recent studies and determine the extent to which removal and treatment technologies can cost-effectively satisfy the NAPL RAOs. Based on this determination to be provided in the RD, the NAPL removal and treatment area may be increased or decreased, with the remaining NAPL contamination being addressed by containment, monitoring, and ICs*." When compared to the conceptual design from the FS and ROD, the current IR-03 design includes a larger area to be contained by the slurry wall and soil cover/cap, as part of an integrated remedy with ISS treatment of mobile NAPL within the containment unit.

Abbreviations and Acronyms

ARARs	applicable or relevant and appropriate requirements
CDFW	California Department of Fish and Wildlife
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/s	centimeters per second
COPEC	chemical of potential ecological concern
CQA	construction quality assurance
CQC	construction quality control
DBR	design basis report
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility Study
GMPs	gas monitoring probes
HPNS	Hunters Point Naval Shipyard
ICs	institutional controls
IR	Installation Restoration
ISS	in-situ solidification/stabilization
LTM	long-term monitoring
LUC RD	land use control remedial design
mg/kg	milligrams per kilogram
NAPL	nonaqueous-phase liquid
Navy	Department of the Navy
OMP	operation and maintenance plan
O&M	operation and maintenance
PRG	preliminary remediation goal
PVC	polyvinyl chloride

Abbreviations and Acronyms *(continued)*

RA	remedial action
RAO	remedial action objective
RAMP	Remedial Action Monitoring Plan
RAWP	Remedial Action Work Plan
RCP	representative concentration pathways
RDP	Remedial Design Package
RD/RA	remedial design/remedial action
ROD	Record of Decision
ROI	radius of influence
SGALs	soil gas action levels
SVE	soil vapor extraction
TPH	total petroleum hydrocarbons
VOCs	volatile organic compounds
Water Board	California Regional Water Quality Control Board

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ITSI Gilbane Company, 2013. "Draft Final Project Work Plan, Petroleum Hydrocarbon Corrective Action Implementation, Parcel E, Hunters Point Naval Shipyard, San Francisco, California." November.

Appendix IC. Responses to Comments on Draft Final Remedial Design Package

Table 6. Responses to Comments from the U.S. Environmental Protection Agency (EPA) on the Draft Final Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by EPA Remedial Project Manager, Judy Huang, dated April 27, 2018				
Comments on Responses to Comments on Revised Draft Design Basis Report				
1	--	--	In regards to the response to EPA's comment on the inclusion of O&M cost in the Draft Opinion of Probable Construction Cost, although EPA understands the Navy's rationale to not include the estimated O&M cost, EPA believes that estimated O&M cost of a project should be included as a part of the remedial action process. EPA strongly encourages the Navy to include O&M costs in future Parcel E O&M documents and have no further comments.	Comment acknowledged. As described in the previous response to this comment, the Navy maintains a cost estimate for the environmental restoration program at HPNS, which includes projected cost for O&M[1] and LTM. The Navy's programmatic cost estimate uses O&M and LTM costs estimated in the FS reports, which are regularly updated to reflect adjustments in the ongoing O&M and LTM program.

[1] Abbreviations and acronyms are defined in a list presented at the end of this document.

Table 7. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Final Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated April 17, 2018				
Comments on Responses to Comments on Revised Draft Design Basis Report				
1	OMP Appendix A, Section 1.4	Pages A-3 and A-4	*Response to Specific Comment 3c.* CDFW-OSPR previously commented that Burrowing Owls and San Francisco garter snake utilize burrows throughout the year, not just during nesting season. Therefore, we requested that a qualified biologist inspect the burrows for special status species prior to backfilling during all times of the year, to prevent impacts to these species (LaBonty, 2018b). The Navy responded, "*The subject bullet item was not revised to require that site inspections be performed by* a *qualified biologist. In accordance with other O&M [Operations and Maintenance] requirements, the soil covers (including animal burrows) will be inspected by qualified personnel overseen by an appropriately registered professional. If evidence of ground-nesting birds are identified during this inspection, then appropriate protective measures will be developed and implemented (including oversight from* a *qualified biologist).*" If a qualified biologist will not be inspecting the burrows to determine if evidence of special status species are present, then please explain how the "*qualified personnel*" and the "*appropriately registered professional*" will be able to confirm that special status species are not present in the burrows prior to backfilling. Please provide the qualifications of the "*qualified personnel*" and the "*appropriately registered professional*" that enable them to correctly identify whether a burrow is occupied by a special status species (including identification of Burrowing Owl sign). If the "*qualified personnel*" and the "*appropriately registered professional*" cannot correctly identify whether a burrow is occupied by a special status species prior to backfilling, then	The Navy acknowledges CDFW's[2] comments and affirms its commitment to implement reasonable measures to ensure protection of bird species in accordance with ARARs identified in the ROD (including the Migratory Bird Treaty Act, which protects numerous bird species including burrowing owls). As noted in Table 3 of the Preconstruction OMP, O&M of the vegetative cover (including backfilling of burrows) may require consultation with and oversight from a biologist with proficicency with California species of special concern. The Navy will prepare a Postconstruction OMP that updates the Preconstruction OMP to reflect post-RA site conditions. The Postconstruction OMP will better describe the required support from a qualified biologist to ensure compliance with ARARs identified in the ROD, and will be subject to review and approval by the FFA signatories (which will include review and consultation with CDFW). Based on this information, the Navy does not believe that changes are needed to finalize the Preconstruction OMP, which is part of the larger RDP. The Navy plans to finalize the RDP so that RA construction can be initiated. The Navy does not wish to delay finalizing the RDP for a component that does not directly affect RA construction.

[2] Abbreviations and acronyms are defined in a list presented at the end of this document.

Table 7. Responses to Comments from the California Department of Toxic Substances Control (DTSC) on the Draft Final Remedial Design Package for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Comment #	Section #	Page #	Comment	Response
Comments provided by Tami LaBonty (formerly Nakahara), California Department of Fish and Game, dated April 17, 2018				
1 *(cont.)*	OMP Appendix A, Section 1.4	Pages A-3 and A-4	"take" of a protected species make occur, which would result in non-compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Therefore, CDFW-OSPR again requests a qualified biologist inspect the burrows prior to backfilling. The Navy further responded, *"The planned O&M activities are minimally intrusive (in comparison to RA [Remedial Action] construction) and do not warrant the* same *degree of biological avoidance measures that are proposed during RA construction"*. ARARs apply to both the RA construction and the O&M activities. Take is prohibited regardless of whether it is by construction activities (i.e., excavation, grading, use of heavy equipment) or by O&M activities (i.e., backfilling of burrows, application of pesticides, trapping, mowing). Therefore, it is necessary for a qualified biologist to inspect all burrows prior to backfilling, to prevent take of any special status species and substantively comply with ARARs.	*(see above)*
2	OMP Appendix A, Section 1.4	Pages A-3 and A-4	CDFW-OSPR reiterates it is necessary that a qualified biologist inspect all burrows for special status species to prevent take and comply with ARARs . We also request the Navy provide the qualifications of the "*qualified personnel*" and the "*appropriately registered professional*" as well as previous experience that enables them to correctly identify special status species and determine whether a burrow is occupied or not by such species.	As discussed in the response above, the Navy will prepare a Postconstruction OMP that better describes the required support from a qualified biologist to ensure compliance with ARARs identified in the ROD. For reference, the Preconstruction OMP includes Table 3 that briefly summarizes the qualifications for personnel overseeing O&M of the soil cover. Qualifications for technical personnel include (1) Certified Professional in Erosion and Sediment Control, (2) Qualified SWPPP Practitioner, and (3) Professional Civil Engineer. Table 3 further states that these technical personnel will be supported by a biologist with proficiency with California species of special concern.

Abbreviations and Acronyms

ARARs	applicable or relevant and appropriate requirements
CDFW	California Department of Fish and Wildlife
FFA	Federal Facility Agreement
FS	Feasibility Study
LTM	long-term monitoring
Navy	Department of the Navy
OMP	operation and maintenance plan
O&M	operation and maintenance
RA	remedial action
RDP	Remedial Design Package
ROD	Record of Decision
SWPPP	Stormwater Pollution Prevention Plan

Department of the Navy
Base Realignment and Closure
Program Management Office West
San Diego, California

FINAL
PRECONSTRUCTION OPERATION AND MAINTENANCE PLAN FOR PARCEL E

Hunters Point Naval Shipyard
San Francisco, California

May 2018

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DCN: CESJ-2215-0006-0007.R1

Final
Preconstruction Operation and Maintenance Plan
Parcel E
Hunters Point Naval Shipyard
San Francisco, California

Submitted by:
Construction Engineering Services, LLC

Signature	May 21, 2018 Date
Doug Bielskis, PE Name	Project Manager/Engineer of Record Title

CERTIFICATION

This document was prepared under the direction and supervision of a qualified Professional Engineer.

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DCN: CESJ-2215-0006-0007.R1

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Appendix A. Inspection and Repair Procedures for Operation and Maintenance of Parcel E Remedy

Abbreviations and Acronyms

AB	aggregate base
ARARs	applicable or relevant and appropriate requirements
ARIC	areas requiring institutional controls
BMPs	best management practices
CalRecycle	California Department of Resources Recycling and Recovery
Caltrans	California Department of Transportation
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSO	Caretaker Site Office
DBR	Design Basis Report
DoD	U.S. Department of Defense
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
GAC	granular activated carbon
GMPs	gas monitoring probes
HDPE	high-density polyethylene
HPNS	Hunters Point Naval Shipyard
ICs	institutional controls
IR	Installation Restoration
LUC RD	Land Use Control Remedial Design
NAPL	nonaqueous-phase liquid
Navy	Department of the Navy
NRDL	Naval Radiological Defense Laboratory
O&M	operation and maintenance
OCII	Office of Community Investment and Infrastructure
OMP	Operation and Maintenance Plan

Abbreviations and Acronyms *(continued)*

RA	remedial action
RAMP	Remedial Action Monitoring Plan
RAWP	Remedial Action Work Plan
RAOs	remedial action objectives
RD	Remedial Design
ROD	Record of Decision
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SVE	soil vapor extraction
UFC	Unified Facilities Criteria
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

Section 1. Introduction

The Department of the Navy (Navy) plans to implement the final remedy at Parcel E, Hunters Point Naval Shipyard (HPNS) in San Francisco, California, pursuant to the Final Record of Decision (ROD) (Navy, 2013). The final remedy for Parcel E includes the following components that require long-term operation and maintenance (O&M) to ensure their integrity and comply with the substantive provisions of pertinent applicable or relevant and appropriate requirements (ARARs):

- Soil vapor extraction (SVE) system at Building 406
- Network of soil gas monitoring probes (GMPs) and groundwater monitoring wells at portions of Parcel E
- Groundwater control features at Installation Restoration (IR) Sites IR-02 and IR-03
- Shoreline protection features at IR-02 and IR-03
- Durable covers (asphalt covers, building foundations, and soil cover with protective liners in select areas)

This report includes:

- A description of inspection, maintenance, and repair procedures for the various remedy components (as listed above)
- Reporting requirements associated with the O&M activities
- Emergency response procedures associated with the O&M activities

Appendix A includes a list of the inspection items, inspection procedures, and inspection frequency. Appendix A also includes generalized repair procedures.

Inspection, maintenance, and repair of the final remedy at Parcel E are the responsibility of the owner. The Navy is the current owner; however, the Navy intends to transfer Parcel E to the City and County of San Francisco's Office of Community Investment and Infrastructure (OCII) in the future. This Operation and Maintenance Plan (OMP) discusses the inspection and maintenance required of the Navy to ensure the integrity of the remedy components and comply with the substantive provisions of pertinent ARARs. The Navy will conduct the O&M described in this plan until it negotiates and implements an agreement to transfer these obligations. The Navy intends to transfer these obligations to the OCII when Parcel E is transferred. Upon transfer of the property, it is anticipated that several documents will be prepared to describe and require compliance with the OMP and specify when the OMP must be revised to reflect

changes to the remedy. It is anticipated that the agreement transferring these O&M obligations will include a requirement to submit a revised OMP that addresses redevelopment of the property (e.g., the final grades). The agreement is also anticipated to specify that the revised OMP needs to address details of how redevelopment may affect the final remedy (e.g., changes in surface water drainage). Any revised OMP will require review and approval by the Federal Facility Agreement (FFA) signatories. FFA signatories include the Navy, the U.S. Environmental Protection Agency (EPA), the Department of Toxic Substances Control (DTSC), and the San Francisco Bay Regional Water Quality Control Board (SFRWQCB). The OMP and other documents associated with site operations, maintenance, and monitoring will be maintained in the HPNS information repositories located at the City of San Francisco Public Library at 100 Larkin Street and at the HPNS office trailer at 690 Hudson Street.

This OMP is a component of the Remedial Design (RD) for Parcel E, which is a primary document under the HPNS FFA. This OMP addresses the content requirements provided in Title 27 California Code of Regulations Sections 21800(c) and 21830, which pertain to closure and maintenance plans for the waste management units at IR-02 Northwest/Central and IR-03. Table 1 identifies the locations in either this OMP or elsewhere in the RD, where the required information regarding closure and maintenance plans is presented. This OMP will be submitted for the review and approval of the FFA signatories.

The Final ROD also requires monitoring of soil gas and groundwater to demonstrate compliance with the remedial action objectives (RAOs) and comply with the substantive provisions of pertinent ARARs. The soil gas and groundwater monitoring network for Parcel E is described in a separate document, the Remedial Action Monitoring Plan (RAMP). In addition, the ROD requires implementation of institutional controls (ICs) to limit the exposure of future landowner(s) or user(s) of the property to hazardous substances present on the property and in groundwater, and to ensure the integrity of the remedy. The implementation requirements for ICs at Parcel E are described in a separate document, the Land Use Control Remedial Design (LUC RD).

Some details in this OMP may change after construction is completed. As a result, this plan is considered the "preconstruction" OMP to highlight the fact that some items in the plan may change in the future. Likewise, changes to the OMP may be needed in the future to address changes in design standards or improved materials. Revisions to this OMP will be subject to review and approval by the FFA signatories, as well as the California Department of Public Health (CDPH) for the area requiring institutional controls (ARIC) for radionuclides. CDPH regulates activities related to remediation of radionuclides; therefore, they are involved in oversight of actions at the portions of Parcel E that are considered potentially radiologically impacted[1].

[1] As defined in the Historical Radiological Assessment (Naval Sea Systems Command, 2004), radiologically impacted areas have the potential for radiological contamination based on historical information or are known to contain or have contained radiological contamination.

1.1. DOCUMENT ORGANIZATION

This OMP describes how the SVE system, soil gas and groundwater monitoring network, groundwater control features, shoreline protection features, and durable covers at Parcel E will be inspected and maintained. The remainder of Section 1 describes Parcel E and its history, summarizes the nature and extent of contamination at the site, provides an overview of the remedy components, and describes the regulatory framework for O&M activities. Section 2 summarizes the inspection, maintenance, and repair procedures to be performed at Parcel E. Section 3 describes the reporting procedures for O&M activities. Section 4 summarizes the emergency response plan related to O&M of the site. Section 5 lists all documents and supporting information used to prepare this OMP. Figures and tables are presented after Section 5.

Appendix A includes a list of inspection items, procedures, and frequency. Generalized repair procedures are also included in Appendix A.

1.2. SITE BACKGROUND

HPNS is located in southeastern San Francisco on a peninsula that extends east into San Francisco Bay (Figure 1). HPNS consists of 853 acres: 407 acres on land and 446 acres under water in the San Francisco Bay. HPNS is divided into nine parcels: B-1, B-2, C, D-1, E, E-2, F, G, and UC-3 (Figure 1). HPNS also includes IR-07 and IR-18, which were formerly part of Parcel B but were not included within the boundaries of Parcels B-1 and B-2 when Parcel B was subdivided in 2014. HPNS formerly contained Parcels A, D-2, UC-1, and UC-2, which included property between Parcels B-1, B-2, C, E, G, and UC-3. Former Parcel A was transferred to the City and County of San Francisco in December 2004. Former Parcels D-2, UC-1, and UC-2 were transferred to the City and County of San Francisco in September 2015.

At each HPNS parcel, contaminated areas were designated as IR sites based on information developed during previous investigations. IR sites were in most cases identified by a two-digit number (e.g., IR-02). Parcel E was established in 1992 by grouping IR sites in the southern portion of HPNS, including IR-01/21 (formerly referred to as the "Industrial Landfill"), IR-02 (referred to as the "Bay Fill Area"), and IR-03 (referred to as the "Former Oily Waste Ponds"). In 1998, Parcel E was expanded to include several additional areas, most notably IR-36 that was formerly located in Parcel D (and includes Building 406). In 2004, IR-01/21 and surrounding areas were designated as Parcel E-2 and separated from Parcel E to facilitate closure of the landfill. In 2005, additional IR sites formerly located in Parcel D (IR-08, IR-38, and IR-39) were added to Parcel E. In 2013, the area along Crisp Road and an adjacent railroad right-of-way (located west of Parcel E-2) were designated as Parcel UC-3 to facilitate closure of a future utility corridor. Parcel E includes about 128 acres of shoreline and lowland coast along the southwestern portion of the shipyard and contains 17 existing buildings, 25 former buildings, and 1 ship berth (Figure 2).

Historically, most of Parcel E was used as an industrial support area, including a warehouse (Building 406) where chlorinated solvents were spilled and Former Oily Waste Ponds, referred to as IR-03, where spent waste oil was stored from 1944 to 1974. Shoreline areas at Parcel E (referred to as IR-02) were used to store construction and industrial materials, as well as to dispose of industrial waste and construction debris. The Naval Radiological Defense Laboratory (NRDL) used several Parcel E buildings during the 1950s and 1960s. During its occupancy of HPNS, Triple A Machine Shop, Inc. allegedly disposed of hazardous wastes at various locations at HPNS, including possibly discharging waste oil within Parcel E using below-ground fuel and steam lines (Navy, 2013).

Two general sources of potential radioactive contamination exist at Parcel E: research activities at various buildings formerly occupied by NRDL and historical waste disposal activities that occurred along the shoreline (IR-02 and IR-03). The NRDL performed practical and applied research on radiation decontamination methods and on the effects of radiation on living organisms and natural and synthetic materials. NRDL conducted research activities within Parcel E, most notably at the former 500 series buildings and within the Building 707 Triangle Area. NRDL activities at these buildings may have discharged small amounts of low-level radioactive liquids into sanitary sewer, storm drain, and septic sewer lines; as a result, sanitary sewer, storm drain, and septic sewer lines throughout Parcel E were identified in the HRA as radiologically impacted. Historical activities in IR-02 and IR-03 also included the disposal of radioluminescent commodity items (such as dials, gauges, and deck markers) in conjunction with the disposal of other construction debris and industrial wastes (Navy, 2013). The historical operations at Parcel E are further described in the Design Basis Report (DBR), which is another component of the Parcel E RD.

1.3. NATURE AND EXTENT OF CONTAMINATION

Activities associated with known or potential contaminant releases at Parcel E were identified, and environmental investigations were conducted to identify and assess the nature and extent of contaminants in the following media of concern at Parcel E: (1) soil and shoreline sediment, (2) soil gas, (3) groundwater, (4) nonaqueous-phase liquid (NAPL) at IR-03, and (5) radiologically impacted media. The DBR summarizes information on the nature and extent of contamination, which is further detailed in the Revised Remedial Investigation Report (Barajas & Associates, Inc., 2008) and Feasibility Study Report (Engineering/Remediation Resources Group, Inc., 2012).

1.4. REMEDY COMPONENTS

The selected remedy for Parcel E includes the following components that require long-term O&M:

- SVE system at Building 406
- Network of GMPs and groundwater monitoring wells at portions of Parcel E
- Groundwater control features at IR-02 and IR-03

- Shoreline protection features at IR-02 and IR-03
- Durable covers (asphalt covers, building foundations, and soil cover with protective liners in select areas)

Figure 3 shows the location of the proposed SVE system, groundwater control features, shoreline protection features, and durable covers. The complete design details are provided in the DBR (and the associated design drawings and project specifications). The following sections briefly summarize the design for the SVE system, groundwater control features, shoreline protection features, and durable covers. The GMP and groundwater monitoring well network at Parcel E is described in a separate document (the RAMP).

1.4.1. SVE System

The SVE system is planned as a source-reduction measure to treat volatile organic compound (VOC) contamination in the vadose zone soil and soil gas at Building 406. The primary system components include 21 extraction wells, conveyance piping, and treatment system equipment (including an SVE blower, 2 granulated activated carbon [GAC] vessels, a condensate discharge pump, and condensate storage tank). This OMP describes the inspection and maintenance requirements for the system components. The RAMP, which is a separate document, describes soil gas monitoring that will be performed in and around Building 406 to guide SVE system operation and evaluate treatment system performance.

1.4.2. Groundwater Control Features

For groundwater plumes near San Francisco Bay (at IR-02 Northwest/Central and IR-03), separate slurry walls will be constructed to control discharge of contaminated groundwater into the bay. The slurry walls will work with the protective liners to minimize migration of contaminants to San Francisco Bay. The slurry wall at IR-02 Northwest/Central would decrease the groundwater flow gradient and consequently increase the residence time (for groundwater behind the barrier) during which chemical concentrations would be reduced through physical, chemical, and biological processes. The slurry wall at IR-03 would encircle the groundwater plume and an area with residual NAPL (that will be treated using in-situ stabilization/ solidification). Figure 3 identifies the proposed slurry walls at IR-02 Northwest/Central and IR-03.

This OMP describes the inspection and maintenance requirements for the slurry walls and associated monitoring network. Groundwater quality (as well as flow direction) will be monitored at the plumes behind the slurry walls to ensure that contamination is not discharged into San Francisco Bay at concentrations greater than the corresponding surface water quality criteria for aquatic wildlife. The design of the slurry walls includes piezometers to measure groundwater levels and the hydraulic gradient across the slurry walls (in combination with inland monitoring wells). The RAMP identifies the monitoring network and describes the data evaluation methods for groundwater quality and flow direction (e.g., identify the acceptable limits for hydraulic gradient across the slurry walls and the associated contingency action if those limits are exceeded).

1.4.3. Shoreline Protection Features

During construction of shoreline protection features, contaminated sediment along the Parcel E shoreline (within IR-02 and IR-03) will be excavated and disposed of at an approved offsite landfill. The shoreline excavations will be backfilled with natural materials (such as sand) and riprap, which will serve to prevent exposure to remaining contaminants in shoreline sediment and adjoining onshore soil (and to integrate with the soil covers at IR-02 and IR-03).

Three types of shoreline protection will be used at Parcel E, as described below.

1. Armored revetment (rock revetment) using rock armor facing (i.e., riprap) slope and a 3-foot-high concrete seawall incorporated into the crest of the revetment. This type of shoreline protection will be constructed in the intertidal shoreline zones that are predominately narrow (most of the zones are 50 feet wide or less) with steep slopes (3 feet of horizontal distance for each 1 foot vertical [3H:1V] or steeper).
2. Hybrid shoreline stabilization using natural shoreline materials (i.e., coarse sand) underlain by rock armor (i.e., riprap). This type of shoreline protection will be constructed in the intertidal shoreline zones that are predominately wide (most of the zones are greater than 50 feet wide) with gradual slopes (less than 3H:1V, with many portions close to 10H:1V).
3. The seawall currently in place along approximately 475 feet of the southeastern shoreline of IR-02 Southeast will remain in place. Portions of this seawall are in disrepair and localized portions of the upland soil have subsided relative to the surrounding topography and will require repair during construction of the durable cover. Specifically, the 2-foot-thick cover adjacent to the existing seawall will use material (e.g., drainage rock) that resists erosion and will be placed at elevations that match the proposed finish grade.

Figure 3 identifies the proposed shoreline protection features at IR-02 and IR-03. This OMP describes the inspection and maintenance requirements for the shoreline protection features.

1.4.4. Durable Covers

Durable covers will be constructed across all of Parcel E as physical barriers to prevent unacceptable exposure to humans and wildlife from contaminants that remain in surface and subsurface soil and sediment after implementation of other remedy components. Two types of durable covers will be constructed at Parcel E: (1) a 2-foot-thick soil cover in the southern portion and the northwestern edge adjacent to Parcel E-2, which are part of the future open space area (Figure 2), and (2) asphalt and concrete surfaces in the northern portion of Parcel E, which are part of the future Multi-Use District (Figure 2). This OMP describes the inspection and maintenance requirements for the durable covers. The proposed covers are considered durable because they will resist erosion and will require deliberate and destructive actions to expose underlying soil (actions that will be restricted under the proposed ICs, as described in the LUC RD). Figure 3 identifies the proposed durable covers at Parcel E, which are briefly described in the following sections. In addition, drainage channels placed in the future open space and Multi-Use District areas at

Parcel E will capture most surface water and direct it to discharge points adjacent to the bay (see DBR Figure 8 for further information).

1.4.4.1. Soil Cover and Protective Liner

Soil covers consisting of a 2-foot-thick soil layer will be placed in the southern half and in small areas on the western edge of Parcel E (the future open space area). In addition, a protective liner, consisting of a high-density polyethylene (HDPE) geomembrane and a drainage geocomposite layer, will be installed under the soil cover in a portion of IR-02 Northwest and throughout IR-03 to minimize surface water infiltration. The protective liners would work with the slurry walls to minimize migration of contaminants to San Francisco Bay.

In addition, a demarcation layer will be installed at the bottom of the soil cover within IR-02 and IR-03 to identify the potential presence of radionuclides at depth. The demarcation layer will consist of an orange-colored geotextile fabric and magnetic marking tape to mark the boundary between the existing surface and the soil cover. In areas covered with a protective liner, the upper layer of drainage geocomposite layer will also serve as the demarcation layer (i.e., the fabric will be orange-colored and overlain by magnetic marking tape) and will be covered by 2 feet of soil.

The design includes installation of a perimeter fence along the inland boundary of the future open space area to protect the soil cover after construction. A perimeter fence is not a requirement of the ROD, and it may be removed or reconfigured as part of the future redevelopment of the site.

1.4.4.2. Asphalt and Concrete Surfaces

Durable covers in the northern portion of Parcel E, which is part of the future Multi-Use District, will consist of existing asphalt or concrete surfaces, existing building foundations, and new asphalt or concrete surfaces. The condition of existing surfaces at Parcel E was visually inspected to inform the durable cover design, but conditions are expected to change prior to cover construction because of ongoing use of the property and implementation of other remedial action (RA) activities. Accordingly, the RA contractor will inspect the condition of existing surfaces and describe any potential changes to the durable cover in the Remedial Action Work Plan (RAWP).

In areas where new asphalt surfaces will be installed, the asphalt pavement will consist of a minimum 4 inches of aggregate base (AB) material and a minimum 2 inches of asphaltic concrete. In areas where the existing asphalt or concrete pavement is generally intact, combinations of asphalt overlay, crack filling, and seal coating will be applied to restore the asphalt pavement to a more durable condition. The repaired building foundations over the site will consist of the existing concrete surfaces that have been repaired by filling cracks, holes, and penetrations that exposed the underlying soil. Repairs will be made using a combination of non-shrink grout, mortar, concrete, and asphaltic concrete.

1.5. REGULATORY FRAMEWORK

The ARARs that pertain to O&M of the cover system, shoreline revetment, SVE system, and groundwater control features are identified in the ROD for Parcel E (Navy, 2013) and are summarized in Table 2. The O&M activities would be performed pursuant to the ARARs for as long as necessary to protect human health and the environment.

The FFA signatories will oversee the effectiveness of O&M activities. FFA signatories include the Navy, EPA, DTSC, and the SFRWQCB. CDPH regulates activities related to remediation of radionuclides; therefore, they are also involved in oversight of actions at IR-02 and IR-03 where radionuclides will be contained under the soil cover and demarcation layer. EPA is the lead oversight agency for the federal government. DTSC is the lead oversight agency for the State of California. Any additions or modifications to the OMP, including the appendices and attachments, must be approved by the FFA signatories (and CDPH for O&M activities at IR-02 and IR-03). In addition, the final remedy will be subject to statutory reviews every 5 years pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to ensure that it remains protective of human health and the environment.

Section 2. Inspection, Maintenance, and Repair

Inspection, maintenance, and repair schedules and practices will follow the ARARs identified in the ROD for Parcel E. A clear delineation of responsibilities is crucial to the success of O&M in cases where the Navy may contract certain responsibilities for maintenance to either internal or external organizations. The Navy may modify the inspection materials or the appendices in this OMP for individual organizations or contractors that may be responsible for specific components of the remedy; however, the FFA signatories (and CDPH for O&M activities at IR-02 and IR-03) must preapprove any modification that reduces the substance or frequency of the inspections. In general, any modification to the OMP must be documented and submitted to the FFA signatories (and CDPH for O&M activities at IR-02 and IR-03) for review and approval before it is adopted. The Navy is responsible for inspection, maintenance, and repair. The Navy intends to negotiate an agreement and then transfer these obligations to the OCII.

The OMP should be revised when or if experience shows a deficiency in the identification, frequency, or adequacy of repair of inspected items. In general, any deficiencies that require repair will be corrected promptly to protect the integrity of each component. In some cases, damaged areas may need to be secured to prevent access by the public while repairs are planned and implemented. The Navy will evaluate the need for and type of security appropriate in relation to the repairs needed.

The site will be visited at least quarterly for the first year and annually thereafter—or as necessary based on the results of the inspections. Select components of the SVE system may require more frequent visits (e.g., weekly or monthly) to ensure its proper operation. Changes to the inspection frequency will be documented in annual inspection reports and will be subject to review and approval by the FFA signatories.

Appendix A includes generalized repair procedures for most components of the remedy. In cases where repairs to the constructed remedy are needed, the guidelines included in this OMP should be followed; the design drawings and project specifications (attached to the DBR) provide additional guidelines for future repairs. In cases where damages to the constructed remedy are being addressed, qualified contractors should complete the repair under the supervision of a licensed professional engineer. Appropriately trained personnel must perform any repairs to the protective liner or SVE system in accordance with manufacturers' instructions.

Any significant repair to the constructed remedy must be proposed to the FFA signatories and CDPH (for O&M activities at IR-02 and IR-03) in the form of a work plan. Approval to proceed with a significant repair must be received from the FFA signatories (and CDPH for O&M activities at IR-02 and IR-03) before any repair work can begin. A significant repair is defined in Appendix A as one that requires specialized

equipment and materials to complete (typically requiring a contractor with specialized experience and training). For example, significant repairs may include, but are not limited to, the addition of revetment armoring material, filling of areas over the soil cover, and repairs associated with exposure of the demarcation layer or the revetment filter fabric.

Following an earthquake, the O&M contractor will assess the severity and follow emergency response procedures, as described in Section 4. The intensity of the earthquake should be determined based on public notification services such as the City and County of San Francisco Outdoor Warning System, the National Earthquake Information Center, and the U.S. Geological Survey Earthquake Notification Service. If a significant earthquake (as defined in Section 4) occurs, the Navy will have qualified personnel visually inspect the constructed remedy for signs of damage within 24 hours of the seismic event, or as soon as it is safe to do so. Any damage will be promptly repaired to ensure the integrity of the constructed remedy. Based on the stability analysis completed as part of the RD (attached to the DBR), potential damage from earthquake shaking will be adequately controlled through proper design and construction of the soil cover and shoreline protection features using methods that are well established for sites in the San Francisco Bay area.

Recording the inspection through forms, note taking, and photographs is a necessary part of the inspection. An O&M logbook or field forms should be maintained and include field notes recorded during inspections. Appendix A includes a list of inspection items, procedures, and frequency that will be modified as necessary during O&M.

It is essential that qualified personnel and contractors are used to perform O&M activities at Parcel E to provide adequate long-term support for the remedy. Table 3 of this OMP summarizes general qualifications that are required for supervisory personnel responsible for oversight of O&M-related work at Parcel E. These qualifications may change following transfer of the site to the OCII and should be adapted for the specific site conditions as they change over time.

Section 2.1 describes the procedures for inspection, maintenance, and repair for the site security measures at Parcel E. Sections 2.2 through 2.7 describe the procedures for inspection, maintenance, and repair of the SVE system, soil gas and groundwater monitoring network, groundwater control features, shoreline protection features, asphalt and concrete surfaces, and soil covers and protective liners. Section 2.8 describes radiological considerations for O&M activities related to the remedy components at IR-02 and IR-03.

2.1. INSPECTION, MAINTENANCE, AND REPAIR OF SITE SECURITY

The following sections describe the procedures for inspection, maintenance, and repair for the site security measures, which include signs and fences, at Parcel E. Signs are used to provide a warning against unauthorized activities at the site and provide contact information. Fencing is used as a physical barrier to

unauthorized access in select areas (i.e., soil cover in the future open space area). Site security measures are not a requirement of the ROD and may not be required after the site is transferred for redevelopment, but would be used to enhance the protectiveness of the remedy and would reduce long-term O&M before the transfer occurs.

2.1.1. Signs

Signs are the primary means of informing the public of the activity restrictions at the site. Signs will be located around the site at approximate 200-foot intervals, where appropriate. Refer to the design drawings and project specifications (provided in the DBR) for the message and the construction of the sign. The sign locations are included in the design drawings. The signs will be in English and Spanish, as shown below, in black capital letters on a yellow background.

CAUTION
NO GROUND DISTURBANCE
ALLOWED WITHOUT APPROVAL
CONTACT (619) 524-6026

AVISO
POSIBILIDAD DE SUSTENCIAS PELIGROSAS EN EL SUBSUELO.
MOVER TIERRA NO PERMITIDO SIN APROBACIÓN.
CONTACTE (619) 524-6026

Signs will also be posted near the gated entrance to the future open space area and at the entrance to Building 406. These signs will read as follows:

AREA CLOSED
RESTRICTED ACCESS AUTHORIZED PERSONNEL ONLY
NO EARTHMOVING OR DUMPING
FOR ACCESS CONTACT (415) 743-4720

SITIO CERRADO
ACCESO PERMITIDO PERSONAL AUTORIZADO SOLAMENTE
NO MOVER TIERRA NI TIRAR BASURA
POR ACCESO CONTACTE (415) 743-4720

The following subsections describe the planned inspection, maintenance, and repair for the signs to be installed at Parcel E.

2.1.1.1. Inspection of Signs

Signs will be inspected quarterly for the first year and annually thereafter for presence, legibility, vandalism, or other inadequacies. The effectiveness of the signs in restricting access to the site will be evaluated. Damage to signs could result from weathering or vandalism.

2.1.1.2. Maintenance of Signs

Signs typically require no maintenance; however, signs will be cleaned or replaced if legibility at a distance of 5 feet is impaired (e.g., as a result of dirt, faded colors, or graffiti).

2.1.1.3. Replacement of Signs

Replacement of signs is recommended instead of repair and will be carried out as necessary to restore the legibility of the signs. Replacement signs will be installed in accordance with design drawings and project specifications provided in the DBR.

2.1.2. Site Security Fencing

Fencing is not required by the ROD, but will be installed, in accordance with design drawings and project specifications provided in the DBR, along the perimeter of the future open space area (except along the shoreline) to help the Navy protect the soil cover after construction. Fencing may also be installed around select areas near Building 406 to help the Navy secure the SVE system inside the building. Fencing is meant to restrict access to the site and to prevent damage that might occur under Navy ownership. The effectiveness of the fence will be assessed based on inspections, and modifications may be necessary over time. The proposed extent of the fence is shown in the design drawings provided in the DBR.

The following subsections describe the planned inspection, maintenance, and repair for the fencing to be installed at Parcel E.

2.1.2.1. Inspection of the Fence

The fence will be inspected quarterly for the first year and annually thereafter for damages both natural and human. Damages could include cut holes in the material, eroding soil from under the fence, digging under the fence, or natural corrosion and degradation of the materials. Inspection of the fence would include walking along the perimeter of the fence and assessing and recording damages.

2.1.2.2. Maintenance of the Fence

Fencing typically requires little routine maintenance. Damage to the fence over time can be expected from vandalism and tampering. Maintenance actions may include (1) promptly removing graffiti within the time frame set by the City and County of San Francisco, (2) removing blown trash or debris from along and lodged in fencing, and (3) repairing holes or damage to fence fabric and damage to fence posts upon

discovery. Fence maintenance would only be required until the fence is removed following property transfer to the OCII.

2.1.2.3. Replacement of the Fence

Sections of the fence may need to be replaced over time and should be replaced using the same material from the same manufacturer when available and cost effective. Repair work should follow the project specifications included in the DBR. Fence replacement would only be required until the fence is removed following property transfer to the OCII.

2.2. SVE SYSTEM

The SVE system will treat VOC contamination in the vadose zone soil and soil gas at Building 406. The primary system components include 21 extraction wells, conveyance piping, and treatment system equipment (including an SVE blower, 2 GAC vessels, a condensate discharge pump, and condensate storage tank). The following paragraphs briefly describe the inspection, maintenance, and repair requirements for the system components. The RAMP, which is a separate document, describes soil gas monitoring that will be performed in and around Building 406 to guide SVE system operation and evaluate treatment system performance. Further information (e.g., manufacturer's instructions for SVE system equipment and procedures for storing and disposing of contaminated material) will be provided in the RAWP, which will include an SVE Startup and Operations Plan.

The SVE system will require regular inspection and maintenance while operational. Table 4 provides the recommended maintenance schedule. The following tasks will be conducted during routine weekly inspections:

- Inspect SVE equipment for leaks, high operating temperature, unusual vibrations, or other indicators of abnormal operation
- Inspect the electrical power connections and supply for SVE equipment
- Inspect and maintain oil levels of the blower as outlined in the product data sheets and manuals (to be provided in the RAWP)
- Inspect and maintain condensate discharge pump and condensate storage tank as outlined in the product data sheets and manuals (to be provided in the RAWP)
- Inspect conveyance piping, extraction wellheads, and GMPs for leaks or signs of damage
- Clean the area and remove trash, as appropriate

Additional inspections will be required prior to system startup and as part of temporary shutdowns. The SVE Startup and Operations Plan will include the specific procedures to be implemented and identify various parameters that will require regular monitoring to ensure proper operation. System parameters include, but are not limited to, vacuum readings, airflow rates, temperature, humidity, and vapor stream

concentrations at various locations (e.g., influent and effluent from GAC treatment vessels). The SVE equipment, extraction wells, and conveyance piping should be promptly repaired to address issues noted during the inspections.

O&M personnel should also consider the following general guidelines to facilitate effective operation of the SVE system:

- Keep spares of frequently used parts on site to allow for timely repairs and/or replacement
- Review equipment manufacturers' O&M manuals for additional inspection, maintenance, and repair requirements
- Ensure that appropriately trained personnel perform maintenance and repair activities in accordance with manufacturers' instructions (e.g., only qualified technicians trained in maintenance of both high- and low-voltage electrical equipment shall open electrical enclosures or handle electrical equipment)

Appendix A describes the general inspection and maintenance requirements for the SVE equipment, extraction wells, and conveyance piping. The inspection and maintenance requirements described in Appendix A will be supplemented, as appropriate, by the equipment manufacturers' O&M manuals (to be provided in the RAWP). As noted above, appropriately trained personnel should repair or replace any malfunctioning component at the treatment facility in accordance with manufacturers' instructions.

2.3. SOIL GAS AND GROUNDWATER MONITORING NETWORK

The constructed remedy will include a network of GMPs and groundwater monitoring wells that will be regularly monitored to demonstrate compliance with the RAOs and comply with the substantive provisions of pertinent ARARs. The GMPs and groundwater monitoring wells will be inspected during all sampling events and annually for damage. Damage to the locks, wells, and well labels could result from vandalism or weathering. The GMPs and groundwater monitoring wells will be inspected for signs of damage, unusual wear, rust and corrosion, vandalism, unauthorized entry and/or use, settlement, and the presence of standing water. Groundwater monitoring wells will be inspected for accumulation of silt and sand by measuring the total depth during sampling and comparing these depths with previous or original depths. The GMPs and wells will be visually inspected for signs of grout or concrete stress or failure, and watertight locking caps will be inspected for cracked or torn rubber seals.

Any damage that may limit the effectiveness of the soil gas or groundwater monitoring network will be repaired or the well will be replaced in a timely manner. Repairs to or replacement of worn parts will be performed as needed. Removal of rust and painting of corroded surfaces will be conducted as necessary. If locks have rusted and do not function properly, they will be replaced. All maintenance of the GMPs and groundwater monitoring wells will be documented in a field logbook or on maintenance forms. Evidence

of vandalism, unauthorized use, or settlement will be photographed and documented in field notes. Repair work will be performed in accordance with the project specifications provided in the DBR.

The long-term monitoring requirements for Parcel E are described in a separate document, the RAMP.

2.4. GROUNDWATER CONTROL FEATURES

As noted in Section 1.4.2, the remedy includes long-term monitoring of groundwater control features to demonstrate compliance with the RAOs and comply with the substantive provisions of pertinent ARARs. Flow of contaminated groundwater into San Francisco Bay will be limited by installing slurry walls near the IR-02 Northwest/Central and IR-03 shorelines to control discharge of contaminated groundwater into San Francisco Bay at concentrations greater than the corresponding surface water quality criteria for aquatic wildlife. The design of the slurry walls includes monitoring/extraction wells and piezometers to measure groundwater levels and the hydraulic gradient across the slurry walls. Existing groundwater monitoring wells in the area of the slurry walls will be extended to the final grade of the soil cover (see Section 3.12.5 in the DBR). New monitoring/extraction wells and piezometers will be installed after the slurry walls are constructed. Monitoring and potential extraction of groundwater will be conducted in accordance with the RAMP. This OMP addresses the inspection, maintenance, and repair procedures for the monitoring and extraction wells associated with the slurry walls.

The monitoring/extraction wells and piezometers will be inspected during all sampling events and annually for damage. Damage to the locks, monitoring/extraction wells and piezometers, and labels could result from vandalism or weathering. Monitoring/extraction wells and piezometers will be inspected for accumulation of silt and sand by measuring the total depth during sampling and comparing these depths with previous or original depths. The monitoring/extraction wells and piezometers will be visually inspected for signs of grout or concrete stress or failure, and watertight locking caps will be inspected for cracked or torn rubber seals. Any damage that may limit the effectiveness of the monitoring/extraction wells will be repaired or the well will be replaced in a timely manner. If locks have rusted and do not function properly, they will be replaced. All maintenance of the monitoring/extraction wells and piezometers will be documented in a field logbook or on maintenance forms.

2.5. SHORELINE PROTECTION FEATURES

The shoreline protection features will serve to prevent exposure to remaining contaminants in shoreline sediment and adjoining onshore soil and to integrate with the soil covers at IR-02 and IR-03. As described in Section 1.4.3, three types of shoreline protection will be used at Parcel E: (1) armored revetment (rock revetment) using riprap, (2) hybrid shoreline stabilization using coarse sand underlain by riprap, and (3) erosion-resistant material (e.g., drainage rock) will be used to repair the durable cover in select areas behind the existing seawall. The shoreline protection features will be constructed in accordance with design drawings and project specifications provided in the DBR. The following subsections describe the planned inspection, maintenance, and repair for the shoreline protection features at Parcel E.

2.5.1. Inspection of Shoreline Protection Features

The shoreline protection features will be inspected quarterly for the first year and annually thereafter and will include observations for settlement, vandalism, and displacement of the protective materials. The shoreline protection features will also be inspected following significant earthquake events for settling or other breaches (as described in Section 4). The frequency of site inspections may be reduced after the first 5-year review period following remedy construction. Appendix A provides the inspection tasks and procedures.

The toe of the shoreline protection features will be closely inspected at low tidal stages for any signs of undercutting. The crest of the shoreline protection features should be inspected and the original elevation maintained. Final survey of the shoreline protection features will be conducted after installation to measure as-built elevations. The elevations of settlement monuments will be established during the final survey. As part of the routine inspection, settlement marker locations and elevations will be surveyed once per year. When annual settlement of 0.1 foot or less has been measured for 2 consecutive years, surveys can be scaled back to once every 5 years. The Navy will use data collected from the settlement markers to assess the amount of settlement, if any, from consolidation of the underlying Bay Mud. The filter fabric underlying the shoreline protection features should not be exposed; and, if exposed, would trigger the need for repair.

2.5.2. Maintenance of Shoreline Protection Features

The armored revetment and other rock layers are not expected to require major maintenance. For the hybrid stabilization structures, the riprap layer (underlying the coarse sand) is the primary structural component of the hybrid stabilization design, is sized based on a worst-case scenario of the rock being exposed to wave action, and is not expected to require major maintenance. The coarse sand (overlying the riprap layer) is designed to improve pedestrian access to shoreline areas and, typical of sand beaches, may partially erode due to tidal and wave action. The O&M contractor should monitor areas where the coarse sand has eroded and evaluate the extent to which maintenance is required based on pertinent factors, including but not limited to those listed below.

- Volume of eroded sand and its impact on pedestrian access – Localized areas of erosion (particularly in lower elevations frequently inundated with water) may not significantly hinder pedestrian access, but larger areas of erosion (particularly at elevations above the mean high water level) may have a more significant impact.
- Presumed cause of the erosion and its anticipated recurrence interval – Erosion caused by wave action following severe winter storms is typically an infrequent event, and prompt maintenance is likely to be an effective way to maintain pedestrian access. In contrast, erosion caused by wave action during normal weather conditions is likely to occur frequently, and regular maintenance may not be an effective way to maintain pedestrian access. Further evaluation of the offshore dynamics may be needed to develop effective mitigation strategies.
- The cost, benefit, and effectiveness of various mitigation strategies – The U.S. Army Corps of Engineers' (USACE) Coastal Engineering Manual (USACE, 2008) identifies a range of mitigation strategies for coastal erosion and considers various design constraints (e.g.,

understanding of coastal dynamics, cost-effectiveness, environmental concerns, and aesthetic considerations).

Based on an evaluation of the above-listed criteria, the O&M contractor will develop and implement, in consultation with the FFA signatories, an appropriate strategy to repair erosion of the coarse sand layer.

The O&M contractor should monitor shoreline areas adjacent to the existing seawall (currently in place along approximately 475 feet of the southeastern shoreline of IR-02 Southeast) and verify the integrity of the rock layer (that will be used in place of the soil cover material). The O&M contractor should evaluate the extent to which maintenance of the rock layer is required based on the factors described above (to evaluate maintenance of the sand layer).

Trash should be cleared from the shoreline and disposed of properly. Nuisance vegetation (e.g., trees, shrubs, and herbaceous plants with deep taproots; see Section 2.7.2 for further information) along the shoreline is not expected to be a significant issue but should be removed if present.

2.5.3. Repair of Shoreline Protection Features

Any missing stones on the riprap face should be promptly replaced with similar size stones. Gaps caused by settlement should be filled with appropriately sized rocks. Areas of undercutting at the toe of the structure should be monitored and repaired when the integrity of the structure could be compromised. The toe should be submerged in sediment; and, if not, the conditions should be recorded and monitored regularly. Similar consideration should be given to the ends or the flanks of each type of shoreline protection feature.

Areas where damage to the shoreline protection results in a breach of the filter layer will be secured to prevent access by the public. The Navy will notify the FFA signatories and CDPH of such damage as soon as practicable, but no later than 10 days after discovery. The shoreline protection feature will be repaired to design conditions as soon as practicable, but no later than 60 days after the Navy becomes aware of the breach. Any repairs to the shoreline protection feature should follow the design drawings and project specifications provided in the DBR.

2.6. ASPHALT AND CONCRETE SURFACES

Asphalt and concrete surfaces will prevent contact with and release of the chemicals of concern remaining in soil at the northern portion of Parcel E, which is part of the future Multi-Use District. Most of the area will be covered with new asphalt pavement consisting of a minimum 4 inches of AB course and a minimum 2 inches of asphaltic concrete (for a total minimum thickness of 6 inches). Existing building foundations over the site are primarily reinforced concrete that will be repaired as part of the RA. Appendix A includes an inspection checklist. Figure 3 show the proposed asphalt and concrete surfaces at Parcel E.

Maintenance, repair, or replacement of the asphalt pavement or the building foundations is required when damage that reduces the effectiveness of the remedy is observed. Cracking of the asphalt pavement or the building foundations is not an immediate concern but will be repaired when cracks expand and underlying soil is accessible. Stormwater will flow over paved surfaces and discharge to paved drainage channels that direct surface water to discharge points adjacent to the bay. The asphalt and concrete surfaces are non-erodible, and overland flow will not erode the wear surface or reduce the effectiveness of the cover for preventing human contact with the underlying soil. Settlement and subsidence are not an immediate concern but will be monitored over time and repaired if water accumulation is or becomes persistent.

2.6.1. Inspection of Asphalt Pavement and Building Foundations

An inspection will be conducted on a quarterly basis for the first year and annually thereafter. The asphalt cover, including drainage swales, and building foundations will also be inspected after significant earthquakes for settling, cracking, or other breaches. Refer to Appendix A for inspection tasks, triggers, and procedures. Items to note during inspections include:

- Pavement condition (depressions and excessive cracking)
- Cracks in the building foundation
- Crawlspace access is blocked off
- Excessive vehicle or pedestrian traffic
- Settlement and subsidence
- Condition of survey benchmarks
- Surface water accumulation and drainage within and adjacent to parcel boundary
- Vandalism and unauthorized access to site or buildings

The asphalt pavement surface will be inspected for signs of stress, which may include excessive cracking and settlement. Cracking of the covers is expected over time and will be repaired when underlying soil becomes exposed or accessible or when expansion of cracks is observed. Areas where cracking occurs on a frequent basis will be inspected for settlement and may require replacement of the asphaltic concrete surface layer and the underlying AB material. Subsidence and settlement will be repaired when damage that would expose underlying soil is imminent. When damage to the asphalt pavement includes loss of cover material (either the asphaltic concrete or the AB material), the cover will be repaired to the design thickness of at least 6 inches. Additionally, vegetation should not be present over the asphalt pavement portion of the site and will be removed when present and conditions repaired to prevent future growth.

The drainage channels over the asphalt pavement will be inspected for signs of stress, efficient drainage, and potential debris that obstruct flow. Additionally, drainage channels, catch basins, and gutters adjacent to Parcel E will be inspected. Areas of vehicle access will be more susceptible to asphaltic concrete

cracking because of the increased loads in those areas. Any entrance points to the site or other areas where vehicle traffic accumulates will be inspected more closely.

Concrete building foundations will be inspected for cracking or signs of stress from outside of the buildings. Building interiors will be inspected as part of each scheduled inspection event and when exterior cracking or evidence of unauthorized access is observed. The aboveground structures themselves do not require maintenance because they are not considered part of the durable cover. Access points to subslab or subfloor crawlspaces will be inspected for integrity and evidence of vandalism or tampering.

All survey monuments will be inspected, and their conditions will be noted for vandalism, tampering, and damage that may compromise the monument.

2.6.2. Maintenance of Asphalt Pavement and Building Foundations

The asphaltic concrete wear surface of the durable cover, including drainage channels, and the building foundations will be maintained in a manner to prevent human exposure to the underlying soil. The asphalt pavement (including channels) and building foundations will be maintained in a condition to allow for visual inspection of the cover. The O&M contractor will evaluate periodic slurry or seal coat application to minimize long-term maintenance and repair costs. Accumulated windblown soil and debris will be removed when they restrict an adequate inspection process and may require periodic power brooming. Debris and sediment accumulated in drainage channels, if identified during an inspection, will be removed to maintain proper conveyance of surface water from the site and to prevent unauthorized discharges to San Francisco Bay.

2.6.3. Repair of Asphalt Pavement and Building Foundations

Deficiencies, damage, settlement, or failure of the asphalt pavement and the building foundations will be repaired when underlying soil is exposed or accessible. Temporary repairs will be made, if necessary, until permanent repairs can be scheduled. When damage to the asphalt pavement includes loss of cover material (either the asphaltic concrete or the AB material), the cover will be repaired to the design thickness of at least 6 inches. When repairs to the building foundations are required, the foundation will be restored to the condition of the surrounding foundation.

Cracks in the asphalt pavement and the building foundations will be monitored and sealed if necessary with a sealant patch material. Cracking of the asphaltic concrete layer could progress, leading to further cracking and ultimately a breach of the outer cover layer if not controlled in a timely manner. The amount of time necessary for a surficial crack in the covers to progress to a point where it reduces durability of the cover will vary considerably, depending on location. Light cracking contained within the surface of the asphaltic concrete does not affect the integrity of the cover, so long as it does not extend through the AB course. However, cracks in asphaltic concrete frequently originate at the base of the asphaltic concrete layer and progress upward to the surface. All areas of cracking will be monitored and repaired as needed to maintain

the protectiveness of the remedy. Alternative repair methods such as asphalt overlays and seal coats will be considered when cracking is extensive. Large cracks and potholes will be cleaned, loose materials will be removed, and the crack will be filled using additional asphalt pavement materials and returned to the original condition. Additional base course material may be required. Any repair work, which includes patching, crack treatment, and asphalt overlays, must be conducted in compliance with California Department of Transportation (Caltrans) standard specifications (Caltrans, 2015) and the U.S. Department of Defense (DoD) Unified Facilities Criteria (UFC) (DoD, 2001a, 2001b, and 2006).

Cracks in the building foundations will be monitored and sealed if necessary when underlying soil is exposed or accessible. Cracks in building foundations will be noted during the inspection and monitored over time for expansion. Wooden floors in buildings will be monitored and maintained in an intact condition to prevent access beneath. Crawlspaces beneath the foundation slabs must be secured to prevent access. If crawlspaces become accessible, repairs will be made to restore the area, which may include refastening or replacing the securing fabric material.

Modifications to the asphalt pavement cover would be required if the site is opened to vehicle traffic and vehicle loading causes damage. The cover will be modified where necessary in accordance with UFC 3-250-18FA (DoD, 2006), which describes criteria for construction of roads and other asphalt pavement surfaces designed to withstand significant vehicular traffic. Additionally, traffic provisions such as signs and traffic markings may be required, depending on the amount and type of traffic expected.

2.7. SOIL COVER AND PROTECTIVE LINERS

As shown on Figure 3, soil covers consisting of a 2-foot-thick vegetative soil layer will be placed over the entire southern half and in small areas on the western edge of Parcel E (the future open space area). In addition, a protective liner, consisting of an HDPE geomembrane and a drainage geocomposite layer, will be installed under the soil cover in a portion of IR-02 Northwest and throughout IR-03 to minimize surface water infiltration. In IR-02 and IR-03, a demarcation layer will be placed at the bottom of the soil cover to identify the potential presence of radionuclides at depth. The soil cover, protective liner, and demarcation layer will be constructed in accordance with design drawings and project specifications provided in the DBR.

The following subsections describe the planned inspection, maintenance, and repair for the soil cover, protective liner, and demarcation layer.

2.7.1. Inspection of Soil Cover

A site walk will be conducted on a quarterly basis for the first year and annually thereafter to check for the formation of rills or gullies on the cover. The soil cover will also be inspected after major storms (i.e., storms exceeding 0.5 inch of rainfall in 24 hours) during the vegetation establishment period (i.e., approximately 6 months) following construction. Lastly, the soil cover will also be inspected

following significant earthquake events for settling, cracking, or other breaches (as described in Section 4). The frequency of site inspections may be reduced after the first 5-year review period following remedy construction. Appendix A provides the inspection tasks and procedures. The soil cover in Parcel E will be visually inspected to ensure the following conditions are maintained:

- No evidence of burrowing mammals or other holes in the soil cover
- No erosion of the soil cover is evident
- No excessive vegetation is growing in the surface and subsurface drainage features
- No noticeable sliding (slope failure) or desiccation cracks are present in the soil cover
- No signs of vandalism of the soil cover and associated components (e.g., settlement monuments and survey benchmarks)

In addition, the soil cover at IR-02 and IR-03, which will be underlain by a demarcation layer and (in select areas) a protective liner, will be visually inspected to ensure the following conditions are maintained:

- No large trees, brush, or weeds (with deep taproots) are present on the soil cover that may penetrate the protective liner
- No noticeable depressions or ponded water are present on the soil cover
- Neither the protective liner nor the demarcation layer is not protruding, exposed, or torn.

The following subsections describe the additional inspections related to grading, drainage, and erosion control for the soil cover.

2.7.1.1. Grading

A final survey of the soil cover will be conducted after installation to measure as-built elevations. The elevations of the settlement monuments installed in IR-02 Northwest and IR-03 will be established during the final survey. As part of the routine inspection, settlement marker locations and elevations will be surveyed once per year. When annual settlement of 0.1 foot or less has been measured for 2 consecutive years, surveys can be scaled back to once every 5 years. The Navy will use data collected from the settlement markers to assess the amount of settlement, if any, from waste consolidation or consolidation of the underlying Bay Mud.

The soil cover at IR-02 Northwest and IR-03 will be visually inspected for evidence of liner exposure, or differential settlement. Any differential settlement sufficient to cause surface water ponding will be repaired as soon as possible after the observation. If the inspection identifies items to be addressed, a copy of the general site inspection checklist (Appendix A) will be forwarded to the Caretaker Site Office (CSO) for immediate action. If significant damage, erosion, or liner exposure is observed, the CSO will be

contacted immediately at the telephone number on the inspection form. The CSO will notify the appropriate personnel, including the Navy Base Realignment and Closure Office in San Diego, California.

2.7.1.2. Drainage

Rainfall that does not infiltrate through the vegetative cover will run off as sheet flow to drainage swales. The drainage swales will discharge directly to San Francisco Bay. Stormwater best management practices (BMPs) will be inspected during the site walk. BMPs include, but are not limited to, vegetation on the soil cover and surface drainage swales. BMPs will be inspected to ensure they are intact and functioning properly. In addition, drainage features adjacent to Parcel E should be inspected for proper function and condition and any deficiencies reported to the Navy. Future development of the surrounding area could affect drainage to Parcel E and should be addressed through revisions to the OMP, if necessary.

2.7.1.3. Erosion Control

Vegetation established on the soil cover will be the primary means by which erosion will be controlled. The vegetated surface of the cover will (1) protect the surface of the cover from erosion by wind and water, (2) improve the stability of the cover slopes, (3) help ensure the integrity of the final cover, and (4) improve aesthetics.

The soil cover will be inspected for signs of erosion and desiccation. Corrective action may be needed if signs of soil erosion or desiccation are excessive (e.g., desiccation cracks greater than 2 inches wide or extending to the cap liner) and continual (recurring in the same area). Actions may include (1) filling in the eroded area or cracks with non-expansive soil containing no chemicals of concern, (2) investigating the cause of erosion, (3) checking the integrity of the protective liner (where present), and (4) regrading slopes.

Vegetation on the cover will be inspected for signs of stress, stunted growth, wilting, changes in color, and bare spots. Areas of significantly healthier or sickly growth will be noted, as well as the presence of invasive species that could affect growth of native grasses or deep-rooting species that could damage the protective liner or demarcation layer (discussed further in Section 2.7.2). Chronic deficiencies may require selecting and planting species better adapted to the environment.

An area is considered bare if healthy vegetation is not covering the soil. Bare spots shall not exceed 2 percent of the total cover area and 30 percent of any individual 100-square-foot area. These areas must be reseeded or planted in accordance with the project specification for seeding (provided in the DBR). Table 5 identifies the seed mix for the soil cover.

Seeding should be performed during the spring, fall, or winter months when evapotranspiration rates are lower. Planting during the summer should be avoided to minimize seed germination during the dry summer months. Once the seed germinates, it is important to maintain moist conditions because young plants are more sensitive to dry soil conditions than fully mature plants. After seeding, soil in the area will be kept

wet to a depth of 1 inch by frequent watering that will be adjusted by weather conditions, until vegetation in the distressed area has reached maturity. Water will be applied at a rate recommended by the seeding suppliers, but will not be so excessive as to cause erosion, puddling, or surface runoff. Vegetation should be cut or mown when it would promote a healthier stand of vegetation or when desired to prevent creation of wildlife habitat. Annual mowing of the site should be sufficient to maintain the health of the cover, but the frequency may need to be altered depending on future use.

If mowing is performed during the nesting season (from February 1 to September 15), the soil cover should be inspected prior to mowing to identify the potential presence of ground-nesting birds. If evidence of ground-nesting birds is identified during the site inspection, no mowing activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resources trustees) and properly implemented (with oversight from a qualified biologist). Vegetation should not require irrigation once established because it is of drought-tolerant varieties. Loss of vegetation caused by lack of water is a trigger to consider establishment or reestablishment of more drought-tolerant plant species.

Burrowing animal activity can be expected on the soil cover and, if the burrows extend deep enough, such activity could be indicative of potential damage to the protective liner or demarcation layer (where present). Accordingly, the soil cover will be regularly inspected for evidence of burrowing animals. Appendix A includes specific inspection procedures for burrowing animal activity.

2.7.2. Maintenance of Soil Cover

Vegetation on the cover will be maintained in a manner to minimize soil erosion from wind and water. To protect the integrity of the protective liner and demarcation layer, trees, shrubs, and herbaceous plants with deep taproots will be identified and removed from the soil cover at IR-02 and IR-03. The following invasive species have been previously identified at HPNS:

- Sweet fennel (Foeniculum vulgare)
- Cocklebur (Xanthium strumarium)
- Black mustard (Brassica nigra)
- Short-pod mustard (Hirschfeldia incana)
- Wild radish (Raphanus raphanistrum) and cultivated radish (Raphanus sativus)
- Sour clover (Melilotus indica) and sweet clover (Melilotus officinalis)
- Cheeseweed (Malva parviflora)
- Pampas grass (*Cortaderia* sp.)

Cheeseweed was found on the adjacent Parcel E-2 just south of the existing landfill cover. This plant can develop very large and powerful roots and is competitive, growing and setting seed very quickly. Pampas grass is another plant of concern. It is highly invasive and can develop deep root structures. If any invasive species are found, corrective measures should be developed and implemented as soon as possible in accordance with the adaptive management process described in Appendix A (Table A-1).

If burrowing animal activity is observed, maintenance actions would include prompt repair of any damage to the soil cover (or underlying protective liner and demarcation layer) and may involve the use of animal control measures. Appendix A (Table A-1) describes the corrective measures and adaptive management that will be used to control burrowing animal activity, if necessary, to limit erosion of the soil cover or ensure the integrity of the protective liner and demarcation layer. As previously described, the adaptive management process incorporates integrated pest management principles and will be implemented in consultation with the FFA signatories and other natural resources trustees.

Mowing will be performed at least once a year to reduce fire hazards on the site. Mowing events will be timed so the seeds are not harmed. If mowing occurs before the seed is mature, the vegetation will not reseed itself for the following season. Mowing will occur throughout most of the soil cover; however, portions of the site (most notably the shoreline slopes) will not be mowed. Assuming good growth on the cover, the cover should be mowed during the spring. Additional mowing may be performed during the fall, if necessary, to promote a healthier stand of vegetation. If motorized mowing equipment is used, precautions should be taken so ruts are not created on the soil cover during mowing. For instance, mowing should not be performed when the soil surface is fully saturated and mowing configurations should avoid having a tight turning radius.

If mowing is performed during the nesting season (from February 1 to September 15), the site should be inspected prior to mowing to identify the potential presence of ground-nesting birds. If evidence of ground-nesting birds is identified during the site inspection, no mowing activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resources trustees) and properly implemented (with oversight from a qualified biologist).

2.7.3. Repair of Soil Cover

Deficiencies, damage, and failure of the final grade will be repaired and the cover will be restored to constructed conditions based on the as-built record drawings. Temporary repairs will be made, if necessary, until permanent repairs can be scheduled. Damage to vegetation or insufficient stands will also be repaired in a timely manner. When damage includes loss of soil cover, the cover will be repaired to the design thickness. Cracks in the final cover will be sealed with similar soil. Erosion that results from heavy rainfall will be repaired. Temporary berms, ditches, and straw mulch will be used to minimize further erosion damage until site conditions permit reestablishment of the final cover and vegetation. The seeding

specification provided in the DBR should be used for any additional reseeding that may be necessary during O&M because it has been selected specifically for the conditions at Parcel E.

If damage to the soil cover results in a breach in the demarcation layer, the site will be secured to prevent access by the public. The Navy will notify the FFA signatories and CDPH of such damage as soon as practicable, but no later than 10 days after discovery. The soil cover will be repaired and the cover will be restored to design conditions as soon as practicable, but no later than 60 days after the Navy becomes aware of the breach. Any repairs to the soil cover should follow the design drawings and the project specifications in the DBR. For significant repairs, a completion report documenting the repair and final condition of the restored cover shall be submitted along with the annual inspection report for the year in which the significant repair occurs.

2.8. RADIOLOGICAL CONSIDERATIONS

Some maintenance activities (e.g., major repair work to the soil cover or shoreline protection features, or replacement of a groundwater monitoring well) within IR-02 and IR-03 may require excavation of native soil that was not screened for radionuclides during construction of the soil cover. Activities that involve movement of soil from below the demarcation layer or the shoreline protection features to the surface will follow the soil screening, handling, health and safety, and disposal procedures described in a task-specific work plan, which will be prepared and provided to the regulatory agencies for review. Excavation below the demarcation layer will be prohibited until such time that concurrence from the FFA signatories and CDPH is received on the work plan. Procedures for excavation below the demarcation layer and shoreline protection features must also follow the requirements in the LUC RD.

Section 3. Reporting

An annual inspection report will be prepared to summarize the inspections for each year; this report will be forwarded for review and approval by the FFA signatories and CDPH. The annual inspection report will include, at a minimum, results of the inspections and a summary of all repair and maintenance activities conducted. The report will be certified by a professional engineer registered in California. Annual inspection reports will support the ongoing 5-year review reports that will be prepared under CERCLA.

Statutory 5-year reviews pursuant to CERCLA Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan will be conducted because the selected remedy will leave contamination in place at Parcel E above levels that allow for unrestricted use and unlimited exposure. Five-year reviews for Parcel E will follow the ongoing schedule of 5-year reviews established for other remedies in place at HPNS.

Additional reporting will be provided following significant repair of the soil cover or revetment and following inspections triggered by an earthquake or other natural event. Additional reporting requirements and procedures will be considered during O&M to refine the plan based on experience at the site.

The O&M contractor will maintain a copy of this OMP and keep a copy at an onsite location designated by the Navy, as appropriate.

Section 4. Emergency Response Plan

This section describes the emergency response plan for Parcel E if potential emergencies, failure, or breakdown of the components of the remedy occur. The Navy will be responsible for inspection, maintenance, and repair until it transfers these obligations to another entity. The Navy intends to negotiate an agreement and transfer these obligations to the OCII. The post-construction OMP and its emergency response plan will be maintained with the active O&M contractor at all times.

4.1. POTENTIAL EMERGENCIES

Although the Navy and future owners will take action to reduce the potential for emergencies, it is possible for events to occur at Parcel E that cannot be prevented. This plan provides response procedures for the following emergencies:

- Earthquakes
- Floods or major storms
- Fire

Equipment and materials required to mitigate the emergency may include portable berms, absorbency media or blankets, loaders and backhoes, clean fill soil, waste receptacles, caution tape, sandbags, erosion control blankets or media, bulldozers, compactors, sand, chain-link fencing, bailing wire, and straw bales. These equipment and materials are commonly available commercial items. The Navy will ensure that their O&M contractor has these items available on an immediate basis when needed through prompt delivery or storage.

The following subsections describe the emergency response procedures to be implemented if an earthquake, flood or major storm, or fire should occur at Parcel E.

4.1.1. Earthquakes

The San Francisco Bay area has a high potential for earthquakes because it is located on the tectonic boundary between the Pacific and North American plates. A significant earthquake is defined as 7.0 magnitude or higher centered within 40 miles of the site, 6.0 magnitude or higher within 10 miles of the site, or 4.0 magnitude or higher within 1 mile of the site. If a significant earthquake occurs, qualified personnel will visually inspect the constructed remedy for signs of damage within 24 hours of the seismic event, or as soon as it is safe to do so. Any damage will be promptly repaired to ensure the integrity of the remedy. If the soil cover (and protective liner and demarcation layer, where present) have sustained

extensive damage, corrective actions will be implemented to ensure that potential contaminants are contained and human health is protected. Post-earthquake site inspection records will be submitted to the FFA signatories, California Department of Resources Recycling and Recovery (CalRecycle), and CDPH (if damage occurs within IR-02 and IR-03), as stated in Table 6.

Following a significant earthquake, the soil cover will also be inspected for lateral shifting of debris toward San Francisco Bay and damage to the shoreline protection features. Settlement markers will be resurveyed to assess any horizontal or vertical movement of the cap. The shoreline area will be inspected for significant shifting of soil or slope failure cracks. A summary of damages and repairs will be submitted to the FFA signatories, CalRecycle, and CDPH (if damage occurs within IR-02 and IR-03), as stated in Table 6.

4.1.2. Floods or Major Storms

If a flood or major storm occurs, the Navy will dispatch a team within 24 hours of the event to inspect the constructed remedy to ensure its integrity. A major storm is defined in this plan as 4.17 inches of precipitation or more over a 24-hour period (24-hour, 25-year storm). Any damage will be promptly repaired to ensure the integrity of the remedy. A summary of damages and repairs will be submitted to the FFA signatories, CalRecycle, and CDPH (if damage occurs within the radiological ARIC), as stated in Table 6.

4.1.3. Fire

If a surface fire occurs near the waste management units at IR-02 Northwest/Central and IR-03 (i.e., areas protective liner underlying the soil cover), the local fire department will be notified. The Navy will share applicable site-specific information with local fire officials. If a breach in the soil cover and protective liner is observed during a fire, other firefighting methods (such as using foam or smothering with dirt) will be considered and used, as appropriate. Following the incident, the Navy will thoroughly inspect the soil cover and protective liner using the emergency response checklist included in Appendix A to ensure that the integrity of the geosynthetic layers has not been compromised. If there is fire damage, the Navy will implement corrective actions to ensure that potential contaminants are contained and human health is protected. The corrective actions will include reestablishment of vegetation over any burned areas (in accordance with the procedures described in Section 2.7.3). A summary of damages and repairs will be submitted to the FFA signatories, CalRecycle, and CDPH, as stated in Table 6.

4.2. EMERGENCY RESPONSE PROCEDURES

Table 6 provides recommended responses for emergency situations and occurrences. This plan is intended to address contingencies that are reasonably foreseeable, but will be amended when appropriate as follows:

- Whenever a failure or release occurs and the O&M contractor did not account for an appropriate response
- Whenever the use of the site changes in ways that are not addressed in the existing O&M contract
- If the local enforcement agency notifies the Navy in writing that the current emergency response plan is inadequate

Section 5. References

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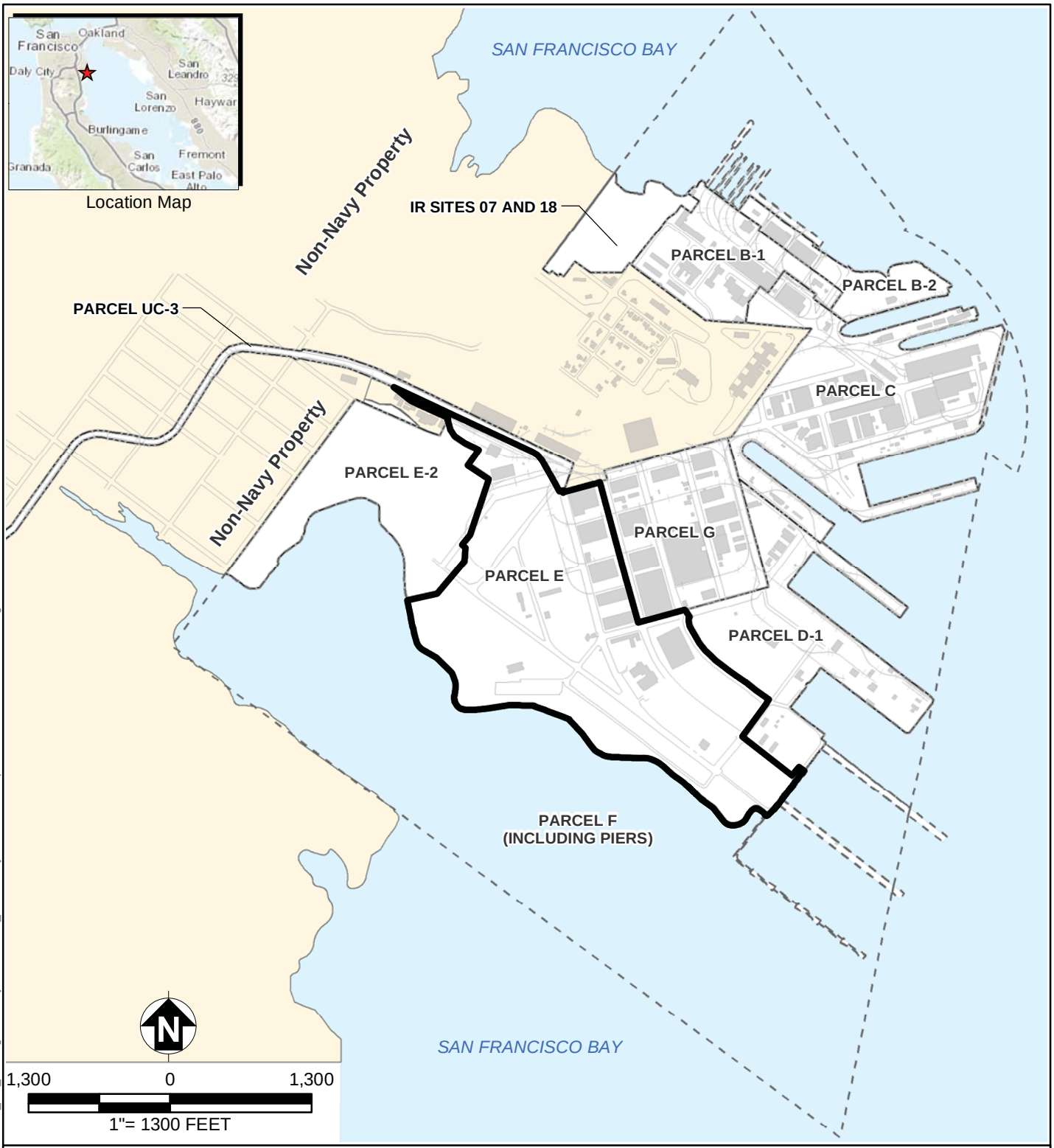
Figures



LEGEND

- Parcel E Boundary
- Other HPNS Parcel Boundary
- Parcel F Boundary
- Non-Navy Property
- Road
- Rail Line
- Building

CES CONSTRUCTION ENGINEERING SERVICES, LLC.

Hunters Point Naval Shipyard, San Francisco, California

Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 1

SITE VICINITY AND LOCATION MAP

Operation and Maintenance Plan

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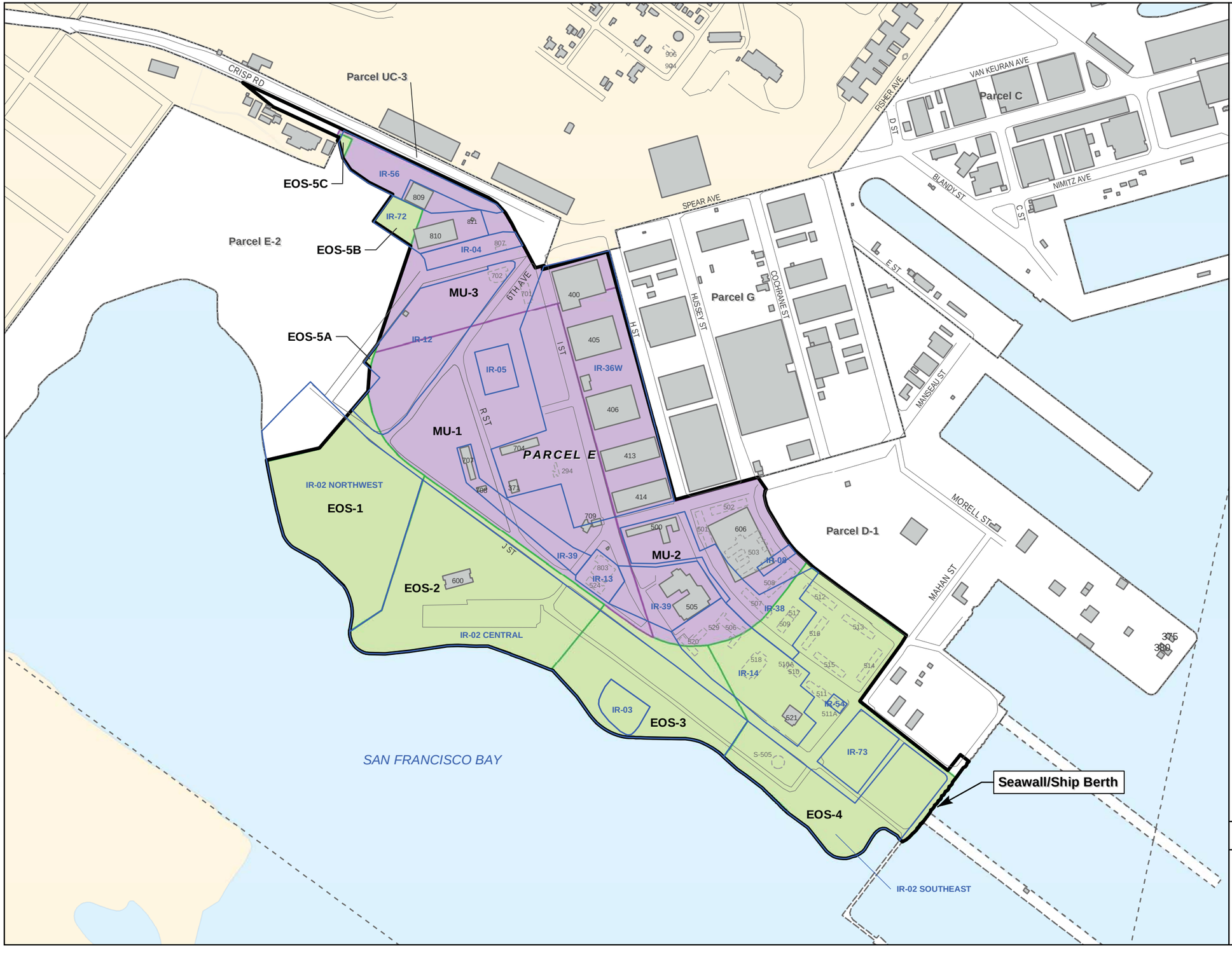

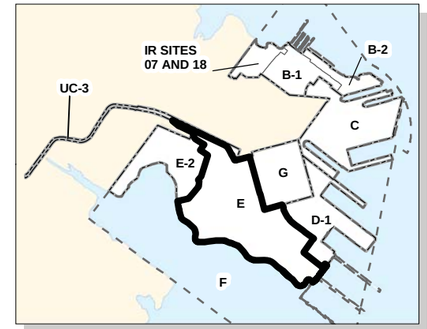

Legend

- Parcel E Boundary
- Other HPNS Parcel Boundaries
- Parcel F Boundary
- IR-03 IR Site Boundary
- Multi-Use District
- Open Space
- 400 Existing Building
- 502 Demolished Building
- Road
- Non-Navy Property

N

500 0 500

SCALE: 1"= 500 FEET
APPROXIMATE SCALE

CES CONSTRUCTION ENGINEERING SERVICES, LLC.

Hunters Point Naval Shipyard, San Francisco, California
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2

REUSE AREAS, REDEVELOPMENT BLOCKS, AND IR SITES AT PARCEL E

Operation and Maintenance Plan

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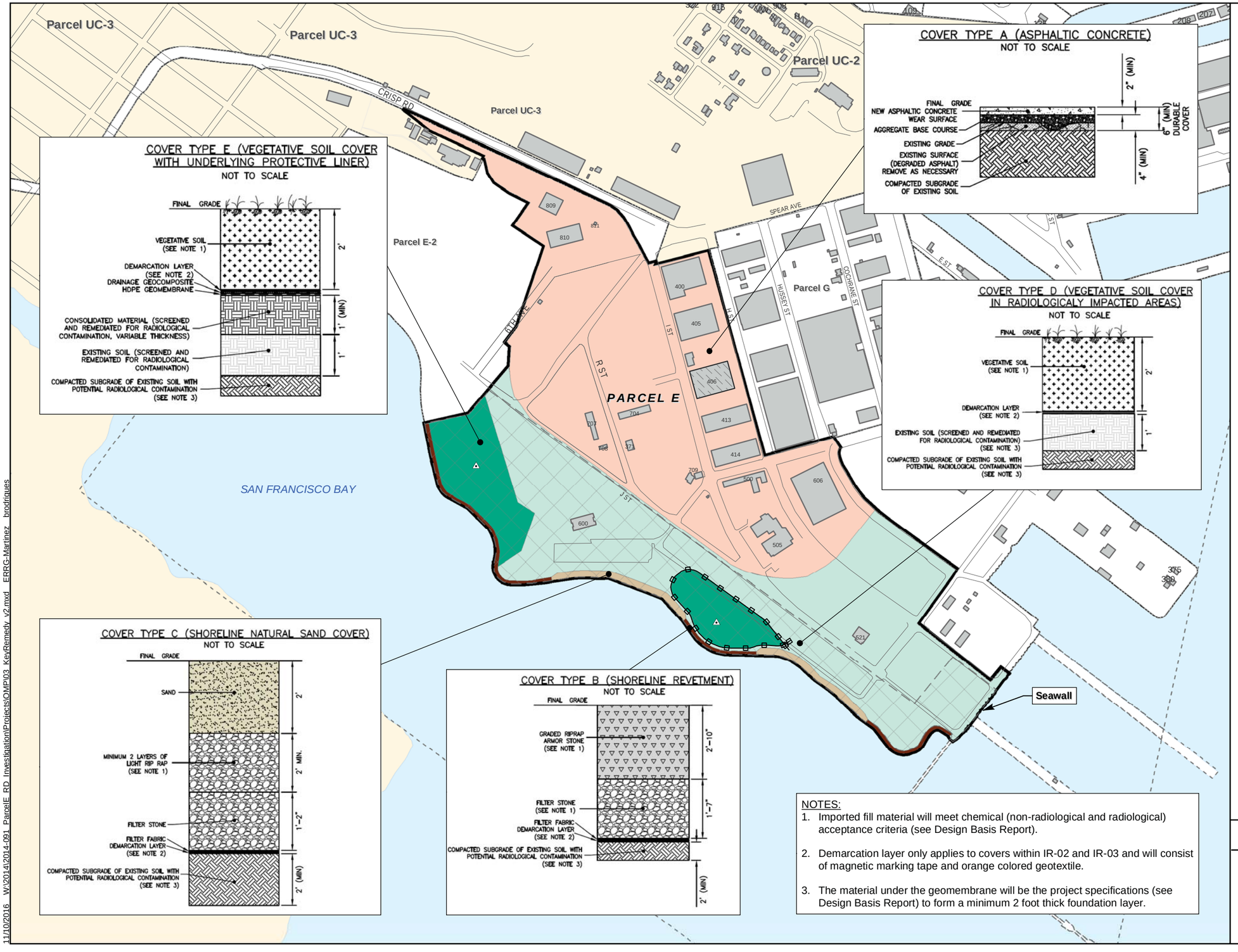

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Hunters Point Naval Shipyard, San Francisco, California
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 3

KEY REMEDY COMPONENTS FOR PARCEL E

Operations and Maintenance Plan

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Tables

Table 1. Required Content for Closure and Maintenance Plan at IR-02 Northwest/Central and IR-03

Citation	Required Information	Location in Design Package
Title 27 Cal. Code Regs. § 21800(c) (for closure plans)	Closure cost estimate	Preconstruction Cost Opinion (to be provided in the Final RD)
	Location maps indicating property boundaries; general location of the waste management units; and the existing, permitted, and proposed final limits of waste placement, entry roads, and structures	DBR Figures and Appendix C (Design Drawings)
	Location map of the current monitoring and control systems, including systems drainage and erosion control, and groundwater monitoring and control	DBR Figures and Appendix C (Design Drawings)
	Description of proposed post-closure land uses	DBR Section 2.1 and Figure 2
	Estimate of the maximum extent of the waste management units that will require closure	DBR Section 3.12 and Figures 2 and 8
	Estimate of the closure date	N/A
	Preliminary description of closure activities related to site security and structure removal	DBR Sections 3.1.1 and 3.1.6
	Preliminary description of closure activities related to final cover and grading	DBR Section 3.12
	Preliminary description of closure activities related to construction quality assurance methods	DBR Appendix D (Project Specifications)
	Preliminary description of closure activities related to drainage and erosion control systems	DBR Section 3.12.6
	Preliminary description of closure activities related to gas monitoring and control systems	N/A
	Preliminary description of closure activities related to leachate monitoring and control measures	DBR Sections 3.5.5 and 3.9.2, RAMP Section 2
	Preliminary schedules for implementation of closure activities	N/A

Table 1. Required Content for Closure and Maintenance Plan at IR-02 Northwest/Central and IR-03 *(continued)*

Citation	Required Information	Location in Design Package
Title 27 Cal. Code Regs. § 21830 (for maintenance plans)	Emergency response plan	OMP Section 4
	Persons or companies responsible for each aspect of post-closure maintenance, and their addresses and telephone numbers	OMP Table 3
	Description of the planned uses of the property during the post-closure maintenance period	DBR Section 2.1 and Figure 2
	As-built description of the current monitoring and control systems at the waste management units, including a detailed description of any proposed changes to be implemented as part of closure	DBR Sections 3.5.5 and 3.9.2, RAMP Section 2
Title 27 Cal. Code Regs. § 21830 (for maintenance plans)	Detailed description of the methods, procedures, and processes that will be used to maintain, monitor, and inspect the closed waste management units during the post-closure maintenance period	OMP Section 2 and Appendix A
	Operations and maintenance plan for the gas control system	N/A
	Summary of the requirements for reporting the results of monitoring and maintenance	RAMP Section 4 and OMP Section 3
	Post-closure maintenance cost estimates	N/A

Notes:
Cal. Code Regs. = California Code of Regulations
DBR = Design Basis Report
IR = Installation Restoration
N/A = not applicable for the site
OMP = Operations and Maintenance Plan
RAMP = Remedial Action Monitoring Plan
RD = Remedial Design
§ = Section

Table 2. ARARs for Containment, Soil Vapor Extraction, and Shoreline Protection

Design Requirement	Citation[a]	Element to Address Basis of Design Criteria
Federal ARARs for Containment		
Resource Conservation and Recovery Act (Title 42 USC, ch. 82, §§ 6901–6991[i])[b]		
The final cover will prevent the downward entry of water into the closed waste management unit throughout a period of at least 100 years.	Cal. Code Regs. tit. 22, § 66264.310(a)(1)	Design includes an OMP relevant to the post-closure maintenance of low-permeability covers at IR-02 Northwest/Central and IR-03, providing: ▪ emergency response action information; ▪ descriptions of the proposed monitoring and control systems of the low-permeability covers at IR-02 Northwest/Central and IR-03; ▪ detailed descriptions of the methods, procedures, and processes that will be used to maintain, monitor, and inspect the low-permeability covers at IR-02 Northwest/Central and IR-03 during the post-closure maintenance period; and ▪ a summary of the requirements for reporting monitoring results.
Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events throughout the post-closure period.	Cal. Code Regs. tit. 22, § 66264.310(b)(1) and (4)	Design includes a post-closure OMP with detailed descriptions of the methods, procedures, and processes that will be used to maintain, monitor, and inspect the covers throughout Parcel E during the post-closure maintenance period.
Protect and maintain surveyed benchmarks throughout the post-closure period.	Cal. Code Regs. tit. 22, § 66264.310(b)(5)	Design includes a post-closure OMP that details procedures for the required maintenance of the surveyed benchmarks.
State ARARs for Containment		
State Water Resources Control Board/California Department of Resources Recycling and Recovery[b]		
Diversion and drainage facilities will be designed, constructed, and maintained to accommodate the anticipated volume of precipitation and peak flows.	Cal. Code Regs. tit. 27, § 20365(c) and (d)	Low-permeability covers at IR-02 Northwest/Central and IR-03 are designed to accommodate anticipated volume of precipitation and peak flows. Cover will be seeded with native species mixture identified in the OMP. In addition, design includes an OMP that requires regular inspections and maintenance of the soil cover and drainage features.

Table 2. ARARs for Containment, Soil Vapor Extraction, and Shoreline Protection *(continued)*

Design Requirement	Citation[a]	Element to Address Basis of Design Criteria
State ARARs for Containment		
State Water Resources Control Board/California Department of Resources Recycling and Recovery[b] *(continued)*		
Erosion and related damage to the final cover due to drainage must be prevented throughout the post-closure maintenance period.	Cal. Code Regs. tit. 27, § 21090(c)(4)	Design includes an OMP that requires regular inspections and maintenance of the soil covers throughout Parcel E.
The post-closure maintenance period will extend as long as the wastes pose a threat to water quality. The waste management unit will be maintained and monitored for a period of not less than 30 years after closure of the entire solid waste management unit.	Cal. Code Regs. tit. 27, § 20950(a) and § 21180(a)	Design includes an OMP relevant to the post-closure maintenance of low-permeability covers at IR-02 Northwest/Central and IR-03, providing: ▪ emergency response action information; ▪ descriptions of the proposed monitoring and control systems of the low-permeability covers at IR-02 Northwest/Central and IR-03; ▪ detailed descriptions of the methods, procedures, and processes that will be used to maintain, monitor, and inspect the low-permeability covers at IR-02 Northwest/Central and IR-03 during the post-closure maintenance period; and ▪ a summary of the requirements for reporting monitoring results.
The final cover of closed waste management units will be designed, graded, and maintained to prevent ponding and to prevent site erosion caused by high runoff velocities. Slopes should be at least 3 percent.	Cal. Code Regs. tit. 27, § 21090(b)(1)	Low-permeability covers at IR-02 Northwest/Central and IR-03 are designed to prevent ponding and to prevent site erosion caused by high runoff velocities. Cover will be seeded with native species identified in the OMP. In addition, design includes an OMP that requires regular inspections and maintenance of the soil cover and drainage features.
Closed units shall be provided with at least two permanent monuments, installed by a licensed land surveyor or a registered civil engineer, from which the location and elevation of containment structures can be determined throughout the post-closure maintenance period.	Cal. Code Regs. tit. 27, § 20950(d)	Design for soil covers includes installation of permanent survey monuments and settlement markers that will be routinely monitored.

Table 2. ARARs for Containment, Soil Vapor Extraction, and Shoreline Protection *(continued)*

Design Requirement	Citation[a]	Element to Address Basis of Design Criteria
State ARARs for Containment		
State Water Resources Control Board/California Department of Resources Recycling and Recovery[b] *(continued)*		
For a closed waste management unit, when all closure activities are complete for the unit, the discharger shall conduct an aerial photographic survey. The data obtained shall be used to produce a topographic map of the site at a scale and contour interval sufficient to depict the as-closed topography of each portion of the unit. The map produced pursuant to this paragraph shall act as a baseline against which to measure the total settlement, through time.	Cal. Code Regs. tit. 27, § 21090(e)(1) and (3)	Design for soil covers includes an aerial survey to provide a baseline for future settlement measurements.
Potential emergency conditions that may exceed the design of the site and could endanger the public health or the environment must be anticipated.	Cal. Code Regs. tit. 27, § 21130	The Navy will comply with the substantive portions of this requirement as they pertain to low-permeability covers at IR-02 Northwest/Central and IR-03. Design includes an OMP relevant to the post-closure OMP, providing emergency response information.
Requires that all points of access be restricted except at permitted entry points, and that the monitoring, control, and recovery systems be protected from unauthorized access.	Cal. Code Regs. tit. 27, § 21135 (f) and (g)	The Navy will comply with the substantive portions of this requirement as they pertain to low-permeability covers at IR-02 Northwest/Central and IR-03. Design includes fencing to restrict access to the site and to prevent damage that might occur under Navy ownership. Fencing is not a permanent feature of the remedy because no aboveground equipment is associated with the monitoring or control systems. Subsurface monitoring points (e.g., wells) will be secured with locks.
The drainage and erosion control system will be designed and maintained to (1) ensure integrity of post-closure land uses, roads, and structures; (2) prevent public contact with waste and leachate; (3) ensure the integrity of gas monitoring and control systems; (4) prevent safety hazards; and (5) prevent exposure of waste.	Cal. Code Regs. tit. 27, § 21150(a)	Design includes an OMP that requires regular inspections and maintenance of the soil covers throughout Parcel E.

Table 2. ARARs for Containment, Soil Vapor Extraction, and Shoreline Protection *(continued)*

Design Requirement	Citation[a]	Element to Address Basis of Design Criteria
State ARARs for Containment		
State Water Resources Control Board/California Department of Resources Recycling and Recovery[b] *(continued)*		
Sets forth requirements for final closure plan contents.	Cal. Code Regs. tit. 27, § 21800(c)	Design of the post-closure OMP considers the substantive portions of Cal. Code Regs. tit. 27, § 21800(c) in developing the final closure plan, as described in Table 1.
Provides the content requirements for post-closure maintenance plans for solid waste disposal sites.	Cal. Code Regs. tit. 27, § 21830	Design of the post-closure OMP considers the substantive portions of Cal. Code Regs. tit. 27, § 21830 in developing the final maintenance plan as described in Table 1.
Federal ARARs for SVE		
Clean Air Act (Title 42 USC, § 7401 et seq.)		
New emission sources must use best available control technology	BAAQMD Regulation 2-5-301	The design requires development of an SVE system startup and operations plan that will identify procedures for startup, maintenance, monitoring, shutdown, and closure. The SVE system startup and operations plan will ensure compliance with the substantive provisions of this requirement; the plan will also evaluate site conditions relative to the exemption criteria identified in this requirement.
Requirements for SVE systems.	BAAQMD Regulation 8-47	The design requires development of an SVE system startup and operations plan that will identify procedures for startup, maintenance, monitoring, shutdown, and closure. The SVE system startup and operations plan will ensure compliance with the substantive provisions of this requirement; the plan will also evaluate site conditions relative to the exemption criteria identified in this requirement.
State ARARs for Shoreline Protection		
McAteer-Petris Act (California Government Code §§ 66600 through 66661)[b]		
Riprap revetments should be constructed of properly sized and placed material. Protective projects should be maintained to ensure that the shoreline will be protected from tidal erosion.	Part IV of Bay Plan (Findings and Policies Concerning Shoreline Protection around the Bay, Policies 2, 3, and 4)	The Navy will comply with the substantive portions of this requirement. Design includes an OMP relevant to the operation and maintenance of the shoreline protection measures to ensure protection from tidal erosion.

Table 2. ARARs for Containment, Soil Vapor Extraction, and Shoreline Protection *(continued)*

Notes:

a = Only the substantive provisions of the requirements cited in this table are ARARs.

b = Statutes and policies and their citations are provided as headings to identify general categories of ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as ARARs; specific ARARs are addressed in the table below each general heading; only substantive requirements of specific citations are considered ARARs.

ARARs = applicable or relevant and appropriate requirements

BAAQMD = Bay Area Air Quality Management District

Bay Plan = San Francisco Bay Plan

Cal. Code Regs. = California Code of Regulations

ch. = Chapter

IR = Installation Restoration

Navy = Department of the Navy

OMP = Operation and Maintenance Plan

SVE = soil vapor extract

tit. = Title

USC = United States Code

§ = Section

Table 3. Operation and Maintenance Oversight Personnel

General O&M Item	Qualifications
Maintain Updated OMP	Authorized Navy Representative
Financial Responsibility	Authorized Navy Representative
Bookkeeping	Authorized Navy Representative
Institutional Controls	
Site Security	Navy and O&M Contractor
Signs and Gates	O&M Contractor
Site Access	O&M Contractor
Land Use	Authorized Navy Representative
Soil Cover	
Vegetative Cover[1]	CPESC, QSP, or Civil PE (O&M Contractor)[1]
Protective Liner and Demarcation Layer	PG or Civil PE (O&M Contractor)
Durable Covers	
Asphalt Pavement Cover	CPESC, QSP, or Civil PE (O&M Contractor)
Vegetative Cover[1]	CPESC, QSP, or Civil PE (O&M Contractor)[1]
Groundwater Monitoring Wells	PG or Civil PE (O&M Contractor)
Drainage[1]	CPESC, QSP, or Civil PE (O&M Contractor)[1]
Maintenance Path[1]	CPESC, QSP, or Civil PE (O&M Contractor)
SVE System	
System Operations	Civil PE (O&M Contractor)
System Optimization	Civil PE (O&M Contractor)
Revetment	
Armoring Material[1]	Civil PE (O&M Contractor)[1]
Scour and Erosion Impacts	CPESC, QSP, or Civil PE (O&M Contractor)
Drainage Structures	O&M Contractor
Other	
Emergency Response	O&M Contractor
Wildlife (including invasive species management)	Biologist with California Species of Special Concern proficiency

Notes:

1. O&M of these remedy components may require consultation with and oversight from a biologist with proficiency with California species of special concern (see Appendix A).

CPESC = Certified Professional in Erosion and Sediment Control
Navy = Department of the Navy
O&M = operation and maintenance
OMP = Operation and Maintenance Plan
PE = Professional Engineer
PG = Professional Geologist
QSP = Qualified SWPPP (Stormwater Pollution Prevention Plan) Practitioner
SVE = soil vapor extraction

Table 4. System Maintenance Schedule

Activity	Schedule
Clean sight glass and knockout tank	As needed
Inspect system for leaks, high temperatures, unusual vibrations, and other indicators of abnormal operation	Weekly
Inspect the electrical power connections and supply for the SVE system	Weekly
Inspect and maintain oil levels of the blower as outlined in the product data sheets and manuals	Weekly
Inspect gauges, piping, hoses, and valves at treatment system, the SVE well network, and monitoring points	Weekly
Inspect and maintain condensate discharge pump and condensate storage tank as outlined in the product data sheets and manuals	Weekly
Inspect and record temperature at blower influent and effluent	Weekly
Inspect pressure relief valve at blower	Weekly
Inspect GAC vessels for leaks and rust	Weekly
Maintain housekeeping, clean the area and remove trash, as appropriate	Weekly
Inspect liquid/air separator for accumulated sediments	Monthly
Inspect liquid/air separator level switches, and trip the high-high level switch to ensure proper operation	Monthly
Inspect and test liquid transfer pump	Monthly
Grease blower drive end	Monthly
Inspect system vacuum and pressure	Monthly
Test system motor over amp interlock at control panel	Quarterly
General inspection and cleaning of wellheads and valve boxes, including removal of debris and cleaning gaskets on well covers	Quarterly
Drain and replace oil at gear end of blower	Semiannual
Inspect and clean holding tank	Biannual

Notes: Appendix A provides a general inspection checklist with select items pertaining to the SVE system. The SVE Startup and Operations Plan (to be prepared in conjunction with the Remedial Action Work Plan) will provide additional field forms and checklist.

GAC = granular activated carbon

SVE = soil vapor extraction

Table 5. Seed Mix

Scientific Name	Common Name	Pounds/Acre
Bromus carinatus	California Brome	37.50
Hordeum brachyantherum	Meadow Barley	15.00
Vulpia microstachys	Small Fescue	9.00
Trifolium willdenovii	Tomcat Clover	6.00
Eschscholzia californica	California Poppy	2.25

Table 6. Emergency Responses

Occurrence	Threat Posed	Response
Earthquake, including liquefaction	▪ Health and safety hazards ▪ Damage to monitoring systems ▪ Slope failure ▪ Damage to cover or its components	1. Immediately conduct visual inspection of area to assess damage and potential impact. 2. If safety hazards are present, immediately cordon off area. 3. If damage to monitoring systems has occurred, contact maintenance contractor to facilitate repairs. 4. Resurvey the area and increase the frequency of inspection and maintenance of final cover, drainage system, vegetative cover, and final grading to quarterly for a period of 1 year. 5. If slope failure, surface cracking, or similar damage occurs, contact the contracted geotechnical consultant, as appropriate, to evaluate problem areas within 48 hours of notice. If necessary, perform a geotechnical investigation of failure to develop a corrective action plan. 6. For damage or potential damage to other components that affect site integrity, security, or safety, arrange immediate temporary repairs (if necessary) and arrange repair or restoration within 2 weeks (weather and conditions permitting) to design conditions in accordance with project specifications. 7. Notify FFA signatories, CalRecycle, and CDPH. **Required Equipment:** erosion control blankets or media, bulldozer, loader, compactor, sand, clean fill, and cordon tape.
Flood or Major Storm	▪ Excessive erosion of surface ▪ Slope failure ▪ Health and safety hazards ▪ Damage to cover or its components	1. Immediately conduct visual inspection of area to assess damage and potential impact. 2. If safety hazard is present, immediately cordon off the affected area. 3. If slope failure occurs, contact contracted geotechnical consultant, as appropriate, to evaluate the problem area with 48 hours. If necessary, conduct a geotechnical investigation of the failure to develop a corrective action plan. 4. For damage or potential damage to components that affect site integrity, security, or safety, arrange repair or restoration within 2 weeks (weather and conditions permitting) to design conditions and in accordance with project specifications (appended to the DBR). 5. Investigate preventive measures. 6. Notify FFA signatories, CalRecycle, and CDPH. **Required Equipment:** erosion control blankets or media, bulldozer, loader, compactor, sand, clean fill, and cordon tape.

Table 6. Emergency Responses *(continued)*

Occurrence	Threat Posed	Response
Fire	▪ Health and safety hazards ▪ Damage to monitoring systems ▪ Damage to cover or its components	1. Notify San Francisco Fire Department and Navy representative. 2. Immediately conduct visual inspection of area to assess damage and potential impact. 3. Immediately cordon off affected area. 4. For damage or potential damage to other components that affect site integrity, security, or safety, arrange immediate temporary repairs (if necessary) and arrange repair or restoration within 2 weeks (weather and conditions permitting) to design conditions and in accordance with project specifications (appended to the DBR). 5. Notify FFA signatories, CalRecycle, and CDPH. **Required Equipment:** erosion control blankets or media, silt fencing, straw bales, sandbags, bulldozer, loader, compactor, sand, clean fill, and cordon tape.

Notes:

CalRecycle = California Department of Resources Recycling and Recovery

CDPH = California Department of Public Health

DBR = Design Basis Report

FFA = Federal Facility Agreement

Navy = Department of the Navy

Appendix A. Inspection and Repair Procedures for Operation and Maintenance of Parcel E Remedy

Section 1. Inspection and Repair Procedures

Parcel E will be visited at least quarterly for the first year and annually thereafter—or as necessary based on the results of the inspections. Select components of the soil vapor extraction (SVE) system may require more frequent visits (e.g., weekly or monthly) to ensure its proper operation. Some items will not be inspected during every site visit—for instance, subsurface geosynthetic materials. Changes to the inspection frequency will be documented in annual inspection reports and will be subject to review and approval by the Federal Facility Agreement signatories. At a minimum, the following materials should be brought to the site for each site visit, and this list should be adapted over time based on previous inspections conducted by the operations and maintenance (O&M) contractor:

- Camera
- Operations and Maintenance Plan (OMP)
- Land Use Control Remedial Design Report
- Appropriate documentation materials, including any inspection checklists
- Copies of appropriate maps and figures
- O&M logbook
- Telephone and contact list
- Appropriate personal protective equipment
- Approved site safety and health plan
- Common items requiring replacement (e.g., locks, well caps, well seals, and similar equipment)
- Previous inspection reports and photographs of concern (as necessary)

Inspection reports summarizing the findings of the inspections should be filed promptly with the Department of the Navy (Navy) following the inspection; and, in cases where significant damage has been observed, the Navy should be notified as soon as possible. Appendix A1 provides the general inspection checklist.

Significant issues of vandalism and theft, especially when recurring, should be reported to police and may result in increased inspection frequency.

Basic repairs can be conducted on site at the time of inspections. Basic repairs may include, but are not limited to, replacement of signage, replacement of monitoring well locks and protective caps, filling in of small gullies caused by water erosion, and replanting of small areas.

Significant repairs are those that are not defined as or considered to be similar to the basic repairs listed in the previous sentence. Significant repairs may include, but are not limited to, adding shoreline protection material, filling of areas over the soil cover, and conducting repairs associated with exposure of the demarcation layer or the protective liner. This level of repair will require specialized equipment and materials and should be conducted by an appropriate contractor in accordance with the design- and construction-related documents, including the design drawings and the project specifications. Repairs such as these will have a potential impact on the protectiveness of the remedy and should be conducted under the supervision of a licensed professional engineer and in accordance with a work plan approved by the Federal Facility Agreement signatories and California Department of Public Health for the area requiring institutional controls for radionuclides. The following sections list the procedures to be used during the site inspection process that should be adapted based on site conditions as they evolve over time.

1.1. GENERAL SITE CONDITIONS

- The perimeter of the site should be walked, and the fence and boundary conditions should be inspected for signs of breaching, vandalism, and degradation. Issues should be documented in inspection summary reports, and photographs should be taken of any areas of concern and the exact location should be documented.
- The shoreline protection features should be inspected during low tide, so the full extent of the structure can be viewed.
- The condition of any designated access points to the site should be inspected for damages.
- Any trash, debris, or other materials should be removed from the site and disposed of properly. This material also includes debris that may wash up onto the revetment and vegetation along the revetment.
- Any issues of concern should be reported to the Navy as necessary. Repairs to the fence should be scheduled with an appropriate contractor.
- Any unauthorized digging on the site should be recorded, and excavated areas should be filled and compacted as necessary.

1.2. SITE SIGNAGE

- Each sign should be inspected for integrity and vandalism. Structural issues should be dealt with appropriately during the inspection when possible or scheduled with an appropriate contractor.
- If the signs begin to degrade visually, photographs should be taken to document and monitor degradation and signs should be replaced promptly when necessary.
- Signs that are illegible at a distance of 5 feet should be cleaned or replaced.
- Any stolen signs should be replaced promptly.

1.3. SITE SECURITY FENCING

- Fences should be inspected for integrity and vandalism. Structural issues should be dealt with appropriately during the inspection when possible or scheduled with an appropriate contractor.
- Graffiti should be removed promptly.
- Any vegetation that is growing too close to the fence and may damage the fence over time should be removed.
- Holes or damaged portions of the fence should be fixed promptly to prevent access to the site.

1.4. SOIL COVER AND PROTECTIVE LINER

- The cover should be walked systematically to inspect the complete extent of the cover. Particular attention should be given to the side slopes, drainage swales, and the portion where the soil cover meets the crest of the revetment.
- The as-built drawings, along with records from previous inspections and repairs, should serve as the basis of comparison to document changes in the cover.
- Areas where vegetation has been damaged should be documented, photographed, and monitored. The vegetative cover should naturally regenerate without additional seeding. If the damaged areas do not regenerate or are extensive (i.e., greater than 20 percent of a 400 square-foot subarea), then the damaged areas should be reseeded using seed mix provided in the OMP (see Table 5). Reseeding should also occur when erosional damage is observed by the inspector (e.g., visible rills or depressions, and evidence of sediment deposition).
- The roots of any species outgrowing the predominant grasses could breach the demarcation layer (or underlying protective liner) and must be promptly removed. Exposure of underlying soil beneath trees should be prevented, and herbicide should be applied as necessary. Manage invasive plant species in accordance with the approach described in Section 2.
- Mowing should be conducted when grasses are greater than 2 feet in height. Do not remove more than 1/3 of the total height within a 1-week period. A minimum grass height of 6 inches should be maintained.
- If mowing or other vegetation removal is performed during the nesting season (from February 1 to September 15), the site should be inspected prior to vegetation removal to identify the potential presence of ground-nesting birds. If evidence of ground-nesting birds is identified during the site inspection, no vegetation removal activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resources trustees) and properly implemented (with oversight from a qualified biologist).
- Areas of settlement or displacement should be recorded. Minor settlement or displacement is not an immediate concern but should be monitored over time. Major settlement or displacement (i.e., a visible slope failure of any size, cracks deeper than 6 inches at a given location, or depressions greater than 6 inches over a 100 square-feet subarea) should be promptly repaired using soil that meets the requirements of the project specifications. Specialized labor and equipment may be required for these types of major repairs.

- Obstructions to the drainage channels should be removed.
- Evidence of burrowing animals on the soil cover should be noted and monitored over time. The approximate location, diameter, and vertical depth of burrows will be recorded (where the burrow daylights at the ground surface). Pest control measures, to be performed in accordance with the approach described in Section 2, may be necessary if damage to the cover occurs.
- If any animal burrow or hole in the soil cover is identified, it should be backfilled using material removed from the hole and compacted manually using a hand tamper. Prior to backfilling activities, the site should be inspected to identify the potential presence of ground-nesting birds (including burrowing owls). If evidence of ground-nesting birds is identified during the site inspection, no backfilling activities will occur until appropriate protective measures can be developed (in consultation with the FFA signatories and other natural resources trustees) and properly implemented (with oversight from a qualified biologist).
- For burrows that extend to the demarcation layer (at least 2 feet vertically below the ground surface), the following inspections should be performed:
  - excavate and expose the demarcation layer by hand;
  - for covers in Installation Restoration (IR) Site IR-02 and IR-03, examine the demarcation layer for damage that exposes any of the underlying geosynthetic materials (for portions of IR-02 and IR-03, these layers will also include a high-density polyethylene [HDPE] geonet, geotextile fabric, and HDPE geomembrane);
  - if the demarcation layer or underlying geosynthetic materials are damaged, promptly repair the affected areas in accordance with the project specifications and pertinent manufacturer guidelines;
  - backfill the excavation using material removed from the hole and compact manually using a hand tamper; and
  - reseed the area using the seed mix provided in the OMP (see Table 5).
- Repairs to the soil cover should follow the procedures outlined in the design and construction documents, including the design drawings and project specifications.

1.4.1. Demarcation Layer

- Any exposure of the demarcation layer should be documented, and the approximate location, size, and depth of the opening should be recorded.
- Damage to the soil cover and, if necessary, the demarcation layer should be promptly repaired, in accordance with the project specifications and, for the demarcation layer, pertinent manufacturer guidelines.
- Depending on the recommendation of the material manufacturer, the demarcation layer fabric may require periodic inspection. No regular inspection of the demarcation layer fabric is currently planned; however, the O&M contractor should document the condition of the fabric during any inspections or repairs (based on the requirements described above) that expose the demarcation layer.

1.4.2. Protective Liner

- If the demarcation layer is found to be damaged, then the underlying geosynthetic materials should be inspected and repaired, if necessary.
- During inspection of damage to the demarcation layer, any exposed geosynthetic materials (e.g. geocomposite drainage layer, HDPE geomembrane, etc.) should be visually inspected.
- Any exposure should be documented, and the geosynthetic materials should be repaired in accordance with the project specifications and based on procedures in the manufacturer's specifications.

1.5. ASPHALT PAVEMENT COVER AND BUILDING FOUNDATIONS

- The extent of the cover should be inspected systematically. Particular attention should be given to areas that abut buildings, drainage areas, areas of accumulated water, and the portion where the cover meets the offsite grade.
- Areas where the asphaltic concrete or a building foundation has been damaged by cracking should be documented, photographed, and monitored.
- Access to crawlspaces beneath building foundations must remain inaccessible. Repairs should be made, as needed, to maintain the condition.
- Surveyed benchmarks should be inspected. If damages are observed, the benchmarks should be replaced and resurveyed by a licensed surveying contractor.
- Areas of settlement or displacement should be recorded. Minor settlement or displacement is not an immediate concern but should be monitored over time. Major settlement or displacement (that causes surface cracks wider than 0.25 inches) should be promptly repaired using material that meets the requirements of the project specifications. Specialized labor and equipment may be required for these types of major repairs.
- Areas of water accumulation should be monitored and may require filling if cracking becomes a recurring or constant issue. Use of appropriate contractors and equipment may be necessary.
- The drainage channels should be inspected, including recording overall conditions, removing obstructions, and noting evidence of channel flow and flow depths.
- Changes at adjoining parcels that would affect stormwater flow at the site should be observed and documented.
- Repairs to the asphalt pavement cover should follow the procedures outlined in the design and construction reports and the included repair specifications, and should be based on the record drawings.
- Buildings should be maintained in a locked and inaccessible condition. If unauthorized access to the buildings is noted, entry points should be repaired, as needed, to prevent further access. New locks or other physical controls should be used, as needed.
- The cover should be repaired in accordance with the design basis report and the associated project specifications.

1.6. SHORELINE PROTECTION

- The limits of the shoreline protection features should be inspected for vandalism or theft of materials and documented or replaced accordingly. The revetment should be compared to the as-built drawings.
- Any shifting of materials or settlement should be recorded. This record should be done through comparison to previous inspections. Shifting and settling is anticipated to occur and does not impact the integrity of the structure but should be monitored.
- The toe portion of the shoreline protection features should be observed during low tide so the entire extent of the structure can be properly documented. Photographs of the revetment should be taken as necessary.
- Trash or debris that may have accumulated on the shoreline protection features should be removed and disposed of properly. Excessive nuisance vegetation should be removed from the structure. Manage invasive plant species in accordance with the approach described in Section 2.
- The toe portion and the flanks of the shoreline protection features should be inspected for signs of settlement, changes in slope, and undercutting and erosion. The toe portion should be fully covered by sediment, and any exposure of rocks should be recorded. Exposure of the armoring material does not jeopardize the integrity of the structure but should be monitored over time.
- Exposure of the filter fabric indicates that the shoreline protection features armoring has been displaced. This exposure should be recorded, and repairs should be made through the addition of material. The integrity and consistency of subgrade should be inspected.
- Any signs of vandalism or theft should be noted. Areas where additional revetment armoring rock may be necessary should be replaced promptly. Procedures summarized in the design and construction documents should be followed, and repairs should be made based on the as-built drawings and the project specifications.
- The crest of the shoreline protection features should be inspected for degradation and the movement of rock.
- Any signs of wave overtopping of the shoreline protection features should be documented and monitored over time.

1.7. SOIL GAS MONITORING PROBES AND GROUNDWATER MONITORING WELLS

- Protective materials (casing, pads, etc.) should be inspected for integrity. Damages should be documented through photographs. Slight damages can be monitored over time, but damages that may jeopardize the functionality of the probe or well should be reported and repaired promptly.
- Vandalism and theft of any materials related to the probes or wells should be repaired promptly. Repair may include replacing locks, caps, and other items or covering vandalized items with paint.
- Rusted or otherwise nonfunctional well locks should be repaired or replaced.
- The probes and wells should be inspected to ensure they are free of obstructions. This inspection is especially important in situations where locks or well caps are missing or when there are other signs that the well has been breached. Appropriate probes can be used to check that obstructions do not exist within the well itself.

- Any issues should be recorded through photographs and written descriptions, and the probe and well locations should be recorded.
- Any repair needing immediate attention should be promptly reported to the Navy for scheduling with appropriate contractors.

1.8. SOIL VAPOR EXTRACTION SYSTEM

- Equipment should be maintained in accordance with the manufacturers' specifications.
- Vacuum pressures at the extraction wells and the monitoring points should be recorded. Repair if significant increases or decreases are observed from the previous inspection.
- Flame ionization detector readings should be recorded at each monitoring point and extraction well. Extraction wells with low readings (e.g., less than the instrument detection limit) should be taken offline, as necessary, to allow for rebound to occur prior to bringing the extraction well back online.
- Influent and effluent concentrations to the GAC units should be assessed in the field, and samples for laboratory analysis should be collected on the first and last day of the first week and at least once every 90 calendar days thereafter. GAC should be exchanged as necessary.
- Vapor flow rates entering the treatment system should be recorded. Issues related to low rates should be investigated and documented.
- Ambient temperature, weekly precipitation, groundwater levels, and SVE system temperatures should be measured and recorded.
- All piping and fittings should be inspected and replaced, as necessary, if leaks are observed. Significant leaks that cannot be repaired will result in taking extraction points offline or shutting down the system until repairs can be made.
- Liquid levels in the knockout drum and water in the accumulation tank should be monitored and disposed of as necessary.
- Accumulated sediment should be removed from the knockout drum as necessary.

Section 2. Invasive Species Management

Colonization of the final remedy, including the soil cover and constructed wetlands, by invasive, undesirable plants and animals is a concern and will require that measures be taken to prevent their establishment and ensure long-term viability of the constructed remedy. An adaptive management approach, which incorporates integrated pest management (IPM) principles (as established by the U.S. Environmental Protection Agency and the California Statewide Integrated Pest Management Program), will be used to address invasive plant and animal species. In general, IPM is a strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment, and nontarget organisms. IPM programs include the following general elements[1]:

- Identify potential pests
- Establish monitoring guidelines for each pest
- Establish action thresholds for each pest before making any treatment
- Establish a recordkeeping system
- Develop a list of acceptable management strategies for each pest
- Develop criteria for selecting pest management methods
- Develop guidelines for pesticide use
- Designate responsible party for IPM decisions
- Identify additional resources for consultation

The following sections identify the invasive plant and animal species that are of primary concern, and provide information on the means by which they will be managed. The following information provides preliminary guidelines for managing invasive plant and animal species at Parcel E. These guidelines should be reevaluated on a regular basis (e.g., in conjunction with the annual inspection reports, as appropriate) and in consultation with the FFA signatories and other natural resources trustees (e.g., California Department of Fish and Wildlife).

2.1. INVASIVE PLANTS

Previously identified invasive species at Parcel E (and adjacent Parcel E-2) include sweet fennel (*Foeniculum vulgare*), cocklebur (*Xanthium strumarium*), black mustard (*Brassica nigra),* short-pod mustard *(Hirschfeldia incana),* wild radish (*Raphanus raphanistrum)* and cultivated radish *(Raphanus sativus*), sour clover

[1] Flint, M.L., S. Daar, and R. Molinar. 2003. "Establishing Integrated Pest Management Policies and Programs: A Guide for Public Agencies." University of California Division of Agriculture and Natural Resources Publication 8093.

(*Melilotus indica*), sweet clover (*Melilotus officinalis*), cheeseweed (*Malva parviflora*), and pampas grass (*Cortaderia* sp.*)*. Cheeseweed was found on dump piles just south of the Parcel E-2 landfill cover. This plant can develop very large and powerful roots and is competitive, growing and setting seed very quickly. Pampas grass is another plant of concern. It is highly invasive and can develop deep root structures.

2.2. MANAGEMENT OF INVASIVE PLANT SPECIES

As described in Section 2, an adaptive management approach, which incorporates IPM principles, will be used to address invasive plant species (a preliminary list of which were provided in Section 2.1). The management approach will include the following activities:

- Regular inspections will be conducted, in conjunction with the general site inspections, to identify invasive plant species, record the approximate extent of their impact, and assess the extent to which they might impair the selected remedy
- The inspection results will be used to evaluate whether additional action is necessary to address invasive plant species
- Necessary follow-up actions will be performed to address invasive plant species, using established guidelines that identify acceptable management strategies (including a consultation process with the FFA signatories and other natural resources trustees prior to using herbicides)
- Follow-up inspections will be conducted to ensure the effectiveness of the management approach and to identify potential modifications, if necessary

Table A-1 identifies the invasive species management steps to be followed during future inspections. These steps should be reevaluated on a regular basis (e.g., in conjunction with the annual inspection reports, as appropriate) in consultation with the FFA signatories and other natural resources trustees.

2.3. INVASIVE ANIMALS IN SHORELINE AREAS

Two rodents of concern are the Norway rat (*Rattus norvegicus*) and the Black rat (*Rattus rattus*), which could become established by inhabiting small crevices in the shoreline revetment sections (a condition in which the animals impact the wetlands to be constructed at adjacent Parcel E-2). These species are common pests that can survive in a wide range of habitats, but are common in marshlands near buildings in urbanized areas. They nest in burrows and rock outcroppings and have caused major damage to wildlife by consuming the eggs of ground, shrub, and tree-nesting birds. Although a limited amount of information is available about their behavior in the San Francisco Bay area, Norway rats are confirmed predators of the California clapper rail (*Rallus longirostris obsoletus*), salt marsh harvest mouse (*Reithrodontomys raviventris*), and salt marsh wandering shrew (*Sorex vagrans halicoetes*). The constructed wetlands at Parcel E-2 are also intended to be inhospitable to predatory mammals such as rats, feral cats, skunks, and coyotes; however, control measures may be needed if such mammals are documented preying on birds in the wetland areas.

2.4. INVASIVE ANIMALS IN UPLAND AREAS

Burrowing animals that could damage the soil cover include Botta's pocket gopher (*Thomomys bottae*), California mole (*Scapanus latimanus*), California ground squirrel (*Spermophilus beecheyi*), and California vole (*Microtus californicus*). The California ground squirrel was the most common mammal identified during past biological surveys of Hunters Point Naval Shipyard (HPNS) and the Candlestick Point area. Sporadic occurrences of Botta's pocket gopher and the California vole were observed during the survey, but the presence of these species was characterized as uncommon because of the urban and industrial development that surrounds HPNS[2]. The California mole was not identified during past biological surveys of HPNS and the Candlestick Point area.

2.5. MANAGEMENT OF INVASIVE ANIMAL SPECIES

As described in Section 2, an adaptive management approach, which incorporates IPM principles, will be used to address invasive animal species (a preliminary list of which were provided in Sections 2.3 and 2.4). The management approach will include the following activities:

- Regular inspections will be conducted, in conjunction with the general site inspections, to identify invasive animal species, record the approximate extent of their impact, and assess the extent to which they might impair the selected remedy (e.g., cause unacceptable erosion, prevent the establishment of surface vegetation, or damage the protective liner)
- The necessary follow-up actions will be performed to address invasive animal species, using established guidelines that identify acceptable management strategies (including a consultation process with the FFA signatories and other natural resources trustees prior to using pesticides)
- Follow-up inspections will be conducted to ensure the effectiveness of the management approach and to identify potential modifications, if necessary

Table A-1 identifies the invasive species management steps to be followed during future inspections. These steps should be reevaluated on a regular basis (e.g., in conjunction with the annual inspection reports, as appropriate) in consultation with the FFA signatories and other natural resources trustees.

[2] San Francisco Redevelopment Agency (SFRA), 2010. "Final Environmental Impact Report, Candlestick Point-Hunters Point Phase II." Volumes I through X. May 13.

Tables

Table A-1. Steps for Invasive Species Management

Program Element	Planned Activities
Identify potential invasive species	▪ Review list of species identified in this document ▪ Obtain representative photographs of invasive species (to aid in field identification) ▪ Consult with biological specialists, as appropriate, to aid in the identification process
Establish monitoring guidelines for each invasive species	▪ Perform regular inspections (in conjunction with general site inspections) ▪ Identify invasive species present ▪ Record the extent of invasive species impacts ▪ Assess the extent to which invasive species may impair the selected remedy
Establish action thresholds for each invasive species	▪ Categorize the potential damage to the selected remedy caused by the invasive species ▪ Take prompt action to repair any damage that impairs the function of the remedy ▪ Identify the invasive species which caused the damage (consult with biological specialists, as appropriate) ▪ Develop and implement appropriate management strategy for the invasive species which causes damage that impairs the function of the remedy ▪ Continue to monitor invasive species that do not currently impair the function of the remedy, but may do so in the future if not properly managed
Establish recordkeeping system	▪ Complete general inspection checklist ▪ Promptly submit to completed checklist to appropriate Navy personnel ▪ Document necessary follow-up action ▪ Compile records in annual inspection report
Develop list of acceptable management strategies	<u>Plant Species</u> ▪ Manual removal of plant species present over a localized area (particularly deep rooted plant species that may penetrate the protective liner) ▪ Adjustment to irrigation practices, as appropriate, to limit growth of invasive plant species ▪ Seeding or planting to reestablish native species ▪ Targeted application of herbicide that focuses on the target species and is approved for use by project stakeholders <u>Animal Species</u> ▪ Fill animal burrows and compact soil to limit erosion potential (with oversight from a qualified biologist, as appropriate; see Section 1.4 for further information) ▪ Install raptor perches to encourage predation of burrowing animals, in a manner that minimizes impact to nontarget species (including consultation with qualified biologist to perform survey and oversight, as appropriate) ▪ Consider low-impact mechanical controls over a localized area (e.g., sonic devices on soil cover, or filling crevices in revetment with concrete) ▪ Consider low-impact mechanical controls over a larger area (e.g., modify fencing adjacent to property boundary with below-ground material that limits movement of burrowing animals
Develop criteria for selecting invasive species management methods	▪ Use control measures with low environmental impact whenever practical: • Biological controls use natural enemies (predators, parasites, pathogens, and competitors) to control invasive species (e.g., raptor perches to control burrowing animals) • Cultural controls are practices that reduce the establishment, reproduction, dispersal, and survival of invasive species (e.g., changing irrigation practices can reduce the growth of invasive plant species) • Mechanical or physical controls make the environment unsuitable for invasive species (e.g., filling revetment crevices with concrete to control Norway rats)

Table A-1. Steps for Invasive Species Management *(continued)*

Program Element	Planned Activities
Develop criteria for selecting invasive species management methods *(continued)*	▪ Ensure that control measures focus on the target invasive species and minimize impact to nontarget species (particularly protected bird species throughout Parcel E); consult with qualified biologist to perform survey and oversight, as appropriate ▪ Carefully implement mechanical or physical trapping, if needed, to ensure the protection of nontarget species; consult with qualified biologist to perform survey and oversight, as appropriate, of trapping (by an experienced contractor), and coordinate with project stakeholders prior to implementation ▪ Use chemical controls (i.e., pesticides or herbicides) only when needed and in combination with other control measures; see guidelines below for the proper use of herbicides and pesticides
Develop guidelines for herbicide/ pesticide use	▪ Compile specific information for the proposed use: • Target invasive species and its approximate area of impact • Planned herbicide or pesticide product, and confirmation that it addresses the target species and does not contain chemicals at concentrations that will harm nontarget species • Planned application area, and confirmation that it will cover no more area than necessary to address the invasive species • Planned frequency for application and follow-up inspections • Decision criteria for follow-up inspections to determine if additional applications are required or further evaluation is needed ▪ Submit information to Navy and project stakeholders ▪ Proceed with application only after receiving and responding to input from project stakeholders, and receiving written authorization from the Navy; in accordance with Title 40 of the Code of Federal Regulations Section 171, restricted use pesticides and herbicides must be applied by a certified applicator.
Designate responsible party for management decisions	▪ Navy project team (including the remedial project manager and representatives from the Caretaker Site Office and the Resident Officer In Charge of Construction) will be responsible for management decisions ▪ O&M contractor will be responsible for the proper implementation of the procedures approved by the Navy project team and other project stakeholders ▪ Other project stakeholders (including the FFA signatories and natural resources trustees) will regularly review inspection reports and other project submittals (e.g., requests to use herbicides and pesticides)
Identify additional resources for consultation	▪ University of California Statewide IPM program website: http://www.ipm.ucdavis.edu/ ▪ U.S. Environmental Protection Agency IPM manual for schools: https://www.epa.gov/managing-pests-schools ▪ Association of Applied IPM Ecologists: http://aaie.net/ ▪ California Weed Science Society: http://www.cwss.org/ ▪ Pesticide Applicators Professional Association: http://www.papaseminars.com/

Notes: This information should be considered preliminary guidelines for managing invasive plant and animal species at Parcel E. These guidelines should be reevaluated on a regular basis (e.g., in conjunction with the annual inspection reports, as appropriate) and in consultation with the FFA signatories and other natural resources trustees.

FFA = Federal Facility Agreement

IPM = integrated pest management

Navy = Department of the Navy

O&M = operations and maintenance

Appendix A1. General Inspection Checklist

INSPECTION RECORD (PRELIMINARY) – PARCEL E
HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CA

Date and time of inspection:	**Inspector name and organization:**
Weather and tidal conditions – include details of most recent rain event:	
Reason for inspection (circle one): **Scheduled Emergency response**	**If inspection is initiated by an emergency response (see note 3), explain condition:**

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
GENERAL SITE CONDITION (APPLIES TO ALL AREAS OF SITE)			
Overall condition of site	Every inspection (at least annual)	Note general conditions. Trash and debris accumulation, unauthorized access, etc.	
Land use	Every inspection (at least annual)	Digging or unauthorized activity/land use per LUC RD.	
SITE SECURITY			
Security of area	Every inspection (at least annual, until transfer)	Assess condition of fence, including holes, corrosion, digging, and concrete condition—repair as necessary.	
		Condition of locks, fencing, and gates—repair and replace as necessary.	
		Note signs of vandalism.	
		Assess condition of access roads and gates.	
		Note evidence of unauthorized access.	

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
SITE SECURITY *(continued)*			
Site signage	Every inspection (at least annual, until transfer)	All signs in place and secure—repair and replace as necessary.	
		Wording legible—replace and repair as necessary or document degradation.	
		Note signs of vandalism.	
SOIL GAS MONITORING PROBES AND GROUNDWATER MONITORING WELLS			
Soil gas monitoring probes and groundwater monitoring wells	During all sampling events and every inspection (at least annual)	Security (locks intact) – repair and replace as necessary.	
		Vandalism/signs of unauthorized access.	
		Well box is free of obstructions.	
		Well casing is free of obstruction.	
		Seals not damaged.	
ASPHALT PAVEMENT COVER			
Surface Inspection	Every inspection (at least annual)	Assess cracking in asphaltic concrete layer.	
		Assess cracking in foundations.	
		Assess the crawlspace access to maintain the prevention of access.	
		Inspect transitions between different cover types (e.g., building foundations/utility features).	
		Evidence of settlement and subsidence.	
		Note evidence of burrowing animals[4].	
		Assess condition of survey benchmarks.	
		Assess accumulation of soils over cover.	

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
ASPHALT PAVEMENT COVER *(continued)*			
Surface Inspection *(cont.)*	Every inspection (at least annual) *(cont.)*	Inspect areas of previous repair.	
		Remove any vegetative species penetrating through cover and repair asphalt.	
		Note signs of excessive traffic.	
		Note signs of unauthorized access to the site or the buildings.	
Stormwater drainage	Every inspection (at least annual)	Observe areas of accumulated water for cracking and settlement.	
		Remove trash and debris from catch basins.	
		Note integrity and function of outfalls.	
		Monitor areas of accumulation in the vicinity of site buildings.	
		Note evidence of overflow in drainage channels.	
		Remove trash or debris from drainage channels.	
		Note any change in condition of drainage contributing areas.	
SOIL COVER			
Vegetation	Every inspection (at least annual)	Assessment of unhealthy/bare areas (not to exceed 2% of total area or >30% of any 100-ft^2 area.	
		Note evidence of burrowing animals[4].	
		Assess adequacy of mowing and watering.	
		Remove deep-rooting plants[4].	
		Note signs of excessive traffic.	
		Note signs of unauthorized access.	

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
SOIL COVER *(continued)*			
Soil cover	Every inspection (at least annual)	Note evidence of cover settlement.	
		Note evidence of slope failure along boundaries and slope transition areas.	
		Note evidence of cracking or soil movement.	
		Note evidence of overflow in drainage channels.	
		Remove trash or debris from drainage channels.	
		Note evidence of geosynthetic material under soil cover being exposed or damaged.	
		Note evidence of ponding over areas with protective liner.	
SHORELINE PROTECTION			
Crest inspection	Every inspection (at least annual)	Note evidence of settlement or movement.	
		Note evidence of wave overtopping.	
		Inspect transition from cover to revetment.	
		Assess any areas of erosion.	
		Inspect for proper placement of filter fabric.	
Armoring inspection	Every inspection (at least annual)	Note evidence of settlement or movement.	
		Note placement and stability of riprap (armored revetment).	
		Note erosion of sand cover (natural shoreline revetment).	
		Note evidence of invasive plants or animals[4].	
		Inspect for proper placement of filter fabric and filter layer.	

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
SHORELINE PROTECTION *(continued)*			
Toe and flank inspection	Every inspection (at least annual)	Note areas of scour and erosion.	
		Inspect for proper placement of filter fabric and filter layer.	
		Note changes in the bay slope.	
SVE SYSTEM			
System shutdown	Each SVE site visit	Document any system shut down.	
System configuration	Each SVE site visit	Record extraction wells in use.	
		Record duration of extraction at each well or optimization.	
Extraction wells	Each SVE site visit	Monitor vacuum pressure at each well.	
		Check for leaks.	
		Monitor VOCs at each well.	
Soil gas monitoring wells	Each SVE site visit	Monitor vacuum pressures.	
Extracted water	Each SVE site visit	Check amount of water extracted.	
		Dispose of extracted water as necessary.	
GAC units	Each SVE site visit	Check influent concentration with FID.	
		Check effluent concentration with FID.	
		Laboratory analysis as necessary.	
Knockout drum	Each SVE site visit	Check for accumulated sediments.	
System components	Each SVE site visit	Maintain according to manufacturer.	

ITEM	INSPECTION FREQUENCY[1]	ACTION/ INSPECTION ITEM	COMMENTS — INCLUDING EXPLANATION IF NOT COMPLETED. INCLUDE ANY PHOTO DESCRIPTIONS[2]
SVE SYSTEM *(continued)*			
General operational	Each SVE site visit	Record operating hours.	
		Record vapor flow rate at treatment system influent.	
		Assessment of configuration—optimization.	

OTHER OBSERVATIONS:	
FOLLOW-UP ACTIONS (Include area requiring further action):	
Signature Date	

Notes:

1. Inspections should be completed on at least an annual basis for all components of the remedy other than the SVE system. Every inspection, as used in the inspection frequency, includes both scheduled annual inspections and inspections triggered by emergency responses. All items on the checklist should be included in all inspections triggered by emergency responses in addition to the scheduled annual inspections.
2. List significant repairs completed and attach documentation describing repairs.
3. Section 4 of the OMP identifies the potential emergencies that will prompt supplemental site inspections. However, the O&M contractor should use professional judgment and site experience to identify whether inspections are necessary following significant earthquakes, regardless of location and magnitude. Inspections should be conducted after hurricane-level storm events, and the storm response trigger should be adjusted over time based on site experience. The O&M contractor may determine the appropriate trigger for inspection and emergency response from the following information resources:

    - Emergency Response Plan – Earthquake Annex (San Francisco, 2008).
    - City and County of San Francisco Outdoor Warning System.
    - Emergency Alert System. The primary local Emergency Alert System broadcast station for the Bay Area is KCBS (740 AM). Emergency Alert System messages may be sent via the Internet-based HazCollect system (maintained by the National Oceanic and Atmospheric Administration).
    - Public service announcements through radio and television, including radio broadcasts using the local public radio station, KALW (owned and operated by San Francisco Unified School District).
    - On-scene loudspeaker announcements.
    - The AlertSF system. Operational from the city's Emergency Operations Center and will provide the ability to send broadcast digital messaging to any number of groups, such as vulnerable populations, large business owners, and community-based organizations.
    - The National Earthquake Information Center and the USGS Earthquake Notification Service. These organization provide notifications of earthquakes free to interested parties. Users of the service can specify the regions of interest, establish notification thresholds of earthquake magnitude, designate whether they wish to receive notification of aftershocks, and even set different magnitude thresholds for daytime or nighttime to trigger a notification (Congressional Research Service, 2010).
    - ShakeMap. A product of USGS Earthquake Hazards Program in conjunction with regional seismic network operators and provides MM intensities (listed as "instrumental intensity" on the ShakeMap). ShakeMaps are now triggered automatically and made available within minutes of the event via the Internet, including Parcel E (USGS, 2010).
4. Corrective measures should be developed and implemented in accordance with the adaptive management process described in Appendix A of the OMP. The adaptive management described in Appendix A incorporates integrated pest management principles (as established by EPA and the California Statewide Integrated Pest Management Program) and will be implemented in consultation with the FFA signatories and other natural resources trustees (e.g., California Department of Fish and Wildlife).

EPA = U.S. Environmental Protection Agency
FFA = Federal Facility Agreement
FID = flame ionization detector
ft^2 = square feet
GAC = granular activated carbon
LUC RD = land use control remedial design
MM = Modified Mercalli
OMP = Operations and Maintenance Plan
SVE = soil vapor extraction system
USGS = U.S. Geological Survey
VOCs = volatile organic compounds

Source:

City and County of San Francisco, 2008. "Earthquake Response Plan Enhancement – Administrative Draft." September. Accessed Online at: <http://SFDEM.org?Modules/ShowDocuments.aspx?document=67>.

Congressional Research Service, 2010. "Earthquakes in the United States – Risk, Detection, Warning, and Research." Peter Sundry, Ed. September 5. Accessed Online at: <http://www.eoearth.org/article/Earthquakes_in_the_United_States_-_Risk,_Detection,_Warning,_and_Research>.

USGS, 2010. "ShakeMaps. Earthquake Hazards Program." September 6. Accessed Online at: <http://earthquake.usgs.gov/earthquakes/shakemap/>

Department of the Navy
Base Realignment and Closure
Program Management Office West
San Diego, California

FINAL
CONSTRUCTION QUALITY ASSURANCE PLAN FOR PARCEL E

Hunters Point Naval Shipyard
San Francisco, California

May 2018

Approved for public release; distribution is unlimited

DCN: CESJ-2215-0006-0007.R1

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May 2018

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Final
Construction Quality Assurance Plan for Parcel E
Hunters Point Naval Shipyard
San Francisco, California

Submitted by
Construction Engineering Services, LLC:

Signature	May 21, 2018 Date
Doug Bielskis, PE Name	Project Manager/Engineer of Record Title

CERTIFICATION

This document was prepared under the direction and supervision of a qualified Professional Engineer.

Doug Bielskis
California Professional Engineer No. 63113

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Abbreviations and Acronyms

ARARs	applicable or relevant and appropriate requirements
ASTM	ASTM International
CQA	construction quality assurance
CQC	construction quality control
DBR	design basis report
HDPE	high-density polyethylene
IR	Installation Restoration
Navy	Department of the Navy
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RA	remedial action
RAWP	remedial action work plan

Section 1. Introduction

Construction Engineering Services, LLC has prepared this Construction Quality Assurance (CQA) Plan for select components of the remedy at Parcel E, Hunters Point Naval Shipyard in San Francisco, California. As described in the Design Basis Report (DBR), the remedy at Parcel E includes containment of waste at Installation Restoration (IR) Sites IR-02 Northwest and IR-03 that poses a potential threat to water quality. Accordingly, the waste containment at IR-02 Northwest and IR-03, which includes construction of slurry walls and placement of soil covers with a protective liner, is subject to applicable or relevant and appropriate requirements (ARARs) that pertain to the closure of waste management units (see DBR Table 1 for a list of pertinent ARARs). This plan, which was prepared on behalf of the Department of the Navy (Navy), describes the necessary quality assurance (QA) procedures that are to be undertaken during the closure activities (listed in Section 1.1) planned as part of selected remedy. In addition, construction quality control (CQC) procedures will be implemented for all remedial action construction activities (listed in DBR Section 3), in accordance with a CQC Plan that will be part of a remedial action work plan (RAWP) prepared by the construction contractor.

1.1. PURPOSE

This CQA Plan is to be used by the CQA organization during construction of the slurry walls, shoreline revetment, and soil covers with a protective liner at IR-02 Northwest and IR-03 to ensure that appropriate quality control (QC) and QA procedures are followed during construction. This CQA Plan is a guidance document that contains general and specific work element requirements to be used to monitor construction. General requirements include organization and responsibilities of CQA personnel, documentation control, and reporting procedures. The following specific work elements require CQC and CQA:

- Earthwork
  - Clearing and grubbing
  - Acceptance and backfilling of imported fill
  - Stockpiling and management of soil
  - Excavation and grading (to achieve subgrade elevations)
  - Placement of foundation layer
  - Preparation of geomembrane subgrade
  - Installation of slurry walls
  - Installation of shoreline revetment
  - Placement of vegetative layer
  - Placement of service road materials

- Wells
  - Destruction of groundwater monitoring wells
  - Installation of groundwater monitoring wells
- Geosynthetic Materials
  - Installation of geogrid reinforcement and geotechnical filter fabric (for slope abutting the shoreline at IR-02 Northwest)
  - Installation of geomembrane
  - Installation of geocomposite drainage layer and demarcation layer
- Runoff Control Features
  - Installation of surface water and stormwater controls
  - Installation of temporary erosion and sediment controls

The CQC organization will prepare a final construction completion report following completion of construction. The report will include information generated through the CQC program and will document the extent to which construction was performed in accordance with this plan and the intent of the DBR.

The CQA organization will prepare a CQA summary report documenting the CQA tasks performed at Parcel E during construction. The CQA summary report will be submitted as an appendix to the construction completion report.

1.2. CONSTRUCTION QUALITY ASSURANCE ORGANIZATION

The CQA organization has the primary responsibility of implementing and managing the CQA program described in this plan and will document that CQC was performed in compliance with the CQC plan, and that construction was performed in compliance with the design and contract documents. Section 2.1 presents the specific responsibilities for the CQA organization's site personnel.

1.3. REPORT ORGANIZATION

This CQA Plan is organized as follows:

- Section 1, Introduction: summarizes the purpose of the CQA Plan; the CQA organization; the report organization; and provides terms, including their definitions, used throughout the plan.
- Section 2, General Requirements: provides an overview of the CQC and CQA program, including CQC and CQA personnel and responsibilities, meetings, document control, nonconformance documentation, construction monitoring, materials quality verification, and equipment control.
- Section 3, Construction Quality Assurance: describes the construction testing and test frequencies.

- Section 4, Monitoring and Testing Requirements for Earthwork: summarizes the CQC and CQA requirements for the specific work elements discussed in Section 1.1.
- Section 5, Monitoring and Testing Requirements for Wells: summarizes the CQC and CQA requirements for the specific work elements discussed in Section 1.1.
- Section 6, Monitoring and Testing Requirements for Geosynthetic Materials: describes the CQC and CQA requirements for the different geosynthetic materials (see Section 1.1), as well as the requirements for delivery, conformance testing, installation, repair, and acceptance.
- Section 7, Monitoring and Testing Requirements for Runoff Control Features: describes the CQC and CQA requirements for the components of surface water drainage controls (including concrete) for specific work elements discussed in Section 1.1.
- Section 8, Documentation: provides general requirements for CQC project documentation: including recordkeeping, photographs, design and construction specification changes, the CQA summary report, and the final construction report.
- Section 9, References: lists the documents and other supporting information that were used to prepare this plan.

All parties involved in construction activities should be thoroughly familiar with this plan, the design drawings, and the project specifications.

1.4. TERMS AND DEFINITIONS

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

Construction Manager. The individual responsible for providing overall construction management for the project. The construction manager is the primary contact on the project site.

Construction Drawings. The official plans, profiles, typical cross sections, elevations, and details, as well as their amendments and supplemental drawings, that show the locations, character, dimensions, and details of the work to be performed. Construction drawings are also referred to as "plans."

Construction Quality Assurance (or "CQA"). Those actions that ensure a contractor's CQC measures are working effectively, and that the end product complies with the QC requirements established by the contract. CQA also includes verifying that the contractor is performing QC requirements of the CQC Plan and project specifications. An independent engineering firm that is not affiliated with the construction contractor will complete CQA.

Construction Quality Control (or "CQC"). CQC encompasses all actions that measure and regulate the characteristics of an item or service to determine conformance with contractual and regulatory requirements. The remedial action (RA) contractor, at a minimum, conducts CQC. Performance of selected CQC functions may be delegated to subcontractors, but remain the responsibility of the RA contractor. The RA contractor will be responsible for CQC oversight.

Project Specifications. The qualitative requirements for products, materials, and workmanship upon which the design is based.

Contract Documents. The official set of documents issued by the contracting entity. This set of documents includes bidding requirements, contract forms, contract conditions, contract specifications, addenda, and contract modifications.

Contract Specifications. Administrative requirements for project performance upon which the contract is based.

RA Contractor. The firm, partnership, or corporation, or any combination, private, municipal, or public, who, as an independent contractor, has entered into a contract to complete the project.

CQA Manager. Authorized representative of the CQA organization and professional engineer registered in the state of California. The CQA Manager is responsible for certifying that construction was performed in accordance with the intent of the contract documents and design.

CQA Monitors. Authorized representative of the CQA organization, responsible for observing and documenting activities related to CQA during construction.

CQC Manager. Onsite authorized representative of the CQC organization responsible for preparing and maintaining QC documentation, in addition to the QC plans and inspection system. The CQC Manager is responsible for ensuring that all specified inspections and tests are performed, and that all field and laboratory data are reviewed and approved or disapproved.

Design Engineers. The individuals or firms responsible for design and preparation of the design drawings and project specifications; also referred to as "designers" or "engineers."

Department of the Navy (or "the Navy"). The implementing party for this project.

Nonconformance. A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of nonconformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

Procedure. A document that specifies or describes how an activity is to be performed.

Program Manager. The individual responsible for administering the contract and coordinating with the Project Manager, CQC Manager, and CQA Manager.

Project Documents. This set of documents includes contractor submittals, construction drawings, record drawings, project specifications, shop drawings, RAWP, CQC and CQA plans, an Accident Prevention Plan (including a Site Safety and Health Plan), Environmental Management Plan, Stormwater Pollution Prevention Plan, and project schedule.

Project Manager. Representative of the RA contractor with overall responsibility for work performed under assigned task(s). The Project Manager provides project direction and interpretation of scope of work, as well as verification and approval of quantities and work completion.

Record Drawings. Drawings recording the constructed dimensions, details, and coordinates of the project; also referred to as "as-builts."

Subcontractor. The person or persons, firm, partnership, corporation, or any combination, or any combination private, municipal, or public, who as an independent contractor has entered into a contract with the RA contractor.

Surveyor. A licensed surveyor in the state of California responsible for checking locations and elevations of the completed work. The surveyor is also responsible for producing stamped as-built drawings for inclusion in the final construction report.

Testing. Verification that an item meets specified requirements by subjecting that item to a set of physical, chemical, environmental, or operating conditions.

Testing Laboratory. A laboratory capable of conducting the tests required by this CQA Plan and within the project specifications.

Section 2. General Requirements

2.1. CONSTRUCTION QUALITY ASSURANCE PERSONNEL AND RESPONSIBILITIES

This section discusses the roles and primary responsibilities of key project CQA and CQC personnel, including the CQA Manager, CQA Monitors, Design Engineers, and the CQC Manager, as well as the required appointment letters.

2.1.1. Responsibilities of the CQA Manager

The CQA Manager administers the CQA program. The CQA Manager has authority to identify deficiencies and implement corrective action measures to the CQA program. The CQA Manager has the key responsibilities listed below.

- Reviewing Engineer Manual 1110-1-4011 (U.S. Army Corps of Engineers, 1999) and the CQA Plan.
- Reviewing the design plans, project specifications, and any proposed changes to plans and specifications.
- Attending project meetings, including the Post-Award Kickoff Meeting, Partnering Meeting, Preconstruction Meeting, Design Development Meeting, and Coordination and Mutual Understanding Meeting.
- Reviewing and recommending approval or disapproval of CQC data, submittals, and reports requiring Navy review for compliance with the project CQC and CQA Plan.
- Acting as an auditor to verify and document proper and complete implementation of the CQC and CQA programs.
- Reviewing RA contractor personnel qualifications to verify conformance with the contract and project specifications.
- Attending weekly CQA/CQC meetings with the CQC Manager, RA contractor superintendent, and the Navy representative.
- Educating CQA Monitors about onsite-specific CQA requirements and procedures.
- Assigning CQA Monitors to observe all activities requiring monitoring.
- Reviewing warranty submittals to verify they comply with the specified warranty requirements.
- Reviewing as-built surveys and drawings.
- Reviewing and recommending approval or denial of the final construction completion report. The CQA Manager reports directly to the Navy.

2.1.2. Responsibilities of the CQA Monitors

The CQA Monitors implement the CQA program under the direction of the CQA Manager. The CQA Monitors perform all construction monitoring and construction materials testing requested by the CQA Manager. The CQA Monitors report directly to the CQA Manager. The CQA Monitors have the key responsibilities listed below.

- Preparing and maintaining required reports, files, and logs, including Daily CQA Reports, a testing plan and log, a rework log, and a submittal log.
- Verifying that the RA contractor is following this CQA Plan and the approved CQC Plan.
- Verifying construction is performed in accordance with the plans and the project specifications.
- Overseeing any activities that could result in damage to installed remedy components.
- Stopping any segment of work that does not comply with the approved plans and project specifications.
- Directing removal and replacement of any defective work.
- Confirming calibrations of CQA and CQC testing equipment are correctly performed and recorded.
- Confirming that CQA and CQC tests are properly performed and recorded and the results meet specified requirements.
- Overseeing the collection, marking, packaging, and shipping of CQA conformance samples.

2.1.3. Responsibilities of the Design Engineers

The Design Engineers represent their organizations and are responsible for site engineering services related to their design. Those services include reviewing RA contractor submittals, resolving technical issues related to construction, providing interpretation of the construction drawings and project specifications, and approving substantial design modifications and technical revisions, if necessary.

2.1.4. Responsibilities of the CQC Manager

The CQC Manager implements the CQC program under the direction of the Program Manager. The CQC Manager has the key responsibilities listed below.

- Reviewing and approving the CQC Plan and any proposed amendments to the plan and reviewing QC sections of contract specifications.
- Attending project meetings, including the Post-Award Kickoff Meeting, Partnering Meeting, Preconstruction Meeting, Design Development Meeting, and Coordination and Mutual Understanding Meeting.
- Conducting weekly QA/QC meetings with the CQA Manager, RA contractor superintendent, and the Navy representative.

- Performing submittal review and approval.
- Overseeing the quality of all construction, construction monitoring, and construction materials testing.
- Performing the three phases of control.
- Identifying deficiencies and implementing corrective action measures in accordance with the requirements of the CQC Plan.
- Maintaining all documentation and test data summaries related to construction, construction monitoring, and construction materials testing.
- Providing QC certifications and documentation required in the contract.
- Managing and coordinating the three phases of control and documentation performed by the testing laboratory personnel and any other inspection and testing personnel required by the contract.

The CQC Manager has the authority to stop work at any sign of noncompliance. If potential concerns are identified during execution of the fieldwork, the CQC Manager will consult with the CQA Manager who may authorize work to continue upon review. The CQC Manager will communicate QC inspection and testing results directly with the Construction Manager and coordinate with the Construction Manager to implement corrective actions, if needed.

2.1.5. Appointment Letters

The CQA Manager will be granted authority to stop work and to implement and manage the three phases of control. If any QA Specialists are necessary, once they have been selected, the CQA Manager will issue a Letter of Appointment outlining their duties, authorities, and responsibilities.

2.2. MEETINGS

Prior to and during the design phase of this project, the Navy, Construction Manager, Project Manager, CQA Manager, and CQC Manager will attend the following meetings to facilitate coordination between the different entities:

- Post-Award Kickoff Meeting
- Partnering Meeting
- Coordination and Mutual Understanding Meeting
- Design Development Meeting

Close coordination between the Navy, Construction Manager, Project Manager, CQA Manager, and CQC Manager is essential to facilitate construction and to clearly define construction goals and activities. To meet this objective, preconstruction, progress, weekly, and other meetings will be held, as discussed in Sections 2.2.1 through 2.2.4. The Navy or designee, unless otherwise specified, will document resolutions and action items from the meetings and forward the documentation to all meeting attendees.

2.2.1. Preconstruction Meeting

Following bid award, the Navy, Construction Manager, Project Manager, CQA Manager, CQC Manager, and others as designated by the CQA organization will attend a preconstruction meeting. Regulatory agency representatives (e.g., U.S. Environmental Protection Agency and California Department of Toxic Substances Control) may request to attend the preconstruction meeting. The purpose of the meeting will be to:

- review construction drawings, project specifications, CQA and CQC plans, work area security, safety and health procedures, and related issues;
- provide all attendees with relevant project documents;
- review responsibilities of each attendee;
- define lines of communication and authority;
- establish reporting and documenting procedures;
- review procedures for handling submittals;
- review testing equipment and procedures;
- review procedures for field directives and changes to scope, schedule, and budget;
- establish testing protocols and procedures for correcting and documenting construction or nonconformance;
- establish weekly or other regular meetings schedule;
- discuss work areas, laydown areas, and related items (this task typically includes conducting a site visit as part of the meeting); and
- review the project schedule and critical path items.

The CQC organization will prepare handouts for all attendees and document the meeting. The CQA organization will review copies of the minutes.

2.2.2. Progress Meetings

Informal progress meetings will be held each morning before the start of the day's work. At a minimum, the CQC Manager and Construction Manager will attend the meeting. The purpose of the meeting is to:

- discuss problems and resolutions;
- review test data;
- discuss the RA contractor's personnel and equipment assignments for the day;
- review the previous day's activities and accomplishments;
- resolve any outstanding problems or disputes; and
- any action items will be documented on the daily report by the CQC Manager.

2.2.3. Weekly Meetings

Weekly meetings will be held either at the site or by conference call. The CQC Manager, CQA Manager, and Construction Manager will attend the weekly meetings, with additional support from the Navy and other project team personnel, as needed. The meetings will be held to:

- review the minutes of the previous meeting; review the schedule and status of work, including work or testing accomplished since the last meeting; rework items identified since the last meeting; and rework items completed since the last meeting;
- review the status of submittals, including submittals reviewed and approved since the last meeting and submittals required in the future;
- review work to be accomplished in the next 2 weeks and documentation required (e.g., establish completion dates for rework items, discuss construction methods and approach to be used to provide construction quality and identify potential problems, discuss status of offsite work or testing, identify documentation required, and resolve QC and production problems); and
- address items that may require revising the QC plan (e.g., changes in CQC organization personnel and in procedures).

2.2.4. Other Meetings

As required, other meetings will be held to discuss problems or nonconformance. These meetings will be attended by parties as directed by the CQA organization. If the problem requires a design modification and subsequent change order, the design engineering firm should also be present. As described in Section 8.3, regulatory agency representatives will be consulted for all design modifications, and they may request to attend meetings that discuss design modifications. The meeting will be documented.

2.3. CONTROL OF DOCUMENTS, RECORDS, AND FORMS

2.3.1. Control of Construction Documents

The Project Manager will control contract documents, including project specifications, construction drawings, and change orders. The Project Manager will maintain one or more copies of the most current set of construction documents for use by the CQA and CQC organizations. Upon issuance of new copies or revisions, the Project Manager will notify the CQA and CQC organizations of the revisions, provide revised contract documents, and order the recall of all unrevised copies of the contract documents. The Project Manager will also provide the latest revised set of contract documents to the CQA and CQC organizations.

2.3.2. Control of As-Built Information

The CQC Manager will control as-built information generated by the RA contractor. During the progress of work, the CQC Manager obtains and initials all as-built information provided by the RA contractor, surveyors, or others and compiles all as-built data. The CQA Manager will review record drawings

resulting from the topographic surveys performed by the registered land surveyor. At the completion of the project, this information will be used to prepare final drawings for the final construction report. The set of as-built markups of design drawings must be maintained on site and be clearly marked as such.

2.3.3. Control of Forms

The CQC Manager will control daily report forms, test report forms, and other project forms and maintain a master of each form for reproduction. Upon issuance of a new form, the CQC Manager will recall and remove all superseded copies along with the master and provide new copies for use. The CQA Manager will approve substantive updates to project forms.

2.3.4. Processing Daily Reports

The CQC Manager will write a daily record of work progress, submit the daily reports to the Navy, and maintain daily reports at the site. The CQA Manager will review daily reports for legibility, clarity, traceability, and completeness. The CQA Manager must sign off on the review before the CQC Manager submits the daily reports to the Navy.

2.3.5. Processing Test Reports

The CQC organization will complete a test report whenever testing is performed. Prior to submittal to the Navy, the CQA Manager will review the test reports for mathematical accuracy; conformance to test requirements and to project specifications; and clarity, legibility, traceability, and completeness. The CQA Manager will document the review by signature, and the CQC organization will submit test reports to the Navy. Test reports must be maintained on site in an organized manner.

2.3.6. Processing Project Records

Project records will be completed as needed. Use of the project records is limited to the scope for which they are intended. The record must be completed by filling in all of the blanks provided on the form, followed by the signature of the individual completing the form. All project records must be maintained at the site.

2.3.7. Photographic Records

The CQA Monitors will take photographs of construction progress, nonconformance, corrective actions, etc., to provide a supplemental and visual record. The photographs will be identified by number, location, time, date, photographer, as well as a brief description or caption. The CQC Manager will append hard copies of the captioned photographs to the daily reports and provide them to the CQA Manager on a weekly basis. The CQC organization will provide digital files for the photographs (on compact disc) to the CQA Manager upon completion of the project.

2.4. DOCUMENTATION AND CONTROL OF NONCONFORMANCE

2.4.1. Observation of Nonconformance

Whenever a nonconformance is discovered or observed in the construction process, product, job-related materials, documentation, or elsewhere, the CQC Manager will notify the Construction Manager and the CQA Manager.

2.4.2. Determining Extent of Nonconformance

Whenever a nonconformance is discovered or observed in the construction process, product, job-related materials, documentation, or elsewhere, the CQC Manager and their organization will determine the extent of the nonconformance. The extent of the deficiency may be determined by additional sampling, testing, observations, review of records, or any other means deemed appropriate. The CQA Manager will review all nonconformance assessments made by the CQC organization.

2.4.3. Documenting Nonconformance

The CQC organization must document all nonconformance in writing on the daily records, logs, and elsewhere, as appropriate. The documentation must occur immediately upon determining the extent of the nonconformance. For those nonconformances that are considered serious or complex in nature or that require an engineering evaluation, the CQC organization will prepare and issue a nonconformance report to the CQA Manager, the Construction Manager, and the Project Manager.

2.4.4. Corrective Measures

For a simple or routine nonconformance, corrective measures will be determined by specification direction; or, if none exists, the CQC Manager, Construction Manager, and Project Manager will discuss standard construction methods to correct the deficiency. For nonconformance reports that require an engineering evaluation, the Design Engineers must determine corrective measures. The CQC Manager will forward a copy of the nonconformance report, with the Design Engineer's corrective measure determination, to the CQA Manager for informational purposes and to the Construction Manager for implementation of the corrective action.

2.4.5. Verification of Corrective Measures

Upon notification by the Construction Manager that a corrective measure is complete, the CQC Manager will verify its completion and report the results of the corrective actions to the CQA Manager. The verification must be accomplished by observations or retesting and documented photographically. The CQC Manager will provide written documentation of the corrective measures on daily reports, logs, and forms, and, if applicable, a nonconformance report. The Project Manager will review and verify the corrective measure. The Design Engineer will review and verify completion of corrective action measures that require an engineering evaluation.

2.5. CONSTRUCTION MONITORING

Before construction begins, the CQA Manager will establish a list of monitoring priorities for the CQC organization. The list will include the various construction activities and the monitoring priority of those activities. The monitoring priorities may change during construction based on RA contractor performance and Navy request. The CQA Manager must approve any changes in the monitoring priorities.

2.6. MATERIALS QUALITY VERIFICATION

The CQC organization may identify material sources, and samples from those materials may be tested to evaluate whether the material meets the project specifications for specific work elements. Definitions and requirements of materials are provided in the project specifications appended in the DBR. Material samples will be obtained and tested in accordance with most current version of the ASTM International (ASTM) standards identified in this CQA Plan and the project specifications. The CQC organization will maintain and store archive samples and results of the test samples at the project site. The CQC organization will establish and maintain a materials quality verification list. The list will include material sources, sample locations, testing requirements, test results, and verification action items. The CQA Manager will review the list as it is updated. The CQA Manager may, through onsite CQA Monitors, obtain and test samples or certificates of compliance and conformance to verify the results of the CQC organization's analyses.

2.6.1. Materials Submittals

When sample submittals are required, the RA contractor will make them available to both the CQC and CQA organizations. The CQA Manager is responsible for review and acceptance material submittals from the CQC organization, if those submittals are designated as requiring government approval in the project specifications. The CQA organization may use material submittals (submitted by the CQC organization) to establish the acceptability of materials. The CQC organization will submit submittals not requiring government approval to the CQA Manager for informational purposes.

2.6.2. Certificates of Compliance and Conformance

The CQA Manager may use certificates of compliance and conformance (submitted by the CQC organization or obtained by the CQA Monitor) to establish the acceptability of materials. The certificates generally state that the material is in compliance or conformance with a particular code, standard, or specification. The certificate may be used for acceptance of a product before or instead of testing, if allowed by the project specifications.

2.7. EQUIPMENT CONTROL

Before the start of construction, the CQC Manager will complete a list of all measuring, sampling, and testing equipment to be used at the site. As new equipment becomes available during the course of the project, it must be added to the list. When more than one type of equipment is available, a unique number will be affixed to each piece to maintain its identity. The equipment list is maintained in the project files and contains the following information:

- Type of equipment
- Serial number or identifying number
- Date item received at site
- Use of the equipment
- Date removed from service

Before using a piece of testing equipment, the CQC organization must calibrate and establish its accuracy. Types of equipment requiring calibration include nuclear gauges, sand cone devices, sand to be used in sand cones, and scales. The calibration procedures and frequencies must be in accordance with manufacturer's instructions or ASTM standards. Whenever the equipment is suspect or is producing questionable results, the CQC Manager must remove the equipment from service immediately and recalibrate.

The CQA Manager will review equipment maintenance and calibration records periodically to verify that the CQC organization is conforming to the operations and maintenance protocols for the testing equipment.

Section 3. Construction Quality Assurance

This section describes the CQA monitoring required to verify proper implementation of the CQC program at IR-02 Northwest and IR-03, which will include construction testing for earthwork and installation of geosynthetic materials. The scope of items with related CQC and CQA requirements includes the specific work elements listed in Section 1.1.

3.1. CONSTRUCTION TESTING

The project specifications in the DBR identify all required CQC testing methods and procedures.

3.2. TEST FREQUENCIES

Tables 1, 2, and 3 establish the test frequencies for CQC of earthwork and geosynthetic materials. The test frequencies listed establish a minimum number of required tests. Extra testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Extra testing may also be performed to provide additional data for engineering evaluation. Any retests performed as a result of a failing test do not contribute to the total number of tests performed in satisfying the minimum test frequency. The CQA organization's role partly consists of monitoring the frequency and quality of testing conducted by the CQC organization, as described in this CQA Plan.

3.2.1. Soil Sample Numbering

The CQC organization maintains soil sample numbers in a master log maintained at the site. Sample numbers begin with (001) and proceed upward. No sample number can be repeated, and retests of a failing sample are given the original number with a letter suffix (e.g., retests for a failing sample 021 would be 021A, 021B, etc.). The master log of test samples includes the following information:

- Sample number
- Test(s) to be performed
- Date and time sampled
- Monitor obtaining sample
- Location sampled
- Location to testing (site vs. offsite)
- Date sample sent offsite

- Date test results received
- Site testing monitor
- Date testing completed at site
- Test results and remarks

The CQA Manager will periodically review the master log of test samples to verify that sample collection and testing are being performed in accordance with the project specifications.

3.2.2. Soil Sample Tagging

The CQC organization is responsible for maintaining sample identification for all soil samples while on site, from time of sampling through completion of testing. The CQC organization must place a sample tag on the soil sample container immediately upon sampling. The tag must remain with the soil sample throughout processing. The tag contains the following information:

- Sample number
- Material type
- Project name and project number
- Sampling monitor
- Date sampled
- Test(s) to be performed

The CQA Monitors will periodically inspect sample tags to verify that they conform to the format specified above.

3.2.3. Soil Sample Processing

The CQC organization is responsible for the timely processing of soil test samples. The CQC Manager determines which samples are tested on site and which are tested off site. The CQC Manager bases this determination on labor available, equipment available, complexity of test, and time available for results. For expediency, samples to be tested off site should be shipped the same day as they are collected.

The CQA Manager will periodically assess the timeliness and expediency of the CQC organization's soil sample processing. The CQA Manager will make recommendations to the CQC Manager regarding soil sample processing deficiencies, if any are discovered.

3.2.4. Field Density Tests

The CQC organization is responsible for maintaining test numbers and results for field density tests performed by the nuclear moisture density method (ASTM D6938 [ASTM, 2015f]). All other testing is

identified through the sample number (Section 3.2.1). The CQA Monitors maintain field logbooks that identify soil segments, data tested, person performing the test, and sequential test number. The CQA Monitors will periodically inspect field logbooks to verify that field test documentation conforms to the requirements described in this CQA Plan. The CQA Monitors will also observe density testing procedures and, if deemed necessary, may commission independent simultaneous testing to verify the quality of the CQC organization's testing program.

Each soil segment will have a series of numbers as listed below.

Soil Segment	Test Number Series
Solid Waste	1000–1999
Foundation/Subgrade Layer	2000–2999
Drainage Layer	3000–3999
Cover Layer/Vegetative Layer	4000–4999
General Fill	5000–5999

No test number can be repeated for a given soil segment, and retests of failing tests must be given a letter suffix along with the original test number (e.g., retests for a failing Test 1201 would be 1201A, 1201B, etc.). Test data and results must be filled out on the field density test form.

3.2.5. Field Density Test Locations

The intention of the CQC program is to provide confidence that the earthwork materials and work conform to the project specifications. To meet this intent, the CQC organization will perform density tests of soil products used during construction. Density tests must be performed at various elevations and be uniformly dispersed throughout the entire plan dimensions of the fill. Density test locations must be chosen without bias; however, additional testing can be performed in any areas that are suspect, marginal, or appear to be of poor quality. During the progress of the work, the CQC Manager will plot density test locations on a drawing to verify that no significant areas are untested.

The CQA organization will provide confidence that the CQC organization is adequately evaluating and testing the earthwork materials and work to confirm that the project specifications are being met. To achieve this, the CQA organization will monitor the distribution of field density test locations to confirm that the coverage of testing meets the requirements identified in the project specifications.

Section 4. Monitoring and Testing Requirements for Earthwork

This section summarizes CQC monitoring and testing requirements for earthwork at IR-02 Northwest and IR-03. The CQA organization will verify that the following monitoring and testing requirements are being fulfilled by the CQC organization.

4.1. CLEARING AND GRUBBING

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for clearing and grubbing. Determine and note corrective action items, if applicable.
- Verify that erosion and sediment control silt fences, straw bale barriers, and other measures are securely in place prior to initiating clearing and grubbing operations in any area.
- Verify that existing plant life designated to remain is protected against damage during construction.
- Consult with a biologist to ensure that noxious weeds are not spread through the clearing and grubbing process.
- Consult with a biologist to assess the potential presence of wildlife species that may require protection to comply with pertinent ARARs.
- Verify that clearing in areas required for site access and execution of the work is complete.
- Verify that all vegetation, roots, and highly organic soil within marked areas are removed to a minimum depth of 6 inches below the existing ground surface.
- Verify that all stumps, tree and shrubbery roots, buried logs, and any other harmful material are removed to a minimum of 3 feet below the existing ground surface.
- Verify that all stumps and plant life are placed in the site recycling yard.
- Verify that stockpile subgrades are surveyed prior to stockpiling.

4.2. ACCEPTANCE OF IMPORTED FILL

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for imported fill material testing and acceptance. Determine and note corrective action items, if applicable.
- Imported fill must meet soil classification criteria outlined in the project specifications (Section 31 00 00, Earthwork; see Appendix D of the DBR).

- Perform visual and manual soil classifications (ASTM D2487 [ASTM, 2011a]) to verify that the material source is suitable for use. Verify that the material is free of organic and oversized materials. Perform classifications continually during import and placement operations.
- Perform moisture and density relationship testing (ASTM D1557 [ASTM, 2012a]) to determine the maximum dry density and optimum moisture content of imported fill material. Perform tests at the testing frequencies specified in Table 1.
- Verify backfill testing will include collection of samples for analysis of the site-specific chemicals of concern and radionuclides of concern, and other contaminants based on the nature of the fill source.
- Verify chemical testing of imported fill is performed in accordance with the "Information Advisory, for Clean Imported Fill Material" (Department of Toxic Substances Control, 2001).
- Verify that backfill materials are placed and compacted in accordance with the project specifications (Section 31 00 00, Earthwork; see Appendix D of the DBR).

4.3. STOCKPILING AND MANAGEMENT OF SOIL

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for stockpiling and management of soil. Determine and note corrective action items, if applicable.
- Verify stockpile locations; stockpile dimensions; haul routes; material segregation procedures; and erosion, sediment, and drainage control measures. Determine and note corrective action items, if applicable.
- Verify that stockpile locations have been cleared, grubbed, and stripped in accordance with Section 4.1 of this CQA Plan and the project specifications.
- Identify and verify material classifications for excavated soil to be consolidated on site, in accordance with ASTM D2487 (ASTM, 2011a), as necessary, to support field density testing during placement of consolidated material.
- Verify that stockpiles are covered, watered, or stabilized in accordance with the RA contractor's approved RAWP, so that dust generation is minimized. Determine and note corrective action items, if applicable.
- Verify that stockpiles are constructed with slopes no steeper than 2:1 (horizontal to vertical), and that the top surface maintains a minimum 5 percent grade. Verify slopes and grades using hand-held levels and inclinometers, range poles, and measuring tapes.

4.4. EXCAVATION AND GRADING

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for excavations. Determine and note corrective action items, if applicable.
- Verify that dewatering systems, if any, are installed and operated in accordance with the RA contractor's approved RAWP, and that the static groundwater level is sufficiently drawn down to allow excavations to proceed.
- Verify that construction staking is performed before work, and that survey benchmarks with elevations are secured outside the work area.
- Verify that the RA contractor has notified the Underground Service Alert to identify and locate underground utilities.
- Verify that excavated materials are segregated into proper stockpiles and placement areas.
- Verify that dust control methods are being implemented in accordance with the RA contractor's approved RAWP. Determine and note corrective action items, if applicable.
- Coordinate with RA contractor to perform radiological screening of excavation subgrade.
- Coordinate with the RA contractor to perform excavation verification surveys upon completion of excavating operations. Verify completion of corrective action measures, as determined by verification surveys.
- If sandblast waste is encountered during excavation activities, the waste will be handled in accordance with the Navy-approved work instruction specifically written to govern material with possible radioactivity.

4.5. PLACEMENT OF FOUNDATION LAYER

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for placement of the foundation layer (which, as described DBR Section 3.12.5.2, will use both onsite soil and imported fill material). Determine and note corrective action items, if applicable.
- Verify that construction staking is performed before work, and that survey benchmarks with elevations are secured outside the work area.
- Imported fill must meet soil classification criteria outlined in the project specifications (Section 31 00 00, Earthwork; see Appendix D of the DBR).
- Perform visual and manual soil classifications (ASTM D2487 [ASTM, 2011a]) to verify that the material source is suitable for the foundation layer. Verify that the material is free of organic and oversized materials. Perform classifications continually during excavation of borrow materials.
- Perform moisture and density relationship testing (ASTM D1557 [ASTM, 2012a]) to determine the maximum dry density and optimum moisture content of earth fill materials. Perform tests at the testing frequencies specified in Table 1.
- Verify that foundation materials are placed and compacted in 8-inch maximum loose lifts. If a sheepsfoot compactor is not used, verify that the top of each compacted lift is scarified before placing the subsequent lift.

- Perform nuclear gauge density and moisture tests (ASTM D6938 [ASTM, 2015f]) to verify that each lift is compacted as required by the project specifications. Perform tests at the testing frequencies specified in Table 1.
- Verify that soil materials that are too wet for proper compaction per the specifications are properly aerated and processed to bring the moisture content of the material into the acceptable range of the optimum moisture content.
- Verify that soil that is too dry for proper compaction per the specifications is properly moisture conditioned and processed to bring the moisture content into the acceptable range of the optimum moisture content.
- Verify that desiccated lifts are properly repaired or removed before placing subsequent lifts.
- Verify that the surface of the final foundation layer is free of sharp objects or rocks larger than 0.5 inch protruding at the surface that may damage the geomembrane.
- During placement of the foundation layer, field-verify lines, grades, and dimensions using hand-held levels, range poles, and measuring tapes.
- Coordinate with the RA contractor to perform verification surveys at the completion of foundation layer operations. Verify completion of corrective action measures, as determined by verification surveys. Verification surveys will also be used to determine the limits of foundation layer for measurement and payment applications.

4.6. PREPARATION OF GEOMEMBRANE SUBGRADE

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for the preparation of the geomembrane subgrade. Determine and note corrective action items, if applicable.
- Verify that material source is suitable for the subgrade, is free of organic and oversized materials, and meets the grading requirements of the project specifications.
- Verify that grade control construction staking is performed prior to work.
- Perform moisture and density relationship testing (ASTM D1557 [ASTM, 2012a]) to determine the maximum dry density and optimum moisture content of subgrade materials.
- Verify that the top of the subgrade is compacted as required by the project specifications with nuclear gauge density and moisture tests (ASTM D6938 [ASTM, 2015f]). Perform tests at the testing frequencies specified in Table 1.
- Verify that angular or sharp rocks and other debris that could damage the geomembrane are removed from the surface of the subgrade. Verify that the subgrade is free of irregularities and is rolled smooth using a steel drum prior to placement of geosynthetic material.
- Verify that the final surface provides continuous and intimate contact with the overlying geosynthetic material.
- Coordinate with the RA contractor to perform subgrade verification surveys upon completion of the subgrade preparation. Verify completion of corrective action measures, as determined by the verification surveys. Verification surveys will also be used to determine the limits of the subgrade preparation for measurement and payment applications.

4.7. INSTALLATION OF SLURRY WALL

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for excavation and installation of backfill materials for a slurry wall. Determine and note corrective action items, if applicable.
- Perform sieve analysis (ASTM D422 [ASTM, 2007a]) to verify that slurry wall materials for the subsurface drain comply with material requirements of the project specifications. Perform tests at the testing frequencies specified in Table 1.
- Verify that grade control construction staking is performed prior to work.
- Verify and record material depth during placement of the slurry wall against grade control stakes. Verify that the slurry wall is installed to the bottom and top elevations identified in the design drawings (e.g., slurry wall is keyed at least 2 feet into the Bay Mud and extends to the top of the foundation layer).
- Coordinate with the RA contractor to perform verification surveys of the base and finished elevations and final alignment of the slurry wall upon completion of placement operations. Verify completion of corrective action measures, as determined by the verification surveys. Verification surveys will also be used to determine the limits of the slurry backfill for measurement and payment applications. Submit copy of verification to the Construction Manager.

4.8. INSTALLATION OF SHORELINE REVETMENT

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for placement of the shoreline protection materials. Determine and note corrective action items, if applicable.
- Verify that crushed rock and graded riprap materials for the revetment comply with material size distribution and gradation requirements of the project specifications.
- Verify that grade control construction staking is performed prior to work.
- Monitor placement of the crushed rock layer and graded riprap to verify that underlying geosynthetic materials are not damaged during placement operations. Mark damaged geosynthetic materials, and verify that damage is repaired.
- Verify and record material depth during placement of the crushed rock and graded riprap against grade control stakes.
- Coordinate with the RA contractor to perform verification surveys of the crushed rock and graded riprap layers upon completion of placement operations. Verify completion of corrective action measures, as determined by the verification surveys. Verification surveys will also be used to determine the limits of the crushed rock and riprap for measurement and payment applications. Submit copy of verification to the Construction Manager.

4.9. PLACEMENT OF VEGETATIVE LAYER

The CQC organization will perform the tasks listed below.

- Verify that construction staking is performed before work, and that survey benchmarks with elevations are secured outside the work area.
- Imported fill must meet soil classification criteria outlined in the project specifications (Section 31 00 00, Earthwork; see Appendix D of the DBR).
- Perform visual and manual soil classifications (ASTM D2487 [ASTM, 2011a]) to verify that the material source is suitable for the vegetative layer. Verify that the material is free of debris, trash, large organic materials (e.g., branches, large roots, etc.), and oversized inorganic materials. Perform classifications continually during excavation of borrow materials.
- Perform moisture and density relationship testing (ASTM D1557 [ASTM, 2012a]) to determine the maximum dry density and optimum moisture content of earthfill materials. The vegetative layer should be compacted as required by the project specifications. Perform tests at the testing frequencies specified in Table 1.
- Verify that vegetative layer is placed and compacted in 8-inch-thick loose lifts. If a sheepsfoot compactor is not used, verify that the top of each compacted lift is scarified before placing the subsequent lift.
- Perform nuclear gauge density and moisture tests (ASTM D6938 [ASTM, 2015f]) to verify that each lift is compacted as required by the project specifications. Perform tests at the testing frequencies specified in Table 1.
- Verify that soil materials that are too wet for proper compaction per the specifications are properly aerated and processed to bring the moisture content of the material into the acceptable range of the optimum moisture content.
- Verify that soil that is too dry for proper compaction per the specifications is properly moisture conditioned and processed to bring the moisture content into the acceptable range of the optimum moisture content.
- Verify that desiccated soil is properly repaired or removed before placing subsequent lifts.
- Verify that final vegetative layer surfaces are free of ruts, gouges, and other features that might contribute to erosion and sediment runoff.
- During placement of the vegetative layer, field-verify lines, grades, and dimensions using hand-held levels, range poles, and measuring tapes.
- Coordinate with the RA contractor to perform verification surveys at the completion of vegetative layer operations. Verify completion of corrective action measures as determined by verification surveys. Verification surveys will also be used to determine the limits of earth fills for measurement and payment applications.

4.10. PLACEMENT OF SERVICE ROAD MATERIALS

The CQC organization will perform the tasks listed below.

- Verify that construction staking is performed before work, and that survey benchmarks with elevations are secured outside the work area.
- Imported fill must meet soil classification criteria outlined in the project specifications (Section 31 00 00, Earthwork; see Appendix D of the DBR).
- Perform moisture and density relationship testing (ASTM D1557 [ASTM, 2012a]) to determine the maximum dry density and optimum moisture content for road materials.
- If a sheepsfoot compactor is not used, verify that the top of each compacted lift is scarified before placing the subsequent lift.
- Perform nuclear gauge density and moisture tests (ASTM D6938 [ASTM, 2015f]) to verify that each lift is compacted as required by the project specifications. Perform tests at the testing frequencies specified in Table 1.
- Verify that soil materials that are too wet for proper compaction per the specifications are properly aerated and processed to bring the moisture content of the material into the acceptable range of the optimum moisture content.
- Verify that soil that is too dry for proper compaction per the specifications is properly moisture conditioned and processed to bring the moisture content into the acceptable range of the optimum moisture content.
- Verify that desiccated lifts are properly repaired or removed before placing subsequent lifts.
- Verify that final road surfaces are free of ruts, gouges, and other features that might contribute to erosion or undermine the roadway.
- Coordinate with the RA contractor to perform verification surveys at the final road. Verify completion of corrective action measures, as determined by verification surveys.

Section 5. Monitoring and Testing Requirements for Wells

The following sections list CQC monitoring and testing requirements for the groundwater monitoring wells at IR-02 Northwest and IR-03. The CQA organization will verify that the following monitoring and testing requirements are being fulfilled by the CQC organization.

5.1. DESTRUCTION OF GROUNDWATER MONITORING WELLS

Existing groundwater monitoring wells will be protected throughout construction if they are to be incorporated into the post-remedial action monitoring program. Groundwater monitoring wells not required for future monitoring, as specified in the Remedial Action Monitoring Plan, will be destroyed in accordance with City and County of San Francisco and State of California regulations. If necessary, groundwater monitoring wells will be destroyed and replaced if protecting the well adversely affects construction. If relocation of a well is required, the well will be installed as close to the original location as feasible and will have the same construction (inside diameter, depth, and screen interval) as the original well. The DBR, specifically Table 11, identifies which existing groundwater monitoring wells at Parcel E will be protected, destroyed, or replaced. Approval by the regulatory agencies will be requested prior to destroying and replacing monitoring wells.

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods for well abandonment. Ensure compliance with City and County of San Francisco and State of California regulations, including all relevant sections of (1) California Water Code Division 7, Chapter 10; (2) California Health and Safety Code Division 104, Part 9.5; (3) California Water Well Standards Bulletins 74-81 and 74-90; and (4) the standards specified by the San Francisco County Department of Environmental Management. Determine and note corrective action items if applicable.
- Verify abandonment is by over-drilling, removing all casing and filter pack, and grouting with an appropriate sealing material.
- Verify that wells are sounded immediately prior to destruction to ensure they are free of obstructions.
- Verify removal of all material (e.g., annular seal, casing, screen, filter pack, etc.) within the original borehole.
- Verify complete backfilling of borehole with impervious sealing material. Acceptable sealing materials include neat cement, sand-cement grout, or concrete.
- Verify placement of sealing material by tremie pipe or equivalent method in one continuous operation.

5.2. INSTALLATION OF GROUNDWATER MONITORING WELLS

The DBR, specifically Table 11, identifies new groundwater monitoring wells at Parcel E that will be installed.

The CQC organization will perform the tasks listed below.

- Review the RA contractor's approved RAWP of proposed methods to install groundwater monitoring wells. Determine and note corrective action items, if applicable.
- Verify the depth and volume of the borehole, including the over-drilling, if applicable, is calculated and the appropriate materials are procured prior to drilling activities.
- Perform visual and manual soil classifications (ASTM D2487 [ASTM, 2011a] and D2488 [ASTM, 2009a]) of soil samples recovered from the borehole.
- Verify depth of screen intervals for groundwater monitoring wells.
- Complete visual inspections of slotted polyvinyl chloride (PVC) and solid PVC pipe to ensure material quality, dimensions, and conformance with RA contractor's approved RAWP and project specifications.
- Complete visual inspections of sand pack material for all groundwater monitoring wells to ensure conformance with RA contractor's approved RAWP.
- Verify borehole is bored, drilled, or augered as close to vertical as possible and ensure conformance with RA contractor's approved RAWP.

Section 6. Monitoring and Testing Requirements for Geosynthetic Materials

The objectives of the geosynthetic materials CQC program are to (1) ensure that proper construction techniques and procedures are used and (2) ensure that the project is completed in accordance with the design drawings and project specifications. The intents of the CQA program are to (1) verify that the CQC organization is monitoring the installation of geosynthetic materials at IR-02 Northwest and IR-03 in accordance with the project specifications, (2) identify and define problems that may occur during installation, and (3) verify that these problems are corrected before construction is complete.

CQC for the installation of geosynthetic materials will be performed to verify that geosynthetic materials at IR-02 Northwest and IR-03 are installed in accordance with the design. Construction must be conducted in accordance with the design drawings and project specifications. To monitor compliance, the CQC organization will (1) review the RA contractor's QC submittals, (2) perform material conformance testing, (3) monitor construction testing, and (4) monitor installations. Conformance testing refers to activities that take place before installation of geosynthetic materials. Construction testing includes activities that occur during installation of geosynthetic materials. All CQC testing will be conducted in accordance with this CQA Plan, the project CQC Plan, and the design drawings and project specifications. If a discrepancy exists in the testing requirements, the document that requires the most stringent testing will govern.

This section describes CQC procedures for the installation of geosynthetic components at IR-02 Northwest and IR-03. The following types of geosynthetic materials will be used for this project:

- Geogrid reinforcement and geotechnical filter fabric (for slopes abutting the IR-02 Northwest shoreline)
- High-density polyethylene (HDPE) geomembrane (at least 60-mil-thick)
- Geocomposite drainage layer (includes nonwoven geotextile and HDPE geonet) and demarcation layer (includes nonwoven geotextile and magnetic marking tape)

The CQA organization will verify that the following monitoring and testing requirements are being fulfilled by the CQC organization.

6.1. INSTALLATION OF GEOGRID REINFORCEMENT AND GEOTECHNICAL FILTER FABRIC

As described in the DBR, one layer of Tencate Miragrid® 20XT geogrid (or equivalent reinforcement with a combined long-term design strength of 7,500 pounds per foot) will be installed to ensure the stability of

the shoreline slopes at IR-02 Northwest. The geogrid layer will be placed on the shoreline slope directly below the revetment material and will extend horizontally to an appropriate anchor point under the protective liner. The geogrid layer will be installed in segments (perpendicular to the shoreline) in the following sequence:

1. Excavate material along the shoreline slope and upland area requiring reinforcement
2. Install the geogrid layer
3. Place and compact soil within the upland area to properly anchor the geogrid layers
4. Install revetment material

This general construction sequence is important because the short-term slope stability analyses (see Appendix F of the DBR) identified a potential slope failure if the geogrid layer is not installed and anchored before placement of the revetment material. The revetment material will include a geotechnical filter fabric that will be installed between the armor rock and the underlying soil to ensure that the revetment is supported. The geotechnical filter fabric will run under the entire length of the revetment and will be tied into the armor layer at both the toe and the crest. Securing the filter fabric into the revetment will secure the material in place even if the revetment material settles over time.

6.1.1. Delivery

During delivery of the geogrid reinforcement and geotechnical filter fabric, the CQC organization will perform the tasks listed below.

- Verify that the geogrid reinforcement and geotechnical filter fabric are packaged in opaque, waterproof protective coverings.
- Verify that equipment used to unload the rolls will not damage the geotextile.
- Verify that care is used to unload the rolls.
- Verify that all manufacturing documentation required by the project specifications has been received.
- Verify that each roll is marked or tagged with the following information: manufacturer's name, project identification, lot number, roll number, and roll dimensions.
- Verify that the geogrid reinforcement and geotechnical filter fabric are stored in accordance with the project specifications and are protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, direct sunlight, and other damage.
- Verify that the geosynthetic materials receipt log form has been completed for all geogrid reinforcement and geotechnical filter fabric materials received. Damaged rolls will be rejected. Verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geogrid reinforcement and geotechnical filter fabric rolls that do not have proper manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

6.1.2. Conformance Testing

Testing Frequency. The CQC organization will obtain conformance test samples for every 200,000 square feet of geogrid reinforcement and every 100,000 square feet of geotechnical filter fabric delivered to the site (and a minimum of one per batch or lot), as summarized in Table 2. The CQC organization will collect samples of the material at the site, or an independent third party will collect samples at the manufacturing plant under the direction of the CQC Manager. The CQC organization will forward the samples to an independent testing laboratory for the conformance tests listed in Table 2.

The CQC Manager will review all test results and report any nonconformance to the Construction Manager and the CQA Manager. The CQA organization will forward additional samples (for every 500,000 square feet of geogrid reinforcement and geotechnical filter fabric delivered to the site) to an independent testing laboratory for QA conformance tests as specified in Table 2.

Sampling Procedure. Samples will be collected from across the entire roll width and will be 3 feet long. Samplers must mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number.

6.1.3. Geotextile Installation

Surface Preparation. Before installation of the geotextile, the CQC organization will perform the tasks listed below.

- Verify that all lines and grades have been verified by the RA contractor.
- Verify that the subgrade has been prepared in accordance with the earthwork section of the project specifications; and, if placed over a geomembrane, that the geomembrane installation and all associated documentation have been completed.
- Verify that soil or geomembrane surfaces do not contain protrusions that could damage the geotextile.
- Verify that no excessively soft areas exist in the soil surface that could damage the geogrid reinforcement and geotechnical filter fabric.
- Verify that all construction stakes have been removed.

Geogrid Reinforcement and Geotechnical Filter Fabric Placement and Seaming. During placement and seaming of geogrid reinforcement and geotechnical filter fabric, the CQC organization will perform the tasks listed below.

- Observe the geogrid reinforcement and geotechnical filter fabric as they are deployed and record all defects and defect corrective actions (e.g., panel rejected, patch installed, etc.). Verify that corrective actions are performed in accordance with the project specifications.
- Verify that equipment used does not damage the geotextile by handling, equipment transit, leakage of hydrocarbons, or other means.
- Verify that crews working on the geogrid reinforcement and geotechnical filter fabric do not smoke, wear shoes that could damage the geogrid reinforcement and geotechnical filter fabric, or engage in activities that could damage the geogrid reinforcement and geotechnical filter fabric.
- Verify that the geogrid reinforcement and geotechnical filter fabric are temporarily anchored to prevent movement by the wind.
- Verify that adjacent panels are placed in accordance with the project specifications.
- Verify that the geogrid reinforcement and geotechnical filter fabric were not exposed to direct sunlight for more than 5 days.
- Examine the geogrid reinforcement and geotechnical filter fabric after installation to ensure that no potentially harmful foreign objects are present.

The CQC Manager must inform both the CQA Monitor and Construction Manager if the above conditions are not met.

6.1.4. Repairs

The repair techniques listed below are acceptable.

- Patching – used to repair large holes, tears, and small defective areas.
- Removal – used to replace large defective areas where the preceding method is not appropriate.

6.1.5. Acceptance

The RA contractor retains all ownership and responsibility for the geogrid reinforcement and geotechnical filter fabric until acceptance by the Navy. After panels are placed and repairs made, the CQC Manager and RA contractor will inspect the completed installation. The RA contractor will repair any damage or defect found during this inspection. The installation will not be accepted until it meets the requirements of both parties. In addition, the CQC Manager will recommend acceptance of the geogrid reinforcement and geotechnical filter fabric by the CQA Manager only when the following activities have been completed:

- All required laboratory tests have been completed and reviewed
- The installation is finished
- All seams have been inspected and verified to be acceptable
- All required contractor-supplied documentation has been received and reviewed
- All as-built record drawings have been completed and verified by the CQC Manager to show the true panel dimensions and the locations of all seams, trenches, and repairs

6.2. INSTALLATION OF GEOMEMBRANE

An HDPE geomembrane at least 60-mil (0.06 inch) thick will be installed as part of the soil cover at IR-02 Northwest and IR-03. The HDPE geomembrane will form a continuous low-permeability layer that minimizes water seeping into the contaminated material, thereby reducing the potential for contamination to leach to underlying groundwater.

6.2.1. Delivery

Upon delivery of geomembrane, the CQC organization will perform the tasks listed below.

- Verify that equipment used to unload the rolls will not damage the geomembrane.
- Verify that care is used to unload the rolls.
- Verify that all manufacturing documentation required by the project specifications has been received.
- Inspect the geomembrane rolls for damage during shipping and handling. Identify damaged materials and verify that damaged materials are set aside.
- Verify that each roll is marked or tagged with the following information: manufacturer's name, project identification, lot number, roll number, and roll dimensions.
- Verify that the geomembrane is stored in accordance with the project specifications and is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, direct sunlight, and other damage.
- Verify that the geosynthetic materials receipt log form has been completed for all geomembrane materials received.

Damaged geomembrane may be rejected. If rejected, verify that the material is removed from the site or stored at a location, separate from accepted geomembrane. Geomembrane that does not have proper manufacturer's documentation must be stored at a separate location, until all documentation has been received, reviewed, and accepted.

6.2.2. Conformance Testing

Testing Frequency. The CQC organization will obtain conformance test samples for every 50,000 square feet of geomembrane delivered to the site as summarized in Table 3. The CQC organization will collect samples of the material at the site, or an independent third party will collect samples at the manufacturing plant under the direction of the CQC Manager. The CQC organization will forward the samples to an independent testing laboratory for the conformance tests listed in Table 3.

The CQC Manager will review all test results and report any nonconformance to the CQA Manager and the Navy. The CQA organization will forward additional samples (for every 500,000 square feet of geomembrane delivered to the site) to an independent testing laboratory for QA conformance tests as specified in Table 3.

Sampling Procedure. Samples will be collected across the entire roll width. Samples may be cut for shipping purposes, but a minimum of 5 square feet must be sent to the testing laboratory. Samplers must mark the machine direction and the manufacturer's roll identification number on the sample (each piece). Samplers will also assign a conformance test number to the sample and mark the sample with that number.

6.2.3. Geomembrane Installation

Surface Preparation. The soil surface must be prepared in accordance with the project specifications. Before installation of the geomembrane, the CQC Manager and geosynthetic materials subcontractor will inspect the subgrade. The CQA organization must verify the following.

- All lines and grades for soil surface have been verified by the RA contractor
- The soil surface has been rolled and compacted to be free of surface irregularities, loose soil, and protrusions
- The soil surface does not contain stones or other objects that could damage the geomembrane
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones
- No excessively soft areas exist
- The soil surface is not saturated, and no standing water is present
- The soil surface has not desiccated
- All construction stakes have been removed, and no debris, rocks, or any other objects are in or on the soil surface
- The geosynthetic materials subcontractor has certified in writing that the surface on which the geomembrane will be installed is acceptable

Panel Placement. Before installing any of the geomembrane, the geosynthetic materials subcontractor must submit drawings in accordance with the project specifications. The drawings will show the proposed layout of the panels, including panel identification numbers, field seams, and any other details that do not conform to the construction drawings.

The CQC Manager will maintain an up-to-date panel layout drawing that shows the (1) roll numbers, (2) panel numbers, (3) seam numbers, (4) test locations, (5) repair locations, and (6) nondestructive testing information.

During placement of the panel, the CQC organization will perform the tasks listed below.

- Record panel numbers and dimensions on the panel and seam log.
- Observe the panel surface as it is deployed and record all panel defects and defect corrective actions (e.g., panel rejected, patch installed, extrudate placed over the defect, etc.) on the repair sheet. Verify that corrective actions are made in accordance with the project specifications.
- Verify that equipment used during deployment operations does not damage the geomembrane. Verify that equipment used on the geomembrane does not leak hydrocarbons onto the geomembrane or that corrective measures are taken to prevent leakage.
- Verify that the surface beneath the geomembrane has not deteriorated since previous acceptance. Verify that no stones, construction debris, or other items are beneath the geomembrane that could damage the geomembrane.
- Verify that the geomembrane is not dragged across an unprotected surface. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for scratches and repaired or rejected, if necessary.
- Record weather conditions, including humidity, temperature, wind speed, and direction. Verify that the geomembrane is not deployed in the presence of excess moisture (e.g., fog, dew, mist, etc.). In addition, verify that the geomembrane is not placed when the ambient temperature is below 40°F, higher than 104°F, or when standing water or frost is on the ground.
- Verify that crews working on the geomembrane do not smoke, wear shoes that could damage the liner, or engage in activities that could damage the geomembrane.
- Verify that methods used to deploy the geomembrane minimize wrinkles, and that panels are anchored to prevent movement by the wind. Verify that the geosynthetic materials subcontractor corrects any damage resulting to or from windblown geomembrane.
- Verify that no more panels are deployed than can be seamed on the same day.

The CQC Manager must inform both the RA contractor and the CQA Manager if any of the above conditions are not met.

Field Seaming. Before the start of geomembrane welding and during welding operations, the geosynthetic materials subcontractor will test each welding apparatus in accordance with the project specifications to verify that the equipment is functioning properly. One trial weld will be taken before the start of work, and one trial weld will be taken at mid-shift. The CQC Manager will observe all welding operations and verify that the geosynthetic materials subcontractor quantitatively tests each trial weld for peel adhesion and bonded seam strength (ASTM D6392 [ASTM, 2012d]). The CQC Manager will record the results of the peel and shear tests on the trial weld form. If at any time the CQC Manager concludes that the welding apparatus is not functioning properly, a trial weld must be performed. Another trial weld must be performed if wide changes in temperature (~30°F), humidity, or wind speed occur. The trial weld must be allowed to cool to ambient temperature before it is tested.

During geomembrane welding operations, the CQA organization will perform the tasks listed below.

- Verify that the geosynthetic materials subcontractor has the number of welding apparatuses and spare parts necessary to perform the work.
- Verify that equipment used for welding will not damage the geomembrane.
- Verify that extrusion welding apparatuses are purged before beginning a weld, so that all heat-degraded extrudate is removed from the nozzle of the welder.
- Verify that seam grinding is completed less than 1 hour before seam welding and the upper sheet is beveled (extrusion welding only).
- Verify that the ends of extrusion welds that are more than 5 minutes old are ground to expose new material before restarting a weld.
- Verify that contact surfaces of the panels are clean and free of dust, grease, dirt, debris, and moisture before welding.
- Verify that welds are free of dust, rocks, and other debris.
- Verify that cross seams are ground to a smooth incline before welding (fusion welding only).
- Verify that all seams are overlapped a minimum of 3 inches (75 millimeters) or in accordance with manufacturer's recommendations, whichever is more stringent.
- Verify that solvents or adhesives are not present in the seam area.
- Verify that procedures used to temporarily hold the panels together do not damage the panels and do not preclude CQC testing.
- Verify that strips of geomembrane, wide enough and long enough to protect the hot wedge welder from running on the subgrade, are placed below the geomembrane. These strips may be as long as the seam itself or shorter and moved with the seaming equipment. If necessary, a firm material such as a flat board or similar hard surface may be placed directly under the weld overlap to achieve firm support.
- Verify that panels are being welded in accordance with the engineering plans and project specifications.
- Verify that no free moisture is in the weld area.
- Measure surface temperature of the panels every 2 hours.

Anchor Trench. During geomembrane placement within an anchor trench, the CQC organization will perform the tasks listed below.

- Verify that termination points of the geomembrane within the anchor trench are correct.
- Verify that loose soil or objectionable materials, such as geosynthetic scraps and miscellaneous debris, are removed from the anchor trench prior to placement of geomembrane.

- Verify that the anchor trench is dewatered (pumped out) if standing water is present in the bottom of the trench.
- Verify that the geomembrane is temporarily anchored in the anchor trench until seaming is complete and all geosynthetic layers are installed as shown on the construction drawings.
- Ensure that expansion and contraction of the geomembrane is accounted for in the liner placement, and that the anchor trench is filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

6.2.4. Construction Testing

Nondestructive Seam Testing. The purpose of nondestructive geomembrane testing is to detect discontinuities or holes in the seams. Nondestructive geomembrane tests include vacuum and air pressure testing. Nondestructive testing must be performed over the entire length of the seam in compliance with the project specifications.

It is the geosynthetic materials subcontractor's responsibility to perform all nondestructive testing as part of the QC program. The CQC organization's responsibility is to observe and document that the geosynthetic materials subcontractor's QC testing complies with the project specifications and to document seam defects and repairs.

During nondestructive testing, the CQC organization will perform the tasks listed below.

- Review project specifications regarding test procedures.
- Verify that equipment operators are fully trained and qualified to perform their work.
- Verify that test equipment meets the project specifications.
- Verify the entire length of each seam is tested in accordance with the project specifications.
- Observe all continuity testing and record results on the panel and seam log and the panel layout drawing.
- Verify that all testing is completed in accordance with the project specifications.
- Identify any failed areas by marking the area with a waterproof marker compatible with the geomembrane, inform the geosynthetic materials subcontractor of any required repairs, and record the repair on the panel and seam log.
- Verify that all repairs are completed and tested in accordance with the project specifications.
- Record all completed and tested repairs on a repair sheet and the panel layout drawing.

Destructive Seam Sampling Procedures and Field Testing. Destructive seam samples will be collected at intervals of at least one test per 500 linear feet of geomembrane seams. However, additional samples will be collected if the CQC Manager suspects that a seam does not meet the construction specification requirements. Reasons for collecting additional samples may include, but are not limited to:

- Wrinkling in seam area
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Failing tests

The CQC Manager selects the locations from where seam samples will be cut for destructive laboratory testing, as described below.

- A minimum of one test per 500 feet of seam length, which is an average sampling frequency that shall be dispersed in a manner representative of the entire installation; individual samples may be collected at greater or lesser intervals. The testing frequency will be increased if welding operations are conducted in temperatures below 40°F. The Project Manager and CQA Manager will agree upon the increase.
- The Project Manager and CQC Manager will agree to a maximum frequency at the preconstruction meeting. However, if the number of failed samples exceeds 5 percent of the tested samples, the CQA Manager may increase this frequency. Samples collected as the result of failed tests do not count toward the total number of required tests.

The CQC Manager will not inform the geosynthetic materials subcontractor in advance of selecting the destructive sample locations.

The geosynthetic materials subcontractor will remove specimens and samples at locations identified by the CQC Manager and field test the specimens for peel and shear before the samples are shipped off site for laboratory testing. During sampling procedures, the CQC Manager will:

- observe sample cutting;
- mark each specimen and sample with an identifying number that contains the seam number, destructive sample test number, welder, and date and time welded;
- record sample locations on the panel layout drawing and panel seam logs; and
- record the sample locations, weather conditions, and reasons samples were collected (e.g., random sample, visual appearance, result of a previous failure, etc.) in the destructive seam test form.

All seam specimens will be collected and tested per the project specifications. Results of field testing will be recorded on the destructive seam tests form, and the panel and seam log and seam samples will be archived in accordance with the project specifications.

6.2.5. Repairs

Portions of geomembrane panels and seams that contain (1) a flaw, (2) a destructive test, or (3) nondestructive test cuts of holes must be repaired in accordance with the project specifications. The CQC organization must locate and record all repairs on the repair sheet and panel layout drawing. The repair techniques listed below are acceptable.

- Patching – used to repair large holes, tears, large panel defects, undispersed raw materials, welds, contamination by foreign matter, and destructive sample locations.
- Abrading and Rewelding – used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than 2 inches in diameter.
- Spot Welding – used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
- Capping – used to repair failed welds or to cover seams where welds cannot be nondestructively tested.
- Removal – used to replace area with large defects where preceding methods are not appropriate. Also used to remove excess material (e.g., wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal shall be patched or capped.

Repair procedures outlined in the project specifications will be followed during all geomembrane repairs.

During placement of materials over the geomembrane, temperature changes or creep may cause wrinkles to develop in the geomembrane. Any wrinkles that can fold over must be repaired either by cutting out excess material or, if possible, by allowing the geomembrane to contract by reducing the temperature. All folded geomembrane must be removed. In no case can material be placed over the geomembrane, which could result in the geomembrane folding. The CQC organization must monitor geomembrane for wrinkles and notify the CQA Monitor and Construction Manager if wrinkles are being covered by soil. The CQC Manager is then responsible for documenting corrective action to remove the wrinkles.

6.2.6. Acceptance

The geosynthetic materials subcontractor retains all ownership and responsibility for the geomembrane until acceptance by the Navy. If the geosynthetic materials subcontractor is responsible for placing the cover over the geomembrane, the geosynthetic materials subcontractor retains all ownership and responsibility for the geomembrane until all required documentation is complete and the cover material is placed. The CQC Manager and geosynthetic materials subcontractor will inspect the completed installation after the panels are placed, seamed, and tested successfully and repairs are made. The geosynthetic materials subcontractor will repair any damage or defect found during the inspection. The installation will not be accepted until it meets the requirements of both parties. In addition, the CQC Manager will recommend acceptance of the geomembrane by the CQA Manager only when the following activities have been completed:

- The installation is finished
- All seams have been inspected and verified to be acceptable, and all required laboratory and field tests have been completed and reviewed
- All required contractor-supplied documentation has been received and reviewed
- All as-built record drawings have been completed and verified by the CQC Manager to show the true panel dimensions, the locations of all seams, trenches, pipes, appurtenances, and repairs

6.2.7. Installer Experience and Qualifications

Proper layout, seaming, and testing of the geomembrane requires skill and experience. As such, the integrity of the geomembrane is dependent upon the installers. To ensure a minimum level of experience and expertise, qualification standards are established in the project specifications. The CQC Manager will ensure that the geosynthetic materials subcontractor, geosynthetic materials subcontractor superintendent, master seamer, and all other seaming personnel meet the experience requirements outlined in the project specifications.

6.3. INSTALLATION OF GEOCOMPOSITE DRAINAGE LAYER AND DEMARCATION LAYER

A geocomposite drainage layer will be installed over the geomembrane and will consist of the following layers:

- A nonwoven polypropylene geotextile fabric placed over the HDPE geomembrane (to cushion it from the overlying geonet)
- A geonet comprising two bonded overlapping HDPE strands to transmit infiltrated water to drainage features at the top of the cap
- Another layer of geotextile fabric to prevent soil from clogging the underlying geonet (this fabric layer may also serve as the demarcation layer that is described below)

Because IR-02 and IR-03 are radiologically impacted, a demarcation layer will be installed at the bottom of the soil cover to mark the presence of remaining radionuclides at depth. The demarcation layer will consist of an orange-colored geotextile fabric and marking tape to ensure proper identification of the bottom of the soil cap. The marking tape will be printed with a warning message indicating the presence of contaminated soil beneath the demarcation layer. The marking tape will be placed in a 10-foot grid on top of the fabric. The marking tape will be of a material suitable to be detectable by electromagnetic geophysical equipment. The following sections discuss the monitoring and testing requirements during installation of the geocomposite drainage layer and demarcation layer (referred to collectively as “geocomposite materials”).

6.3.1. Delivery

During delivery of geocomposite material, the CQC organization will perform the tasks listed below.

- Verify that equipment used to unload the rolls will not damage the geocomposite.
- Verify that care is used to unload the rolls.
- Verify that all documentation required by the project specifications has been received.
- Verify that each roll is marked or tagged with the following information: manufacturer's name, project identification, lot number, roll number, and roll dimensions. Log this information on the geosynthetic receipt form.
- Verify that the geosynthetic receipt form is completed.
- Verify that materials are stored in a location that will protect the rolls from exposure to ultraviolet light, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or harmful conditions.

Any damaged rolls may be rejected. Verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geocomposite rolls that do not have proper manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

6.3.2. Conformance Testing

Testing Frequency. The CQC organization will obtain conformance test samples for every 100,000 square feet of geocomposite drainage layer delivered to the site (and a minimum of one per batch or lot), as summarized in Table 2. The CQC organization will collect samples of the material at the site, or an independent third party will collect samples at the manufacturing plant under the direction of the CQC Manager. The geotextile component will be tested as discussed in Section 6.1.2. The CQC organization will forward the samples to an independent testing laboratory for the conformance tests listed in Table 2.

The CQC Manager will review all test results and report any nonconformance to the CQA Manager and the Construction Manager. The CQA organization will forward additional samples (for every 500,000 square feet of geocomposite drainage layer delivered to the site) to an independent testing laboratory for QA conformance tests as specified in Table 2.

Sampling Procedure. Samples will be collected across the entire roll width and will be 3 feet long. Samplers must mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number.

6.3.3. Geocomposite Installation

Surface Preparation. Before geocomposite installation, the CQC organization will perform the tasks listed below.

- Verify that all lines and grades have been verified by the RA contractor.
- Verify that the underlying geomembrane has been prepared in accordance with the project specifications, and that all associated documentation has been completed.
- Verify that soil or geomembrane surfaces do not contain protrusions that could damage the geocomposite.
- Verify that no excessively soft areas exist in the soil surface that could damage the geocomposite.
- Verify that all construction stakes have been removed.
- Verify that all aspects of surface preparation have been performed according to the project specifications.

Geocomposite Placement and Seaming. During geocomposite placement, the CQC organization will perform the tasks listed below.

- Observe the geocomposite as it is deployed and record all defects and defect corrective actions (e.g., panel rejected, patch installed, etc.). Verify that corrective actions are performed in accordance with the project specifications.
- Verify that equipment used does not damage the geocomposite by handling, equipment transit, leakage of hydrocarbons, or other means.
- Verify that crews working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite.
- Verify that the geocomposite is securely anchored to prevent movement by the wind.
- Verify that adjacent panels are overlapped and seamed in accordance with the project specifications.
- Examine the geocomposite after installation to ensure that no potentially harmful foreign objects are present.

The CQC Manager must inform both the CQA Manager and RA contractor if the above conditions are not met.

6.3.4. Repairs

The repair techniques listed below are acceptable.

- Patching – used to repair large holes, tears, and small defective areas.
- Removal – used to replace large defective areas where the preceding method is not appropriate.

Repair procedures will be performed per project specifications.

Section 7. Monitoring and Testing Requirements for Runoff Control Features

This section summarizes CQC monitoring and testing requirements for installation of surface water and stormwater control systems and temporary erosion and sediment controls at IR-02 Northwest and IR-03. The CQA organization will verify that the following monitoring and testing requirements are being fulfilled by the CQC organization.

7.1. INSTALLATION OF SURFACE WATER AND STORMWATER CONTROLS

The CQC organization will verify that all drainage ditches are graded and sloped in accordance with the project specifications and drawings.

7.2. INSTALLATION OF TEMPORARY EROSION AND SEDIMENTS CONTROL

The CQC organization will perform the tasks listed below.

- Verify that the RA contractor has prepared Navy-approved erosion and sediment control plans. Secure and review a copy of the plans to verify that the RA contractor is implementing practices and procedures described therein. Verify that all erosion and sediment control facilities are approved by the Navy before beginning site earthwork.
- Verify that all temporary erosion and sediment control facilities (e.g., sediment basin, straw bale barriers, erosion control wattles, and silt fences) are in place and operational prior to construction. Note additional erosion control opportunities and inform the Construction Manager.
- Verify that disturbed ground surfaces are stabilized at the end of each workday. Verify that ground surfaces are immediately roughened by dozer track-walking upon reaching final grade. Verify that the dozer track imprints are perpendicular to the slope.
- Verify that permanent soil stabilization and erosion and sediment controls are implemented upon reaching final grade.
- Verify that silt fence materials comply with product requirements of the project specifications.
- Verify that silt fence lines are at a constant elevation for each continuous length of fence.
- Verify that a trench is excavated along the silt fence line, if required by the project specifications.
- Verify that fence posts are evenly spaced and securely driven into the ground along the downslope side of the excavated trench.
- Verify that the filter fabric and wire mesh support are securely fastened together and to the fence post.

- Verify that the filter fabric and wire mesh ends are joined by overlapping a minimum of 6 inches.
- Verify that the filter fabric extends into the trench a minimum of 4 inches.
- Verify that the trench is backfilled with soil.
- Verify that erosion control wattles comply with the product requirements of the project specifications.
- Verify that the erosion control wattles are placed along the contour, perpendicular to the slope.
- Verify that the wattles are set into the trench a minimum of 2 inches, with no gap between the soil and bottom of wattle.

Verify that wooden stakes have been used to fasten the wattles to soil at 4-foot intervals.

Section 8. Documentation

The CQA Plan depends on thorough monitoring and documentation of all construction activities. Therefore, the CQA organization will document that all QA requirements have been addressed and satisfied. Documentation will consist of daily recordkeeping, weekly progress reports, photographs, design and specification changes, and a final construction report. The CQA Manager will review all CQC documentation related to IR-02 Northwest and IR-03 to verify that the quality standards identified in the project specifications are being met.

8.1. DAILY RECORDKEEPING

At a minimum, CQA Monitor's daily records will consist of a daily record of construction progress, acceptance certificates, inspection reports and logs, test data sheets, and nonconformance reports, as needed. The CQA Monitor will submit daily records to the CQA Manager for review on a weekly basis.

8.1.1. Daily Record of Construction Progress

The daily field report will summarize ongoing construction activities and the CQA activities performed. The CQA Monitor will prepare the daily field reports. At a minimum, the report will include the following information:

- Date, project name, project number, and location
- A unique number for cross-referencing and document control
- Weather data
- A description of all ongoing construction for the day in the area of the CQA Monitor's responsibility, including any concerns noted
- An inventory of equipment used by the RA contractor
- Items of discussion and names of parties involved in discussions
- A summary of the CQA activities performed
- A description of placement activities for all soil, and notes of any visual changes in earthwork materials
- A summary of CQA and CQC tests performed, test methods used, and test results, including corrective actions taken for all construction material tests that do not comply with the project specifications
- A summary of results for CQA lift thickness, density, and moisture content measurements

- A summary of geosynthetic materials received and placed, including locations, panel numbers, seams completed, test results, repairs, and methods of repairs
- A list of nonconformance and corrective actions taken to repair damage (include nonconformance report, see Section 8.1.5)
- A list of items requiring Navy attention
- Follow-up information on previously reported problems or deficiencies
- A record of significant discussions with Navy, CQC personnel, contractors, regulators and others
- Signature of CQA Monitor

8.1.2. Acceptance Certificates

The form listed below will be used to document the acceptance of the subgrade by the CQA Monitor prior to installation of the geosynthetic materials.

- **Certificate of Subgrade Acceptance** – A certificate of subgrade acceptance will be signed each day geomembrane are placed. The installer and CQA Engineer will sign each certificate prior to installation of the geomembrane. The area being accepted must be described on the certificate.

8.1.3. Inspection Reports and Logs

The forms listed below will be used to document the geosynthetic materials received at the site and to document deployment and seaming as the geosynthetic materials are incorporated into the project.

- **Receiving Inspection Report** – Receiving inspection reports shall be completed for incoming geosynthetic materials and other materials. An example receiving report is provided for the delivery of geosynthetic materials and should be completed by the CQA Monitors.
- **Geomembrane Panel Deployment Log** – This log shall be used to record geomembrane panel numbers as they are placed in the field and to cross-reference assigned panel numbers with roll numbers. The weather conditions, time, and temperature at placement shall be recorded on the log. Measured dimensions of the geomembrane shall also be recorded on the log.
- **Geomembrane Seam Log** – Each seam constructed shall be recorded on a geomembrane seam log.

8.1.4. Test Data Sheets

Test data sheets should include the following information, as is appropriate for the form being used:

- Date, project name, and location
- A unique number for cross-referencing and document control
- Weather data, as applicable
- A reduced scale site plan showing sample and test locations

- Test equipment calibrations, if applicable
- A summary of test results identified as passing; failing; or, if a test fails, retest
- Completed calculations
- Signature of the CQA Monitor

The testing data sheets listed below will be used to document the QA testing at the site.

- **Geomembrane Trial Seam Data Sheet** – Test results for each trial seam will be recorded on the Geomembrane Trial Seam Data Sheet.
- **Nondestructive and Destructive Geomembrane Seam Testing Data Sheets** – These data sheets will be used to record test results for all nondestructive and destructive geomembrane seam tests.
- **Field Moisture and Density Test Result Data Sheet** – All CQA moisture content and density tests will be recorded on this data sheet.
- **Test Report** – This data sheet will be used to record all other CQA test results for which a specific data sheet does not exist.

8.1.5. Nonconformance Reports

If a nonconformance occurs, a nonconformance verification report form will be included with the daily report. Procedures for implementing and resolving any nonconformities to the contract are outlined in Section 2.4 of this CQA Plan.

8.2. PHOTOGRAPHS

The CQC organization will photograph construction activities. Photographs will include any significant problems encountered and corrective actions, as well as document the progress of construction. The photographs will be identified by number, location, time, date, and photographer. The photographer should document the subject or the photograph, either on the back of the picture or in a photograph log. The CQC Manager will append hard copies of the captioned photographs to the daily reports and provide the daily reports to the CQA Manager on a weekly basis. The CQC Manager will also provide digital files for the photographs (on compact disc) to the CQA Manager upon completion of the project.

8.3. DESIGN AND SPECIFICATION CHANGES

Design and specification changes may be required during construction. Design and specification changes will only be made with written agreement of the Design Engineer, Navy, and the RA contractor. Design and specification changes will also require consultation with the regulatory agencies and, if appropriate, their written agreement. These changes will be made by change order to the contract. When change orders are issued, they will be prepared by the Program Manager. The Program Manager will distribute change orders for signature and execution to the required parties.

8.4. CONSTRUCTION QUALITY ASSURANCE SUMMARY REPORT

At the completion of the project, the CQA organization will prepare a CQA summary report documenting the CQA tasks performed at Parcel E during construction. The CQA summary report will include the information listed below.

- A brief description of the project, including type of facility, name of site, location, altitude, name of owner, design engineer, general contractor, and all major subcontractors.
- A detailed description of the cover and lining systems, including surface area, cross sections, and a summary of all materials used.
- A chronological summary of construction activities.
- Photographic documentation, including photographs of the site at different phases of construction, photographs of construction details, and photographs of all CQA operations.
- A general record of activities, such as dates of performance of CQA operations, number and names of CQA Monitors, and number and names of geosynthetic installer's personnel.
- QA sampling and testing locations.
- Copies of all CQA data sheets and records completed during construction of the remedy.
- All CQA field and laboratory test results, as well as a tabulated summary of the results.
- A discussion of special problems encountered and their solutions.
- A discussion of significant changes from the design and project specifications.
- QA as-built survey records.
- CQA record drawings, which include the geomembrane panel's layout and all survey conformance data.
- A summary statement, sealed and signed by the CQA Manager, documenting that CQA was conducted in accordance with the CQA Plan and, based on visual observations and data generated in accordance with the CQA Plan, the remedy and related features shown on the construction drawings were constructed in accordance with design drawings and project specifications, except as properly authorized and documented in the CQA Summary Report.

The CQA summary report will be submitted as an appendix to the construction completion report.

8.5. FINAL CONSTRUCTION REPORT

At the completion of the project, the CQC Manager and the Project Manager will prepare and submit a final construction report to the CQA Manager and the Navy. This report will document that the work has been performed in compliance with the construction drawings and project specifications.

At a minimum, the report will contain the following information:

- A summary of all construction activities
- A summary of all laboratory and field test results
- Sampling and testing location drawings
- A description of significant construction problems and the resolution of these problems
- A list of changes from the construction drawings and project specifications and the justifications for these changes
- As-built record drawings
- A statement of compliance with the construction contract documents and design intent signed and stamped by the CQC Manager, a professional engineer registered in the state of California

The as-built record drawings will accurately locate the constructed location of all work items, including the location of piping, anchor trenches, etc. The RA contractor will prepare all surveying and base maps required for development of the record drawings. The CQC Manager must review and verify that the as-builts are correct. As-built record drawings will be included in the final construction report. The CQA Manager will review the final construction report, including the as-built drawings, on behalf of the Navy.

Section 9. References

ASTM International, 2007[1]. "ASTM D422 Standard Test Method for Particle-Size Analysis of Soils."

ASTM International, 2008[1]. "ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles."

ASTM International, 2009[1]. "ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)."

ASTM International, 2010[1]. "ASTM D1505 Standard Test Method for Density of Plastics by the Density- Gradient Technique."

ASTM International, 2011[1]. "ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)."

ASTM International, 2012a[1]. "ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort, Method C."

ASTM International, 2012b[1]. "ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile."

ASTM International, 2012c[1]. "ASTM D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics."

ASTM International, 2012d[1]. "ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods."

ASTM International, 2013[1]. "ASTM D4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products."

ASTM International, 2014a[1]. "ASTM D638 Standard Test Method for Tensile Properties of Plastics."

ASTM International, 2014b[1]. "ASTM D1603 Standard Test Method for Carbon Black Content in Olefin Plastics."

ASTM International, 2014c[1]. "ASTM D4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus."

[1] The most current version of each cited ASTM standard should be followed for the CQC and CQA program. The CQC organization is responsible for identifying and following the most current standards by consulting the ASTM web site, which is available at: <http://www.astm.org/Standard/>

ASTM International, 2014d[1]. "ASTM D4716 Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head."

ASTM International, 2014e[1]. "ASTM D5321 Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear."

ASTM International, 2014f[1]. "ASTM D6241 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe."

ASTM International, 2015a[1]. "ASTM D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity."

ASTM International, 2015b[1]. "ASTM D4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles."

ASTM International, 2015c[1]. "ASTM D5035 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)."

ASTM International, 2015d[1]. "ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembrane."

ASTM International, 2015e[1]. "ASTM D6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method."

ASTM International, 2015f[1]. "ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)."

Department of Toxic Substances Control, 2001. "Information Advisory, Clean Imported Fill Material." October. Available Online at: <https://www.dtsc.ca.gov/Schools/upload/SMP_FS_Cleanfill-Schools.pdf>.

Geosynthetic Research Institute, 2012. "GRI Standard Practice GG4(b), Determination of the Long-Term Design Strength of Flexible Geogrids." December. Available Online at: <http://www.geosynthetic-institute.org/grispecs/gg4b.pdf>.

U.S. Army Corps of Engineers, 1999. Engineer Manual 1110-1-4011, "Engineering and Design – Construction Quality Assurance (CQA) Plan – Requirements for Hazardous Waste Landfills." October 1. Available Online at: <http://www.publications.usace.army.mil/>.

Tables

Table 1. Testing Frequencies for Earthwork Construction of Covers

Test Method	Frequency
Nuclear Gauge Density and Moisture (ASTM D6938)	One per 10,000 square feet per lift
Compaction Curves (ASTM D1557)	One per change in material (every 5,000 cubic yards for select fill)
Identification of Soils (Unified Soil Classification System) (ASTM D2487)	One per change in material
Oven Moisture Content (ASTM D2216)	1 per 150,000 square feet (minimum 1 per day)
Surveying	50-foot grid and at all grade breaks

Additional Testing Frequencies for Earthwork Construction

Material	Testing Requirements	Reference	Criteria
Top Lift of Foundation Soil	Sieve Analysis	ASTM D422	1 sieve analysis per 2,000 cubic yards
First Lift of Vegetative Soil	Sieve Analysis	ASTM D422	1 sieve analysis per 2,000 cubic yards

Notes:

1 = These tests will be performed at stated frequencies and at each material or source change.

2 = For general fill in trenches, the frequency shall be one test per 100 linear feet of trench.

ASTM = ASTM International

Table 2. Testing Frequencies for Construction of Geocomposite Drainage Layer and Geogrid

Conformance Test Method[1]	QC Testing Frequency	QA Testing Frequency
Geocomposite Drainage Layer (combined geonet and geotextile)		
Transmissivity (ASTM D4716)	Minimum of 1	At the discretion of the CQA Manager
Interface Friction (ASTM D5321)	2 per interface	not applicable
Geonet Component (of geocomposite drainage layer)		
Thickness (ASTM D5199)	1 per 100,000 ft^2	1 per 500,000 ft^2
Polymer Density (ASTM D1505)	1 per 100,000 ft^2	1 per 500,000 ft^2
Carbon Black Content (ASTM D1603)	1 per 100,000 ft^2	1 per 500,000 ft^2
Tensile Strength (ASTM D5035)	1 per 100,000 ft^2	1 per 500,000 ft^2
Geotextile Component (of geocomposite drainage layer)		
Grab Strength (ASTM D4632)	1 per 100,000 ft^2	1 per 500,000 ft^2
Puncture Resistance (ASTM D6241)	1 per 100,000 ft^2	1 per 500,000 ft^2
Tear Strength (ASTM D4533)	1 per 100,000 ft^2	1 per 500,000 ft^2
Permittivity (for filter geotextile only) (ASTM D4491)	1 per 100,000 ft^2	1 per 500,000 ft^2
Apparent Opening Size (filter geotextile only) (ASTM D4751)	1 per 100,000 ft^2	1 per 500,000 ft^2
Ultraviolet Resistance at 500 Hours (ASTM D4355)	1 per 100,000 ft^2	1 per 500,000 ft^2
Geogrid		
Tensile Strength (at ultimate) (ASTM D6637)	1 per 200,000 ft^2	1 per 500,000 ft^2
Tensile Strength (at 5% strain) (ASTM D6637)	1 per 200,000 ft^2	1 per 500,000 ft^2
Long Term Allowable Design Load (GRI Standard Practice GG4b)	1 per 200,000 ft^2	1 per 500,000 ft^2

Notes:

1 = Conformance testing to be performed on samples collected for QC and QA. Manufacturer testing requirements and frequencies are listed in the project specifications (Appendix D to the Design Basis Report).

ASTM = ASTM International

ft^2 = square feet

GRI = Geosynthetic Research Institute

QA = quality assurance

QC = quality control

Source:

Table 3. Testing Frequencies for Construction of Geomembrane

Test Method	QC Testing Frequency	QA Testing Frequency
Conformance Testing[1]		
Tensile Properties (ASTM D638)	1 per 50,000 ft^2	1 per 500,000 ft^2
Puncture Resistance (ASTM D4833)	1 per 50,000 ft^2	1 per 500,000 ft^2
Thickness (ASTM D5994)	1 per 50,000 ft^2	1 per 500,000 ft^2
Density (ASTM D1505)	1 per 50,000 ft^2	1 per 500,000 ft^2
Interface Friction (ASTM D5321)	2 per interface	Not Applicable
Field Seaming Trial Welds		
Peel Adhesion – Fusion and Extrusion (ASTM D6392)	1 every 4 hours or change in equipment/operator	Observation at the discretion of the CQA Manager
Shear Strength – Fusion and Extrusion (ASTM D6392)	1 per every 4 hours or change in equipment/operator	Observation at the discretion of the CQA Manager
Nondestructive Seam Testing		
Vacuum Testing (ASTM D5641)	Continuous observation	Continuous observation
Air Pressure Testing (ASTM D5820)	Continuous observation	Continuous observation
Destructive Seam Testing		
Destructive Testing (ASTM D6392)	1 per 500 feet of seam length	1 per 5,000 feet of seam length

Notes:

1 = Conformance testing to be performed on samples collected for QC and QA. Manufacturer testing requirements and frequencies are listed in the project specifications (Appendix D to the Design Basis Report).

ASTM = ASTM International

CQA = Construction Quality Assurance

ft^2 = square feet

QA = quality assurance

QC = quality control

Department of the Navy
Base Realignment and Closure
Program Management Office West
San Diego, California

FINAL
OPINION OF PROBABLE CONSTRUCTION COST FOR PARCEL E

Hunters Point Naval Shipyard
San Francisco, California

May 2018

Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southwest
BRAC PMO West
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Contract Number N62473-11-D-2215
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DCN: CESJ-2215-0006-0007.R1

Final
Opinion of Probable Construction Cost for Parcel E
Hunters Point Naval Shipyard
San Francisco, California

Submitted by:
Construction Engineering Services, LLC

Signature	May 21, 2018 Date
Doug Bielskis, PE Name	Project Manager/Engineer of Record Title

CERTIFICATION

This document was prepared under the direction and
supervision of a qualified Professional Engineer.

Doug Bielskis, P.E.
California Professional Engineer No. C63113

DCN: CESJ-2215-0006-0007.R1

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Abbreviations and Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DBR	Design Basis Report
HPNS	Hunters Point Naval Shipyard
IR	Installation Restoration
NAPL	nonaqueous-phase liquid
Navy	Department of the Navy
ROD	Record of Decision
VOC	volatile organic compound

Section 1. Introduction

The Department of the Navy (Navy) plans to implement the final remedy at Parcel E, Hunters Point Naval Shipyard (HPNS) in San Francisco, California, pursuant to the Final Record of Decision (ROD) (Navy, 2013). This opinion of probable construction cost (cost opinion) identifies the anticipated costs associated with the construction of the remedy developed in the design basis report (DBR) to protect human health and the environment from chemicals in soil, shoreline sediment, groundwater, and non-aqueous phase liquid (NAPL). The selected remedy for Parcel E includes the following design components, which are grouped into activities for the purposes of organizing the cost opinion:

Activity 1, Site Preparation

- Establish radiological and nonradiological material handling and storage areas
- Demolish site features to facilitate remedy implementation
- Remove and dispose of existing soil stockpiles

Activity 2, Excavation and Offsite Disposal

- Excavation and offsite disposal of Tier 1, Tier 2, and total petroleum hydrocarbons locations (including NAPL source along IR-03 shoreline)
- Closure of steam and fuel lines
- Radiological surveys and remediation (including grading required at Installation Restoration [IR] Sites IR-02 and IR-03 prior to soil cover construction)

Activity 3, Treatment of Volatile Organic Compound (VOC) Plumes

- Soil vapor extraction at Building 406
- In-situ groundwater treatment at Building 406, IR-04, and IR-12

Activity 4, Treatment/Containment at IR-02 and IR-03

- Groundwater controls at IR-02 Northwest
- Groundwater controls and NAPL source treatment at IR-03

Activity 5, Durable Covers

- Shoreline protection
- Asphalt covers, building foundation repairs, and soil covers (with protective liners in select areas)
- Miscellaneous completion activities (e.g., install new groundwater monitoring wells, and perform soil gas survey)

This cost opinion only includes estimates for capital costs associated with construction of the selected remedy for Parcel E and was developed for the Navy to support budgeting and construction contracting. This cost opinion does not include costs for operation and maintenance of the remedy, but does include costs for the first year of post-treatment monitoring at the VOC plumes (to support a demonstration that the remedy is operating properly and successfully).

Section 2. Cost Opinion Summary

The cost opinion presented in this section was developed using a comprehensive itemized approach. Costs were determined based on available design information and material quantities, along with RSMeans Cost Data (www.rsmeans.com), similar or recent HPNS projects, and from vendor quotes. Location- (i.e., regional) and site-specific adjustments were made accordingly. Adjustments were also made on an item- and project component-specific basis. Profit margins and multipliers were assumed for the project based on industry averages for similar projects. Standard labor rates were also assumed and the hours were based on similar and previous project experience. For the purpose of this cost opinion, direct costs are assumed to be equipment, material, labor, construction, development, and implementation of work. Indirect costs are assumed to include health and safety, site supervision and security, engineering, overhead, and profit.

Table 1 summarizes the estimated costs for each of the major activities. Appendices A through H include detailed tables summarizing the cost data and quantities used to develop this cost opinion. The cost estimate tables are organized as follows:

- Appendix A provides the cost estimate for Activity 1 (Site Preparation)
- Appendix B provides the cost estimate for Activity 2 (Excavation and Offsite Disposal)
- Appendix C provides the cost estimate for Activity 3 (Treatment of VOC Plumes)
- Appendix D provides the cost estimate for Activity 4A (Groundwater Controls at IR-02 Northwest)
- Appendix E provides the cost estimate for Activity 4B (Groundwater Controls and NAPL Source Treatment at IR-03)
- Appendix F provides the cost estimate for Activity 5A (Shoreline Protection)
- Appendix G provides the cost estimate for Activity 5B (Asphalt Covers, Building Foundation Repairs, and Soil Covers)
- Appendix H provides the cost estimate for Activity 5C (Miscellaneous Completion Activities)

The quantities used in the cost opinion, which were derived from the DBR, are provided solely for planning purposes and will be verified and updated prior to remedy implementation. The cost opinion assumes that each activity will be implemented in accordance with the DBR, including the design drawings and project specifications. The list on the following page identifies general assumptions that informed the cost opinion. Other assumptions are listed in the cost estimate tables located in Appendices A through H.

Project Duration

- The construction activities will not necessarily be implemented sequentially, and breaks in the project may occur when construction is halted or when activities are implemented concurrently.
- This estimate includes time for pre-construction submittals, post-construction submittals, and other tasks that may not occur during physical construction of the remedy at the site.

Project Support Staffing

- Staffing for the project will come from local labor and travel and per diem will not be incurred.
- Staffing is based on current estimated hourly rates and staffing support needs for similar projects at HPNS.
- Personal protective equipment will be Modified Level D.

Temporary Facilities

- A field office for staff, storage trailers for materials, and other related facilities will be required for the entire duration of the project.
- Temporary fence will be placed along site boundaries where existing permanent fence does not exist.

Mobilization and Demobilization

- Equipment to be mobilized to the site is available in the San Francisco area or within a 60-mile radius.
- The Parcel E remedy will be performed by multiple contractors. Mobilizations and demobilizations were included for each major phase of work to account for the fact that different contractors may be performing each phase of work.

Environmental Protection

- Dust control measures will be necessary throughout construction in work areas.
- Air monitoring will be performed using upwind and downwind high-volume air samplers throughout construction.
- Erosion and sediment control best management practices will be necessary at various locations along the shoreline during the project. Silt curtain will be installed and maintained offshore of the proposed shoreline construction throughout the excavation and revetment construction period.

Excavation and Offsite Disposal

- Excavated material radiologically-impacted areas (most notably, all of IR-02 and IR-03) will be will be screened for radioactivity, sampled for analysis of the radionuclides of concern, and then remediated for radiological constituents, if necessary.
- All excavated soil will be disposed of at one or more offsite landfills approved to accept Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes in accordance with Title 40 Code of Federal Regulations Section 300.440 (also referred to as the "CERCLA Off-Site Rule").

Section 3. References

Department of the Navy, 2013. "Final Record of Decision for Parcel E, Hunters Point Naval Shipyard, San Francisco, California." December.

Tables

Table 1. Summary of Estimated Capital Costs

Activity[1]	Task Description[2]	Task Duration[3]	Estimated Capital Cost[4]
Activity 1, Site Preparation	Miscellaneous site preparation and demolition tasks (e.g., establish material handling and storage areas, and demolish site features to facilitate remedy implementation)	2 months	$1,602,800
	Remove and dispose of existing soil stockpiles (including radiological screening)	4 months	$2,798,800
Activity 2, Excavation and Offsite Disposal	Excavation and offsite disposal of Tier 1, Tier 2, and TPH locations	10 months	$35,614,800
	Closure of steam and fuel lines	1.5 months	$1,196,200
	Radiological surveys and remediation (including grading required at IR-02 and IR-03 prior to soil cover construction)	2.5 months	$4,392,500
Activity 3, Treatment of VOC Plumes	Soil vapor extraction at Building 406	2 months	$1,443,200
	In-situ groundwater treatment at Building 406, IR-04, and IR-12	3 months	$1,439,400
Activity 4, Treatment/ Control at IR-02 and IR-03	*Activity 4A* – Groundwater controls at IR-02 Northwest	2 months	$3,032,500
	Activity 4B – Groundwater controls at IR-03	4 months	$7,517,100
	Activity 4B – NAPL treatment at IR-03	11 months	$9,860,300
Activity 5, Durable Covers	*Activity 5A* – Shoreline protection	6 months	$12,186,300
	Activity 5B – Soil covers (with protective liners in select areas)	9 months	$16,145,100
	Activity 5B – Asphalt covers and building foundation repairs	4 months	$6,819,500
	Activity 5C – Miscellaneous completion activities (e.g., install new groundwater monitoring wells, and perform soil gas survey)	2 months	$1,381,600
		Subtotal	$105,430,100
		Contingency (10%)	$10,543,010
		Total	$115,973,110

Table 1. Summary of Estimated Capital Costs *(continued)*

Notes:

1. Activities are listed in the general sequence in which they will be implemented; however, this sequence is preliminary and will be further refined as the plans for the remedial action are developed.
2. For this summary table, each activity is separated into multiple tasks that each comprise a significant level of effort. In addition, Activities 4 and 5 are subdivided because their magnitude and complexity requires independent cost estimates.
3. The estimated durations of each task are for field construction only and are provided to apply distributive costs (e.g., field quality control oversight and project management) across multiple tasks within a given activity; the duration of each activity will be refined as the plans for the remedial action are developed.
4. The estimated costs for each activity are detailed in Appendices A through I. The quantities used in the cost opinion, which were derived from the DBR, are provided solely for planning purposes and will be verified and updated prior to remedy implementation.

DBR = Design Basis Report

IR = Installation Restoration

NAPL = nonaqueous-phase liquid

TPH = total petroleum hydrocarbons

VOC = volatile organic compound

Appendix A. Activity 1 Cost Estimate (Site Preparation)

Available on CD.

Table A-1. Site Preparation, Demolition, and Stockpile Removal - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 102 working days
6 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS			**DISTRIBUTIVE COSTS SUBTOTAL =**		**$ 1,054,680**	**Includes labor and temporary facilities**
Labor			**Labor Subtotal =**		**$ 913,920**	
Total project professional/technical labor cost					$ 573,240	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 191,760	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 148,920	See backup worksheet "LABOR"
Temporary Facilities			**Temporary Facilities Subtotal =**		**$ 140,760**	
30' connex office trailer	6	mo	$ 550.00	15%	$ 3,795	Quote from Mobile Mini
Office Equipment Rental	6	mo	$ 800.00	15%	$ 5,520	Costs from HPNS Parcel C
Office Supplies	6	mo	$ 100.00	15%	$ 690	Costs from HPNS Parcel C
Telephone Bill	6	mo	$ 50.00	15%	$ 345	Costs from HPNS Parcel C
Internet Bill	6	mo	$ 200.00	15%	$ 1,380	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	6	mo	$ 5,400.00	15%	$ 37,260	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	6	mo	$ 500.00	15%	$ 3,450	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	6	mo	$ 2,000.00	15%	$ 13,800	Quote from Hertz
Fuel for Rental Trucks	6	mo	$ 1,200.00	15%	$ 8,280	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	6	mo	$ 6,000.00	15%	$ 41,400	Quote from Sitech
(2) Kubotas	6	mo	$ 1,300.00	15%	$ 8,970	Quote from Hertz
8K Forklift	6	mo	$ 2,300.00	15%	$ 15,870	Quote from United Rentals
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**		**$ 3,137,355**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization			**Mobilization and Demobilization Subtotal =**		**$ 11,960**	
CAT 330 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 14H Motor Grader	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
2000 Gallon Water Truck	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
Bobcat T-190	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
JD710 Backhoe	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
JD710 Backhoe Breaker	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
(3) JD210 Skiploader	6	ea	$ 150.00	15%	$ 1,035	Quote from Hertz
(2) CAT 735 Off Road Dump Truck	4	ea	$ 1,000.00	15%	$ 4,600	Quote from Harris Blade Rental
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment			**Health and Safety Equipment Subtotal =**		**$ 28,980**	
Equipment	102	day	$ 100.00	15%	$ 11,730	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	6	mo	$ 2,500.00	15%	$ 17,250	Quote from BlueLine Rentals
Site Preparation			**Site Preparation Subtotal =**		**$ 442,597**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 39,900.79		$ 39,901	See Backup Worksheet "SITE PREP INSTALL"
Install Silt Curtain	1	ea	$ 329,820.00		$ 329,820	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	6	mo	$ 1,763.00	15%	$ 12,165	Quote from Cam Guard
Land survey	5	day	$ 2,200.00	15%	$ 12,650	Quote from ESP Surveying
Subsurface utility surveying	3	day	$ 1,400.00	15%	$ 4,830	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C

Table A-1. Site Preparation, Demolition, and Stockpile Removal - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 102 working days
6 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Air Monitoring				**Air Monitoring Subtotal =**	**$ 231,530**	
(2) Air Monitor Rental for PM10, TSP and Metals	6	mo	$ 2,800.00	15%	$ 19,320	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	6	mo	$ 1,200.00	15%	$ 8,280	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	102	day	$ 790.00	15%	$ 92,667	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	102	day	$ 725.00	15%	$ 85,043	Costs from HPNS Parcel C
Shipment of Sample Media	6	mo	$ 800.00	15%	$ 5,520	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	6	mo	$ 1,800.00	15%	$ 12,420	Quote from Pine Environmental
Portable Multi Gas Meter	6	mo	$ 1,200.00	15%	$ 8,280	Quote from Equipco
Decontamination				**Decontamination Subtotal =**	**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	6	mo	$ 1,150.00	15%	$ 7,935	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	204	hr	$ 70.00	15%	$ 16,422	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*				**CAPITAL COSTS SUBTOTAL =**	**$ 3,137,355**	**Includes mob/demob and all construction activities**
Clearing and Grubbing				**Excavation =**	**$ 214,125**	See Backup Worksheet "CLEARING AND GRUBBING"
Clearing and Grubbing	1	ea	$ 214,125.00		$ 214,125	
Demolition				**Backfill SG & Foundation =**	**$ 193,509**	See Backup Worksheet "DEMOLITION"
Demolition	1	ea	$ 193,508.50		$ 193,509	
Stockpile Excavation				**Fabric Installation =**	**$ 869,551**	See Backup Worksheet "STOCKPILE EXCAVATION"
Stockpile Excavation	1	ea	$ 869,551.01		$ 869,551	
Radiological Screening and Offsite Disposal of Waste			**Radiological Screening, Loading and Waste T&D Subtotal =**		**$ 1,125,356**	
Radiological Screening, loading of waste	1	ea	$ 1,125,356.28		$ 1,125,356	See Backup Worksheet "RADIOLOGICAL LOE"
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 209,602**	**Includes management, plans, and reports**
Assumed to be 5% of construction cost (including permitting)					$ 209,602	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 4,401,636**	**Includes Distributive Costs**
Total Construction Cost					$ 4,192,035	
Total Management/Planning/Reporting Cost					$ 209,602	
General Assumptions:						
Work will be performed in Level D PPE						30' connex office trailer
15% Equipment/Subcontractor/Material Fee						

Table A-2. Site Preparation, Demolition, and Stockpile Removal - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	10	1	$ 13.00
	Project Engineer, Geologist or Scientist	$ 125.00	100	1	$ 125.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table A-3. Site Preparation, Demolition, and Stockpile Removal - Radiological Screening Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Unit Production Rate	Units	Comments	Production per Day	Assumptions	Total Production per day
Excavated soil from Stockpiles	100	CY/hr per excavator (1)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Load out soil within 1000m^2 x 6" grid	100	CY/hr per excavator (2)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Transport excavated 1000m^2 x 1' volume to rad screening area / soil staging area in 20 CY loads	60	CY/hr per truck (3)	20 min cycle, 3 loads per hour	480 CY/day per truck	480 CY/day/truck x 2 trucks = 960 CY/day	960 CY/day ≈ 4.8 grids
Rad screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (4)	1 grid per crew per day	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids
UXO screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (5)	8 hours per grid per crew	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids

Notes:

(1) Average production rate determined from screening operations at other Hunter's Point parcels

(2) Average production rate determined from screening operations at other Hunter's Point parcels

(3) Average production rate determined from screening operations at other Hunter's Point parcels

(4) Average production rate determined from screening operations at other Hunter's Point parcels

(5) Average production rate determined from screening operations at other Hunter's Point parcels

Table A-4. Site Preparation, Demolition, and Stockpile Removal - Lab Analyses Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample
Encore Samplers for TPH-purgeable range (3 per sample)	**$ 39.00**
Analysis (for excavation chemicals only)	**$ 420.00**
Volatile Organic Compounds (VOCs)	$ 180.00
Semivolatile Organic Compounds (SVOCs)	$ 210.00
Pesticides	$ 138.00
Polychlorinated Biphenyls (PCBs)	$ 78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$ 54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$ 54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$ 108.00
Strontium-90	$ 142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$ 156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$ 90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$ 90.00
Total Cost/Pre-Excavation Characterization Sample:	**$ 753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$ 1,003.80**
Total Cost/Waste Characterization Sample:	**$ 586.80**

Analysis[2]	Cost per Sample
Analysis (Geotechnical for import fill only)	
Modified Proctor (1 every 5,200 CY)	$ 260.00
Sieve Analysis (1 every 2,000 CY)	$ 109.00
Atterberg Limits (1 every 2,000 CY)	$ 163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnical costs provided by Cooper Testing Labs 2017

Table A-5. Site Preparation - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

	Total SF of Excavated material 6" thick		Total Rad Pads, 1000m^2 at most 6" thick		Total SF need for Rad Pads		
	Units	Quantity	Units	Quantity	Units	Quantity	Notes
Soil Staging Area	SF	1,057,212	EA	99	SF	1,065,627	This location will be used to place excavated soil into rad pads for scanning wait for release

Area For Trailers, support equipment and temp facilities			
	Units	Quantity	Notes
Lay Down Area	Acres	0.5	This locations will be used as a support area

Prep Existing Rad Pads			
	Units	Quantity	Notes
Rad Pads	EA	12	

Temporary Fence			
	Units	Quantity	Notes
Temp Fence	LF	10,546.00	Temp fence will be placed around staging and laydown areas

Table A-6. Clearing, Demolition, and Stockpile Removal - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Clearing and grubbing			Notes
Area for Clearing and Grubbing	4,591,986	SF	Calculated from ACAD
Area for Clearing and Grubbing in ACRES	105	ACRES	Calculated from ACAD
Vegetation to be removed	3,150	CY	30 Yds of vegetation per 5 acres. Per Parcel B

Notes:

Vegetation to be removed with no ground disturbance. Will be cut off above ground surface.

Demolition			Notes
Permanent Fence	18428.52	LF	Quantity takeoff on Plans
Concrete Foundations	491.27926	CY	1' thick slabs. Quantity takeoff on Plans
Ground Water Monitoring Wells	42	EA	Quantity takeoff on Plans

Stockpiles			Notes
Area of Soil Stockpiles	126,920.23	SF	Quantity takeoff on Plans
Average Height of Stockpiles	8	LF	From visuals of stockpiles
Stockpile Volumes	19,578.00	CY	Calculated from visuals and quantity takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads	99	EA	Rad Pads 6" thick

Table A-7. Site Preparation - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Restore Rad Pads (16) for use						
(6) Labors LBO1	3	Day	$ 3,360.00		$ 10,080.00	See "LABOR" Worksheet for detail
Rad Pad Repair Materials	12	EA	$ 1,500.00	15%	$ 20,700.00	Costs from Treasure Island
Install Silt Curtain	4,780	LF	$ 60.00	15%	$ 329,820.00	Costs from HPNS Parcel B RA
Install Temp Fence and 6 Month Rental	10,546	LF	$ 3.29	15%	$ 39,900.79	Costs from HPNS Parcel B RA
TOTAL					$ 430,943	

Note:

Soil staging area volumes and areas:

Rad pad prep	12	EA
Soil Staging area for Rad Soil	1,065,627	SF
Number of 1000m^2 x 6" rad pads	99	Pad
Soil Staging area perimeter	19,800	LF
Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) conver	605	Tons

Table A-8. Vegetation Clearance - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Remove Vegetation	105	Acres				
(3) JD 210 Skiploader	24.0	Day	$ 450.00	15%	$ 12,420.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	24.0	Day	$ 200.00	15%	$ 5,520.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	24.0	Day	$ 300.00	15%	$ 8,280.00	Costs from HPNS Parcel B RA
(6) Labors LBO1	24.0	Day	$ 3,360.00		$ 80,640.00	See "LABOR" Worksheet for detail
(3) Equipment Operator EQ04	24.0	Day	$ 2,352.00		$ 56,448.00	See "LABOR" Worksheet for detail
Truck Driver TM02	24.0	Day	$ 608.00		$ 14,592.00	See "LABOR" Worksheet for detail
30 Yard Debris Bin for vegetation	42.0	30 CY Bin	$ 750.00	15%	$ 36,225.00	Quote from Recology Debris Bin. Costs for HPNS parcel B/C
TOTAL					$ 214,125	

Note:

Clearing and Grubbing area volumes and areas:

Area to be cleared and grubbed	4,591,986	SF
Area to be cleared and grubbed in acres	105	Acres
Vegetation generated at 30 CY per 2.5 acres	3,150	CY
Debris Bins needed for Vegetation	42	Bins

Table A-9. Demolition - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Removal of Permanent Fence	18,429	LF				
JD 210 Skiploader	24.0	Day	$ 150.00	15%	$ 4,140.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	24.0	Day	$ 100.00	15%	$ 2,760.00	Costs from HPNS Parcel B RA
(2) Labors LBO1	24.0	Day	$ 1,120.00		$ 26,880.00	See "LABOR" Worksheet for detail
Equipment Operator EQ04	24.0	Day	$ 784.00		$ 18,816.00	See "LABOR" Worksheet for detail
Remove Concrete Foundations	491.3	CY				
JD 710 Backhoe	25.0	Day	$ 1,000.00	15%	$ 28,750.00	Costs from HPNS Parcel B RA
JD 710 Backhoe Breaker	25.0	Day	$ 1,000.00	15%	$ 28,750.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	25.0	Day	$ 200.00	15%	$ 5,750.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25.0	Day	$ 150.00	15%	$ 4,312.50	Costs from HPNS Parcel B RA
Equipment Operator EQ03	25.0	Day	$ 808.00		$ 20,200.00	See "LABOR" Worksheet for detail
Truck Driver TM02	25.0	Day	$ 608.00		$ 15,200.00	See "LABOR" Worksheet for detail
Removal of Ground Water Monitoring Wells	42.0	EA				
Cascade Drilling Decommissioning GW Monitoring Wells	6.0	Day	$ 5,500.00	15%	$ 37,950.00	Cascade can Decommission 8 wells per day
TOTAL					$ 193,509	

Note:

Demolition area volumes and areas:

Linear Feet of Permanent Fence to be removed	18,429	LF
Volume of Concrete at 1' thick to be removed	491	CY
Number of Ground Water Monitoring Wells to be remove	42	EA

Table A-10. Stockpile Removal - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Stockpile Excavation	18,803	LCY				
CAT 330 Excavator	25.0	Day	$ 1,000.00	15%	$ 28,750.00	Costs from HPNS Parcel B RA
(2) CAT 735 Off Road Dump Truck	25.0	Day	$ 2,000.00	15%	$ 57,500.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	25.0	Day	$ 200.00	15%	$ 5,750.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25.0	Day	$ 500.00	15%	$ 14,375.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	25.0	Day	$ 808.00		$ 20,200.00	See "LABOR" Worksheet for detail
(2) Truck Driver TM03	25.0	Day	$ 1,232.00		$ 30,800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	25.0	Day	$ 608.00		$ 15,200.00	See "LABOR" Worksheet for detail
Transport and disposal of excavated material						
Class II Beneficial Reuse Soil to Altamont	564.1	ton	$ 42.70	15%	$ 27,700.93	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	1,410.2	ton	$ 79.66	15%	$ 129,192.53	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	1,692.3	ton	$ 89.27	15%	$ 173,719.53	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	846.1	ton	$ 143.04	15%	$ 139,189.69	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	846.1	ton	$ 189.46	15%	$ 184,358.91	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	282.0	ton	$ 132.00	15%	$ 42,814.42	Assumed Fraction of Total Waste: 5%
TOTAL					$ 869,551	

Note:

Stockpiles area volumes and areas:

Foot Print of stockpiles	126,920	SF		
Average Height of Stockpiles	8	LF		
Stockpile Volumes	18,803	CY		
Number of equivalent 1000m^2 x 6" Rad Pads	99	Pads		
Expected material to go off site	3,760.60	CY	0.2	Factor of Hot Spot Excavation
Off site material in tons	5,641	Tons	1.5	BCY to Ton Factor

Table A-11. Radiological Survey/Remediation for Stockpiles - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Geophysical monitoring equipment rental for UXO screening	1	months	$ 5,000.00	15%	$ 5,750	Costs from HPNS IR 7 & 18
Radiological Support Services	102	Day	$ 3,650.00	15%	$ 428,145	Costs from HPNS IR 7 & 18
SUPRA/FSS Rad Pads (Screening)	99	EA	$ 3,700.00	15%	$ 421,245	Costs from HPNS IR 7 & 18
Soil analysis for disposal (1 per 500 CY) (4 pt. composite samples)	4	EA	$ 586.80	15%	$ 2,699	See "LAB COST" Worksheet for Detail
Manage Excavated Soil Material & Debris						
CAT 14H Motor Grader	25	Day	$ 1,000.00	15%	$ 28,750	Costs from HPNS Parcel B RA
Bobcat T-190	102	Day	$ 400.00	15%	$ 46,920	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25	Day	$ 300.00	15%	$ 8,625	Costs from HPNS Parcel B RA
Equipment Operator EQ02	25	Day	$ 840.00		$ 21,000	See "LABOR" Worksheet for detail. Operator will use Motor Grader
Equipment Operator EQ06	102	Day	$ 736.00		$ 75,072	See "LABOR" Worksheet for detail. Operator will use bobcat
Excavate 1000m^2 x 1' grid and Load out						
CAT 330 Excavator	25	Day	$ 1,000.00	15%	$ 28,750	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	25	Day	$ 300.00	15%	$ 8,625	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25	Day	$ 500.00	15%	$ 14,375	Costs from HPNS Parcel B RA
Equipment Operator EQ03	25	Day	$ 808.00		$ 20,200	Costs from HPNS Parcel B RA
Truck Driver TM02	25	Day	$ 608.00		$ 15,200	Costs from HPNS Parcel B RA
TOTAL					$ 1,125,356	

Note:

Soil quantities:

Total CY to Rad Pads	19,578	LCY	
Total CY to be disposed of	1958	LCY	Assume 10% to be disposed of for Rad
Total Days Excavating	25	Days	
Excavated Volume Per Day	783	LCY/Day	
Number of equivalent rad pads 1000m^2 x 1'	99	rad pads	
Number of rad pads to be disposed of	10	rad pads	Assume 10% to be disposed of for Rad

Table A-12. Site Preparation, Demolition, and Stockpile Removal - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B
Rad Pad Repairs	4 Pad/Day	12 Pads	3 days	Production Rates from Treasure Island
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/day	21,780 SF	1 days	Production rate from HPNS IR7 &18
CLEARING AND GRUBBING				
Clearing Vegetation	4.5 Acre/day	105 Acre	24 days	Production rate from HPNS Parcel B
DEMOLITION				
Remove Permanent Fence	800 LF/day	18,429 LF	24 days	Production rate from HPNS Parcel B
Remove Concrete Foundations	20 CY/day	491 CY	25 days	Production rate from HPNS Parcel B
Remove Ground Water Monitoring Wells	8 EA/day	42 EA	6 days	Production Rate from Cascade Drilling
STOCKPILE EXCAVATING				
Excavate stockpiles	800 LCY/day	19,578 LCY	25 days	Production rate from HPNS Parcel B
RADIOLOGICAL SCREENING AND LOAD OUT				
Radiological and UXO characterization and release			20 days	20 days to obtain radiological and UXO release of screening pads (about 10,000 CY; to be performed 12 time)
Manage Rad Pad Material			25 days	Smooth out Rad Pads and prepare material for Rad Screening
Excavate 1000m^2 x 6" grid and transport to disposal facility	4 grids/day	99 grids	25 days	See Backup Worksheet "RAD SCREENING"; see Backup Worksheet "EXCAVATIONS"
SURVEY/DEMOBILIZATION				
Survey Crew			5 day	Misc Survey
Demobilization			2 day	
		TOTAL	**102 days**	

Appendix B. Activity 2 Cost Estimate (Excavation and Offsite Disposal)

Available on CD.

Table B-1. Excavation and Offsite Disposal - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 276 working days
14 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS			**DISTRIBUTIVE COSTS SUBTOTAL =**		**$ 3,159,648**	**Includes labor and temporary facilities**
Labor			**Labor Subtotal =**		**$ 2,734,608**	
Total project professional/technical labor cost					$ 1,812,768	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 518,880	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 402,960	See backup worksheet "LABOR"
Temporary Facilities			**Temporary Facilities Subtotal =**		**$ 425,040**	
30' connex office trailer	14	mo	$ 550.00	15%	$ 8,855	Quote from Mobile Mini
Office Equipment Rental	14	mo	$ 800.00	15%	$ 12,880	Costs from HPNS Parcel C
Office Supplies	14	mo	$ 100.00	15%	$ 1,610	Costs from HPNS Parcel C
Telephone Bill	14	mo	$ 50.00	15%	$ 805	Costs from HPNS Parcel C
Internet Bill	14	mo	$ 200.00	15%	$ 3,220	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	14	mo	$ 5,400.00	15%	$ 86,940	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	14	mo	$ 500.00	15%	$ 8,050	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	14	mo	$ 2,000.00	15%	$ 32,200	Quote from Hertz
Fuel for Rental Trucks	14	mo	$ 1,200.00	15%	$ 19,320	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	14	mo	$ 6,000.00	15%	$ 96,600	Quote from Sitech
Trimble GPS Cab Kit	14	mo	$ 6,000.00	15%	$ 96,600	Quote from Sitech
(2) Kubotas	14	mo	$ 1,300.00	15%	$ 20,930	Quote from Hertz
8K Forklift	14	mo	$ 2,300.00	15%	$ 37,030	Quote from United Rentals
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**		**$ 37,635,837**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization			**Mobilization and Demobilization Subtotal =**		**$ 34,615**	
CAT 330 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
(3) John Deere 225 Excavators	2	ea	$ 3,000.00	15%	$ 6,900	Quote from Harris Blade Rental
(3) Excavator Compaction Wheels	2	ea	$ 450.00	15%	$ 1,035	Quote from Harris Blade Rental
(3) 10 Wheel Dump Trucks	2	ea	$ 3,000.00	15%	$ 6,900	Quote from Harris Blade Rental
(2) CAT 14H Motor Grader	2	ea	$ 2,000.00	15%	$ 4,600	Quote from Harris Blade Rental
(2) 2000 Gallon Water Truck	2	ea	$ 300.00	15%	$ 690	Quote from Hertz
CAT D5 Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT D6T Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 617 Paddle Wheel Scraper	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Bobcat T-190	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
(2) CAT 735 Off Road Dump Truck	4	ea	$ 1,000.00	15%	$ 4,600	Quote from Harris Blade Rental
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment			**Health and Safety Equipment Subtotal =**		**$ 71,990**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	276	day	$ 100.00	15%	$ 31,740	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	14	mo	$ 2,500.00	15%	$ 40,250	Quote from BlueLine Rentals
Site Preparation			**Site Preparation Subtotal =**		**$ 228,440**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 45,964.74		$ 45,965	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	14	mo	$ 1,763.00	15%	$ 28,384	Quote from Cam Guard
Land survey	40	day	$ 2,200.00	15%	$ 101,200	Quote from ESP Surveying
Subsurface utility surveying	6	day	$ 1,400.00	15%	$ 9,660	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C

Table B-1. Excavation and Offsite Disposal - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 276 working days
14 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Air Monitoring			**Air Monitoring Subtotal =**		**$ 606,441**	
(2) Air Monitor Rental for PM10, TSP and Metals	14	mo	$ 2,800.00	15%	$ 45,080	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	14	mo	$ 1,200.00	15%	$ 19,320	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	276	day	$ 790.00	15%	$ 250,746	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	276	day	$ 725.00	15%	$ 230,115	Costs from HPNS Parcel C
Shipment of Sample Media	14	mo	$ 800.00	15%	$ 12,880	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	14	mo	$ 1,800.00	15%	$ 28,980	Quote from Pine Environmental
Portable Multi Gas Meter	14	mo	$ 1,200.00	15%	$ 19,320	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	14	mo	$ 1,150.00	15%	$ 18,515	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	552	hr	$ 70.00	15%	$ 44,436	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 37,635,837**	**Includes mob/demob and all construction activities**
Hot Spot Excavation			**Hot Spot Excavation =**		**$ 12,252,487**	See Backup Worksheet "HOT SPOT EXCAVATION"
Hot Spot Excavation	1	ea	$ 12,252,486.70		$ 12,252,487	
Hot Spot Backfill			**Hot Spot Backfill =**		**$ 3,469,570**	See Backup Worksheet "HOT SPOT BACKFILL"
Hot Spot Backfill	1	ea	$ 3,469,570.37		$ 3,469,570	
IR-03 Shoreline Excavation			**IR-03 Shoreline Excavation =**		**$ 8,228,670**	See Backup Worksheet "IR-03 SHORLINE EXCAVATION"
IR-03 Shoreline Excavation	1	ea	$ 8,228,669.94		$ 8,228,670	
IR-03 Shoreline Backfill			**IR-03 Shoreline Backfill =**		**$ 2,457,370**	See Backup Worksheet "IR-03 SHORLINE BACKFILL"
IR-03 Shoreline Backfill	1	ea	$ 2,457,370.36		$ 2,457,370	
Fuel Lines			**Fuel Lines =**		**$ 503,158**	See Backup Worksheet "FUEL LINES"
Fuel Lines	1	ea	$ 503,157.56		$ 503,158	
Steam Lines			**Steam Lines =**		**$ 240,085**	See Backup Worksheet "STEAM LINES"
Steam Lines	1	ea	$ 240,085.02		$ 240,085	
Sewer & Storm Lines			**Sewer & Storm Lines =**		**$ 1,726,943**	See Backup Worksheet "SEWER & STORM LINES"
Sewer & Storm Lines	1	ea	$ 1,726,942.98		$ 1,726,943	
Demo Rad Pads			**Demo Rad Pads =**		**$ 96,633**	See Backup Worksheet "DEMO RAD PADS"
Demo Rad Pads	1	ea	$ 96,632.50		$ 96,633	
Grade Foundation Layer			**Grade Foundation Layer =**		**$ 855,394**	See Backup Worksheet "GRADE FOUNDATION LAYER"
Grade Foundation Layer	1	ea	$ 855,393.50		$ 855,394	
Water Treatment			**Water Treatment Subtotal =**		**$ 690,487**	
Water Treatment System	1	ea	$ 683,684.98		$ 683,685	See Backup Worksheet "WATER TREATMENT"
Metals wastewater analysis (1 sample per day + 10% QC samples)	8	ea	$ 130.00		$ 1,099	C&T 2017
PCBs/Pesticides wastewater analysis (1 sample per day + 10% QC samples)	8	ea	$ 205.00		$ 1,732	C&T 2017
PAHs wastewater analysis (1 sample per day + 10% QC samples)	8	ea	$ 150.00		$ 1,268	C&T 2017
VOCs wastewater analysis (1 sample per day + 10% QC samples)	8	ea	$ 130.00		$ 1,099	C&T 2017
SVOCs wastewater analysis (1 sample per day + 10% QC samples)	8	ea	$ 190.00		$ 1,606	C&T 2017
Radiological Screening, loading of waste			**Radiological Screening, Loading of waste =**		**$ 6,153,808**	
Radiological Screening, loading of waste	1	ea	$ 6,153,807.55		$ 6,153,808	See Backup Worksheet "RADIOLOGICAL LOE"
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 407,955**	**Includes management, plans, and reports**
Assumed to be 1% of construction cost (including permitting)					$ 407,955	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR

Table B-1. Excavation and Offsite Disposal - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 276 working days
14 months

Description	Quantity	Unit	Unit Price	Fee		Cost	Comments
TOTAL PROJECT CAPITAL COST	**TOTAL PROJECT CAPITAL COST =**				**$**	**41,203,440**	**Includes Distributive Costs**
Total Construction Cost					$	40,795,485	
Total Management/Planning/Reporting Cost					$	407,955	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table B-2. Excavation and Offsite Disposal - General Labor Classifications and Rates

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	5	1	$ 6.50
	Project Engineer, Geologist or Scientist	$ 125.00	100	2	$ 250.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table B-3. Excavation and Offsite Disposal - Radiological Screening Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Unit Production Rate	Units	Comments	Production per Day	Assumptions	Total Production per day
Excavated soil from Hotspots	100	CY/hr per excavator (1)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Excavated soil from Shoreline	100	CY/hr per excavator (1)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Load out soil within 1000m^2 x 6" grid	100	CY/hr per excavator (2)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Transport excavated 1000m^2 x 1' volume to rad screening area / soil staging area in 20 CY loads	60	CY/hr per truck (3)	20 min cycle, 3 loads per hour	480 CY/day per truck	480 CY/day/truck x 2 trucks = 960 CY/day	960 CY/day ≈ 4.8 grids
Excavate Fuel Lines and Soil	33.33	CY/hr per excavator (2)	Each Excavator exc 150LF/day	267 CY/day per excavator	(3) excavators at 267 CY each = 800 CY/day	800 CY/day ≈ 4 grids
Excavate Steam Lines and Soil	33.33	CY/hr per excavator (2)	Each Excavator exc 150LF/day	267 CY/day per excavator	(3) excavators at 267 CY each = 800 CY/day	800 CY/day ≈ 4 grids
Excavate Storm & Sewer Lines and Soil	33.33	CY/hr per excavator (2)	Each Excavator exc 150LF/day	267 CY/day per excavator	(3) excavators at 267 CY each = 800 CY/day	800 CY/day ≈ 4 grids
Rad scan Foundation Layer	10,764	ft^2/day per crew (4)	Scan equivalent to a grid/day/crew	1 grids screened per day per crew	4 crews of 2 to scan equivalent of 4 grids per day of foundation layer	43,056 SF
Rad screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (4)	1 grid per crew per day	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids
UXO screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (5)	8 hours per grid per crew	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids

Notes:

(1) Average production rate determined from screening operations at other Hunter's Point parcels

(2) Average production rate determined from screening operations at other Hunter's Point parcels

(3) Average production rate determined from screening operations at other Hunter's Point parcels

(4) Average production rate determined from screening operations at other Hunter's Point parcels

(5) Average production rate determined from screening operations at other Hunter's Point parcels

Table B-4. Excavation and Offsite Disposal - Lab Analyses Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample
Encore Samplers for TPH-purgeable range (3 per sample)	**$ 39.00**
Analysis (for excavation chemicals only)	
Volatile Organic Compounds (VOCs)	$ 180.00
Semivolatile Organic Compounds (SVOCs)	$ 210.00
Pesticides	$ 138.00
Polychlorinated Biphenyls (PCBs)	$ 78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$ 54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$ 54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$ 108.00
Strontium-90	$ 142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$ 156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$ 90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$ 90.00
Total Cost/Pre-Excavation Characterization Sample:	**$ 753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$ 1,003.80**
Total Cost/Waste Characterization Sample:	**$ 586.80**

Analysis[2]	Cost per Sample
Analysis (Geotechnical for import fill only)	
Modified Proctor (1 every 5,200 CY)	$ 260.00
Sieve Analysis (1 every 2,000 CY)	$ 109.00
Atterberg Limits (1 every 2,000 CY)	$ 163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnicall costs provided by Cooper Testing Labs 2017

Table B-5. Excavation and Offsite Disposal - Site Preparation Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, support equipment and temp facilities			
	Units	**Quantity**	**Notes**
Lay Down Area	Acres	0.5	This locations will be used as a support area
Prep Existing Rad Pads			
	Units	**Quantity**	**Notes**
Rad Pads	EA	16	
Temporary Fence			
	Units	**Quantity**	**Notes**
Temp Fence	LF	10,546.00	Temp fence will be placed around staging and laydown areas

Table B-6. Excavation and Offsite Disposal - Quantities
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Hot Spot Excavation			Notes
Hot Spot Excavation Locations	109	EA	DBR Table 12
Hot Spot Excavation Volume	56,810	BCY	DBR Table 12
Sloping/Benching for Hotspots	12,500	BCY	DBR Table 12
Total Excavated Volume	69,310	BCY	Calculated
Number of equivalent 1000m^2 x 6" Rad Pads	348	EA	Calculated
Hot Spot Backfill			**Notes**
Import Fill Backfill (Hot Spots)	56,810	BCY	Calculated
Sloping/Benching Backfill Volume (Re-use)	12,500	BCY	Calculated
IR-03 Shorline Excavation			**Notes**
Install Sheet Pile	800	LF	Calculated from ACAD
Excavate Shorline	37,690	BCY	DBR Table 12
Number of equivalent 1000m^2 x 6" Rad Pads	190	EA	Calculated
IR-03 Shorline Excavation			**Notes**
Backfill Shorline Subgrade	37,690	BCY	Calculated from ACAD
Remove Sheet Pile	800	LF	Calculated
Fuel Lines			**Notes**
Fuel Lines Length	3,100	LF	Calculated from ACAD
Inspection Points	16	EA	Calculated
Number of equivalent 1000m^2 x 6" Rad Pads	28	EA	Calculated
Steam Lines			**Notes**
Steam Line Length (for inspection)	2,700	LF	Calculated from ACAD
Inspection Points	42	EA	Calculated
Asbestos spot removal (for inspection)	14	EA	Spot removal once per 200 LF
Steam Line Length (for removal)	270	LF	Assumes 10 percent requires removal
Asbestos spot removal (for line removal)	27	EA	Spot removal once per 10 LF
Number of equivalent 1000m^2 x 6" Rad Pads	8	EA	Calculated
Storm & Sewer Lines			**Notes**
Storm & Sewer Line Length	11,175	LF	Quantity Takeoff
Number of equivalent 1000m^2 x 6" Rad Pads	100	EA	Calculated
Demolition			**Notes**
Rad Pads to be Demolished	75	EA	Quantity takeoff on Plans
Grading			**Notes**
Grade Foundation Layer	4,591,986	SF	Calculated from ACAD
Number of equivalent 1000m^2 x 6" Rad Pads	427	EA	Calculated from ACAD
Radiological Survey			**Notes**
IR-02 and IR-03	1,895,284	SF	Calculated from ACAD
Salvage Yard (northern portion of IR-12)	148,297	SF	Calculated from ACAD

Table B-7. Excavation and Offsite Disposal - Site Preparation Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Restore Rad Pads (16) for use						
(6) Labors LBO1	4	Day	$ 3,360.00		$ 13,440.00	See "LABOR" Worksheet for detail
Rad Pad Repair Materials	16	EA	$ 1,500.00	15%	$ 27,600.00	Costs from Treasure Island
Install Temp Fence and 12 Month Rental	10,546	LF	$ 3.79	15%	$ 45,964.74	Costs from HPNS projects
TOTAL					$ 117,447	

Note:

Soil staging area volumes and areas:

Rad Pads to be preped for use	16	Pad
Number of 1000m^2 x 6" rad pads	348	Pad
Soil Staging area perimeter	69,600	LF
Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table B-8. Hot Spot Excavation and Offsite Disposal - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Pre-Excavation Characterization Sampling						
Direct Push (sampling Rig)	30	EA	$ 250.00	15%	$ 8,625.00	Driller Sub Pricing
Pre-excavation Sample analysis	30	EA	$ 753.00	15%	$ 25,978.50	See "LAB COST" Worksheet for Detail
Post-Excavation Confirmation Sampling						
Excavation Floor Sample	109	EA	$ 1,003.80	15%	$ 125,826.33	See "LAB COST" Worksheet for Detail
Sidewall Samples	872	EA	$ 1,003.80	15%	$ 1,006,610.64	See "LAB COST" Worksheet for Detail
Waste Characterization Sampling						
Soil Analysis for Disposal (per 1K CY)	57	EA	$ 586.80	15%	$ 38,464.74	See "LAB COST" Worksheet for Detail
Hot Spot & Overburden Excavation	69,310	BCY				
CAT 330 Excavator	87	Day	$ 750.00	15%	$ 75,037.50	Costs from HPNS Parcel B RA
(2) CAT 735 Off Road Dump Truck	87	Day	$ 1,500.00	15%	$ 150,075.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	87	Day	$ 125.00	15%	$ 12,506.25	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	87	Day	$ 500.00	15%	$ 50,025.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	87	Day	$ 808.00		$ 70,296.00	See "LABOR" Worksheet for detail
(2) Truck Driver TM03	87	Day	$ 1,232.00		$ 107,184.00	See "LABOR" Worksheet for detail
Truck Driver TM02	87	Day	$ 608.00		$ 52,896.00	See "LABOR" Worksheet for detail
Transport and disposal of excavated material						
Class II Beneficial Reuse Soil to Altamont	8,522	ton	$ 42.70	15%	$ 418,467.86	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	21,304	ton	$ 79.66	15%	$ 1,951,664.23	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	25,565	ton	$ 89.27	15%	$ 2,624,317.36	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	12,782	ton	$ 143.04	15%	$ 2,102,687.79	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	12,782	ton	$ 189.46	15%	$ 2,785,042.65	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	4,261	ton	$ 132.00	15%	$ 646,781.85	Assumed Fraction of Total Waste: 5%
TOTAL					$ 12,252,487	

Note:

Hot Spot volumes and areas:

Hot spot Locations	109	EA	
additional pre-characterization samples needed	30	EA	
Foot Print of Excavations	296,700	SF	
Approx. Average Depth of Excavation	5	FT	
Hot Spot Excavation Volume	56,810	CY	
Hotspot Tonnage	85,215	Tons	1.5 BCY to Ton Factor
Sloping/Benching Volume	12,500	CY	
Total Excavated Volume	69,310	CY	
Number of equivalent 1000m^2 x 6" Rad Pads	348	Pads	

Table B-9. Hot Spot Backfilling - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Overburden Sampling						
Modified Proctor (1 every 5,200 CY)	3	EA	$ 260.00	15%	$ 897.00	See "LAB COST" Worksheet for Detail
Sieve Analysis (1 every 2,000 CY)	7	EA	$ 109.00	15%	$ 877.45	See "LAB COST" Worksheet for Detail
Atterberg Limits (1 every 2,000 CY)	7	EA	$ 163.00	15%	$ 1,312.15	See "LAB COST" Worksheet for Detail
Import Fill Sampling						
Import Fill Chemical Sampling	57	EA	$ 1,003.80	15%	$ 65,799.09	See "LAB COST" Worksheet for Detail
Modified Proctor (1 every 5,200 CY)	11	EA	$ 260.00	15%	$ 3,289.00	See "LAB COST" Worksheet for Detail
Sieve Analysis (1 every 2,000 CY)	29	EA	$ 109.00	15%	$ 3,635.15	See "LAB COST" Worksheet for Detail
Atterberg Limits (1 every 2,000 CY)	29	EA	$ 163.00	15%	$ 5,436.05	See "LAB COST" Worksheet for Detail
Backfill Import Fill (Hot Spots)	56,810	CY				
CAT D6T Dozer	64	Day	$ 450.00	15%	$ 33,120.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	64	Day	$ 125.00	15%	$ 9,200.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	64	Day	$ 400.00	15%	$ 29,440.00	Costs from HPNS Parcel B RA
Laborer LB01	64	Day	$ 560.00		$ 35,840.00	See "LABOR" Worksheet for detail
Equipment Operator EQ03	64	Day	$ 808.00		$ 51,712.00	See "LABOR" Worksheet for detail
Truck Driver TM02	64	Day	$ 608.00		$ 38,912.00	See "LABOR" Worksheet for detail
Filter Fabric 14N	296,700	SF	$ 0.12	15%	$ 39,491.32	Quote from White Cap
Backfill Overburden	12,500	CY				
CAT 330 Excavator	16	Day	$ 750.00	15%	$ 13,800.00	Costs from HPNS Parcel B RA
(2) CAT 735 Off Road Dump Truck	16	Day	$ 1,500.00	15%	$ 27,600.00	Costs from HPNS Parcel B RA
CAT D6T Dozer	16	Day	$ 450.00	15%	$ 8,280.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	16	Day	$ 125.00	15%	$ 2,300.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	16	Day	$ 500.00	15%	$ 9,200.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	16	Day	$ 808.00		$ 12,928.00	See "LABOR" Worksheet for detail
(2) Truck Driver TM03	16	Day	$ 1,232.00		$ 19,712.00	See "LABOR" Worksheet for detail
Truck Driver TM02	16	Day	$ 608.00		$ 9,728.00	See "LABOR" Worksheet for detail
Drain Rock - Trucking and Material	15,907	Tons	$ 38.00	15%	$ 695,127.16	Costs from HPNS Parcel B RA
Import Fill - Trucking and Material	68,172.0	Tons	$ 30.00	15%	$ 2,351,934.00	Costs from HPNS Parcel B RA
TOTAL					$ 3,469,570	

Table B-9. Hot Spot Backfilling - Cost Detail *(continued)*

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Note:

Hot Spot volumes and areas:

Hot spot Locations	109	EA		
Additional pre-characterization samples needed	30	EA		
Foot Print of Excavations	296,700	SF		
Approx. Average Depth of Excavation	5	FT		
Hot Spot Backfill Import Volume	56,810	CY		
Hot Spot Drain Rock Volume	11,362	CY	0.2	assumes 20% of the total import will be drain rock for bridging
Hot Spot Drain Rock Tonnage	15,907	Tons	1.4	BCY to Ton Factor
Hotspot Backfill Volume (Import Fill)	45,448	CY	0.8	assumes 80% of the backfill material will be import fill
Hotspot Backfill Tonnage (Import Fill)	68,172	Tons	1.5	BCY to Ton Factor
Sloping/Benching Volume	12,500	CY		
Total Backfill Volume	69,310	CY		
Number of equivalent 1000 m^2 x 6" Rad Pads	348	Pads		

Table B-10. IR-03 Shoreline Excavation and Offsite Disposal - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Sheet Pile Installation	12	Day				
Install Sheet Pile (35' long)	800	LF	$ 900.00	15%	$ 828,000.00	Quote from Blue Iron
Post-Confirmation Sampling						
Excavation Floor Sample	20	EA	$ 1,003.80	15%	$ 23,087.40	See "LAB COST" Worksheet for Detail
Sidewall Samples	70	EA	$ 1,003.80	15%	$ 80,805.90	See "LAB COST" Worksheet for Detail
Waste Characterization Sampling						
Soil Analysis for Disposal (per 1K CY)	38	EA	$ 586.80	15%	$ 25,643.16	See "LAB COST" Worksheet for Detail
Shorline Excavation	37,690	BCY				
CAT 330 Excavator	48.0	Day	$ 750.00	15%	$ 41,400.00	Costs from HPNS Parcel B RA
(2) CAT 735 Off Road Dump Truck	48.0	Day	$ 1,500.00	15%	$ 82,800.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	48.0	Day	$ 125.00	15%	$ 6,900.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	48.0	Day	$ 500.00	15%	$ 27,600.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	48.0	Day	$ 808.00		$ 38,784.00	See "LABOR" Worksheet for detail
(2) Truck Driver TM03	48.0	Day	$ 1,232.00		$ 59,136.00	See "LABOR" Worksheet for detail
Truck Driver TM02	48.0	Day	$ 608.00		$ 29,184.00	See "LABOR" Worksheet for detail
Transport and disposal of excavated material						
Class II Benificial Reuse Soil to Altamont	5,653.5	ton	$ 42.70	15%	$ 277,628.12	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	14,133.8	ton	$ 79.66	15%	$ 1,294,811.21	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	16,960.5	ton	$ 89.27	15%	$ 1,741,075.89	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	8,480.3	ton	$ 143.04	15%	$ 1,395,006.21	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	8,480.3	ton	$ 189.46	15%	$ 1,847,707.40	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	2,826.8	ton	$ 132.00	15%	$ 429,100.65	Assumed Fraction of Total Waste: 5%
TOTAL					$ 8,228,670	

Note:

Shorline line volumes and areas:

Excavation Area	49,726	SF	
Floor Confirmation Samples	20.00	EA	
Perimieter Excavation Length	1,750	LF	
Aprox Average Depth of Excavation	17	FT	
Sidewall Samples	70	EA	
Shorline Excavation Volume	37,690	CY	
Shorline Tonnage	56,535	Tons	1.5 BCY to Ton Factor
Number of equivalent 1000m^2 x 6" Rad Pads	190	Pads	

Table B-11. IR-03 Shoreline Excavation Backfilling - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Import Fill Sampling						
Import Fill Chemical Sampling	14	EA	$ 1,003.80	15%	$ 16,161.18	See "LAB COST" Worksheet for Detail
Modified Proctor (1 every 5,200 CY)	3	EA	$ 260.00	15%	$ 897.00	See "LAB COST" Worksheet for Detail
Sieve Analysis (1 every 2,000 CY)	7	EA	$ 109.00	15%	$ 877.45	See "LAB COST" Worksheet for Detail
Atterberg Limits (1 every 2,000 CY)	7	EA	$ 163.00	15%	$ 1,312.15	See "LAB COST" Worksheet for Detail
Backfill Drain Rock & Import Fill (Shoreline)	37,690	CY				
CAT D6T Dozer	48	Day	$ 450.00	15%	$ 24,840.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	48	Day	$ 125.00	15%	$ 6,900.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	48	Day	$ 300.00	15%	$ 16,560.00	Costs from HPNS Parcel B RA
Laborer LB01	48	Day	$ 560.00		$ 26,880.00	See "LABOR" Worksheet for detail
Equipment Operator EQ03	48	Day	$ 808.00		$ 38,784.00	See "LABOR" Worksheet for detail
Truck Driver TM02	48	Day	$ 608.00		$ 29,184.00	See "LABOR" Worksheet for detail
Filter Fabric 14N	59,860.59	SF	$ 0.12	15%	$ 7,967.56	Quote from White Cap
Drain Rock - Trucking and Material	36,581.5	Tons	$ 38.00	15%	$ 1,598,610.26	Costs from HPNS Parcel B RA
Import Fill - Trucking and Material	19,953.5	Tons	$ 30.00	15%	$ 688,396.76	Costs from HPNS Parcel B RA
TOTAL					$ 2,457,370	

Note:

Shoreline volumes and areas:

Shoreline Backfill Import Volume	37,690	CY		
Shoreline Backfill Bridging Drain Rock Volume	24,388	CY	0.65	Assumes about 2/3s of the material or 11 of the 17 feet needs rock
Drain Rock Tonnage	36,581	Tons	1.4	BCY to Ton Factor
Shoreline Import Fill Volume	13,302	CY	0.35	Assumes top 6' of the 17 will be import fill
Hotspot Backfill Tonnage (Import Fill)	19,954	Tons	1.5	BCY to Ton Factor

Table B-12. Fuel Line Closure - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Excavate and Remove Fuel Lines	3,100	LF				
(3) John Deere 225 Excavator	7.0	Day	$ 1,500.00	15%	$ 12,075.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	7.0	Day	$ 1,200.00	15%	$ 9,660.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	7.0	Day	$ 125.00	15%	$ 1,006.25	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	7.0	Day	$ 750.00	15%	$ 6,037.50	Costs from HPNS Parcel B RA
(3) Equipment Operator EQ03	7.0	Day	$ 2,424.00		$ 16,968.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	7.0	Day	$ 1,848.00		$ 12,936.00	See "LABOR" Worksheet for detail
Truck Driver TM02	7.0	Day	$ 608.00		$ 4,256.00	See "LABOR" Worksheet for detail
Backfill Removed Fuel Lines	3,100	LF				
(3) John Deere 225 Excavator	7.0	Day	$ 1,500.00	15%	$ 12,075.00	Costs from HPNS Parcel B RA
(3) Compaction Wheels	7.0	Day	$ 600.00	15%	$ 4,830.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	7.0	Day	$ 1,200.00	15%	$ 9,660.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	7.0	Day	$ 125.00	15%	$ 1,006.25	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	7.0	Day	$ 750.00	15%	$ 6,037.50	Costs from HPNS Parcel B RA
Laborer LB01	7.0	Day	$ 560.00		$ 3,920.00	See "LABOR" Worksheet for detail
(3) Equipment Operator EQ03	7.0	Day	$ 2,400.00		$ 16,800.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	7.0	Day	$ 1,848.00		$ 12,936.00	See "LABOR" Worksheet for detail
Truck Driver TM02	7.0	Day	$ 608.00		$ 4,256.00	See "LABOR" Worksheet for detail
Filter Fabric 14N	31,000.0	SF	$ 0.12	15%	$ 4,126.16	Quote from White Cap
Inspect Fuel Lines						
Shielding (Shoring quipment)	8.0	Day	$ 400.00	15%	$ 3,680.00	Costs from HPNS Parcel B RA
Inspection Equipment	8.0	Day	$ 300.00	15%	$ 2,760.00	Costs from HPNS Parcel B RA
(2) Labors LBO1	8.0	Day	$ 1,120.00		$ 8,960.00	See "LABOR" Worksheet for detail
Waste Characterization Sampling	6.0	EA	$ 586.80	15%	$ 4,048.92	See "LAB COST" Worksheet for Detail
Transport and disposal of excavated material						
Class II Benificial Reuse Soil to Altamont	210.0	ton	$ 42.70	15%	$ 10,312.53	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	525.0	ton	$ 79.66	15%	$ 48,095.93	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	630.0	ton	$ 89.27	15%	$ 64,672.49	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	315.0	ton	$ 143.04	15%	$ 51,817.69	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	315.0	ton	$ 189.46	15%	$ 68,633.33	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	105.0	ton	$ 132.00	15%	$ 15,939.00	Assumed Fraction of Total Waste: 5%
Drain Rock - Trucking and Material	1,960.0	Tons	$ 38.00	15%	$ 85,652.00	Costs from HPNS Parcel B RA
TOTAL					$ 503,158	

Table B-12. Fuel Line Closure - Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Note:
Fuel Lines volumes and areas:

Total Fuel Lines	3,100	LF		
Expected Fuel Line Removal	3,100	LF	1	Factor of Fuel Line Removal
Trench Width	5	FT		
Pipe Depth	10	FT		
Volume Excavated per Day	800	CY		
Backfill Volume per Day	800	CY		
Total Volume Excavated	5,600	CY		
Expected Material for Disposal	1,400	CY	0.25	Factor for contaminated soil
Material for Disposal in tons	2,100	Tons	1.5	BCY to tons factor
Total Volume Backfill	5,600	CY		
Backfill Re-use Soil	4,200	CY		
Backfill Import Fill Material (Drain Rock)	1,400	CY		
Import Material in Tons	1,960	Tons	1.4	BCY to tons factor
Fuel Line Inspection	16.00	EA		

Table B-13. Steam Line Closure - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Inspect Steam Lines						
(1) John Deere 225 Excavator	21.0	Day	$ 500.00	15%	$ 12,075.00	To remove utilidor covers
Fuel For heavy Equipment	21.0	Day	$ 250.00	15%	$ 6,037.50	To remove utilidor covers
(1) Equipment Operator EQ03	21.0	Day	$ 808.00		$ 16,968.00	See "LABOR" Worksheet for detail
(2) Laborers LB01 - for asbestos spot removal	2.0	Day	$ 1,120.00		$ 2,240.00	See "LABOR" Worksheet for detail
Asbestos spot removal equipment and disposal	2.0	Day	$ 2,000.00	15%	$ 4,600.00	Costs from other projects
Inspection Equipment	21.0	Day	$ 300.00	15%	$ 7,245.00	Costs from HPNS Parcel B RA
Wipe Analysis	42.0	EA	$ 586.80	15%	$ 28,342.44	See "LAB COST" Worksheet for Detail
(2) Laborers LB01 - for line inspection	21.0	Day	$ 1,120.00		$ 23,520.00	See "LABOR" Worksheet for detail
Excavate and Remove Steam Lines	270	LF				
(2) Laborers LB01 - for asbestos spot removal	3.0	Day	$ 1,120.00		$ 3,360.00	See "LABOR" Worksheet for detail
Asbestos spot removal equipment and disposal	3.0	Day	$ 2,000.00	15%	$ 6,900.00	Costs from other projects
(3) John Deere 225 Excavator	2.0	Day	$ 1,500.00	15%	$ 3,450.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	2.0	Day	$ 1,200.00	15%	$ 2,760.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	2.0	Day	$ 200.00	15%	$ 460.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	2.0	Day	$ 750.00	15%	$ 1,725.00	Costs from HPNS Parcel B RA
(3) Equipment Operator EQ03	2.0	Day	$ 2,424.00		$ 4,848.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	2.0	Day	$ 1,848.00		$ 3,696.00	See "LABOR" Worksheet for detail
Truck Driver TM02	2.0	Day	$ 608.00		$ 1,216.00	See "LABOR" Worksheet for detail
Dispose of steam line sections (with intact asbestos)	1.0	Bin	$ 4,500.00	15%	$ 5,175.00	Costs from other projects
Backfill Removed Steam Lines	270	LF				
(3) John Deere 225 Excavator	1.0	Day	$ 1,500.00	15%	$ 1,725.00	Costs from HPNS Parcel B RA
(3) Compaction Wheels	1.0	Day	$ 600.00	15%	$ 690.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	1.0	Day	$ 1,200.00	15%	$ 1,380.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 200.00	15%	$ 230.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 750.00	15%	$ 862.50	Costs from HPNS Parcel B RA
Laborer LB01	1.0	Day	$ 560.00		$ 560.00	See "LABOR" Worksheet for detail
(3) Equipment Operator EQ03	1.0	Day	$ 2,400.00		$ 2,400.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	1.0	Day	$ 1,848.00		$ 1,848.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Filter Fabric 14N	2,700.0	SF	$ 0.12	15%	$ 359.38	Quote from White Cap

Table B-13. Steam Line Closure - Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Waste Characterization Sampling (for excavated soil)	2.0	EA	$ 586.80	15%	$ 1,349.64	See "LAB COST" Worksheet for Detail	
Transport and disposal of excavated material							
Class II Beneficial Reuse Soil to Altamont	60.0	ton	$ 42.70	15%	$ 2,946.44	Assumed Fraction of Total Waste:	10%
Class II Soil to Altamont	150.0	ton	$ 79.66	15%	$ 13,741.70	Assumed Fraction of Total Waste:	25%
Class I Non-RCRA Soil to Kettleman Hills	180.0	ton	$ 89.27	15%	$ 18,477.86	Assumed Fraction of Total Waste:	30%
Class I RCRA Direct LF Soil to Kettleman Hills	90.0	ton	$ 143.04	15%	$ 14,805.05	Assumed Fraction of Total Waste:	15%
Class I RCRA Stabilization Soil to Kettleman Hills	90.0	ton	$ 189.46	15%	$ 19,609.52	Assumed Fraction of Total Waste:	15%
Disposal of radiologically impacted waste	30.0	ton	$ 132.00	15%	$ 4,554.00	Assumed Fraction of Total Waste:	5%
Drain Rock - Trucking and Material	560.0	Tons	$ 30.00	15%	$ 19,320.00	Costs from HPNS Parcel B RA	
TOTAL					$ 240,085		

Note:

Steam Lines Volumes and areas:

Length of Steam Line Utilidors	2,700	LF		Utilidors contain steam lines, condensate return lines, and pump return lines
Expected Steam Line Removal	270	LF	0.1	Factor of Steam Line Removal
Trench Width	5	FT		
Pipe Depth	10	FT		
Volume Excavated per Day	800	CY		
Backfill Volume per Day	800	CY		
Total Volume Excavated	1,600	CY		
Expected Material for Disposal	400	CY	0.25	Factor for contaminated soil
Material for Disposal in tons	600	Tons	1.5	BCY to tons factor
Total Volume Backfill	800	CY		
Backfill Re-use Soil	400	CY		
Backfill Import Fill Material (Drain Rock)	400	CY		
Import Material in Tons	560	Tons	1.4	BCY to tons factor
Steam Line Inspection	42.00	EA		Up to 3 separate lines within each 200-foot utilidor inspected

Table B-14. Fuel Line Closure - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Excavate and Remove Fuel Lines	11,175	LF				
(3) John Deere 225 Excavator	25.0	Day	$ 1,500.00	15%	$ 43,125.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	25.0	Day	$ 1,200.00	15%	$ 34,500.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	25.0	Day	$ 125.00	15%	$ 3,593.75	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25.0	Day	$ 750.00	15%	$ 21,562.50	Costs from HPNS Parcel B RA
(3) Equipment Operator EQ03	25.0	Day	$ 2,424.00		$ 60,600.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	25.0	Day	$ 1,848.00		$ 46,200.00	See "LABOR" Worksheet for detail
Truck Driver TM02	25.0	Day	$ 608.00		$ 15,200.00	See "LABOR" Worksheet for detail
Backfill Removed Fuel Lines	11,175	LF				
(3) John Deere 225 Excavator	25.0	Day	$ 1,500.00	15%	$ 43,125.00	Costs from HPNS Parcel B RA
(3) Compaction Wheels	25.0	Day	$ 600.00	15%	$ 17,250.00	Costs from HPNS Parcel B RA
(3) 10 Wheel Haul Truck	25.0	Day	$ 1,200.00	15%	$ 34,500.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	25.0	Day	$ 125.00	15%	$ 3,593.75	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	25.0	Day	$ 750.00	15%	$ 21,562.50	Costs from HPNS Parcel B RA
Laborer LB01	25.0	Day	$ 70.00		$ 1,750.00	See "LABOR" Worksheet for detail
(3) Equipment Operator EQ03	25.0	Day	$ 2,400.00		$ 60,000.00	See "LABOR" Worksheet for detail
(3) Truck Driver TM03	25.0	Day	$ 1,848.00		$ 46,200.00	See "LABOR" Worksheet for detail
Truck Driver TM02	25.0	Day	$ 608.00		$ 15,200.00	See "LABOR" Worksheet for detail
Filter Fabric	111,750.0	SF	$ 0.12	15%	$ 14,874.13	Quote from White Cap
Waste Characterization Sampling	20.0	EA	$ 586.80	15%	$ 13,496.40	See "LAB COST" Worksheet for Detail
Transport and disposal of excavated material						
Class II Beneficial Reuse Soil to Altamont	748.8	ton	$ 42.70	15%	$ 36,771.55	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	1,872.0	ton	$ 79.66	15%	$ 171,496.35	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	2,246.4	ton	$ 89.27	15%	$ 230,603.63	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	1,123.2	ton	$ 143.04	15%	$ 184,767.07	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	1,123.2	ton	$ 189.46	15%	$ 244,726.86	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	374.4	ton	$ 132.00	15%	$ 56,833.92	Assumed Fraction of Total Waste: 5%
Drain Rock Import - Trucking and Material	6,988.8	Tons	$ 38.00	15%	$ 305,410.56	Costs from HPNS Parcel B RA
TOTAL					$ 1,726,943	

Table B-14. Fuel Line Closure - Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Note:
Storm & Sewer Lines volumes and areas:

Total Fuel Lines	11,175	LF		
Expected Fuel Line Removal	11,175	LF	1	Factor of Fuel Line Removal
Trench Width	5	FT		
Pipe Depth	7	FT		
Volume Excavated per Day	800	CY		
Backfill Volume per Day	800	CY		
Total Volume Excavated	19,968	CY	1	Volume based on E&E-2 proposal and takeoff for 11175LF
Expected Material for Disposal	4,992	CY	0.25	Factor for contaminated soil
Material for Disposal in tons	7,488	Tons	1.5	BCY to tons factor
Total Volume Backfill	19,968	CY		
Backfill Re-use Soil	14,976	CY		
Backfill Import Fill Material (Drain Rock)	4,992	CY		
Import Material in Tons (Drain Rock)	6,989	Tons	1.4	BCY to tons factor

Table B-15. Demolition of Radiological Screening Pads - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Rad Pads to be Demoed	75	EA				
CAT 330 Excavator	15.0	Day	$ 1,000.00	15%	$ 17,250.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	15.0	Day	$ 200.00	15%	$ 3,450.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	15.0	Day	$ 200.00	15%	$ 3,450.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	15.0	Day	$ 808.00		$ 12,120.00	See "LABOR" Worksheet for detail
(2) Laborers	15.0	Day	$ 1,120.00		$ 16,800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	15.0	Day	$ 608.00		$ 9,120.00	See "LABOR" Worksheet for detail
AC debris for Recycling	28.0	Load	$ 400.00	15%	$ 12,880.00	Costs from HPNS Parcel B RA
Misc. Debris for Disposal	25.0	Bin	$ 750.00	15%	$ 21,562.50	Costs from HPNS Parcel B RA
TOTAL					$ 96,633	

Note:

Volumes from Rad Pads:

Total Rad Pads to be demoed	75	EA
Pad AC Debris	278.00	CY
Pad AC Debris in loads	28.00	Load
Misc. Construction Debris (40 CY Bin)	25	Bin

Table B-16. Soil Cover Foundation Layer - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Foundation Layer Grading	4,591,986	SF				
(2) CAT 14H Motor Grader	58.0	Day	$ 1,500.00	15%	$ 100,050.00	Costs from HPNS Parcel B RA
CAT 617 Paddle Wheel Scrapper	58.0	Day	$ 750.00	15%	$ 50,025.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	58.0	Day	$ 125.00	15%	$ 8,337.50	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	58.0	Day	$ 750.00	15%	$ 50,025.00	Costs from HPNS Parcel B RA
Equipment Operator EQ02	58.0	Day	$ 840.00		$ 48,720.00	See "LABOR" Worksheet for detail
Equipment Operator EQ04	58.0	Day	$ 784.00		$ 45,472.00	See "LABOR" Worksheet for detail
Truck Driver TM02	58.0	Day	$ 608.00		$ 35,264.00	See "LABOR" Worksheet for detail
Import Fill for Foundation Layer (balance)	15,000.0	Tons	$ 30.00	15%	$ 517,500.00	Costs from HPNS Parcel B RA
TOTAL					$ 855,394	

Note:

Foundation Layer volumes and areas:

Area of Foundation Layer for Grading	4,591,986	SF	
Foundation layer area in acres	105.42	Acres	
Expected Import Fill for Foundation Layer Balance	10,000.00	CY	
Expected Import Fill for Foundation Layer Balance	15,000	Tons	1.5 BCY to tons factor

Table B-17. Radiological Survey/Remediation for Excavation Work - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Geophysical monitoring equipment rental for UXO screening	1	months	$ 5,000.00	15%	$ 5,750	Costs from HPNS IR 7 & 18
Radiological Support Services	276	Day	$ 3,650.00	15%	$ 1,158,510	Costs from HPNS IR 7 & 18
SUPRA/FSS Rad Pads (Screening)	674	EA	$ 3,700.00	15%	$ 2,867,870	Costs from HPNS IR 7 & 18
SUPRA/FSS IR-02/IR-03/Salvage Yard (Pad area Equivalent)	2,043,581	SF	$ 0.34	15%	$ 807,833	Costs from HPNS IR 7 & 18
Manage Excavated Soil Material & Debris						
CAT 14H Motor Grader	169	Day	$ 1,000.00	15%	$ 194,350	Costs from HPNS Parcel B RA
Bobcat T-190	276	Day	$ 400.00	15%	$ 126,960	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	169	Day	$ 300.00	15%	$ 58,305	Costs from HPNS Parcel B RA
Equipment Operator EQ02	169	Day	$ 840.00		$ 141,960	See "LABOR" Worksheet for detail. Operator will use Motor Grader
Equipment Operator EQ06	276	Day	$ 736.00		$ 203,136	See "LABOR" Worksheet for detail. Operator will use bobcat
Excavate 1000m^2 x 1' grid and Load out						
CAT 330 Excavator	169	Day	$ 1,000.00	15%	$ 194,350	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	169	Day	$ 300.00	15%	$ 58,305	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	169	Day	$ 500.00	15%	$ 97,175	Costs from HPNS Parcel B RA
Equipment Operator EQ03	169	Day	$ 808.00		$ 136,552	Costs from HPNS Parcel B RA
Truck Driver TM02	169	Day	$ 608.00		$ 102,752	Costs from HPNS Parcel B RA
TOTAL					$ 6,153,808	

Note:

Soil quantities:

Total CY to Rad Pads	134,168	CY	
Total CY to be disposed of	13417	CY	Assume 10% to be disposed of for Rad
Total Days Excavating	169	Days	
Excavated Volume Per Day	794	CY/Day	

Table B-18. Excavation and Offsite Disposal - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate		Total Amount		Days to Complete		Assumptions
SITE PREP							
Grade Laydown area (0.5 acres)	40,000	SF/day	21,780	SF	1	days	Production rate from HPNS Parcel B
Rad Pad Repairs	4	Pad/Day	16	Pads	4	days	Production rates from Treasure Island
Cover over laydown area with 1.5" Rock (6" thick)	20,000	SF/day	21,780	SF	1	days	Production rate from HPNS IR7 &18
Hot Spot Excavations							
Hot Spot Excavation	800	CY/day	69,310	CY	87	days	Production rate from HPNS Parcel B
Hot Spot Backfill							
Import Fill for Hotspots	900	CY/day	56,810	CY	64	days	Production rate from HPNS Parcel B
Backfill Overburden	800	CY/day	12,500	CY	16	days	Production rate from HPNS Parcel B
IR-03 Shoreline Excavation							
Install Sheet Pile	70	LF/day	800	LF	12	days	Production rate from HPNS Parcel B
Excavate Shoreline	800	CY/day	37,690	CY	48	days	Production rate from HPNS Parcel B
IR-03 Shoreline Backfill							
Backfill Shoreline	800	CY/day	37,690	CY	48	days	Production rate from HPNS Parcel B
Remove Sheet Pile	70	CY/day	800	LF	12	days	Production rate from HPNS Parcel B
Fuel Line							
Fuel Lines Removal	450	LF/Day	3,100	LF	7	days	Production rate HPNS projects
Backfill Fuel Line Locations	450	LF/Day	3,100	LF	7	days	Production rate HPNS projects
Fuel Line Inspections	2	EA/Day	16	EA	8	days	Production rate HPNS projects
Steam Line							
Steam Lines Removal (incl concrete removal)	200	LF/Day	270	LF	2	days	Production rate HPNS projects
Backfill Steam Lines Locations	450	LF/Day	270	LF	1	days	Production rate HPNS projects
Asbestos spot removal (for inspection)	10	EA/Day	14	EA	2	days	Production rate other projects
Asbestos spot removal (for line removal)	10	EA/Day	27	EA	3	days	Production rate other projects
Steam Line Inspections	2	EA/Day	42	EA	21	days	Production rate HPNS projects
Sewer & Storm Lines							
Sewer & Storm Lines Removal	450	LF/Day	11,175	LF	25	days	Production rate HPNS projects
Backfill Sewer & Storm Line Locations	450	LF/Day	11,175	LF	25	days	Production rate HPNS projects
DEMOLITION							
Rad Pads	5	Pad/day	75	Pads	15	days	Production rate from HPNS Parcel E-2
FOUNDATION PREPERATION							
Grade Foundation layer	80000	SF/day	4,591,986	SF	58	days	Production rate from HPNS Parcel B

Table B-18. Excavation and Offsite Disposal - Production Rate Assumptions *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate		Total Amount		Days to Complete		Assumptions
RADIOLOGICAL SCREENING AND LOAD OUT							
Radiological and UXO characterization and release					20	days	20 days to obtain radiological and UXO release of screening pads
Manage Rad Pad Material					169	days	Smooth out Rad Pads and prepare material for Rad Screening
Excavate 1000m^2 x 6" grid and transport to disposal facility	4	grids/day	674	grids	169	days	See Backup Worksheet "RADIOLOGICAL LOE"; see Backup Worksheet "EXCAVATIONS"
SURVEY/DEMOBILIZATION							
Survey Crew					40	day	Misc Survey
Demobilization					5	day	
				TOTAL	**276**	**days**	

Table B-19. Water Treatment System Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Cost	Remarks
Mobilize modular tank, 21,000 gal. (10)	4.5	hr	$ 1,900.00	$ 8,550	Costs from HPNS Parcel B RA
Mobilization of clay and carbon filtration system	1	ls	$ 500.00	$ 500	Costs from HPNS Parcel B RA
Organphillic clay, initial fill	1	ls	$ 4,945.00	$ 4,945	Costs from HPNS Parcel B RA
Virgin coconut shell carbon acid washed (12x30), initial fill	16,900	lb	$ 1.25	$ 21,125	Costs from HPNS Parcel B RA
Structural slab on grade (8 in. thick; 60 x 15 ft.)	900	sf	$ 10.48	$ 9,429	Costs from HPNS Parcel B RA
Filter bags, 25 micron PDDA	34	ea	$ 3.20	$ 108	Costs from HPNS Parcel B RA
Particulate filter cartridges, 5.0 micron	270	ea	$ 9.05	$ 2,447	Costs from HPNS Parcel B RA
45KW Generator and Fuel (2)	8	mo	$ 6,000.00	$ 50,700	Costs from HPNS Parcel B RA
Dewatering Labor LB01 (4)	8	mo	$ 44,800.00	$ 378,560	Labor rates (included 2 laborers running two shifts so 32 hrs/day)
Equipment Rental					
Modular tank, 21,000 gal. (14)	8	mo	$ 10,500.00	$ 88,725	Costs from HPNS Parcel B RA
Forklift, straight mast, 12' lift, 5,000 lb, 2 wheel drive, gas	8	mo	$ 1,775.00	$ 14,999	Costs from HPNS Parcel B RA
Feed pump (submersible 2", 120 gpm)	8	mo	$ 201.00	$ 1,698	Costs from HPNS Parcel B RA
Box weir	8	mo	$ 1,064.00	$ 8,991	Costs from HPNS Parcel B RA
Electric centrifugal pump, 20 GPM	8	mo	$ 1,250.00	$ 10,563	Costs from HPNS Parcel B RA
Electrical panel and cable	8	mo	$ 100.00	$ 845	Costs from HPNS Parcel B RA
Particulate filter, PF 50 (2)	8	mo	$ 1,500.00	$ 12,675	Costs from HPNS Parcel B RA
Clay vessel, 35 CY	8	mo	$ 225.00	$ 1,901	Costs from HPNS Parcel B RA
Carbon vessels, 2,000 lbs (3)	8	mo	$ 2,277.00	$ 19,241	Costs from HPNS Parcel B RA
Miscellaneous pipe, hose, adapters, etc. rental	8	mo	$ 5,000.00	$ 42,250	Costs from HPNS Parcel B RA
Disposal of clay and carbon	1	ls	$ 3,070.00	$ 3,070	Costs from HPNS Parcel B RA
Demobilization of clay and carbon filtration system	1	ls	$ 725.00	$ 725	Costs from HPNS Parcel B RA
Delivery and pick-up hauling	1	ls	$ 1,260.00	$ 1,260	Costs from HPNS Parcel B RA
Fuel Surcharge	1	ls	$ 378.00	$ 378	Costs from HPNS Parcel B RA
TOTAL				$ 683,685	

Appendix C. Activity 3 Cost Estimate (SVE and In-Situ Groundwater Treatment)

Available on CD.

Table C-1. Soil Vapor Extraction and Groundwater Treatment - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 83 working days
5 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 909,779**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 799,954**	
Total project professional/technical labor cost					$ 389,934	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 156,040	See backup worksheet "LABOR"
Rad Tech Support (Scanning)					$ 132,800	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 121,180	See backup worksheet "LABOR"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 109,825**	
30' connex office trailer	5	mo	$ 550.00	15%	$ 3,163	Quote from Mobile Mini
Office Equipment Rental	5	mo	$ 800.00	15%	$ 4,600	Costs from HPNS Parcel C
Office Supplies	5	mo	$ 100.00	15%	$ 575	Costs from HPNS Parcel C
Telephone Bill	5	mo	$ 50.00	15%	$ 288	Costs from HPNS Parcel C
Internet Bill	5	mo	$ 200.00	15%	$ 1,150	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	5	mo	$ 5,400.00	15%	$ 31,050	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	5	mo	$ 500.00	15%	$ 2,875	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	5	mo	$ 2,000.00	15%	$ 11,500	Quote from Hertz
Fuel for Rental Trucks	5	mo	$ 1,200.00	15%	$ 6,900	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	5	mo	$ 6,000.00	15%	$ 34,500	Quote from Sitech
8K Forklift	5	mo	$ 2,300.00	15%	$ 13,225	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 1,835,518**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 690**	
Manlift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 23,920**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	83	day	$ 100.00	15%	$ 9,545	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	5	mo	$ 2,500.00	15%	$ 14,375	Quote from BlueLine Rentals
Site Preparation	**Site Preparation Subtotal =**				**$ 38,796**	
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	5	mo	$ 1,763.00	15%	$ 10,137	Quote from Cam Guard
Land survey	5	day	$ 2,200.00	15%	$ 12,650	Quote from ESP Surveying
Subsurface utility surveying	2	day	$ 1,400.00	15%	$ 3,220	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C
Air Monitoring	**Air Monitoring Subtotal =**				**$ 189,457**	
(2) Air Monitor Rental for PM10, TSP and Metals	5	mo	$ 2,800.00	15%	$ 16,100	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	5	mo	$ 1,200.00	15%	$ 6,900	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	83	day	$ 790.00	15%	$ 75,406	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	83	day	$ 725.00	15%	$ 69,201	Costs from HPNS Parcel C
Shipment of Sample Media	5	mo	$ 800.00	15%	$ 4,600	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	5	mo	$ 1,800.00	15%	$ 10,350	Quote from Pine Environmental
Portable Multi Gas Meter	5	mo	$ 1,200.00	15%	$ 6,900	Quote from Equipco
Decontamination	**Decontamination Subtotal =**				**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	5	mo	$ 1,150.00	15%	$ 6,613	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	166	hr	$ 70.00	15%	$ 13,363	Costs from HPNS Parcel C

Table C-1. Soil Vapor Extraction and Groundwater Treatment - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 83 working days
5 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 1,835,518**	**Includes mob/demob and all construction activities**
SVE Building 406 Wells & Piping			**SVE Building 406 Wells & Piping =**		**$ 362,352**	See Backup Worksheet "GW AND SOIL GAS PROBE INSTALL"
SVE Building 406 Wells & Piping	1	ea	$ 362,351.74		$ 362,352	
SVE Building 406 Process Equipment and Controls			**SVE Building 406 Process Equipment and Controls =**		**$ 284,013**	See Backup Worksheet "PROCESS EQUIPMENT AND CONTROLS"
SVE Building 406 Process Equipment and Controls	1	ea	$ 284,012.50		$ 284,013	
Groundwater Treatment (Injections) and Monitoring			**Ground Water Treatment and Monitoring =**		**$ 916,544**	See Backup Worksheet "GW TREATMENT AND MONITORING"
Groundwater Treatment (Injections) and Monitoring	1	ea	$ 916,543.75		$ 916,544	
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 137,265**	**Includes management, plans, and reports**
Assumed to be 5% of construction cost (including permitting)					$ 137,265	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 2,882,562**	**Includes Distributive Costs**
Total Construction Cost					$ 2,745,297	
Total Management/Planning/Reporting Cost					$ 137,265	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table C-2. Soil Vapor Extraction and Groundwater Treatment - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	5	1	$ 6.50
	Project Engineer, Geologist or Scientist	$ 125.00	100	1	$ 125.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	1	$ 90.00
	Drafter/Designer	$ 75.00	25	1	$ 18.75
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table C-3. Soil Vapor Extraction and Groundwater Treatment - Lab Analyses
Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample	
Encore Samplers for TPH-purgeable range (3 per sample)	**$**	**39.00**
Analysis (for excavation chemicals only)	**$**	**420.00**
Volatile Organic Compounds (VOCs)	$	180.00
Semivolatile Organic Compounds (SVOCs)	$	210.00
Pesticides	$	138.00
Polychlorinated Biphenyls (PCBs)	$	78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$	54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$	54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$	108.00
Strontium-90	$	142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$	156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$	90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$	90.00
Total Cost/Pre-Excavation Characterization Sample:	**$**	**753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$**	**1,003.80**
Total Cost/Waste Characterization Sample:	**$**	**586.80**

Analysis[2]	Cost per Sample	
Analysis (Geotechnical for import fill only)		
Modified Proctor (1 every 5,200 CY)	$	260.00
Sieve Analysis (1 every 2,000 CY)	$	109.00
Atterberg Limits (1 every 2,000 CY)	$	163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnicall costs provided by Cooper Testing Labs 2017

Table C-4. Soil Vapor Extraction and Groundwater Treatment - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

SVE Building 406 Wells & Piping			Notes
SVE Wells Install (Building 406 only)	21	EA	ACAD and Quantity Takeoffs
Soil Gas Monitoring Probes Install (all plumes)	31	EA	ACAD and Quantity Takeoffs
Conveyance Piping Install (Building 406 only)	1,131	LF	ACAD and Quantity Takeoffs
SVE Building 406 Process Equipment and Controls			**Notes**
Trailer Mounted SVE Process Equipment	1	EA	ACAD and Quantity Takeoffs
GAC Vessels	3	EA	ACAD and Quantity Takeoffs
Condensate Tank	1	EA	ACAD and Quantity Takeoffs
Emission Stack	1	EA	ACAD and Quantity Takeoffs
SVE System Performance Monitoring	12	Events	Monthly sampling of 21 SVE wells and 9 GMPs inside Bldg 406, and influent/effluent of treatment system
Groundwater Treatment (Injections) and Monitoring			**Notes**
Injection Points (Building 406 CVOC Plume)	85	EA	DBR Section 3.4.3
Injection Points (IR-04 CVOC Plume; contingency)	120	EA	DBR Section 3.4.4
Injection Points (IR-12A CVOC Plume; contingency)	92	EA	DBR Section 3.4.5
Groundwater well install (all VOC plumes)	17	EA	DBR Sections 3.4.3 through 3.4.6
Pre-Treatment Characterization (Building 406 CVOC Plume	1	Event	Establish baseline conditions at 18 wells and 35 gas monitoring probes (GMPs)
Pre-Treatment Characterization (IR-04 CVOC Plume)	3	Events	Evaluate concentrations at 8 wells and 3 GMPs (to determine if treatment is needed)
Pre-Treatment Characterization (IR-12A CVOC Plume)	4	Events	Evaluate concentrations at 12 wells and 3 GMPs (to determine if treatment is needed)
Post-Injection Monitoring (all plumes)	4	Events	Quarterly monitoring at 38 wells and 65 GMPs

Table C-5. Soil Vapor Extraction Well/Piping and Monitoring Point Installation - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install New SVE Wells	21.0	EA	$ 3,500.00	15%	$ 84,525.00	Quote from Gregg Drilling
Install New Gas Monitoring Probes (all plumes)	31.0	EA	$ 3,500.00	15%	$ 124,775.00	Quote from Gregg Drilling
Demo Foundation and Driller Support						
Walk Behind Concrete Saw	18.0	Day	$ 270.00	15%	$ 5,589.00	Costs from HPNS Parcel B
Roto Hammer & Bits	18.0	Day	$ 270.00	15%	$ 5,589.00	Costs from HPNS Parcel B
Fuel For heavy Equipment	18.0	Day	$ 60.00	15%	$ 1,242.00	Costs from HPNS Parcel B
(2) Laborer LB01	18.0	Day	$ 1,120.00		$ 20,160.00	See "LABOR" Worksheet for detail
Install Conveyance Pipe	1,131.2	LF				
Conveyance Pipe (4" Sch 80 PVC)	1,131.2	LF	$ 5.50	15%	$ 7,154.84	Quote from R&B
Misc. Fittings, Couplers, Valves, etc. (per well)	21.0	EA	$ 350.00	15%	$ 8,452.50	Costs from HPNS Parcel B
Pipe Anchoring Materials	1,131.2	LS	$ 5.00	15%	$ 6,504.40	Costs from HPNS Parcel B
(3) Laborer LB01	12.0	Day	$ 1,680.00		$ 20,160.00	See "LABOR" Worksheet for detail
Install New Groundwater Monitoring Wells (all plumes)	17.0	EA	$ 4,000.00	15%	$ 78,200.00	Quote from Gregg Drilling
TOTAL					$ 362,352	

Note:

Material volumes and areas:

Install New SVE Wells	21	EA
Duration to Install SVE Wells	7	Days
Install New Gas Monitoring Probes	31	EA
Duration to Install Gas Monitoring Probes	11	Days
Install New Groundwater Monitoring Wells	17	EA
Duration to Install Groundwater Monitoring Wells	9	Days
Conveyance Pipe	1,131	LF
Duration to Install Conveyance Pipe	12	Days

Table C-6. Soil Vapor Extraction Process Equipment Installation and Operation - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install Trailer Mounted SVE Process Equipment	1.0	EA				
SVE Blower System Components	1.0	EA	$ 30,000.00	15%	$ 34,500.00	Costs from HPNS Parcel B
Power Drop	1.0	EA	$ 35,000.00	15%	$ 40,250.00	Costs from HPNS Parcel B
Install Electrical and Controls	1.0	EA	$ 40,000.00	15%	$ 46,000.00	Costs from HPNS Parcel B
(2) Laborer LB01	2.0	Days	$ 1,120.00		$ 2,240.00	See "LABOR" Worksheet for detail
Install GAC Vessels	3.0	EA				
Vessels (3)	12.0	Mo	$ 1,050.00	15%	$ 14,490.00	Costs from HPNS Parcel B
Carbon	15,000.0	LBs	$ 2.00	15%	$ 34,500.00	Costs from HPNS Parcel B
(2) Laborer LB01	2.0	Days	$ 1,120.00		$ 2,240.00	See "LABOR" Worksheet for detail
Condensate Tank	1.0	EA				
Condensate Tank	1.0	EA	$ 7,500.00	15%	$ 8,625.00	Costs from HPNS Parcel B
(2) Laborer LB01	1.0	Day	$ 1,120.00		$ 1,120.00	See "LABOR" Worksheet for detail
Emission Stack	1.0	EA				
Emission Stack	1.0	EA	$ 500.00	15%	$ 575.00	Costs from HPNS Parcel B
Manlift	1.0	Day	$ 350.00	15%	$ 402.50	Costs from HPNS Parcel B
(2) Laborer LB01	1.0	Day	$ 1,120.00		$ 1,120.00	See "LABOR" Worksheet for detail
Initial Period of SVE System Operations	1.0	Year				
Replace Carbon	15,000.0	lbs	$ 2.00	15%	$ 34,500.00	Costs from HPNS Parcel B
Carbon Disposal	15,000.0	lbs	$ 0.20	15%	$ 3,450.00	Costs from HPNS Parcel B
Power for SVE system	12.0	Month	$ 1,500.00	15%	$ 20,700.00	Costs from HPNS Parcel B
Sample Analysis (up to 10 percent of wells/GMPs)	12.0	Event	$ 750.00	15%	$ 10,350.00	Costs from HPNS Parcel B
PID (at all SVE wells and system influent/effluent)	24.0	Day	$ 75.00	15%	$ 2,070.00	Costs from HPNS Parcel B
(2) Laborer LB01	24.0	Day	$ 1,120.00		$ 26,880.00	See "LABOR" Worksheet for detail
TOTAL					$ 284,013	

Note:
Material volumes and areas:

Trailer Mounted SVE Process Equipment	1	EA	
GAC Vessels	3	EA	
Condensate Tank	1	EA	
Emission Stack	1	EA	
Initial Period of SVE System Operations	1	Year	to support OPS determination
Performance Monitoring (Soil Gas)	12	Months	monthly sampling to guide SVE system operations

Table C-7. In-Situ Groundwater Treatment and Soil Gas/Groundwater Monitoring - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Pre-Treatment Characterization (Building 406)	1.0	Event				
Sample Analysis	1.0	Event	$ 5,000.00	15%	$ 5,750.00	Costs from HPNS Parcel B
PID	10.0	Days	$ 75.00	15%	$ 862.50	Costs from HPNS Parcel B
(3) Laborer LB01	10.0	Days	$ 1,680.00		$ 16,800.00	See "LABOR" Worksheet for detail
Pre-Treatment Characterization (IR-04)	3.0	Event				
Sample Analysis	3.0	Event	$ 3,000.00	15%	$ 10,350.00	Costs from HPNS Parcel B
PID	9.0	Days	$ 75.00	15%	$ 776.25	Costs from HPNS Parcel B
(3) Laborer LB01	9.0	Days	$ 1,680.00		$ 15,120.00	See "LABOR" Worksheet for detail
Pre-Treatment Characterization (IR-12)	4.0	Event				
Sample Analysis	4.0	Event	$ 3,800.00	15%	$ 17,480.00	Costs from HPNS Parcel B
PID	16.0	Days	$ 75.00	15%	$ 1,380.00	Costs from HPNS Parcel B
(3) Laborer LB01	16.0	Days	$ 1,680.00		$ 26,880.00	See "LABOR" Worksheet for detail
Groundwater Treatment (Building 406)	13.0	Days				
Inject GW Treatment Materials (HRC & HRC Primer)	85.0	EA	$ 800.00	15%	$ 78,200.00	Quote from Vironex
HRC & HRC Primer (Injection Material)	1.0	LS	$ 95,000.00	15%	$ 109,250.00	Quote from Regenesis
(1) Laborer LB01	13.0	Days	$ 560.00		$ 7,280.00	See "LABOR" Worksheet for detail
Groundwater Treatment (IR-04)	18.0	Days				
Inject GW Treatment Materials (HRC & HRC Primer)	120.0	EA	$ 800.00	15%	$ 110,400.00	Quote from Vironex
HRC & HRC Primer (Injection Material)	1.0	LS	$ 135,000.00	15%	$ 155,250.00	Quote from Regenesis
(1) Laborer LB01	18.0	Days	$ 560.00		$ 10,080.00	See "LABOR" Worksheet for detail
Groundwater Treatment (IR-12A)	14.0	Days				
Inject GW Treatment Materials (HRC & HRC Primer)	92.0	EA	$ 800.00	15%	$ 84,640.00	Quote from Vironex
HRC & HRC Primer (Injection Material)	1.0	LS	$ 103,000.00	15%	$ 118,450.00	Quote from Regenesis
(1) Laborer LB01	14.0	Days	$ 560.00		$ 7,840.00	See "LABOR" Worksheet for detail
Post-Injection Monitoring (all plumes, GW and Soil Gas)	4.0	Events				
Sample Analysis	4.0	Event	$ 12,550.00	15%	$ 57,730.00	Costs from HPNS Parcel B
PID	68.0	Days	$ 75.00	15%	$ 5,865.00	Costs from HPNS Parcel B
(3) Laborer LB01	68.0	Day	$ 1,120.00		$ 76,160.00	See "LABOR" Worksheet for detail
TOTAL					$ 916,544	

Note:
Material volumes and areas:

Injection Points (Building 406)	85	EA
Injection Points (IR-04)	120	EA
Injection Points (IR-12A)	92	EA
Pre-Treatment Characterization (Building 406)	1	Event
Pre-Treatment Characterization (IR-04)	3	Event
Pre-Treatment Characterization (IR-12)	4	Event
Post-Injection Monitoring (GW and Soil Gas)	4	Event

Table C-8. Soil Vapor Extraction and Groundwater Treatment - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
Building 406 SVE Well Installation				
SVE Wells Install	3 EA/day	21 EA	7 days	Production rate from HPNS Parcel B
Soil Gas Monitoring Probes Install	3 EA/day	31 EA	11 days	Production rate from HPNS Parcel B
Install Conveyance Piping	100 LF/Day	1,131 LF	12 days	Production rate from HPNS Parcel B
Building 406 SVE System Process Equipment Installation and Operation				
Trailer Mounted SVE Process Equipment	0.5 EA/day	1 EA	2 days	Production rate from HPNS Parcel B
GAC Vessels	1.5 EA/day	3 EA	2 days	Production rate from HPNS Parcel B
Condensate Tank	1 EA/day	1 EA	1 days	Production rate from HPNS Parcel B
Emission Stack	1 EA/day	1 EA	1 days	Production rate from HPNS Parcel B
Performance Monitoring (inside Bldg 406)	2 Day/Event	12 Event	24 days	Production rate from HPNS Parcel B
Groundwater Treatment (Injections) and Monitoring				
Groundwater well installation (all VOC plumes)	2 EA/day	17 EA	9 days	Production rate from other projects
Groundwater treatment (Building 406)	7 EA/day	85 EA	13 days	Production rate from HPNS Parcel B
Groundwater treatment (IR-04)	7 EA/day	120 EA	18 days	Production rate from HPNS Parcel B
Groundwater treatment (IR-12A)	7 EA/day	92 EA	14 days	Production rate from HPNS Parcel B
Pre-Treatment Characterization (Building 406)	10 Day/Event	1 Event	10 days	Production rate from HPNS Parcel B
Pre-Treatment Characterization (IR-04)	3 Day/Event	3 Event	9 days	Production rate from HPNS Parcel B
Pre-Treatment Characterization (IR-12)	4 Day/Event	4 Event	16 days	Production rate from HPNS Parcel B
Post-Injection Monitoring (all plumes, GW and Soil Gas)	17 Day/Event	4 Event	68 days	Production rate from HPNS Parcel B
SURVEY/DEMOBILIZATION				
Survey Crew			5 day	Misc Survey
Demobilization			5 day	
		TOTAL	**83 days**	

Appendix D. Activity 4A Cost Estimate (Groundwater Controls at IR-02 Northwest)

Available on CD.

Table D-1. Groundwater Controls IR-02 Northwest - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 29 working days

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 335,760**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 288,840**	
Total project professional/technical labor cost					$ 191,980	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 54,520	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 42,340	See backup worksheet "LABOR"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 46,920**	
30' connex office trailer	2	mo	$ 550.00	15%	$ 1,265	Quote from Mobile Mini
Office Equipment Rental	2	mo	$ 800.00	15%	$ 1,840	Costs from HPNS Parcel C
Office Supplies	2	mo	$ 100.00	15%	$ 230	Costs from HPNS Parcel C
Telephone Bill	2	mo	$ 50.00	15%	$ 115	Costs from HPNS Parcel C
Internet Bill	2	mo	$ 200.00	15%	$ 460	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	2	mo	$ 5,400.00	15%	$ 12,420	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	2	mo	$ 500.00	15%	$ 1,150	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	2	mo	$ 2,000.00	15%	$ 4,600	Quote from Hertz
Fuel for Rental Trucks	2	mo	$ 1,200.00	15%	$ 2,760	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	2	mo	$ 6,000.00	15%	$ 13,800	Quote from Sitech
(2) Kubotas	2	mo	$ 1,300.00	15%	$ 2,990	Quote from Hertz
8K Forklift	2	mo	$ 2,300.00	15%	$ 5,290	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 2,472,065**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 26,680**	
Mixing Equipment (Mob/Demob and Setup)	2	ea	$ 5,000.00	15%	$ 11,500	
CAT 330 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 14H Motor Grader	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT D5 Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Pad Foot Compactor (66" Single Drum Roller)	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
2000 Gallon Water Truck	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
CAT D6T Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Bobcat T-190	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
CAT 735 Off Road Dump Truck	4	ea	$ 1,000.00	15%	$ 4,600	Quote from Harris Blade Rental
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 9,085**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	29	day	$ 100.00	15%	$ 3,335	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	2	mo	$ 2,500.00	15%	$ 5,750	Quote from BlueLine Rentals
Site Preparation	**Site Preparation Subtotal =**				**$ 978,614**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 18,917.50		$ 18,918	See Backup Worksheet "SITE PREP INSTALL"
Install Shoring	1	ea	$ 877,450.00		$ 877,450	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	2	mo	$ 1,763.00	15%	$ 4,055	Quote from Cam Guard
Land survey	10	day	$ 2,200.00	15%	$ 25,300	Quote from ESP Surveying
Subsurface utility surveying	6	day	$ 1,400.00	15%	$ 9,660	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C

Table D-1. Groundwater Controls IR-02 Northwest - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 29 working days

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Air Monitoring			**Air Monitoring Subtotal =**		**$ 68,465**	
(2) Air Monitor Rental for PM10, TSP and Metals	2	mo	$ 2,800.00	15%	$ 6,440	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	2	mo	$ 1,200.00	15%	$ 2,760	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	29	day	$ 790.00	15%	$ 26,347	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	29	day	$ 725.00	15%	$ 24,179	Costs from HPNS Parcel C
Shipment of Sample Media	2	mo	$ 800.00	15%	$ 1,840	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	2	mo	$ 1,800.00	15%	$ 4,140	Quote from Pine Environmental
Portable Multi Gas Meter	2	mo	$ 1,200.00	15%	$ 2,760	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	2	mo	$ 1,150.00	15%	$ 2,645	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	58	hr	$ 70.00	15%	$ 4,669	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 2,472,065**	**Includes mob/demob and all construction activities**
Cut Fill Working Platform			**Cut Fill Working Platform =**		**$ 583,070**	See Backup Worksheet "CUT FILL WORKING PLATFORM"
Hot Spot Excavation	1	ea	$ 583,070.40		$ 583,070	
Install Slurry Wall			**Install Slurry Wall =**		**$ 502,255**	See Backup Worksheet "INSTALL SLURRY WALL"
Hot Spot Backfill	1	ea	$ 502,254.96		$ 502,255	
Radiological Screening, loading of waste			**Radiological Screening, Loading of waste =**		**$ 284,148**	See Backup Worksheet "RADIOLOGICAL LOE"
Radiological Screening, loading of waste	1	ea	$ 284,148.24		$ 284,148	
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 224,626**	**Includes management, plans, and reports**
Assumed to be 8% of construction cost (including permitting and pre-construction testing)					$ 224,626	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP,
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 3,032,451**	**Includes Distributive Costs**
Total Construction Cost					$ 2,807,825	
Total Management/Planning/Reporting Cost					$ 224,626	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table D-2. Groundwater Controls IR-02 Northwest - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	10	1	$ 13.00
	Project Engineer, Geologist or Scientist	$ 125.00	100	2	$ 250.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table D-3. Groundwater Controls IR-02 Northwest - Radiological Screening Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Unit Production Rate	Units	Comments	Production per Day	Assumptions	Total Production per day
Excavated soil from slurry wall trench	100	CY/hr per excavator (1)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Load out soil within 1000m^2 x 6" grid	100	CY/hr per excavator (1)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Transport excavated 1000m^2 x 1' volume to rad screening area / soil staging area in 20 CY loads	60	CY/hr per truck (1)	20 min cycle, 3 loads per hour	480 CY/day per truck	480 CY/day/truck x 1 trucks = 960 CY/day	480 CY/day ≈ 2.8 grids
Slurry Wall Trench Excavation	5.83	CY/hr per excavator (1)	Each Excavator exc 150LF/day	140 CY/day per excvator	(1) excavators at 140 CY each = 140 CY/day	140 CY/day ≈ 1 grids
Rad screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (1)	1 grid per crew per day	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids
UXO screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (1)	8 hours per grid per crew	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids

Notes:

(1) Average production rate determined from screening operations at other Hunters Point parcels

Table D-4. Groundwater Controls IR-02 Northwest - Lab Analyses Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample	
Encore Samplers for TPH-purgeable range (3 per sample)	**$**	**39.00**
Analysis (for excavation chemicals only)	**$**	**420.00**
Volatile Organic Compounds (VOCs)	$	150.00
Semivolatile Organic Compounds (SVOCs)	$	175.00
Pesticides	$	115.00
Polychlorinated Biphenyls (PCBs)	$	65.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$	45.00
Total Petroleum Hydrocarbons (TPH), extractable range	$	45.00
Gamma Radium-226, Cesium-137, Cobalt-60	$	90.00
Strontium-90	$	119.00
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$	130.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$	75.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$	75.00
Total Cost/Pre-Excavation Characterization Sample:	**$**	**474.00**
Total Cost/Post-Excavation Confirmation Sample:	**$**	**683.00**
Total Cost/Waste Characterization Sample:	**$**	**1,123.00**

Analysis[2]	Cost per Sample	
Analysis (Geotechnical for import fill only)		
Modified Proctor (1 every 5,200 CY)	$	260.00
Sieve Analysis (1 every 2,000 CY)	$	109.00
Atterberg Limits (1 every 2,000 CY)	$	163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnical costs provided by Cooper Testing Labs 2017

Table D-5. Groundwater Controls IR-02 Northwest - Site Preparation Quantities
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, Support Equipment and Temp Facilities			
	Units	Quantity	Notes
Lay Down Area	Acres	0.5	This location will be used as a support area
Prep Existing Rad Pads			
	Units	Quantity	Notes
Rad Pads	EA	4	
Around Disturbed Area			
	Units	Quantity	Notes
Temp Fence	LF	5,000.00	Will fence around work area and around rad area

Table D-6. IR-02 Northwest Slurry Wall Volume Estimates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Design Drawing C-10/C11 Stations	Existing Elevation (FT MSL)	Final Elevation (FT MSL)	Bottom Slurry Wall Elevation (FT MSL)	Top of Slurry Wall Elevation (FT MSL)	Total Depth (FT)	Slurry Cap Invert Elevation (FT MSL)	Length (FT)	Working Surface Fill Placement Width (FT)	Working Surface Fill Placement Height (FT)	Working Surface Cut (FT)	Trench/Slurry Volume (CY)	Working Surface Fill Placement Volume (CY)	Working Surface Cut Volume (CY)
Station 0+00	4.42	10	-9.81	7.5	17.31	5.5		32	3.08	0			
Station 1+00	6.08	10	-11.4	7.5	18.9	5.5	100	32	1.42	0	163.74	266.67	0.00
Station 2+00	4.1	10	-11.93	7.5	19.43	5.5	100	32	3.4	0	171.59	285.63	0.00
Station 3+00	4.05	10	-7.74	7.5	15.24	5.5	100	32	3.45	0	158.04	405.93	0.00
Station 4+00	10.5	10	-4.56	7.5	12.06	5.5	100	32	0	3	130.74	204.44	177.78
Station 5+00	12.44	10	-2.14	7.5	9.64	5.5	100	32	0	4.94	110.00	0.00	470.52
Station 6+00	13.13	10	-2.97	7.5	10.47	5.5	100	32	0	5.63	104.11	0.00	626.37
Station 7+00	12.55	10	-2.95	7.5	10.45	5.5	100	32	0	5.05	107.11	0.00	632.89
Station 8+00	5.9	10	-0.92	7.5	8.42	5.5	100	32	1.6	0	99.52	94.81	299.26
Station 9+00	4.63	10	-2.49	7.5	9.99	5.5	100	32	2.87	0	97.81	264.89	0.00
Station 10+00	4.05	10	-3.04	7.5	10.54	5.5	100	32	3.45	0	105.67	374.52	0.00
Station 10+80	4.05	10	-3.22	7.5	10.72	5.5	80	32	3.45	0	86.70	327.11	0.00
										TOTALS	1335.03	2224.00	2206.81

Table D-7. Groundwater Controls IR-02 Northwest - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Cut and Fill (IR-02)			Notes
Cut Working Surface	2,207	CY	ACAD and Quantity Takeoffs
Fill to Working Surface	2,224	CY	ACAD and Quantity Takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads	11	Pads	
Install Slurry Wall (IR-02)			**Notes**
Trench Volume	1,335	CY	ACAD and Quantity Takeoffs
Cement - Bentonite - Slurry Volume	1,335	CY	ACAD and Quantity Takeoffs
Install Monitoring Wells	1	EA	ACAD and Quantity Takeoffs
Install Piezometers	5	EA	ACAD and Quantity Takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads	7	Pads	

Table D-8. Groundwater Controls IR-02 Northwest - Site Preparation Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Restore Rad Pads (4) for use						
(6) Labors LBO1	1	Day	$ 3,360.00		$ 3,360.00	See "LABOR" Worksheet for detail
Rad Pad Repair Materials	4	EA	$ 1,500.00	15%	$ 6,900.00	Costs from Treasure Island
Install Temp Fence and 6 Month Rental	5,000	LF	$ 3.29	15%	$ 18,917.50	Costs from HPNS projects
Install Shoring (20' Sheets)	1,090	LF	$ 700.00	15%	$ 877,450.00	Costs from HPNS Parcel B RA
TOTAL					$ 937,070	

Note:

Soil staging area volumes and areas:

Rad Pads to be prepped for use	4	Pad
Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table D-9. Groundwater Controls IR-02 Northwest - Working Surface Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Waste Characterization Sampling						
Soil Analysis for Disposal (per 500 CY)	5	EA	$ 1,123.00	15%	$ 6,457.25	See "LAB COST" Worksheet for Detail
Cut for Working Surface	2,207	BCY				
CAT 330 Excavator	6.0	Day	$ 1,000.00	15%	$ 6,900.00	Costs from HPNS Parcel B RA
(1) CAT 735 Off Road Dump Truck	6.0	Day	$ 1,000.00	15%	$ 6,900.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	6.0	Day	$ 200.00	15%	$ 1,380.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	6.0	Day	$ 300.00	15%	$ 2,070.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	6.0	Day	$ 808.00		$ 4,848.00	See "LABOR" Worksheet for detail
(2) Truck Driver TM03	6.0	Day	$ 1,232.00		$ 7,392.00	See "LABOR" Worksheet for detail
Truck Driver TM02	6.0	Day	$ 608.00		$ 3,648.00	See "LABOR" Worksheet for detail
Fill for Working Surface						
CAT D6T Dozer	6.0	Day	$ 700.00	15%	$ 4,830.00	Quote from Harris Blade
Pad Foot Compactor (66" Single Drum Roller)	6.0	Day	$ 300.00	15%	$ 2,070.00	Quote from Herc
2000 Gallon Water Truck	6.0	Day	$ 200.00	15%	$ 1,380.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	6.0	Day	$ 300.00	15%	$ 2,070.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	6.0	Day	$ 808.00		$ 4,848.00	See "LABOR" Worksheet for detail
Equipment Operator EQ07	6.0	Day	$ 89.00		$ 534.00	See "LABOR" Worksheet for detail
Truck Driver TM02	6.0	Day	$ 608.00		$ 3,648.00	See "LABOR" Worksheet for detail
Import of Fill for Working Surface	3,336.0	Tons	$ 30.00	15%	$ 115,092.00	Costs from HPNS Parcel B & C
Transport and disposal of excavated material						
Class II Beneficial Reuse Soil to Altamont	331.0	ton	$ 42.70	15%	$ 16,255.61	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	827.6	ton	$ 79.66	15%	$ 75,813.44	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	993.1	ton	$ 89.27	15%	$ 101,943.01	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	496.5	ton	$ 143.04	15%	$ 81,680.03	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	496.5	ton	$ 189.46	15%	$ 108,186.47	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	165.5	ton	$ 132.00	15%	$ 25,124.59	Assumed Fraction of Total Waste: 5%
TOTAL					$ 583,070	

Note:

Cut Fill volumes and areas:

Cut For Working Platform	2,207	CY	
Cut For Working Platform in tons	3,310	Tons	1.5 BCY to Ton Factor
Fill For Working platform	2,224	CY	
Fill For Working Platform in tons	3,336	Tons	1.5 BCY to Ton Factor

Table D-10. Groundwater Controls IR-02 Northwest - Slurry Wall Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Excavation of Slurry Trench	1,335	CY				
CAT 330 Excavator	8.0	Day	$ 1,000.00	15%	$ 9,200.00	Costs from HPNS Parcel B RA
(1) CAT 735 Off Road Dump Truck	8.0	Day	$ 1,000.00	15%	$ 9,200.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	8.0	Day	$ 200.00	15%	$ 1,840.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	8.0	Day	$ 250.00	15%	$ 2,300.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	8.0	Day	$ 808.00		$ 6,464.00	See "LABOR" Worksheet for detail
Truck Driver TM03	8.0	Day	$ 616.00		$ 4,928.00	See "LABOR" Worksheet for detail
Batch Plant Operation and Slurry Placement	1,335	CY				
Slurry Mixing Equipment (Jet Shar Mixer, Silo,etc.)	8.0	Day	$ 2,000.00	15%	$ 18,400.00	Costs from HPNS Parcel E-2
(2) Storage Tanks	8.0	Day	$ 100.00	15%	$ 920.00	Costs from HPNS Parcel B RA
Hard Hose, Pumps, hoses	8.0	Day	$ 250.00	15%	$ 2,300.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	8.0	Day	$ 200.00	15%	$ 1,840.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	8.0	Day	$ 750.00	15%	$ 6,900.00	Costs from HPNS Parcel B RA
(4) Laborers LB01	8.0	Day	$ 2,240.00		$ 17,920.00	See "LABOR" Worksheet for detail
Truck Driver TM02	8.0	Day	$ 608.00		$ 4,864.00	See "LABOR" Worksheet for detail
Cement & Bentonite (Material to be mixed onsite)	150.0	CY	$ 750.00	15%	$ 129,375.00	Quote from Central Concrete
Install Monitoring Wells	1.0	EA	$ 5,000.00	15%	$ 5,750.00	Quote from Gregg Drilling
Install Piezometers	5.0	EA	$ 5,000.00	15%	$ 28,750.00	Quote from Gregg Drilling
Waste Characterization Sampling (1 per 500 CY)	3.0	EA	$ 1,123.00	15%	$ 3,874.35	See "LAB COST" Worksheet for Detail
Transport and disposal of excavated material						
Class II Benificial Reuse Soil to Altamont	200.3	ton	$ 42.70	15%	$ 9,833.96	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	500.6	ton	$ 79.66	15%	$ 45,863.92	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	600.8	ton	$ 89.27	15%	$ 61,671.21	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	300.4	ton	$ 143.04	15%	$ 49,412.96	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	300.4	ton	$ 189.46	15%	$ 65,448.24	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	100.1	ton	$ 132.00	15%	$ 15,199.31	Assumed Fraction of Total Waste: 5%
TOTAL					$ 502,255	

Note:

Trench and Slurry volumes and areas:

Trenched Volume	1,335	CY		
Trenched Material weight	2,003	Tons	1.5	BCY to tons factor
Volume of Cement-Bentonite-Slurry	1,335	CY		
Install Monitoring Wells	1.00	EA		
Install Piezometers	5	EA		

Table D-11. Groundwater Controls IR-02 Northwest - Radiological Screening Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Geophysical monitoring equipment rental for UXO screening	1	months	$ 5,000.00	15%	$ 5,750	Costs from HPNS IR 7 & 18
Radiological Support Services	29	Day	$ 3,650.00	15%	$ 121,728	Costs from HPNS IR 7 & 18
SUPRA/FSS Rad Pads (Screening)	18	EA	$ 3,700.00	15%	$ 75,353	Costs from HPNS IR 7 & 18
Manage Excavated Soil Material & Debris						
CAT 14H Motor Grader	14	Day	$ 1,000.00	15%	$ 16,100	Costs from HPNS Parcel B RA
Bobcat T-190	29	Day	$ 400.00	15%	$ 13,340	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	14	Day	$ 300.00	15%	$ 4,830	Costs from HPNS Parcel B RA
Equipment Operator EQ02	14	Day	$ 840.00		$ 11,760	See "LABOR" Worksheet for detail. Operator will use Motor Grader
Equipment Operator EQ06	29	Day	$ 736.00		$ 21,344	See "LABOR" Worksheet for detail. Operator will use bobcat
Excavate 1000m^2 x 1' grid and Load out						
CAT 330 Excavator	4	Day	$ 1,000.00	15%	$ 4,600	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	4	Day	$ 300.00	15%	$ 1,380	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	4	Day	$ 500.00	15%	$ 2,300	Costs from HPNS Parcel B RA
Equipment Operator EQ03	4	Day	$ 808.00		$ 3,232	Costs from HPNS Parcel B RA
Truck Driver TM02	4	Day	$ 608.00		$ 2,432	Costs from HPNS Parcel B RA
TOTAL					$ 284,148	

Note:

Soil quantities:

Total CY to Rad Pads	3,542	CY
Total Days Excavating	14	Days
Excavated Volume Per Day	253	CY/Day

Table D-12. Groundwater Controls IR-02 Northwest - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B
Rad Pad Repairs	4 Pad/Day	4 Pads	1 days	Production rates from Treasure Island
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/day	21,780 SF	1 days	Production rate from HPNS IR7 &18
Cut Fill Working Platform				
Cut	400 CY/day	2,207 CY	6 days	Production rate from HPNS Parcel B
Fill	400 CY/day	2,224 CY	6 days	Production rate from HPNS Parcel B
Install Slurry Wall				
Trench Slurry Wall	140 LF/day	1,090 LF	8 days	Production rate from HPNS
Install Cement-Bentonite-Slurry	140 LF/day	1,090 LF	8 days	Production rate from HPNS
Install Monitoring Wells	2 EA/Day	1 EA	1 days	Production rate from HPNS
Install Piezometers	2 EA/Day	5 EA	3 days	Production rate from HPNS
RADIOLOGICAL SCREENING AND LOAD OUT				
Radiological and UXO characterization and release			20 days	20 days to obtain radiological and UXO release of screening pads
Manage Rad Pad Material			18 days	Smooth out Rad Pads and prepare material for Rad Screening
Excavate 1000m^2 x 6" grid and transport to disposal facility	5 grids/day	18 grids	4 days	See Backup Worksheet "RADIOLOGICAL LOE"
SURVEY/DEMOBILIZATION				
Survey Crew			10 day	Misc Survey
Demobilization			3 day	
		TOTAL	**29 days**	

Appendix E. Activity 4B Cost Estimate (Groundwater Controls and NAPL Source Treatment at IR-03)

Available on CD.

Table E-1. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 293 working days
15 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 3,270,180**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 2,918,280**	
Total project professional/technical labor cost					$ 1,939,660	See backup worksheet "General Labor Classifications and Rates"
Total project field/construction operations labor cost					$ 550,840	See backup worksheet "General Labor Classifications and Rates"
Total project clerical administrative labor cost					$ 427,780	See backup worksheet "General Labor Classifications and Rates"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 351,900**	
30' connex office trailer	15	MO	$ 550.00	15%	$ 9,488	Quote from Mobile Mini
Office Equipment Rental	15	MO	$ 800.00	15%	$ 13,800	Costs from HPNS Parcel C
Office Supplies+A1	15	MO	$ 100.00	15%	$ 1,725	Costs from HPNS Parcel C
Telephone Bill	15	MO	$ 50.00	15%	$ 863	Costs from HPNS Parcel C
Internet Bill	15	MO	$ 200.00	15%	$ 3,450	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	15	MO	$ 5,400.00	15%	$ 93,150	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	15	MO	$ 500.00	15%	$ 8,625	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	15	MO	$ 2,000.00	15%	$ 34,500	Quote from Hertz
Fuel for Rental Trucks	15	MO	$ 1,200.00	15%	$ 20,700	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	15	MO	$ 6,000.00	15%	$ 103,500	Quote from Sitech
(2) Kubotas	15	MO	$ 1,300.00	15%	$ 22,425	Quote from Hertz
8K Forklift	15	MO	$ 2,300.00	15%	$ 39,675	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 13,279,686**	**Includes mob/demob, construction activities, plans/reports, and management**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 26,680**	
Mixing Equipment (Mob/Demob and Setup)	2	EA	$ 5,000.00	15%	$ 11,500	
CAT 330 Excavator	2	EA	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 14H Motor Grader	2	EA	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT D5 Dozer	2	EA	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Pad Foot Compactor (66" Single Drum Roller)	2	EA	$ 150.00	15%	$ 345	Quote from Hertz
2000 Gallon Water Truck	2	EA	$ 150.00	15%	$ 345	Quote from Hertz
CAT D6T Dozer	2	EA	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Bobcat T-190	2	EA	$ 150.00	15%	$ 345	Quote from Hertz
CAT 735 Off Road Dump Truck	4	EA	$ 1,000.00	15%	$ 4,600	Quote from Harris Blade Rental
8K Forklift	2	EA	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 76,820**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	293	DY	$ 100.00	15%	$ 33,695	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	15	MO	$ 2,500.00	15%	$ 43,125	Quote from BlueLine Rentals

Table E-1. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 293 working days
15 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Site Preparation			**Site Preparation Subtotal =**		**$ 127,521**	
Grade laydown area (0.5 acre)	1	EA	$ 2,853.50		$ 2,854	See Backup Worksheet "Site Preparation Cost Detail"
Cover over laydown area with crushed stone (6" thick)	1	EA	$ 27,588.75		$ 27,589	See Backup Worksheet "Site Preparation Cost Detail"
Install Temp Fence and 6 month Rental	1	EA	$ 18,917.50		$ 18,918	See Backup Worksheet "Site Preparation Cost Detail"
Security Camera Set-up/Take-down	1	EA	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	15	MO	$ 1,763.00	15%	$ 30,412	Quote from Cam Guard
Land survey	10	DY	$ 2,200.00	15%	$ 25,300	Quote from ESP Surveying
Subsurface utility surveying	6	DY	$ 1,400.00	15%	$ 9,660	Quote from Safe 2 Core
Construction SWPPP implementation	1	EA	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C
Air Monitoring			**Air Monitoring Subtotal =**		**$ 645,029**	
(2) Air Monitor Rental for PM10, TSP and Metals	15	MO	$ 2,800.00	15%	$ 48,300	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	15	MO	$ 1,200.00	15%	$ 20,700	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	293	DY	$ 790.00	15%	$ 266,191	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	293	DY	$ 725.00	15%	$ 244,289	Costs from HPNS Parcel C
Shipment of Sample Media	15	MO	$ 800.00	15%	$ 13,800	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	15	MO	$ 1,800.00	15%	$ 31,050	Quote from Pine Environmental
Portable Multi Gas Meter	15	MO	$ 1,200.00	15%	$ 20,700	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	15	MO	$ 1,150.00	15%	$ 19,838	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	586	HR	$ 70.00	15%	$ 47,173	Costs from HPNS Parcel C
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**		**$ 13,279,686**	**Includes mob/demob, construction activities, plans/reports, and management**
Install Slurry Wall			**Cut Fill Working Platform =**		**$ 4,791,807**	See Backup Worksheet "Slurry Wall Cost Detail"
Working Platform, Slurry Trench, Protective Cap, Contaminated Material Disposal	1	EA	$ 4,791,807.40		$ 4,791,807	
In Situ Solidification and Stabilization			**Install Slurry Wall =**		**$ 6,614,534**	See Backup Worksheet "In Situ Solidification and Stabilization Cost Detail"
ISS Columns	1	EA	$ 6,614,534.00		$ 6,614,534	
Radiological Screening, Loading of Waste			**Radiological Screening, Loading of waste =**		**$ 977,548**	See Backup Worksheet "RADIOLOGICAL LOE"
Radiological Screening, Loading of Waste	1	EA	$ 977,547.65		$ 977,548	
Management, Planning Documents, and Post-Construction Reporting			**Design Subtotal =**		**$ 827,493**	
Assumed to be 5% of construction cost (including permitting and pre-construction testing)					$ 827,493	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 17,377,360**	**Includes Distributive Costs**
Total Construction Cost					$ 16,549,866	
Total Management/Planning/Reporting Cost					$ 827,493	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table E-2. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - General Labor Classifications and Rates

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	10	1	$ 13.00
	Project Engineer, Geologist or Scientist	$ 125.00	100	2	$ 250.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:
1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table E-3. NAPL Treatment at IR-03 - Labor and Equipment Classifications and Rates for ISS - 2 foot Diameter Columns
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Type or Condition	Rate (per hour)	Level of Effort (% on Project)	No. Required (number)	Ext. Unit Cost (per project hour)
Field/Construction Operations						
B-EQOPR-CRN	Equip. Operators, Heavy	Journeyman	$ 106.74	100	1	$ 106.74
B-EQOPR-MED	Equip. Operators, Medium	Journeyman	$ 102.72	100	1	$ 102.72
B-EQOPR-LT	Equip. Operators, Light	Journeyman	$ 98.99	100	1	$ 98.99
B-EQOPR-OIL	Equip. Operators, Oilers / Grade Checker	Journeyman	$ 97.26	100	1	$ 97.26
B-LABORER	Laborers, (Semi-Skilled)	Journeyman	$ 69.58	100	1	$ 69.58
B-LABORER	Laborers, (Semi-Skilled)	Foreman	$ 71.09	100	1	$ 71.09
Equipment						
USR-010	Delmag RH 24 with drill attachment	Average	$ 225.45	100	1	$ 225.45
USR-015	24" Auger Bit (Rock)	Average	$ 6.28	100	2	$ 12.56
H25KC020	Hydraulic Excavator, Crawler, 53,400 lbs, 0.63 CY Bucket, 39' Max Digging Depth, Long Reach Boom	Average	$ 69.88	100	1	$ 69.88
L40CA012	Loader, Wheel, Integrated Tool Carrier, 2.50 CY Loader; 10,640 lb @ 12.58' High Fork Lift, or 3,195 lb @ 23.25' High, Material Handling Arm	Average	$ 68.80	100	1	$ 68.80

Unit Cost, $/HR:	$ 923.07
Hours per day, HR/DY:	8
Unit Cost, $/DY:	$ 7,384.56
Number of crews, EA:	1
Productivity, CY/HR/EA:	7.5
Unit Cost[2], $/CY:	**$124.00**

Notes:

1. Labor rates are based on a 2017 rate schedule
2. Unit cost rounded up to nearest dollar.
3. Mixing plant, pumps, hoses included in main estimate.

Table E-4. NAPL Treatment at IR-03 - Labor and Equipment Classifications and Rates for ISS - 12 foot Diameter Columns
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Type or Condition	Rate (per hour)	Level of Effort (% on Project)	No. Required (number)	Ext. Unit Cost (per project hour)
Field/Construction Operations						
B-EQOPR-CRB	Equip. Operators Crane with Boom Pay	Journeyman	$ 111.31	100	1	$ 111.31
B-EQOPR-MED	Equip. Operators, Medium	Journeyman	$ 102.72	100	2	$ 205.44
B-EQOPR-LT	Equip. Operators, Light	Journeyman	$ 98.99	100	1	$ 98.99
B-EQOPR-OIL	Equip. Operators, Oilers / Grade Checker	Journeyman	$ 97.26	100	2	$ 194.52
B-TRKDVR-HV	Truck Drivers, Heavy	Journeyman	$ 87.93	100	1	$ 87.93
B-LABORER	Laborers, (Semi-Skilled)	Journeyman	$ 69.58	100	3	$ 208.74
B-LABORER	Laborers, (Semi-Skilled)	Foreman	$ 71.09	100	1	$ 71.09
B-WELDERS	Welders, Structural Steel	Journeyman	$ 94.55	100	1	$ 94.55
Equipment						
C85KC011	Cranes, Mechanical, Lattice Boom, Crawler, 275 Ton, 300' Boom, Lifting	Severe	$ 313.47	100	1	$ 313.47
USR-100	Large diameter drilling platform attachment	Average	$ 125.00	100	1	$ 125.00
H25KC020	Hydraulic Excavator, Crawler, 53,400 lbs, 0.63 CY Bucket, 39' Max Digging Depth, Long Reach Boom	Average	$ 69.88	100	1	$ 69.88
T55CA014	Truck, Off-Highway, Articulated Frame, 18 CY, 25 Ton, 6X6, Rear Dump	Average	$ 91.68	100	1	$ 91.68
L40CA012	Loader, Wheel, Integrated Tool Carrier, 2.50 CY Loader; 10,640 lb @ 12.58' High Fork Lift, or 3,195 lb @ 23.25' High, Material Handling Arm	Average	$ 68.80	100	1	$ 68.80
T15Z6520	Tractor, Crawler (Dozer), 181-250 HP (135-186 KW), Powershift, LGP, w/Universal Blade	Average	$ 132.20	100	1	$ 132.20

Unit Cost, $/HR:	$ 1,873.60
Hours per day, HR/DY:	8
Unit Cost, $/DY:	$ 14,988.80
Number of crews, EA:	2
Productivity, CY/HR/EA:	300
Unit Cost[2], $/CY:	**$7.00**

Notes:

1. Labor rates are based on a 2017 rate schedule
2. Unit cost rounded up to nearest dollar.
3. Mixing plant, pumps, hoses included in main estimate.

Table E-5. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Radiological Screening Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Unit Production Rate	Units	Comments	Production per Day	Assumptions	Total Production per day
Excavated soil from slurry wall trench	100	CY/HR per excavator (1)	2 hours per grid per excavator	800 CY/DY per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/DY ≈ 4 grids
Load out soil within 1000m^2 x 6" grid	100	CY/HR per excavator (1)	2 hours per grid per excavator	800 CY/DY per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/DY ≈ 4 grids
Transport excavated 1000m^2 x 1' volume to rad screening area / soil staging area in 20 CY loads	60	CY/HR per truck (1)	20 min cycle, 3 loads per hour	480 CY/DY per truck	480 CY/DY/truck x 1 trucks = 960 CY/DY	480 CY/DY ≈ 2.8 grids
Slurry Wall Trench Excavation	5.83	CY/HR per excavator (1)	Each Excavator exc 150LF/day	140 CY/DY per excvator	(1) excavators at 140 CY each = 140 CY/DY	140 CY/DY ≈ 1 grids
Rad screen (on pads) 1000m^2 grids	10,764	SF/DY per crew (1)	1 grid per crew per day	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids
UXO screen (on pads) 1000m^2 grids	10,764	SF/DY per crew (1)	8 hours per grid per crew	1 grids screened per day per crew	4 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	4 grids

Notes:

(1) Average production rate determined from screening operations at other Hunters Point parcels

Table E-6. Groundwater Controls and NAPL Treatment at IR-03
Parcel E - Lab Analyses Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample
Encore Samplers for TPH-purgeable range (3 per sample)	**$ 39.00**
Analysis (for excavation chemicals only)	**$ 420.00**
Volatile Organic Compounds (VOCs)	$ 150.00
Semivolatile Organic Compounds (SVOCs)	$ 175.00
Pesticides	$ 115.00
Polychlorinated Biphenyls (PCBs)	$ 65.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$ 45.00
Total Petroleum Hydrocarbons (TPH), extractable range	$ 45.00
Gamma Radium-226, Cesium-137, Cobalt-60	$ 90.00
Strontium-90	$ 119.00
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$ 130.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$ 75.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$ 75.00
Total Cost/Pre-Excavation Characterization Sample:	**$ 474.00**
Total Cost/Post-Excavation Confirmation Sample:	**$ 683.00**
Total Cost/Waste Characterization Sample:	**$ 1,123.00**
Total Cost Imported Backfill Characterization Sample:	**$ 709.00**

Analysis[2]	Cost per Sample
Analysis (Geotechnical for Import Fill Only)	
Modified Proctor	$ 260.00
Sieve Analysis	$ 109.00
Atterberg Limits	$ 163.00

Analysis[3,4]	Cost per Sample
Analysis (In Situ Solidification and Stabilization Quality Assurance Testing)	
Unconfined Compressive Strength	$ 45.00
Hydraulic Conductivity	$ 335.00
Density	$ 45.00
Water Content	$ 10.00
Leachability (SPLP)	$ 880.00

Notes:

(1) Analytical costs provided by C&T 2017

(2) Geotechnical costs provided by Cooper Testing Labs 2017

(3) Geotechnical costs provided by GeoTesting 2017

(4) Leachability cost based on previous work by CDM Smith 2017

Table E-7. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Site Preparation Quantities
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, support equipment and temp facilities			
	Units	Quantity	Notes
Lay Down Area	AC	0.5	This location will be used as a support area
Prep Existing Rad Pads			
	Units	Quantity	Notes
Rad Pads	EA	4	
Around disturbed Area			
	Units	Quantity	Notes
Temp Fence	LF	5,000	Will fence around work area and around rad area

Table E-8. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Summary of Quantities
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Cut and Fill (IR-03)			Notes
Cut Working Surface	8,766	CY	ACAD and Quantity Takeoffs
Fill to Working Surface	2,005	CY	ACAD and Quantity Takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads	44	Pads	
Install Slurry Wall (IR-03)			**Notes**
Trench Volume	9,820	CY	ACAD and Quantity Takeoffs
Bentonite Volume	280	CY	ACAD and Quantity Takeoffs
Clean Fill	4,929	CY	ACAD and Quantity Takeoffs
Install Monitoring Wells	1	EA	
Install Piezometers	5	EA	
Number of equivalent 1000m^2 x 6" Rad Pads	49	Pads	
In Situ Solidification and Stabilization (IR-03)			**Notes**
ISS - 2' diameter columns	1,034	CY	Quantity Takeoffs
ISS - 12' diameter columns	125,176	CY	Quantity Takeoffs
Portland Cement	20,447	TN	Quantity Takeoffs
Bentonite	1,349	TN	Quantity Takeoffs

Table E-9. Groundwater Controls at IR-03 Parcel E - Quantities for Slurry Wall
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Slurry Wall Construction

Area of work platform, SF:	128,503	Measured from Sheet C-13
Platform grading area, SF:	128,503	
Platform grading area, SY:	14,300	*Rounded up to the nearest hundred*
Slurry wall width, FT:	3	*Per engineer*
Slurry cap depth below top elevation, FT:	2	*Based on ERRG IR-02 assumptions*
Minimum depth keyed into bay mud, FT:	3	*Per engineer*
Working surface placement fill width, FT:	75	*Based on ERRG IR-02 assumptions*

Station	Surface Existing Elevation FT MSL	Final Elevation FT MSL	Slurry Wall Bottom Elevation FT MSL	Top Elevation FT MSL	Total Depth FT	Slurry Cap Invert Elevation FT MSL	Length FT	Working Surface Placement Fill Width FT	Working Surface Placement Fill Height FT	Working Surface Cut FT	Working Surface Fill Placement Volume CY	Working Surface Cut Volume CY	Trench Slurry Volume CY
0 + 00	7	8	-18	4	22	2		75	0.0	3.0			
2 + 55	7	10	-43	4	47	2	255	75	0.0	3.0	0	2125	978
5 + 00	7	10	-50	4	54	2	500	75	0.0	3.0	0	2042	1,431
5 + 12	7	10	-50	4	54	2	512	75	0.0	3.0	0	100	183
8 + 58	5	8	-27	6	33	4	858	75	1.0	0.0	481	1442	1,825
10 + 00	4	7	-22	5	27	3	1,000	75	1.0	0.0	394	0	656
11 + 94	4	7	-17	6	23	4	1,194	75	2.0	0.0	808	0	772
13 + 10	8	8	-23	6	29	4	1,310	75	0.0	2.0	322	322	600
13 + 62	8	8	-27	6	33	4	1,362	75	0.0	2.0	0	289	470
14 + 08	8	8	-24	6	30	4	1,408	75	0.0	2.0	0	256	464
15 + 56	8	8	-24	6	30	4	1,556	75	0.0	2.0	0	822	806
16 + 50	8	8	-24	6	30	4	1,650	75	0.0	2.0	0	522	659
18 + 53	7	8	-18	6	24	4	1,853	75	0.0	1.0	0	846	976
Note: Elevations and stations were determined from Sheet BW-2 - Barrier Wall Profile										**Totals**	**2,005**	**8,766**	**9,820**

Cut and Fill for Working Platform

Cut, CY/DY:	400	*Based on ERRG IR-02 assumptions*
Fill, CY/DY:	400	*Based on ERRG IR-02 assumptions*
Working days per week, DY/WK:	5	
Working Surface Cut Volume, CY:	8,766	
Excavation time, DY:	22	*Rounded up to the nearest hundred*
Working Surface Fill Placement Volume, CY:	2,005	
Material weight conversion factor, LB/CY:	3,240	*Assume 120 pcf - in place densities*
Material weight conversion factor, TON/CY:	1.62	
Working Surface Fill Placement, TON:	3,248	
Fill, DY:	6	*Rounded up to the nearest hundred*

Table E-9. Groundwater Controls at IR-03 Parcel E - Quantities for Slurry Wall *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Transportation and Disposal of Excavated Material			
Working Surface Cut Volume, CY:		8,766	
Material weight conversion factor, LB/CY:		3,240	*Assume 120 pcf - in place densities*
Material weight conversion factor, TON/CY:		1.62	
Working Surface Cut Disposal, TON:		14,201	
	Disposal Type	**% of Total**	**Quantity**
Class II Beneficial Reuse Soil to Altamont	10%	1,420	*Based on ERRG IR-02 assumptions*
Class II Soil to Altamont	25%	3,550	*Based on ERRG IR-02 assumptions*
Class I Non-RCRA Soil to Kettleman Hills	30%	4,260	*Based on ERRG IR-02 assumptions*
Class I RCRA Direct LF Soil to Kettleman Hills	15%	2,130	*Based on ERRG IR-02 assumptions*
Class I RCRA Stabilization Soil to Kettleman Hills	15%	2,130	*Based on ERRG IR-02 assumptions*
Disposal of radiologically impacted waste	5%	710	*Based on ERRG IR-02 assumptions*

Slurry Wall Installation

- Clean fill only needed between Sta. 0+00 and 10+00. The shoreline slurry wall will be installed through clean fill installed as part of the shoreline restoration.

Trench Slurry Wall, LF/DY:	140	*Based on ERRG IR-02 assumptions*
Install Bentonite-Slurry, LF/DY:	140	*Based on ERRG IR-02 assumptions*
Install Monitoring Wells, EA/DY:	2	*Based on ERRG IR-02 assumptions*
Install Piezometers, EA/DY:	2	*Based on ERRG IR-02 assumptions*
Excavation of slurry trench, CY:	9,820	
Material weight conversion factor, LB/CY:	3,240	*Assume 120 pcf - in place densities*
Material weight conversion factor, TON/CY:	1.62	
Excavation of slurry trench, TON:	15,908	
Excavation of slurry trench, LF:	1,853	
Soil Unit Weight, PCF:	105	Assumed for back fill loose density
Excavation of slurry trench, DY:	14	
Install slurry, DY:	14	*Rounded up to nearest whole number*
Install slurry, WK:	3	*Rounded up to nearest whole number*
Install slurry, MO:	1	*Rounded up to nearest whole number*
Bentonite as percent of total soil excavated (w/w):	1.0%	*Assumed based on testing*
Bentonite unit weight, PCF:	37.02	
Bentonite unit weight, LBS/CY:	995.53	
Bentonite unit weight, TON/CY:	0.498	
Bentonite, TON:	139	
Bentonite, CY:	280	

Table E-9. Groundwater Controls at IR-03 Parcel E - Quantities for Slurry Wall *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Slurry Wall Installation *(continued)*		
Clean Fill between Sta. 0+00 and Sta. 10+00		
Excavation of slurry trench, CY:	5,073	
Material weight conversion factor, LB/CY:	3,240	*Assume 120 pcf - in place densities*
Material weight conversion factor, TON/CY:	1.62	
Excavation of slurry trench, TON:	8,218	
Excavation of slurry trench, LF:	1,000	
Soil Unit Weight, PCF:	105	Assumed for back fill loose density
Bentonite as percent of total soil excavated (w/w):	1.0%	*Assumed based on testing*
Bentonite unit weight, PCF:	37.02	
Bentonite unit weight, LBS/CY:	995.53	
Bentonite unit weight, TON/CY:	0.498	
Bentonite, TON:	72	
Bentonite, CY:	144	
Clean fill unit weight assumed, PCF:	120	
Clean fill unit weight, LBS/CY:	3240	
Clean fill unit weight, TON/CY:	1.62	
Clean fill needed, CY:	4,929	*Between Sta. 0+00 and 10+00*
Clean fill needed, TON:	7,984	
Import Fill Analysis		
Imported fill chemical sampling frequency, CY/EA:	1,000	
Sieve analysis of imported material, CY/EA:	500	*P2.1.3, Section 02 35 27 - Slurry Trench*
Atterberg Limits, CY/EA:	500	*P2.1.3, Section 02 35 27 - Slurry Trench*
Imported Fill Chemical Analyses, EA:	5	
Number of Sieve Analyses, EA:	10	
Number of Atterberg Limits, EA:	10	
Bentonite Slurry Trench Quality Control Testing		
Backfill slump, CY/EA:	250	*P3.8.4, Section 02 35 27 - Slurry Trench*
Backfill density, CY/EA:	250	*P3.8.4, Section 02 35 27 - Slurry Trench*
Backfill gradation, CY/EA:	250	*P3.8.4, Section 02 35 27 - Slurry Trench*
Flexible wall hydraulic conductivity (remolded), CY/EA:	500	*P3.8.4, Section 02 35 27 - Slurry Trench*
Gradation, CY/EA:	500	*P3.8.4, Section 02 35 27 - Slurry Trench*
Water content, CY/EA:	500	*P3.8.4, Section 02 35 27 - Slurry Trench*
Atterberg limits, CY/EA:	500	*P3.8.4, Section 02 35 27 - Slurry Trench*
Backfill slump, EA:	40	
Backfill density, EA:	40	
Backfill gradation, EA:	40	
Flexible wall hydraulic conductivity (remolded), EA:	20	
Gradation, EA:	20	
Water content, EA:	20	
Atterberg limits, EA:	20	

Table E-9. Groundwater Controls at IR-03 Parcel E - Quantities for Slurry Wall *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Transportation and Disposal of Excavated Material			
Working Surface Cut Volume, CY:		9,820	
Material weight conversion factor, LB/CY:		3,240	*Assume 120 pcf - in place densities*
Material weight conversion factor, TON/CY:		1.62	
Working Surface Cut Disposal, TON:		15,908	
Waste characterization samples, BCY/EA:		500	*Based on ERRG IR-02 assumptions*
Waste characterization, EA:		20	
Disposal Type	**% of Total**	**Quantity**	
Class II Beneficial Reuse Soil to Altamont	10%	1,591	*Based on ERRG IR-02 assumptions*
Class II Soil to Altamont	25%	3,977	*Based on ERRG IR-02 assumptions*
Class I Non-RCRA Soil to Kettleman Hills	30%	4,772	*Based on ERRG IR-02 assumptions*
Class I RCRA Direct LF Soil to Kettleman Hills	15%	2,386	*Based on ERRG IR-02 assumptions*
Class I RCRA Stabilization Soil to Kettleman Hills	15%	2,386	*Based on ERRG IR-02 assumptions*
Disposal of radiologically impacted waste	5%	795	*Based on ERRG IR-02 assumptions*
Protective Cap on Slurry Wall			
Depth of protective cap, FT:		2	*Sheet C-16*
Width either side of barrier wall, FT:		4	*Sheet C-16*
Overall width of protective cap, FT:		11	
Expansion factor of clay:		1.4	*Assumes 40% swell factor*
Clay unit weight assumed, PCF:		110	
Clay unit weight, LBS/CY:		2970	
Clay unit weight, TON/CY:		1.5	
Clay cap on slurry wall, CF:		40,766	
Clay cap on slurry wall, ECY:		1,510	
Clay cap on slurry wall, LCY:		2,120	
Clay cap on slurry wall, TON:		3,180	
Estimated time to place protective cap, DY:		11	
Imported fill chemical sampling frequency, CY/EA:		1,000	
Modified Proctor frequency, CY/EA:		5,200	
Sieve Analysis, CY/EA:		2,000	
Atterberg Limits, CY/EA:		2,000	
Imported Fill Chemical Analyses, EA:		3	
Number of Modified Proctor, EA:		1	
Number of Sieve Analyses, EA:		2	
Number of Atterberg Limits, EA:		2	

Table E-9. Groundwater Controls at IR-03 Parcel E - Quantities for Slurry Wall *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

RAD Monitoring			
Number of RAD Technicians, EA:		2	
Hours per day, HR/DY:		10	
Cost per day, $/DY:	$	2,000	*Based on ERRG labor cost assumptions*
Cost per month for Geiger-Mueller detector, $/MO/EA:	$	450	*Ludlum Model 19 Radiation Monitor, Field Environmental Instruments, September 2017*
Daily rental cost, $/DY/EA:	$	15	*Rounded to nearest whole number*
Daily rental cost, $/DY:	$	30	*Assumes 2 rentals*
Time, DY:		**28**	*Assumes 2 rentals*
Time, WK:		**6**	*Assumes 2 rentals*
Time, MO:		**2**	*Assumes 2 rentals*

Table E-10. NAPL Treatment at IR-03 Parcel E - Quantities for In Situ Solidification and Stabilization
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

In Situ Solidification and Stabilization		
Total impacted area, SF:	74,911	*Measured from Sheet C-14*
Surface elevation - highest, FT AMSL:	8	*Based on slurry wall profile*
Surface elevation - lowest, FT AMSL:	4	*Based on slurry wall profile*
Average surface elevation of solidification/stabilization, FT BGS:	6	
Average elevation of bay mud depth, FT AMSL:	-13	
Average Depth of Penetration into Bay Mud, FT	13	*Assumed based on Pilot Test*
Average total depth of solidification/stabilization, FT BGS:	34	
Solidification/Stabilization Material Mixture Assumptions		
- Based on Section 02 55 00 - Solidification/Stabilization, Paragraph 1.01.B.		
Percentage of treated material, %:	50%	*Percentage of material treated, per engineer*
Dry bentonite, %:	6%	*Slurry prepared at 6% dry to water by weight*
Type I/II Portland Cement, %:	20%	*Based on total weight of material treated*
Water to cement ratio:	1.1	
Unit weight of common earth, LB/BCY:	3,240	*Assume 120 pcf - in place densities*
Unit weight of common earth, TN/BCY:	1.62	
Daily production rate for 2-foot diameter ISS, CY/DAY/EA:	60	*Per engineer*
Number of rigs running, EA:	1	
Daily production rate for 12-foot diameter ISS, CY/DAY/EA:	300	*Per engineer*
Number of rigs running, EA:	2	
Working days per week, DY/WK:	5	
Quality Assurance Testing		
Unconfined compressive strength, CY/EA:	500	*Table 2, Section 02 55 00 - Solidification/Stabilization*
Hydraulic Conductivity, CY/EA:	1,000	*Table 2, Section 02 55 00 - Solidification/Stabilization*
Leachability, CY/EA:	1,000	*Table 2, Section 02 55 00 - Solidification/Stabilization*

Table E-10. NAPL Treatment at IR-03 Parcel E - Quantities for In Situ Solidification and Stabilization *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Sheet Pile Wall Perimeter Columns		
Diameter of columns along sheet pile wall perimeter, FT:	2	
Spacing between columns, FT:	4	*No overlap in columns*
Number of 2-foot diameter columns at 4-foot spacing, EA:	266	*See Sheet C-15*
Area, SF/EA:	3.1	
Total area, SF:	825	
Volume per foot for 2-foot sheet pile wall perimeter column, CF/FT:	3.1	
Volume per column for 2-foot sheet pile wall perimeter column, CF/EA:	105	*Rounded up to nearest whole number*
Volume per column for 2-foot sheet pile wall perimeter column, CY/EA:	4	
Estimated number of columns completed per day, EA/DY:	15	
Total volume for 2-foot sheet pile wall perimeter columns, CF:	27,930	
Total volume for 2-foot sheet pile wall perimeter columns, CY:	1,034	*Rounded up to nearest whole number*
Total for 2-foot sheet pile wall perimeter columns, TON:	1,675	*Rounded to nearest whole number*
Type I/II Portland Cement, TON:	168	*Rounded to nearest whole number*
Water, GAL:	44,286	*Rounded to nearest whole number*
Water, KGAL:	44	*Rounded to nearest whole number*
Water, CCF:	54	*Rounded to nearest whole number*
Bentonite, TON:	11	*Rounded to nearest whole number*
Time, DY:	18	*Rounded up to nearest whole number*
Time, WK:	4	*Rounded up to nearest whole number*
Time, MO:	1	*Rounded up to nearest whole number*
Barrier Columns		
Diameter of barrier columns, FT:	12	
Spacing between columns, FT:	10	*Overlap in columns*
Number of 12-foot diameter columns at 10-foot spacing, EA:	239	*See Sheet C-15*
Area, SF/EA:	113.1	
Total area, SF:	27,031	
Volume per foot for 12-foot barrier column, CF/FT:	113.1	
Volume per column for 12-foot barrier column, CF/EA:	3,845	*Rounded up to nearest whole number*
Volume per column for 12-foot barrier column, CY/EA:	142	
Estimated number of columns completed per day, EA/DY:	4	

Table E-10. NAPL Treatment at IR-03 Parcel E - Quantities for In Situ Solidification and Stabilization *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Barrier Columns *(continued)*		
Total volume for 12-foot barrier columns, CF:	918,955	
Total volume for 12-foot barrier columns, CY:	34,035	*Rounded up to nearest whole number*
Total for 12-foot barrier columns, TON:	55,137	*Rounded to nearest whole number*
Type I/II Portland Cement, TON:	5,514	*Rounded to nearest whole number*
Water, GAL:	1,453,539	*Rounded to nearest whole number*
Water, KGAL:	1,454	*Rounded to nearest whole number*
Water, CCF:	1,766	*Rounded to nearest whole number*
Bentonite, TON:	364	*Rounded to nearest whole number*
Time, DY:	57	*Rounded up to nearest whole number*
Time, WK:	12	*Rounded up to nearest whole number*
Time, MO:	3	*Rounded up to nearest whole number*
Interior Columns		
Diameter of interior columns, FT:	12	
Spacing between columns, FT:	8	*Overlap in columns*
Number of 12-foot diameter columns at 8-foot spacing, EA:	640	*See Sheet C-15*
Area, SF/EA:	113.1	
Total area, SF:	72,384	
Volume per foot for 12-foot interior column, CF/FT:	113.1	
Volume per column for 12-foot interior column, CF/EA:	3,845	*Rounded up to nearest whole number*
Volume per column for 12-foot interior column, CY/EA:	142	
Estimated number of columns completed per day, EA/DY:	4	
Total volume for 12-foot interior columns, CF:	2,460,800	
Total volume for 12-foot interior columns, CY:	91,141	*Rounded up to nearest whole number*
Total for 12-foot interior columns, TON:	147,648	*Rounded to nearest whole number*
Type I/II Portland Cement, TON:	14,765	*Rounded to nearest whole number*
Water, GAL:	3,892,185	*Rounded to nearest whole number*
Water, KGAL:	3,892	*Rounded to nearest whole number*
Water, CCF:	4,730	*Rounded to nearest whole number*
Bentonite, TON:	974	*Rounded to nearest whole number*
Time, DY:	152	*Rounded up to nearest whole number*
Time, WK:	31	*Rounded up to nearest whole number*
Time, MO:	8	*Rounded up to nearest whole number*

Table E-10. NAPL Treatment at IR-03 Parcel E - Quantities for In Situ Solidification and Stabilization *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Totals

Total number of columns, EA:	**1,145**	
Total area, SF:	**100,240**	
Total volume of 2' diameter columns, CY:	**1,034**	
Total volume of 12' diameter columns, CY:	**125,176**	
Time, DY:	**227**	*Working days*
Time, WK:	**47**	
Time, MO:	**12**	
Type I/II Portland Cement, TON:	**20,447**	
Bentonite, TON:	**1,349**	
Water, GAL:	**5,390,010**	
Water, KGAL:	**5,390**	
Water, CCF:	**6,550**	
Unconfined compressive strength, EA:	**128**	
Hydraulic Conductivity, EA:	**64**	
Leachability, EA:	**64**	

RAD Monitoring

Number of RAD Technicians, EA:		2	
Hours per day, HR/DY:		10	
Cost per day, $/DY:	$	2,000	*Based on ERRG labor cost assumptions*
Cost per month for Geiger-Mueller detector, $/MO/EA:	$	450	*Ludlum Model 19 Radiation Monitor, Field Environmental Instruments, September 2017*
Daily rental cost, $/DY/EA:	$	15	
Daily rental cost, $/DY:	$	30	*Assumes 2 rentals*
Number of days, DY:		**227**	

Table E-11. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Site Preparation Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1	DY	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1	DY	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1	DY	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1	DY	$ 808.00		$ 808.00	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM02	1	DY	$ 608.00		$ 608.00	See backup worksheet "General Labor Classifications and Rates"
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1	DY	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1	DY	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1	DY	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1	DY	$ 800.00		$ 800.00	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM02	1	DY	$ 1,000.00		$ 1,000.00	See backup worksheet "General Labor Classifications and Rates"
1.5" Drain Rock	605	TN	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Restore Rad Pads (4) for use						
(6) Labors LBO1	1	DY	$ 3,360.00		$ 3,360.00	See backup worksheet "General Labor Classifications and Rates"
Rad Pad Repair Materials	4	EA	$ 1,500.00	15%	$ 6,900.00	Costs from Treasure Island
Install Temp Fence and 6 Month Rental	5,000	LF	$ 3.29	15%	$ 18,917.50	Costs from HPNS projects
Install Shoring (20' Sheets)	1,090	LF	$ 700.00	15%	$ 877,450.00	Costs from HPNS Parcel B RA
TOTAL					$ 937,070	

Note:

Soil staging area volumes and areas:

Rad Pads to be prepped for use	4	Pad
Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table E-12. Groundwater Controls at IR-03 Parcel E - Slurry Wall Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Mobilization and Demobilization	1	LS	150,000		$ 150,000	
Waste Characterization Sampling						
Soil Analysis for Disposal (per 500 CY)	18	EA	$ 1,123.00	15%	$ 23,247	See backup worksheet "General Labor Classifications and Rates"
Cut for Working Surface	8,766	BCY				
CAT 330 Excavator	22	DY	$ 1,000.00	15%	$ 25,300	Costs from HPNS Parcel B RA
(1) CAT 735 Off Road Dump Truck	22	DY	$ 1,000.00	15%	$ 25,300	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	22	DY	$ 200.00	15%	$ 5,060	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	22	DY	$ 300.00	15%	$ 7,590	Costs from HPNS Parcel B RA
Equipment Operator EQ03	22	DY	$ 808.00		$ 17,776	See backup worksheet "General Labor Classifications and Rates"
(2) Truck Driver TM03	22	DY	$ 1,232.00		$ 27,104	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM02	22	DY	$ 608.00		$ 13,376	See backup worksheet "General Labor Classifications and Rates"
Fill for Working Surface	2,005	BCY				
CAT D6T Dozer	6	DY	$ 700.00	15%	$ 4,830	Quote from Harris Blade
Pad Foot Compactor (66" Single Drum Roller)	6	DY	$ 300.00	15%	$ 2,070	Quote from Herc
2000 Gallon Water Truck	6	DY	$ 200.00	15%	$ 1,380	Costs from HPNS Parcel B RA
Fuel for Heavy Equipment	6	DY	$ 300.00	15%	$ 2,070	Costs from HPNS Parcel B RA
Equipment Operator EQ03	6	DY	$ 808.00		$ 4,848	See backup worksheet "General Labor Classifications and Rates"
Equipment Operator EQ07	6	DY	$ 712.00		$ 4,272	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM02	6	DY	$ 608.00		$ 3,648	See backup worksheet "General Labor Classifications and Rates"
Transport and disposal of excavated material	14,201	TN				
Class II Benificial Reuse Soil to Altamont	1,420	TN	$ 42.70	15%	$ 69,733	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	3,550	TN	$ 79.66	15%	$ 325,221	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	4,260	TN	$ 89.27	15%	$ 437,310	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	2,130	TN	$ 143.04	15%	$ 350,387	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	2,130	TN	$ 189.46	15%	$ 464,093	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	710	TN	$ 132.00	15%	$ 107,778	Assumed Fraction of Total Waste: 5%
Excavation of Slurry Trench	9,820	CY				
CAT 330 BL Long Reach Excavator	14	DY	$ 1,104.00	15%	$ 17,775	Quote from I-5 Rentals
(1) CAT 735 Off Road Dump Truck	14	DY	$ 1,000.00	15%	$ 16,100	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	14	DY	$ 200.00	15%	$ 3,220	Costs from HPNS Parcel B RA
Fuel for Heavy Equipment	14	DY	$ 250.00	15%	$ 4,025	Costs from HPNS Parcel B RA
Equipment Operator EQ03	14	DY	$ 808.00		$ 11,312	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM03	14	DY	$ 616.00		$ 8,624	See backup worksheet "General Labor Classifications and Rates"

Table E-12. Groundwater Controls at IR-03 Parcel E - Slurry Wall Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Batch Plant Operation and Slurry Placement	9,820	CY				
Slurry Mixing Equipment (Jet Shar Mixer, Silo,etc.)	14	DY	$ 2,000.00	15%	$ 32,200	Costs from HPNS Parcel E-2
(2) Storage Tanks	14	DY	$ 100.00	15%	$ 1,610	Costs from HPNS Parcel B RA
Hard Hose, Pumps, hoses	14	DY	$ 250.00	15%	$ 4,025	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	14	DY	$ 200.00	15%	$ 3,220	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	14	DY	$ 750.00	15%	$ 12,075	Costs from HPNS Parcel B RA
(4) Laborers LB01	14	DY	$ 2,240.00		$ 31,360	See backup worksheet "General Labor Classifications and Rates"
Truck Driver TM02	14	DY	$ 608.00		$ 8,512	See backup worksheet "General Labor Classifications and Rates"
Bentonite (material to be mixed onsite)	139	TN	$ 217.90	15%	$ 34,882	Quote from Diversified Minerals
Import Fill - Trucking and Material	7,984	TN	$ 30.00	15%	$ 275,460	Costs from HPNS Parcel B RA
Import Fill Sampling						
Import Fill Chemical Sampling (1 every 1,000 CY)	5	EA	$ 709.00	15%	$ 4,076.75	See Backup Worksheet "Lab Analyses Cost Detail"
Sieve Analysis (1 every 500 CY)	10	EA	$ 109.00	15%	$ 1,253.50	See backup worksheet "General Labor Classifications and Rates"
Atterberg Limits (1 every 500 CY)	10	EA	$ 163.00	15%	$ 1,874.50	See backup worksheet "General Labor Classifications and Rates"
Slurry Trench Quality Control Testing						
Backfill Density (1 every 250 CY)	40	EA	$ 45.00	15%	$ 2,070.00	See backup worksheet "Lab Analyses Cost Detail"
Backfill Gradation (1 every 250 CY)	40	EA	$ 109.00	15%	$ 5,014.00	See backup worksheet "Lab Analyses Cost Detail"
Hydraulic Conductivity (1 every 500 CY)	20	EA	$ 335.00	15%	$ 7,705.00	See backup worksheet "Lab Analyses Cost Detail"
Gradation (1 every 500 CY)	20	EA	$ 109.00	15%	$ 2,507.00	See backup worksheet "Lab Analyses Cost Detail"
Water Content (1 every 500 CY)	20	EA	$ 10.00	15%	$ 230.00	See backup worksheet "Lab Analyses Cost Detail"
Atterberg Limits (1 every 500 CY)	20	EA	$ 163.00	15%	$ 3,749.00	See backup worksheet "Lab Analyses Cost Detail"
Protective Cap						
CAT D6T Dozer	11	DY	$ 700.00	15%	$ 8,855	Quote from Harris Blade
Pad Foot Compactor (66" Single Drum Roller)	11	DY	$ 300.00	15%	$ 3,795	Quote from Herc
Equipment Operator EQ03	11	DY	$ 808.00		$ 8,888	See backup worksheet "General Labor Classifications and Rates"
Equipment Operator EQ07	11	DY	$ 712.00		$ 7,832	See backup worksheet "General Labor Classifications and Rates"
Import Fill - Trucking and Material	3,180	TN	$ 30.00	15%	$ 109,710	Costs from HPNS Parcel B RA
Import Fill Sampling						
Import Fill Chemical Sampling (1 every 1,000 CY)	3	EA	$ 709.00	15%	$ 2,446.05	See backup worksheet "Lab Analyses Cost Detail"
Modified Proctor (1 every 5,200 CY)	1	EA	$ 260.00	15%	$ 299.00	See backup worksheet "Lab Analyses Cost Detail"
Sieve Analysis (1 every 2,000 CY)	2	EA	$ 109.00	15%	$ 250.70	See backup worksheet "Lab Analyses Cost Detail"
Atterberg Limits (1 every 2,000 CY)	2	EA	$ 163.00	15%	$ 374.90	See backup worksheet "Lab Analyses Cost Detail"
RAD Monitoring						
RAD Technicians	28	DY	$ 2,000.00		$ 56,000	2 Technicians onsite for 10 hours per day
Ludlum Pancake Geiger-Mueller detector	28	DY	$ 30.00	15%	$ 966	Assumes 2 rentals
Consumables	28	DY	$ 50.00		$ 1,400	Per Engineer
Monitoring Wells and Piezometers						
Install Monitoring Wells	1	EA	$ 5,000.00	15%	$ 5,750	Quote from Gregg Drilling
Install Piezometers	5	EA	$ 5,000.00	15%	$ 28,750	Quote from Gregg Drilling

Table E-12. Groundwater Controls at IR-03 Parcel E - Slurry Wall Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Waste Characterization Sampling (1 per 500 CY)	20	EA	$ 1,123.00	15%	$ 25,829	See backup worksheet "Lab Analyses Cost Detail"
Transport and disposal of excavated material	15,908	TN				
Class II Beneficial Reuse Soil to Altamont	1,591	TN	$ 42.70	15%	$ 78,130	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	3,977	TN	$ 79.66	15%	$ 364,339	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	4,772	TN	$ 89.27	15%	$ 489,869	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	2,386	TN	$ 143.04	15%	$ 392,499	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	2,386	TN	$ 189.46	15%	$ 519,871	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	795	TN	$ 132.00	15%	$ 120,681	Assumed Fraction of Total Waste: 5%
TOTAL [1]					**$ 4,791,807**	

Cut Fill Volumes and Areas:				
Cut For Working Platform	8,766	CY		
Fill For Working platform	2,005	CY		
Fill For Working Platform	3,248	TN	1.62	BCY to TN Factor
Trench and Slurry Volumes Assumptions and Quantities:				
Slurry Wall Width	3	FT		
Slurry Wall Length	1,853	FT		
Trenched Volume	9,820	CY		
Trenched Material weight	15,908	TN	1.62	BCY to TN Factor
Bentonite as Percent of Total Soil Excavated	1.0	%		
Bentonite	139	TN		
Volume of Bentonite-Slurry	9,820	CY		
Install Monitoring Wells	1	EA		
Install Piezometers	5	EA		

BCY: bank cubic yard; CY: cubic yard; DY: day; EA: each; LS: lump sum; TN: ton

Notes:

1. The costs presented in this estimate are considered Class 2 with an accuracy range of -5%/+10% of actual cost, based on the scope presented, according to the American Society for Testing and Materials (ASTM) Standard Classification for Cost Estimate Classification System (Designation E 2516-11). The level of accuracy range of -5%/+10% means that, for an estimate of $4,791,807, the actual cost is expected to be between $5,000,000 and $6,000,000.

Table E-13. NAPL Treatment at IR-03 Parcel E - In Situ Solidification and Stabilization Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Mobilization and Demobilization	1	LS	300,000		$ 300,000	
In Situ Solidification and Stabilization						
ISS - 2' diameter columns (labor and equipment)	1,034	CY	$ 124.00	15%	$ 147,449	See backup worksheet "Labor and Equipment Rates for ISS"
ISS - 12' diameter columns (labor and equipment)	125,176	CY	$ 7.00	15%	$ 1,007,667	See backup worksheet "Labor and Equipment Rates for ISS"
Obstruction Removal		Lump	$ 350,000.00	15%	$ 402,500	
Slurry Mixing Equipment (Jet Shar Mixer, Silo,etc.)	227	DY	$ 2,000.00	15%	$ 522,100	Costs from HPNS Parcel E-2
(2) Storage Tanks	227	DY	$ 100.00	15%	$ 26,105	Costs from HPNS Parcel B RA
Hard Hose, Pumps, hoses	227	DY	$ 250.00	15%	$ 65,263	Costs from HPNS Parcel B RA
Portland Cement	20,447	TN	$ 135.00	15%	$ 3,174,397	Quote from Cemex USA
Bentonite	1,349	TN	$ 217.90	15%	$ 338,040	Quote from Diversified Minerals
Water Meter - 6" Meter, Industrial Use, FYE 2018	12	MO	$ 306.76	15%	$ 4,234	San Francisco Public Utilities Commission
Water - Industrial Use, FYE 2018	6,550	CCF	$ 7.64	15%	$ 57,549	San Francisco Public Utilities Commission
Quality Control Testing						
Unconfined Compressive Strength (1 every 500 CY)	128	EA	$ 45.00	15%	$ 6,624	See backup worksheet "Lab Analyses Cost Detail"
Hydraulic Conductivity (1 every 1,000 CY)	64	EA	$ 335.00	15%	$ 24,656	See backup worksheet "Lab Analyses Cost Detail"
Leachability (1 every 1,000 CY)	64	EA	$ 880.00	15%	$ 64,768	See backup worksheet "Lab Analyses Cost Detail"
RAD Monitoring						
RAD Technicians	227	DY	$ 2,000.00		$ 454,000	2 Technicians onsite for 10 hours per day
Ludlum Pancake Geiger-Mueller detector	227	DY	$ 30.00	15%	$ 7,832	Assumes 2 rentals
Consumables	227	DY	$ 50.00		$ 11,350	Per Engineer
TOTAL [1]					**$ 6,614,534**	

In Situ Solidification and Stabilization Assumptions and Quantities				
Number of 2' dia. Sheet Pile Wall Perimeter Columns	266	EA		
Sheet Pile Wall Material Treated	1,034	CY		
Sheet Pile Wall Material Treated	1,675	TN	1.62	BCY to TN Factor
Number of 12' dia Barrier Columns	239	EA		
Barrier Column Total Volume	34,035	CY		
Barrier Column Total Tonnage of Soil Mixed	55,137	TN	1.62	BCY to TN Factor
Number of 12' dia Interior Columns	640	EA		
Interior Column Total Volume	91,141	CY		
Interior Column Total Tonnage of Soil Mixed	147,648	TN	1.62	BCY to TN Factor
Treatment Zone Soils as percentage of total soils mixed	50	%		
Dry Bentonite to Water by Weight	6	%		
Type I/II Portland Cement by Total Weight of Material Treated:	20	%		
Water to Cement Ratio	1.1	:1		
Portland Cement	20,447	TN		
Bentonite	1,349	TN		

CY: cubic yard; DY: day; EA: each; LS: lump sum; TN: ton

Notes:

1. The costs presented in this estimate are considered Class 2 with an accuracy range of -5%/+10% of actual cost, based on the scope presented, according to the American Society for Testing and Materials (ASTM) Standard Classification for Cost Estimate Classification System (Designation E 2516-11). The level of accuracy range of -5%/+10% means that, for an estimate of $6,614,534, the actual cost is expected to be between $7,000,000 and $8,000,000.

Table E-14. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Radiological Screening Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Geophysical monitoring equipment rental for UXO screening	1	MO	$ 5,000.00	15%	$ 5,750	Costs from HPNS IR 7 & 18
Radiological Support Services	79	DY	$ 3,650.00	15%	$ 331,603	Costs from HPNS IR 7 & 18
SUPRA/FSS Rad Pads (Screening)	93	EA	$ 3,700.00	15%	$ 395,417	Costs from HPNS IR 7 & 18
Manage Excavated Soil Material & Debris						
CAT 14H Motor Grader	36	DY	$ 1,000.00	15%	$ 41,400	Costs from HPNS Parcel B RA
Bobcat T-190	79	DY	$ 400.00	15%	$ 36,340	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	36	DY	$ 300.00	15%	$ 12,420	Costs from HPNS Parcel B RA
Equipment Operator EQ02	36	DY	$ 840.00		$ 30,240	See backup worksheet "General Labor Classifications and Rates"
Equipment Operator EQ06	79	DY	$ 736.00		$ 58,144	See backup worksheet "General Labor Classifications and Rates"
Excavate 1000m^2 x 1' grid and Load out						
CAT 330 Excavator	19	DY	$ 1,000.00	15%	$ 21,850	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	19	DY	$ 300.00	15%	$ 6,555	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	19	DY	$ 500.00	15%	$ 10,925	Costs from HPNS Parcel B RA
Equipment Operator EQ03	19	DY	$ 808.00		$ 15,352	Costs from HPNS Parcel B RA
Truck Driver TM02	19	DY	$ 608.00		$ 11,552	Costs from HPNS Parcel B RA
TOTAL					**$ 977,548**	

Note:

Soil quantities:

Total CY to Rad Pads	18,586	CY
Total Days Excavating	36	DY
Excavated Volume Per Day	516	CY/DY

Table E-15. Groundwater Controls and NAPL Treatment at IR-03 Parcel E - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/DY	21,780 SF	1 DY	Production rate from HPNS Parcel B
Rad Pad Repairs	4 Pad/DY	4 Pads	1 DY	Production rates from Treasure Island
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/DY	21,780 SF	1 DY	Production rate from HPNS IR7 &18
Cut Fill Working Platform				
Cut	400 CY/DY	8,766 CY	22 DY	Production rate from HPNS Parcel B
Fill	400 CY/DY	2,005 CY	6 DY	Production rate from HPNS Parcel B
Install Slurry Wall				
Trench Slurry Wall	140 LF/DY	1,853 LF	14 DY	Production rate from HPNS
Install Bentonite-Slurry	140 LF/DY	1,853 LF	14 DY	Production rate from HPNS
Install Monitoring Wells	2 EA/DY	1 EA	1 DY	Production rate from HPNS
Install Piezometers	2 EA/DY	5 EA	3 DY	Production rate from HPNS
In Situ Solidification and Stabilization				
2' diameter ISS Column	60 CY/DY	1,034 CY	18 DY	Per Engineer - Assumes 1 rig operating
12' diameter ISS Column	600 CY/DY	125,176 CY	209 DY	Per Engineer - Assumes 2 rigs operating
RADIOLOGICAL SCREENING AND LOAD OUT				
Radiological and UXO characterization and release			20 DY	20 days to obtain radiological and UXO release of screening pads
Manage Rad Pad Material			40 DY	Smooth out Rad Pads and prepare material for Rad Screening
Excavate 1000m^2 x 6" grid and tranport to disposal facility	5 Grids/DY	93 grids	19 DY	See backup worksheet "Radiological Screening Cost Detail"
SURVEY/DEMOBILIZATION				
Survey Crew			10 DY	Misc Survey
Demobilization			3 DY	
		TOTAL	**293 DY**	

Appendix F. Activity 5A Cost Estimate (Shoreline Protection)

Available on CD.

Table F-1. Shoreline Protection - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 105 working days
6 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 1,186,560**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 1,045,800**	
Total project professional/technical labor cost					$ 695,100	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 197,400	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 153,300	See backup worksheet "LABOR"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 140,760**	
30' connex office trailer	6	mo	$ 550.00	15%	$ 3,795	Quote from Mobile Mini
Office Equipment Rental	6	mo	$ 800.00	15%	$ 5,520	Costs from HPNS Parcel C
Office Supplies	6	mo	$ 100.00	15%	$ 690	Costs from HPNS Parcel C
Telephone Bill	6	mo	$ 50.00	15%	$ 345	Costs from HPNS Parcel C
Internet Bill	6	mo	$ 200.00	15%	$ 1,380	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	6	mo	$ 5,400.00	15%	$ 37,260	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	6	mo	$ 500.00	15%	$ 3,450	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	6	mo	$ 2,000.00	15%	$ 13,800	Quote from Hertz
Fuel for Rental Trucks	6	mo	$ 1,200.00	15%	$ 8,280	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	6	mo	$ 6,000.00	15%	$ 41,400	Quote from Sitech
(2) Kubotas	6	mo	$ 1,300.00	15%	$ 8,970	Quote from Hertz
8K Forklift	6	mo	$ 2,300.00	15%	$ 15,870	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 10,644,799**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 21,275**	
CAT 330 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 14H Motor Grader	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT D5 Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
Pad Foot Compactor (66" Single Drum Roller)	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
2000 Gallon Water Truck	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
Bobcat T-190	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
CAT 735 Off Road Dump Truck	4	ea	$ 1,000.00	15%	$ 4,600	Quote from Harris Blade Rental
John Deere 225 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT 972 Loader	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
S-65 Manlift	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
John Deere 210 Skiploader	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
(3) Light Towers	6	ea	$ 450.00	15%	$ 3,105	Quote from Hertz
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 29,325**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	105	day	$ 100.00	15%	$ 12,075	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	6	mo	$ 2,500.00	15%	$ 17,250	Quote from BlueLine Rentals

Table F-1. Shoreline Protection - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 105 working days
6 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Site Preparation			**Site Preparation Subtotal =**		**$ 159,874**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 18,917.50		$ 18,918	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	6	mo	$ 1,763.00	15%	$ 12,165	Quote from Cam Guard
Land survey	30	day	$ 2,200.00	15%	$ 75,900	Quote from ESP Surveying
Subsurface utility surveying	6	day	$ 1,400.00	15%	$ 9,660	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C
Air Monitoring			**Air Monitoring Subtotal =**		**$ 236,756**	
(2) Air Monitor Rental for PM10, TSP and Metals	6	mo	$ 2,800.00	15%	$ 19,320	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	6	mo	$ 1,200.00	15%	$ 8,280	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	105	day	$ 790.00	15%	$ 95,393	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	105	day	$ 725.00	15%	$ 87,544	Costs from HPNS Parcel C
Shipment of Sample Media	6	mo	$ 800.00	15%	$ 5,520	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	6	mo	$ 1,800.00	15%	$ 12,420	Quote from Pine Environmental
Portable Multi Gas Meter	6	mo	$ 1,200.00	15%	$ 8,280	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	6	mo	$ 1,150.00	15%	$ 7,935	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	210	hr	$ 70.00	15%	$ 16,905	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 10,644,799**	**Includes mob/demob and all construction activities**
Upland Grading & Soil Placement			**Upland Grading & Soil Placement =**		**$ 116,060**	See Backup Worksheet "UPLAND GRADING & SOIL PLACEMENT"
Upland Grading & Soil Placement	1	ea	$ 116,059.50		$ 116,060	
Install Armored Shoreline			**Install Armored Shoreline =**		**$ 4,005,507**	See Backup Worksheet "INSTALL ARMOURED SHORLINE"
Install Armored Shoreline	1	ea	$ 4,005,506.77		$ 4,005,507	
Install Hybrid Shoreline			**Install Hybrid Shoreline =**		**$ 4,628,585**	See Backup Worksheet "INSTALL HYBRID SHORLINE"
Install Hybrid Shoreline	1	ea	$ 4,628,585.10		$ 4,628,585	
Radiological Screening, loading of waste			**Radiological Screening, Loading of waste =**		**$ 1,427,670**	See Backup Worksheet "RADIOLOGICAL LOE"
Radiological Screening, loading of waste	1	ea	$ 1,427,670.31		$ 1,427,670	
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 354,941**	**Includes management, plans, and reports**
Assumed to be 3% of construction cost (including permitting)					$ 354,941	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR

Table F-1. Shoreline Protection - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 105 working days
6 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
TOTAL PROJECT CAPITAL COST	**TOTAL PROJECT CAPITAL COST =**				**$ 12,186,300**	**Includes Distributive Costs**
Total Construction Cost					$ 11,831,359	
Total Management/Planning/Reporting Cost					$ 354,941	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table F-2. Shoreline Protection - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	10	1	$ 13.00
	Project Engineer, Geologist or Scientist	$ 125.00	100	2	$ 250.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table F-3. Shoreline Protection- Radiological Screening Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Unit Production Rate	Units	Comments	Production per Day	Assumptions	Total Production per day
Excavated soil from Armoured Shoreline	193.57	CY/hr per excavator (1)	Excavate 60 LF per day	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	200 CY/day ≈ 1 grids
Excavated soil from Hybrid Shoreline Shoreline	364.10	CY/hr per excavator (1)	Excavate 40 LF per day	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	400 CY/day ≈ 2 grids
Load out soil within 1000m^2 x 6" grid	100	CY/hr per excavator (2)	2 hours per grid per excavator	800 CY/day per excavator	1000m^2 x 6" = 5382 ft^3 = 200 CY/grid, 200 CY/grid x 4 grids = 800 CY (1 excavator)	800 CY/day ≈ 4 grids
Rad screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (4)	1 grid per crew per day	1 grids screened per day per crew	2 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	2 grids
UXO screen (on pads) 1000m^2 grids	10,764	ft^2/day per crew (5)	8 hours per grid per crew	1 grids screened per day per crew	2 crew of 2 could scan 2 grid cell per 8 hour, 8 hour day	2 grids

Notes:

(1) Average production rate determined from screening operations at other Hunter's Point parcels

(2) Average production rate determined from screening operations at other Hunter's Point parcels

(3) Average production rate determined from screening operations at other Hunter's Point parcels

(4) Average production rate determined from screening operations at other Hunter's Point parcels

(5) Average production rate determined from screening operations at other Hunter's Point parcels

Table F-4. Shoreline Protection - Lab Analyses Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample	
Encore Samplers for TPH-purgeable range (3 per sample)	**$**	**39.00**
Analysis (for excavation chemicals only)		
Volatile Organic Compounds (VOCs)	$	180.00
Semivolatile Organic Compounds (SVOCs)	$	210.00
Pesticides	$	138.00
Polychlorinated Biphenyls (PCBs)	$	78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$	54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$	54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$	108.00
Strontium-90	$	142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$	156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$	90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$	90.00
Total Cost/Pre-Excavation Characterization Sample:	**$**	**753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$**	**1,003.80**
Total Cost/Waste Characterization Sample:	**$**	**586.80**
Analysis[2]	Cost per Sample	
Analysis (Geotechnical for import fill only)		
Modified Proctor (1 every 5,200 CY)	$	260.00
Sieve Analysis (1 every 2,000 CY)	$	109.00
Atterberg Limits (1 every 2,000 CY)	$	163.00

Notes:

(1) Analytical costs provided by C&T 2017

(2) Geotechnical costs provided by Cooper Testing Labs 2017

Table F-5. Shoreline Protection - Site Preparation Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, support equipment and temp facilities			
	Units	Quantity	Notes
Lay Down Area	Acres	0.5	This location will be used as a support area
Prep Existing Rad Pads			
	Units	Quantity	Notes
Rad Pads	EA	4	
Temporary Fence			
	Units	Quantity	Notes
Temp Fence	LF	5,000.00	Temp fence will be placed around staging and laydown areas

Table F-6. Shoreline Protection - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Upland grading and Soil Placement			**Notes**
Upland grading for Geogrid	135,619	SF	ACAD and Quantity Takeoffs
Berm Volume for Hybrid Shoreline	1,836	CY	ACAD and Quantity Takeoffs
Install Revetment			**Notes**
Armoured Shoreline Length	2,692	LF	ACAD and Quantity Takeoffs
Excavated Soil (Screening and Disposal)	8,711	CY	ACAD and Quantity Takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads (AS)	44	Pads	ACAD and Quantity Takeoffs
1/4 Ton Rip Rap (Armoured Shoreline)	5,543	CY	ACAD and Quantity Takeoffs
6.25 Inch Filter Rock (Armoured Shoreline)	3,168	CY	ACAD and Quantity Takeoffs
Filter Fabric (Armoured Shoreline)	80,178	SF	ACAD and Quantity Takeoffs
Geogrid (Armored Shoreline)	195,282	SF	ACAD and Quantity Takeoffs
Concrete Sea Wall (Armoured Shoreline)	2,692	LF	ACAD and Quantity Takeoffs
Hybrid Shoreline Length	1,774	LF	ACAD and Quantity Takeoffs
Excavated Soil (Screening and Disposal)	16,385	CY	ACAD and Quantity Takeoffs
Number of equivalent 1000m^2 x 6" Rad Pads (AS)	82	Pads	ACAD and Quantity Takeoffs
Light Rip Rap (Hybrid Shoreline)	4,807	CY	ACAD and Quantity Takeoffs
Natural Sand (Hybrid Shoreline)	6,541	CY	ACAD and Quantity Takeoffs
4.7 Inch Filter Rock (Hybrid Shoreline)	5,036	CY	ACAD and Quantity Takeoffs
Filter Fabric (Hybrid Shoreline)	92,715	SF	ACAD and Quantity Takeoffs

Table F-7. Shoreline Protection - Site Preparation Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Restore Rad Pads (4) for use						
(6) Labors LBO1	1	Day	$ 3,360.00		$ 3,360.00	See "LABOR" Worksheet for detail
Rad Pad Repair Materials	4	EA	$ 1,500.00	15%	$ 6,900.00	Costs from Treasure Island
Install Temp Fence and 6 Month Rental	5,000	LF	$ 3.29	15%	$ 18,917.50	Costs from HPNS projects
TOTAL					$ 59,620	

Note:

Soil staging area volumes and areas:

Rad Pads to be prepped for use	4	Pad
Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table F-8. Shoreline Protection - Upland Earthwork Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Upland Grading for Geogrid	135,619	SF				
CAT D5 Dozer	4.0	Day	$ 650.00	15%	$ 2,990.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	4.0	Day	$ 300.00	15%	$ 1,380.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	4.0	Day	$ 250.00	15%	$ 1,150.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	4.0	Day	$ 808.00		$ 3,232.00	See "LABOR" Worksheet for detail
Truck Driver TM02	4.0	Day	$ 608.00		$ 2,432.00	See "LABOR" Worksheet for detail
Hybrid Shorline Berm Placement						
CAT D5 Dozer	3.0	Day	$ 650.00	15%	$ 2,242.50	Quote from Harris Blade
Pad Foot Compactor (66" Single Drum Roller)	3.0	Day	$ 300.00	15%	$ 1,035.00	Quote from Herc
2000 Gallon Water Truck	3.0	Day	$ 300.00	15%	$ 1,035.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	3.0	Day	$ 300.00	15%	$ 1,035.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	3.0	Day	$ 808.00		$ 2,424.00	See "LABOR" Worksheet for detail
Equipment Operator EQ07	3.0	Day	$ 89.00		$ 267.00	See "LABOR" Worksheet for detail
Truck Driver TM02	3.0	Day	$ 608.00		$ 1,824.00	See "LABOR" Worksheet for detail
Import Fill For Berm	2,754.0	Tons	$ 30.00	15%	$ 95,013.00	Costs from HPNS Parcel B RA
TOTAL					$ 116,060	

Note:

Material volumes and areas:

Upland Grading for Geogrid	135,619	SF	
Import Fill for Hybrid Shorline Berm	1,836	CY	
Fill For Working Platform in tons	2,754	Tons	1.5 BCY to Ton Factor

Table F-9. Shoreline Protection - Revetment Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install Armored Revetment (incl anchoring geogrid)	8,711	LF				
CAT 330 Excavator	45.0	Day	$ 750.00	15%	$ 38,812.50	Costs from HPNS Parcel B RA
John Deere 225 Excavation	45.0	Day	$ 375.00	15%	$ 19,406.25	Costs from HPNS Parcel B RA
(1) CAT 735 Off Road Dump Truck	45.0	Day	$ 750.00	15%	$ 38,812.50	Costs from HPNS Parcel B RA
CAT D5 Dozer	45.0	Day	$ 375.00	15%	$ 19,406.25	Costs from HPNS Parcel B RA
CAT 972 Loader	45.0	Day	$ 360.00	15%	$ 18,630.00	Costs from HPNS Parcel B RA
S-65 Manlift	45.0	Day	$ 150.00	15%	$ 7,762.50	Costs from HPNS Parcel B RA
JD 210 Skiploader	45.0	Day	$ 120.00	15%	$ 6,210.00	Costs from HPNS Parcel B RA
Pad Foot Compactor (66" Single Drum Roller)	45.0	Day	$ 300.00	15%	$ 15,525.00	Quote from Herc
(3) Light Towers	45.0	Day	$ 150.00	15%	$ 7,762.50	Costs from HPNS Parcel B RA
Water Parameter Meter w/ Turbidity	45.0	Day	$ 60.00	15%	$ 3,105.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	45.0	Day	$ 125.00	15%	$ 6,468.75	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	45.0	Day	$ 1,000.00	15%	$ 51,750.00	Costs from HPNS Parcel B RA
(3) Equipment Operator EQ03	45.0	Day	$ 2,424.00		$ 109,080.00	See "LABOR" Worksheet for detail
Equipment Operator EQ04	45.0	Day	$ 784.00		$ 35,280.00	See "LABOR" Worksheet for detail
Equipment Operator EQ07	45.0	Day	$ 89.00		$ 4,005.00	See "LABOR" Worksheet for detail
(3) Laborer LBO1	45.0	Day	$ 1,680.00		$ 75,600.00	See "LABOR" Worksheet for detail
Truck Driver TM02	45.0	Day	$ 608.00		$ 27,360.00	See "LABOR" Worksheet for detail
Truck Driver TM03	45.0	Day	$ 616.00		$ 27,720.00	See "LABOR" Worksheet for detail
Geogrid Material	195,282.1	SF	$ 0.57	15%	$ 129,005.51	Quote GeoOptions
Import Fill to Anchor Geogrid	15,068.8	Tons	$ 30.00	15%	$ 519,872.64	Costs from HPNS Parcel B RA
Install Sea Wall	2,692.3	LF	$ 150.00	15%	$ 464,426.93	Sub Rough Quote
Bay Water Analytical Testing (Background Sampling)	4	EA	$ 586.80	15%	$ 2,699.28	See "LAB COST" Worksheet for detail.
Bay Water Analytical Testing (During Revetment Construction)	6	EA	$ 586.80	15%	$ 4,048.92	See "LAB COST" Worksheet for detail
Revetment Filter Fabric (FW700)	23.0	Roll	$ 750.00	15%	$ 19,837.50	Costs from HPNS Parcel B RA
Filter Rock Transportation and Material	4,434.5	Ton	$ 38.00	15%	$ 193,788.26	Costs from HPNS Parcel B RA
Rip Rap Transportation and Material	7,206.1	Ton	$ 65.00	15%	$ 538,655.60	Costs from HPNS Parcel B RA
Waste Characterization Sampling (1 Sample per 1K CY)	9.0	EA	$ 586.80	15%	$ 6,073.38	See "LAB COST" Worksheet for detail.
Class II Beneficial Reuse Soil to Altamont	1,306.6	ton	$ 42.70	15%	$ 64,163.55	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	3,266.5	ton	$ 79.66	15%	$ 299,248.08	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	3,919.8	ton	$ 89.27	15%	$ 402,385.78	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	1,959.9	ton	$ 143.04	15%	$ 322,404.48	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	1,959.9	ton	$ 189.46	15%	$ 427,029.74	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	653.3	ton	$ 132.00	15%	$ 99,170.86	Assumed Fraction of Total Waste: 5%
TOTAL					$ 4,005,507	

Table F-9. Shoreline Protection - Revetment Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Note:
Armoured Revetment volumes and areas:

Revetment Length	2,692	LF		
Excavation Volume	8,711	CY		
Excavation Material weight	13,066	Tons	1.5	BCY to tons factor
Rip Rap Volume	5,543	CY		
Rip Rap Weight	7,206	Tons	1.3	BCY to tons factor
Filter Rock Volume	3,167.51	CY		
Filter Rock Weight	4,435	Tons	1.4	BCY to tons factor
Filter Fabric Area	80,178	SF		
Filter Fabric Rolls	23.00	Roll	3600	SF per roll
Geogrid area (total Upland and Revetment areas)	195,282.08	SF		

Table F-10. Shoreline Protection - Hybrid Stabilization Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install Hybrid Stabilization	1,774	LF				
CAT 330 Excavator	45.0	Day	$ 750.00	15%	$ 38,812.50	Costs from HPNS Parcel B RA
John Deere 225 Excavation	45.0	Day	$ 375.00	15%	$ 19,406.25	Costs from HPNS Parcel B RA
(1) CAT 735 Off Road Dump Truck	45.0	Day	$ 750.00	15%	$ 38,812.50	Costs from HPNS Parcel B RA
CAT D5 Dozer	45.0	Day	$ 375.00	15%	$ 19,406.25	Costs from HPNS Parcel B RA
CAT 972 Loader	45.0	Day	$ 360.00	15%	$ 18,630.00	Costs from HPNS Parcel B RA
S-65 Manlift	45.0	Day	$ 150.00	15%	$ 7,762.50	Costs from HPNS Parcel B RA
JD 210 Skiploader	45.0	Day	$ 120.00	15%	$ 6,210.00	Costs from HPNS Parcel B RA
(3) Light Towers	45.0	Day	$ 150.00	15%	$ 7,762.50	Costs from HPNS Parcel B RA
Water Parameter Meter w/ Turbidity	45.0	Day	$ 60.00	15%	$ 3,105.00	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	45.0	Day	$ 125.00	15%	$ 6,468.75	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	45.0	Day	$ 1,000.00	15%	$ 51,750.00	Costs from HPNS Parcel B RA
(3) Equipment Operator EQ03	45.0	Day	$ 2,424.00		$ 109,080.00	See "LABOR" Worksheet for detail
Equipment Operator EQ04	45.0	Day	$ 784.00		$ 35,280.00	See "LABOR" Worksheet for detail
(3) Laborer LBO1	45.0	Day	$ 1,680.00		$ 75,600.00	See "LABOR" Worksheet for detail
Truck Driver TM02	45.0	Day	$ 608.00		$ 27,360.00	See "LABOR" Worksheet for detail
Truck Driver TM03	45.0	Day	$ 616.00		$ 27,720.00	See "LABOR" Worksheet for detail
Bay Water Analytical Testing (Background Sampling)	4	EA	$ 586.80	15%	$ 2,699.28	See "LAB COST" Worksheet for detail
Bay Water Analytical Testing (During Revetment Construction)	6	EA	$ 586.80	15%	$ 4,048.92	See "LAB COST" Worksheet for detail
Revetment Filter Fabric (FW700)	26.0	Roll	$ 750.00	15%	$ 22,425.00	Costs from HPNS Parcel B RA
Filter Rock Transportation and Material	7,050.9	Ton	$ 40.00	15%	$ 324,342.23	Costs from HPNS Parcel B RA
Rip Rap Transportation and Material	6,249.7	Ton	$ 55.00	15%	$ 395,292.58	Costs from HPNS Parcel B RA
Natural Sand Transportation and Material	9,811.1	Ton	$ 30.00	15%	$ 338,483.30	Costs from HPNS Parcel B RA
Waste Characterization Sampling (1 Sample per 1K CY)	17.0	EA	$ 586.80	15%	$ 11,471.94	See "LAB COST" Worksheet for detail.
Class II Beneficial Reuse Soil to Altamont	2,457.7	ton	$ 42.70	15%	$ 120,690.23	Assumed Fraction of Total Waste: 10%
Class II Soil to Altamont	6,144.2	ton	$ 79.66	15%	$ 562,879.07	Assumed Fraction of Total Waste: 25%
Class I Non-RCRA Soil to Kettleman Hills	7,373.1	ton	$ 89.27	15%	$ 756,878.81	Assumed Fraction of Total Waste: 30%
Class I RCRA Direct LF Soil to Kettleman Hills	3,686.5	ton	$ 143.04	15%	$ 606,435.74	Assumed Fraction of Total Waste: 15%
Class I RCRA Stabilization Soil to Kettleman Hills	3,686.5	ton	$ 189.46	15%	$ 803,233.56	Assumed Fraction of Total Waste: 15%
Disposal of radiologically impacted waste	1,228.8	ton	$ 132.00	15%	$ 186,538.22	Assumed Fraction of Total Waste: 5%
TOTAL					$ 4,628,585	

Table F-10. Shoreline Protection - Hybrid Stabilization Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Note:
Armoured Revetment volumes and areas:

Revetment Length	1,774	LF		
Excavation Volume	16,385	CY		
Excavation Material weight	24,577	Tons	1.5	BCY to tons factor
Rip Rap Volume	4,807	CY		
Rip Rap Weight	6,250	Tons	1.3	BCY to tons factor
Filter Rock Volume	5,036.37	CY		
Filter Rock Weight	7,051	Tons	1.4	BCY to tons factor
Natural Sand Volume	6,541	CY		
Natural Sand Weight	9,811	Tons	1.5	BCY to tons factor
Filter Fabric Area	92,715	SF		
Filter Fabric Rolls	26.00	Roll	3600	SF per roll

Table F-11. Shoreline Protection - Radiological Screening Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Geophysical monitoring equipment rental for UXO screening	1	months	$ 5,000.00	15%	$ 5,750	Costs from HPNS IR 7 & 18
Radiological Support Services	105	Day	$ 3,650.00	15%	$ 440,738	Costs from HPNS IR 7 & 18
SUPRA/FSS Rad Pads (Screening)	125	EA	$ 3,700.00	15%	$ 533,901	Costs from HPNS IR 7 & 18
Manage Excavated Soil Material & Debris						
CAT 14H Motor Grader	90	Day	$ 1,000.00	15%	$ 103,500	Costs from HPNS Parcel B RA
Bobcat T-190	105	Day	$ 400.00	15%	$ 48,300	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	90	Day	$ 300.00	15%	$ 31,050	Costs from HPNS Parcel B RA
Equipment Operator EQ02	90	Day	$ 840.00		$ 75,600	See "LABOR" Worksheet for detail. Operator will use Motor Grader
Equipment Operator EQ06	105	Day	$ 736.00		$ 77,280	See "LABOR" Worksheet for detail. Operator will use bobcat
Excavate 1000m^2 x 1' grid and Load out						
CAT 330 Excavator	32	Day	$ 1,000.00	15%	$ 36,800	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	32	Day	$ 300.00	15%	$ 11,040	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	32	Day	$ 500.00	15%	$ 18,400	Costs from HPNS Parcel B RA
Equipment Operator EQ03	32	Day	$ 808.00		$ 25,856	Costs from HPNS Parcel B RA
Truck Driver TM02	32	Day	$ 608.00		$ 19,456	Costs from HPNS Parcel B RA
TOTAL					$ 1,427,670	

Note:

Soil quantities:

Total CY to Rad Pads	25,095	CY
Total Days Excavating	90	Days
Excavated Volume Per Day	279	CY/Day

Table F-12. Shoreline Protection - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B
Rad Pad Repairs	4 Pad/Day	4 Pads	1 days	Production rates from Treasure Island
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/day	21,780 SF	1 days	Production rate from HPNS IR7 &18
Upland Grading and Soil Placement				
Grade upland geogrid area (Armored Shoreline)	40,000 SF/day	135,619 SF	4 days	Production rate from HPNS Parcel B
Hybrid Shoreline Berm	800 CY/day	1,836 CY	3 days	Production rate from HPNS Parcel B
Place soil cover to anchor geogrid	1020 CY/day	10,046 CY	10 days	Production rate from HPNS
Install Armored Shoreline				
Excavate Shoreline Footprint	60 LF/day	2,692 LF	45 days	Production rate from HPNS
Install Quarter Ton Rip Rap	60 LF/day	2,692 LF	45 days	Production rate from HPNS
Install Filter Rock	60 LF/day	2,692 LF	45 days	Production rate from HPNS
Install Filter Fabric	60 LF/day	2,692 LF	45 days	Production rate from HPNS
Install Geogrid	60 LF/day	2,008 LF	34 days	Production rate from HPNS
Install Hybrid Shoreline				
Excavate Shoreline Footprint	40 LF/day	1,774 LF	45 days	Production rate from HPNS
Install Light Rip Rap	40 LF/day	1,774 LF	45 days	Production rate from HPNS
Install Filter Rock	40 LF/day	1,774 LF	45 days	Production rate from HPNS
Install Natural Sand	40 LF/day	1,774 LF	45 days	Production rate from HPNS
Install Filter Fabric	40 LF/day	1,774 LF	45 days	Production rate from HPNS
RADIOLOGICAL SCREENING AND LOAD OUT				
Radiological and UXO characterization and release			20 days	20 days to obtain radiological and UXO release of screening pads
Manage Rad Pad Material			90 days	Smooth out Rad Pads and prepare material for Rad Screening
Excavate 1000m^2 x 6" grid and transport to disposal facility	4 grids/day	125 grids	32 days	See Backup Worksheet "RADIOLOGICAL LOE"
SURVEY/DEMOBILIZATION				
Survey Crew			30 day	Misc Survey
Demobilization			5 day	
		TOTAL	**105 days**	

Appendix G. Activity 5B Cost Estimate (Asphalt Covers, Building Foundation Repairs, and Soil Covers)

Available on CD.

Table G-1. Asphalt and Soil Covers, and Building Foundation Repairs - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 243 working days
13 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 3,101,424**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 2,796,444**	
Total project professional/technical labor cost					$ 1,596,024	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 456,840	See backup worksheet "LABOR"
Rad Tech Support (Scanning)					$ 388,800	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 354,780	See backup worksheet "LABOR"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 304,980**	
30' connex office trailer	13	mo	$ 550.00	15%	$ 8,223	Quote from Mobile Mini
Office Equipment Rental	13	mo	$ 800.00	15%	$ 11,960	Costs from HPNS Parcel C
Office Supplies	13	mo	$ 100.00	15%	$ 1,495	Costs from HPNS Parcel C
Telephone Bill	13	mo	$ 50.00	15%	$ 748	Costs from HPNS Parcel C
Internet Bill	13	mo	$ 200.00	15%	$ 2,990	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	13	mo	$ 5,400.00	15%	$ 80,730	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	13	mo	$ 500.00	15%	$ 7,475	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	13	mo	$ 2,000.00	15%	$ 29,900	Quote from Hertz
Fuel for Rental Trucks	13	mo	$ 1,200.00	15%	$ 17,940	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	13	mo	$ 6,000.00	15%	$ 89,700	Quote from Sitech
(2) Kubotas	13	mo	$ 1,300.00	15%	$ 19,435	Quote from Hertz
8K Forklift	13	mo	$ 2,300.00	15%	$ 34,385	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 19,412,898**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 20,125**	
John Deere 225 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
(2) CAT 14H Motor Grader	2	ea	$ 2,000.00	15%	$ 4,600	Quote from Harris Blade Rental
(2) CAT D6T Dozer	2	ea	$ 2,000.00	15%	$ 4,600	Quote from Harris Blade Rental
CAT D5 Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
11 Ton Single Drum Roller	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
4000 Gallon Water Truck	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
2000 Gallon Water Truck	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
(2) Bobcat T-190	2	ea	$ 300.00	15%	$ 690	Quote from Hertz
3 Ton Double Drum Smooth Roller	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 65,320**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	243	day	$ 100.00	15%	$ 27,945	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	13	mo	$ 2,500.00	15%	$ 37,375	Quote from BlueLine Rentals
Site Preparation	**Site Preparation Subtotal =**				**$ 218,283**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 37,835.00		$ 37,835	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	13	mo	$ 1,763.00	15%	$ 26,357	Quote from Cam Guard
Land survey	40	day	$ 2,200.00	15%	$ 101,200	Quote from ESP Surveying
Subsurface utility surveying	6	day	$ 1,400.00	15%	$ 9,660	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C

Table G-1. Asphalt and Soil Covers, and Building Foundation Repairs - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 243 working days
13 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Air Monitoring			**Air Monitoring Subtotal =**		**$ 539,977**	
(2) Air Monitor Rental for PM10, TSP and Metals	13	mo	$ 2,800.00	15%	$ 41,860	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	13	mo	$ 1,200.00	15%	$ 17,940	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	243	day	$ 790.00	15%	$ 220,766	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	243	day	$ 725.00	15%	$ 202,601	Costs from HPNS Parcel C
Shipment of Sample Media	13	mo	$ 800.00	15%	$ 11,960	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	13	mo	$ 1,800.00	15%	$ 26,910	Quote from Pine Environmental
Portable Multi Gas Meter	13	mo	$ 1,200.00	15%	$ 17,940	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	13	mo	$ 1,150.00	15%	$ 17,193	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	486	hr	$ 70.00	15%	$ 39,123	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 19,412,898**	**Includes mob/demob and all construction activities**
Asphalt Cover			**Asphalt Cover =**		**$ 5,582,492**	See Backup Worksheet "INSTALL AC DURABLE COVER"
Asphalt Cover	1	ea	$ 5,582,492.47		$ 5,582,492	
Soil Cover in Radiologically Impacted Areas			**Soil Cover in Radiologically Impacted Areas=**		**$ 6,408,579**	See Backup Worksheet "SOIL COVER OVER RAD AREA"
Soil Cover in Radiologically Impacted Areas	1	ea	$ 6,408,579.46		$ 6,408,579	
Soil Cover in Non-Radiologically Impacted Areas			**Soil Cover in Non-Radiologically Impacted Areas =**		**$ 3,590,806**	See Backup Worksheet "SOIL COVER OVER NON-RAD AREA"
Soil Cover in Non-Radiologically Impacted Areas	1	ea	$ 3,590,806.07		$ 3,590,806	
Soil Cover with Protective Liner			**Soil Cover with Protective Liner =**		**$ 2,785,263**	See Backup Worksheet "SOIL COVER WITH LINERS"
Soil Cover with Protective Liner	1	ea	$ 2,785,263.32		$ 2,785,263	
Building Foundation Restoration			**Building Foundation Restoration =**		**$ 182,304**	See Backup Worksheet "BUILDING FOUNDATION RESTORATION"
Building Foundation Restoration	1	ea	$ 182,304.45		$ 182,304	
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 450,286**	**Includes management, plans, and reports**
Assumed to be 2% of construction cost (including permitting)					$ 450,286	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 22,964,609**	**Includes Distributive Costs**
Total Construction Cost					$ 22,514,322	
Total Management/Planning/Reporting Cost					$ 450,286	

Note

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table G-2. Asphalt and Soil Covers, and Building Foundation Repairs - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	5	1	$ 6.50
	Project Engineer, Geologist or Scientist	$ 125.00	100	2	$ 250.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:
1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table G-3. Asphalt and Soil Covers, and Building Foundation Repairs - Lab Analyses Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample
Encore Samplers for TPH-purgeable range (3 per sample)	**$ 39.00**
Analysis (for excavation chemicals only)	
Volatile Organic Compounds (VOCs)	$ 180.00
Semivolatile Organic Compounds (SVOCs)	$ 210.00
Pesticides	$ 138.00
Polychlorinated Biphenyls (PCBs)	$ 78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$ 54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$ 54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$ 108.00
Strontium-90	$ 142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$ 156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$ 90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$ 90.00
Total Cost/Pre-Excavation Characterization Sample:	**$ 753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$ 1,003.80**
Total Cost/Waste Characterization Sample:	**$ 586.80**

Analysis[2]	Cost per Sample
Analysis (Geotechnical for import fill only)	
Modified Proctor (1 every 5,200 CY)	$ 260.00
Sieve Analysis (1 every 2,000 CY)	$ 109.00
Atterberg Limits (1 every 2,000 CY)	$ 163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnicall costs provided by Cooper Testing Labs 2017

Table G-4. Asphalt and Soil Covers, and Building Foundation Repairs - Site Preparation Quantities
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, support equipment and temp facilities			
	Units	Quantity	Notes
Lay Down Area	Acres	0.5	This locations will be used as a support area
Temporary Fence			
	Units	Quantity	Notes
Temp Fence	LF	10,000.00	Temp fence will be placed around staging and laydown areas

Table G-5. Asphalt and Soil Covers, and Building Foundation Repairs - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Asphalt Cover (Type A per C25)		Notes
Class II AB Area	2,162,048 SF	ACAD and Quantity Takeoffs
Class II AB Volume	26,692 CY	ACAD and Quantity Takeoffs
Asphaltic Concrete Area	2,162,048 SF	ACAD and Quantity Takeoffs
Asphaltic Concrete Volume	13,346 CY	ACAD and Quantity Takeoffs
Soil Cover in Radiologically Impacted Area (Type D per C25)		**Notes**
Soil Cover Area	1,272,371 SF	ACAD and Quantity Takeoffs
Soil Cover Volume (2' thick)	94,250 CY	ACAD and Quantity Takeoffs
Demarcation Layer Area	1,335,989 SF	ACAD and Quantity Takeoffs
Soil Cover in Non-Radiologically Impacted Areas		**Notes**
Soil Cover Area	789,566 SF	ACAD and Quantity Takeoffs
Soil Cover Volume (2' thick)	58,486 CY	ACAD and Quantity Takeoffs
Soil Cover with Protective Liner (Type E per C25)		**Notes**
Soil Cover Area	368,002 SF	ACAD and Quantity Takeoffs
Soil Cover Volume (2' thick)	27,259 CY	ACAD and Quantity Takeoffs
Demarcation layer Area	386,402 SF	ACAD and Quantity Takeoffs
Geocomposite Drainage Layer	386,402 SF	ACAD and Quantity Takeoffs
60-mil HDPE Geomembrane	386,402 SF	ACAD and Quantity Takeoffs
Building Foundation Restoration		**Notes**
Building Foundation Repairs	369,133 SF	ACAD and Quantity Takeoffs
Major Building Foundation Repairs	10,000 SF	Quantity Takeoffs

Table G-6. Asphalt and Soil Covers, and Building Foundation Repairs - Site Preparation Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Install Temp Fence and 6 Month Rental	10,000	LF	$ 3.29	15%	$ 37,835.00	Costs from HPNS projects
TOTAL					$ 68,277	

Note:

Soil staging area volumes and areas:

Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table G-7. Asphalt Covers - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Import and Place Class II AB 4" Thick	2,162,048	SF				
(2) CAT 14H Blade	27.0	Day	$ 1,500.00	15%	$ 46,575.00	Costs from HPNS Parcel B & C
(2) Trimble Cab Kits	27.0	Day	$ 600.00	15%	$ 18,630.00	Costs from HPNS Parcel B & C
11 Ton Smooth Single Drum Roller	27.0	Day	$ 250.00	15%	$ 7,762.50	Costs from HPNS Parcel B & C
4000 Gallon Water Truck	27.0	Day	$ 275.00	15%	$ 8,538.75	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	27.0	Day	$ 500.00	15%	$ 15,525.00	Costs from HPNS Parcel B & C
(2) Equipment Operator EQ02	27.0	Day	$ 1,680.00		$ 45,360.00	See "LABOR" Worksheet for detail
Equipment Operator EQ07	27.0	Day	$ 1,424.00		$ 38,448.00	See "LABOR" Worksheet for detail
Truck Driver TM03	27.0	Day	$ 616.00		$ 16,632.00	See "LABOR" Worksheet for detail
Class II AB Import	48,045.5	Tons	$ 25.00	15%	$ 1,381,308.41	Costs from HPNS Parcel B & C
Install AC durable Cover	2,162,047.7	SF				
4000 Gallon Water Truck	20.0	Day	$ 275.00	15%	$ 6,325.00	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	20.0	Day	$ 300.00	15%	$ 6,900.00	Costs from HPNS Parcel B & C
Truck Driver TM03	20.0	Day	$ 616.00		$ 12,320.00	See "LABOR" Worksheet for detail
Sub Install AC Durable Cover 2" Thick	2,162,047.7	SF	$ 1.60	15%	$ 3,978,167.80	Costs from HPNS Parcel B RA
TOTAL					$ 5,582,492	

Note:

Material volumes and areas:

Asphalt Cover Surface Area	2,162,048	SF	
Class II AB Surface Area	2,162,048	SF	
Class II AB Volume	26,692	BCY	
Class II AB Tons	48,045.51	Tons	1.8 BCY to Ton Factor

Table G-8. Soil Covers in IR-02 (without liner) - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Demarcation Layer	1,335,989					
(5) Laborers LB01	31.0	Day	$ 2,800.00		$ 86,800.00	See "LABOR" Worksheet for detail
Demarcation Fabric	1,335,989.4	SF	$ 0.35	15%	$ 537,735.72	Quote from Geo Options
Soil Cover in Rad Impacted Area	1,335,989	SF				
(2) CAT D6T Dozers	93.0	Day	$ 1,300.00	15%	$ 139,035.00	Costs from HPNS Parcel B & C
(2) Trimble Cab Kits	93.0	Day	$ 600.00	15%	$ 64,170.00	Costs from HPNS Parcel B & C
4000 Gallon Water Truck	93.0	Day	$ 275.00	15%	$ 29,411.25	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	93.0	Day	$ 500.00	15%	$ 53,475.00	Costs from HPNS Parcel B & C
(2) Equipment Operator EQ03	93.0	Day	$ 1,616.00		$ 150,288.00	See "LABOR" Worksheet for detail
Truck Driver TM03	93.0	Day	$ 616.00		$ 57,288.00	See "LABOR" Worksheet for detail
Import of Cover Fill	150,799.5	Tons	$ 30.00	15%	$ 5,202,582.91	Costs from HPNS Parcel B & C
Hydroseed Soil Cover	1,272,370.8	SF	$ 0.06	15%	$ 87,793.59	Quote from Selby Soil
TOTAL					$ 6,408,579	

Note:

Material volumes and areas:

Soil Cover Over Rad Impacted Area	1,272,371	SF	
Soil Cover Volume	94,250	CY	
Soil Cover Weight	150,799.50	Tons	1.6 BCY to Ton Factor
Demarcation Layer	1,335,989	SF	

Table G-9. Soil Covers Outside IR-02 (Non-Radiologically-Impacted Areas) - Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Soil Cover in Non-Rad Impacted Area	789,566	SF				
(2) CAT D6T Dozers	58.0	Day	$ 1,300.00	15%	$ 86,710.00	Costs from HPNS Parcel B & C
(2) Trimble Cab Kits	58.0	Day	$ 600.00	15%	$ 40,020.00	Costs from HPNS Parcel B & C
4000 Gallon Water Truck	58.0	Day	$ 275.00	15%	$ 18,342.50	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	58.0	Day	$ 500.00	15%	$ 33,350.00	Costs from HPNS Parcel B & C
(2) Equipment Operator EQ03	58.0	Day	$ 1,616.00		$ 93,728.00	See "LABOR" Worksheet for detail
Truck Driver TM03	58.0	Day	$ 616.00		$ 35,728.00	See "LABOR" Worksheet for detail
Import of Cover Fill	93,578.2	Tons	$ 30.00	15%	$ 3,228,447.52	Costs from HPNS Parcel B & C
Hydroseed Soil Cover	789,566.0	SF	$ 0.06	15%	$ 54,480.05	Quote from Selby Soil
TOTAL					$ 3,590,806	

Note:
Material volumes and areas:

Soil Cover Over Rad Impacted Area	789,566	SF		
Soil Cover Volume	58,486	CY		
Soil Cover Weight	93,578.19	Tons	1.6	BCY to Ton Factor

Table G-10. Soil Covers in IR-02 and IR-03 (with liner) - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Demarcation Layer	386,402					
(5) Laborers LB01	9.0	Day	$ 2,800.00		$ 25,200.00	See "LABOR" Worksheet for detail
Demarcation Fabric	386,402.0	SF	$ 0.35	15%	$ 155,526.81	Quote from Geo Options
Install Geocomposite Drainage Layer						
(4) Laborers LB01	9.0	Day	$ 2,240.00		$ 20,160.00	See "LABOR" Worksheet for detail
Geocomposite	386,402.0	SF	$ 1.10	15%	$ 488,798.53	Costs from Tencate
60-Mil-HDPE Geomembrane (Material and Installation)	386,402.0	SF	$ 0.95	15%	$ 422,144.19	Quote from Layfield Environmental
Soil Cover in Rad Impacted Area	134,761	SF				
(2) CAT D6T Dozers	27.0	Day	$ 1,300.00	15%	$ 40,365.00	Costs from HPNS Parcel B & C
(2) Trimble Cab Kits	27.0	Day	$ 600.00	15%	$ 18,630.00	Costs from HPNS Parcel B & C
4000 Gallon Water Truck	27.0	Day	$ 275.00	15%	$ 8,538.75	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	27.0	Day	$ 500.00	15%	$ 15,525.00	Costs from HPNS Parcel B & C
(2) Equipment Operator EQ03	27.0	Day	$ 1,616.00		$ 43,632.00	See "LABOR" Worksheet for detail
Truck Driver TM03	27.0	Day	$ 616.00		$ 16,632.00	See "LABOR" Worksheet for detail
Import of Cover Fill	43,615.0	Tons	$ 30.00	15%	$ 1,504,718.92	Costs from HPNS Parcel B & C
Hydroseed Soil Cover	368,001.9	SF	$ 0.06	15%	$ 25,392.13	Quote from Selby Soil
TOTAL					$ 2,785,263	

Note:

Material volumes and areas:

Soil Cover Area	368,002	SF	
Soil Cover Volume	27,259	CY	
Soil Cover Weight	43,615.04	Tons	1.6 BCY to Ton Factor
Demarcation Layer	386,402	SF	
Install Geocomposite Drainage Layer	386,402	SF	
Install 60-mil HDPE Geomembrane	386,402	SF	

Table G-11. Building Foundation Repairs - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Building Foundation Repairs	369,133					
(2) Bobcat T190	30	Day	$ 125.00	15%	$ 4,312.50	Quote from Herc
(2) Bobcat Sweeper Attachment	30	Day	$ 50.00	15%	$ 1,725.00	Quote from Herc
(2) Bobcat Grapple Bucket	30	Day	$ 50.00	15%	$ 1,725.00	Quote from Herc
(2) Equipment Operator EQ06	30	Day	$ 1,472.00		$ 44,160.00	See "LABOR" Worksheet for detail
(4) Laborers LB01	30	Day	$ 2,240.00		$ 67,200.00	See "LABOR" Worksheet for detail
Fuel For heavy Equipment	30	Day	$ 100.00		$ 3,000.00	Costs from HPNS Parcel B & C
Foundation Repair Materials	30	Day	$ 150.00	15%	$ 5,175.00	Costs from HPNS Parcel B & C
Debris Bins (30 CY)	10	EA	$ 750.00	15%	$ 8,625.00	Costs from HPNS Parcel B & C
Major Building Foundation Repairs	10,000	SF				
JD 225 Excavator	4.0	Day	$ 750.00	15%	$ 3,450.00	Costs from HPNS Parcel B & C
3 Ton Double Drum Smooth Roller	4.0	Day	$ 300.00	15%	$ 1,380.00	Costs from HPNS Parcel B & C
2000 Gallon Water Truck	4.0	Day	$ 300.00	15%	$ 1,380.00	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	4.0	Day	$ 200.00	15%	$ 920.00	Costs from HPNS Parcel B & C
(4) Laborers LB01	4.0	Day	$ 2,240.00	15%	$ 10,304.00	Costs from HPNS Parcel B & C
Equipment Operator EQ03	4.0	Day	$ 808.00		$ 3,232.00	See "LABOR" Worksheet for detail
Truck Driver TM02	4.0	Day	$ 608.00		$ 2,432.00	See "LABOR" Worksheet for detail
Class II AB (Trucking and Material)	222.2	Tons	$ 30.00	15%	$ 7,666.67	Costs from HPNS Parcel B & C
AC (Trucking and Material)	123.5	Tons	$ 110.00	15%	$ 15,617.28	Quote from Kevin Lawson Trucking
TOTAL					$ 182,304	

Note:

Building volumes and areas:

Building Foundation Repairs (Cracking filling, p	369,133	SF		
Major Foundation Building Repairs	10,000	SF	Conservative assumption because Buildings 600 and 709 have yet to be inspected	
Class II AB Volume	123.46	CY		
Class II AB Weight	222.22	Tons	1.8	BCY to Ton Factor
AC Volume	61.73	Tons		
AC Weight	123.46	Tons	2	BCY to Ton Factor

Table G-12. Asphalt and Soil Covers, and Building Foundation Repairs - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/day	21,780 SF	1 days	Production rate from HPNS IR7 &18
Asphalt Cover (Type A per C25)				
Install Class II AB	1020 CY/day	26,692 CY	27 days	Production rate from HPNS Parcel B & C
Install AC	700 CY/day	13,346 CY	20 days	Production rate from HPNS Parcel B & C
Soil Cover in Radiologically Impacted Areas (Type D per C25)				
Install Demarcation Layer	43560 SF/day	1,335,989 SF	31 days	Production rate from HPNS IR7 &18
Place 2' Soil Cover	1020 CY/day	94,250 CY	93 days	Production rate from HPNS
Soil Cover in Non-Radiologically Impacted Areas				
Place 2' Soil Cover	1020 CY/day	58,486 CY	58 days	Production rate from HPNS
Soil Cover with Protective Liner (Type E per C25)				
Install Demarcation Layer	43560 SF/day	386,402 SF	9 days	Production rate from HPNS IR7 &18
Install Geocomposite Drainage Layer	43560 SF/day	386,402 SF	9 days	Production rate from HPNS
Install 60-mil HDPE Geomembrane	43560 SF/day	386,402 SF	9 days	Production rate from HPNS
Place 2' Soil Cover	1020 CY/day	27,259 CY	27 days	Production rate from HPNS
Building Foundation Restoration				
Building Foundation Repairs	12500 SF/day	369,133 SF	30 days	Production rate from HPNS Parcel B & C
Major Building Foundation Repairs	2500 SF/day	10,000 SF	4 days	Production rate from HPNS Parcel B & C
SURVEY/DEMOBILIZATION				
Survey Crew			40 day	Misc Survey
Demobilization			5 day	
		TOTAL	**243 days**	

Appendix H. Activity 5C Cost Estimate (Miscellaneous Completion Activities)

Available on CD.

Table H-1. Miscellaneous Site Completion Activities - Capital Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 35 working days
2 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
DISTRIBUTIVE COSTS	**DISTRIBUTIVE COSTS SUBTOTAL =**				**$ 414,700**	**Includes labor and temporary facilities**
Labor	**Labor Subtotal =**				**$ 367,780**	
Total project professional/technical labor cost					$ 194,880	See backup worksheet "LABOR"
Total project field/construction operations labor cost					$ 65,800	See backup worksheet "LABOR"
Rad Tech Support (Scanning)					$ 56,000	See backup worksheet "LABOR"
Total project clerical administrative labor cost					$ 51,100	See backup worksheet "LABOR"
Temporary Facilities	**Temporary Facilities Subtotal =**				**$ 46,920**	
30' connex office trailer	2	mo	$ 550.00	15%	$ 1,265	Quote from Mobile Mini
Office Equipment Rental	2	mo	$ 800.00	15%	$ 1,840	Costs from HPNS Parcel C
Office Supplies	2	mo	$ 100.00	15%	$ 230	Costs from HPNS Parcel C
Telephone Bill	2	mo	$ 50.00	15%	$ 115	Costs from HPNS Parcel C
Internet Bill	2	mo	$ 200.00	15%	$ 460	Costs from HPNS Parcel C
45KW Generator and Fuel for Electricity (24hrs)	2	mo	$ 5,400.00	15%	$ 12,420	Costs from HPNS Parcel C
Portable Toilets (2), (1) Tow behind and Hand Wash Station	2	mo	$ 500.00	15%	$ 1,150	Costs from HPNS Parcel C
Rental Trucks (2) (for supervisory staff)	2	mo	$ 2,000.00	15%	$ 4,600	Quote from Hertz
Fuel for Rental Trucks	2	mo	$ 1,200.00	15%	$ 2,760	Costs from HPNS Parcel C
Trimble GPS Rover and Base Station	2	mo	$ 6,000.00	15%	$ 13,800	Quote from Sitech
(2) Kubotas	2	mo	$ 1,300.00	15%	$ 2,990	Quote from Hertz
8K Forklift	2	mo	$ 2,300.00	15%	$ 5,290	Quote from United Rentals
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**				**$ 672,086**	**Includes mob/demob and all construction activities**
Mobilization and Demobilization	**Mobilization and Demobilization Subtotal =**				**$ 7,935**	
John Deere 225 Excavator	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
(1) CAT 14H Motor Grader	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
CAT D5 Dozer	2	ea	$ 1,000.00	15%	$ 2,300	Quote from Harris Blade Rental
8 Ton Single Drum Roller	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
2000 Gallon Water Truck	2	ea	$ 150.00	15%	$ 345	Quote from Hertz
8K Forklift	2	ea	$ 150.00	15%	$ 345	Quote from United Rentals
Health and Safety Equipment	**Health and Safety Equipment Subtotal =**				**$ 9,775**	
Includes PPE, First Aid Equipment, Fire Safety Equipment and Spill Control Equipment	35	day	$ 100.00	15%	$ 4,025	Costs per HPNS Parcel B. $100 per crew day
Water truck for dust suppression, 2,000 gallon capacity (1)	2	mo	$ 2,500.00	15%	$ 5,750	Quote from BlueLine Rentals
Site Preparation	**Site Preparation Subtotal =**				**$ 113,641**	
Grade laydown area (0.5 acre)	1	ea	$ 2,853.50		$ 2,854	See Backup Worksheet "SITE PREP INSTALL"
Cover over laydown area with crushed stone (6" thick)	1	ea	$ 27,588.75		$ 27,589	See Backup Worksheet "SITE PREP INSTALL"
Install Temp Fence and 6 month Rental	1	ea	$ 37,835.00		$ 37,835	See Backup Worksheet "SITE PREP INSTALL"
Security Camera Set-up/Take-down	1	ea	$ 1,121.04	15%	$ 1,289	Quote from Cam Guard
Security Camera Monitoring	2	mo	$ 1,763.00	15%	$ 4,055	Quote from Cam Guard
Land survey	10	day	$ 2,200.00	15%	$ 25,300	Quote from ESP Surveying
Subsurface utility surveying	2	day	$ 1,400.00	15%	$ 3,220	Quote from Safe 2 Core
Construction SWPPP implementation	1	ea	$ 10,000.00	15%	$ 11,500	Silt Fence and Misc. BMPS. From HPNS Parcel C

Table H-1. Miscellaneous Site Completion Activities - Capital Cost Detail *(continued)*
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Construction Project Duration: 35 working days
2 months

Description	Quantity	Unit	Unit Price	Fee	Cost	Comments
Air Monitoring			**Air Monitoring Subtotal =**		**$ 78,919**	
(2) Air Monitor Rental for PM10, TSP and Metals	2	mo	$ 2,800.00	15%	$ 6,440	Quote from SCS Tracer. Need up wind and down wind monitor
(2) Air Monitor Rental for PCBs, PAHs, and Pesticides	2	mo	$ 1,200.00	15%	$ 2,760	Quote from SCS Tracer. Need up wind and down wind monitor
Analysis - PM10, TSP, Leads, Manganese, Arsenic, Asbestos, aluminum, antimony, cadmium, copper, iron, mercury, vanadium and Zinc. 2 samples each day, 1 upwind and 1 downwind	35	day	$ 790.00	15%	$ 31,798	Costs from HPNS Parcel C
Analysis - PCB, PAH and Pesticides. Alternate days for PCB and PAH for upwind and Down wind. Pesticides every other day for both upwind and down wind	35	day	$ 725.00	15%	$ 29,181	Costs from HPNS Parcel C
Shipment of Sample Media	2	mo	$ 800.00	15%	$ 1,840	Costs from HPNS Parcel C
(3) Dust Meters PDR1000s	2	mo	$ 1,800.00	15%	$ 4,140	Quote from Pine Environmental
Portable Multi Gas Meter	2	mo	$ 1,200.00	15%	$ 2,760	Quote from Equipco
Decontamination			**Decontamination Subtotal =**		**$ 19,747**	
Pressure washer (1,800 psi, 5gpm)	2	mo	$ 1,150.00	15%	$ 2,645	Quote from Hertz
Pressure washer operation (assume 2 hr/day)	70	hr	$ 70.00	15%	$ 5,635	Costs from HPNS Parcel C
CAPITAL COSTS *(continued)*			**CAPITAL COSTS SUBTOTAL =**		**$ 672,086**	**Includes mob/demob and all construction activities**
Service Road Install			**Service Road Install =**		**$ 52,151**	See Backup Worksheet "SERVICE ROAD INSTALL"
Service Road Install	1	ea	$ 52,151.08		$ 52,151	
Install Wells			**Install Wells =**		**$ 195,149**	See Backup Worksheet "INSTALL WELLS"
Install Wells	1	ea	$ 195,148.75		$ 195,149	
Soil Gas Survey			**Install Wells =**		**$ 229,056**	See Backup Worksheet "SOIL GAS SURVEY"
Soil Gas Survey	1	ea	$ 229,056.25		$ 229,056	
Fence, Signs and Monuments			**Fence, Signs and Monuments =**		**$ 194,769**	See Backup Worksheet "FENCE SIGNS AND MONUMENTS"
Fence, Signs and Monuments	1	ea	$ 194,768.94		$ 194,769	
Management, Planning Documents, and Post-Construction Reporting			**Management Subtotal =**		**$ 65,792**	**Includes management, plans, and reports**
Assumed to be 5% of construction cost (including permitting)					$ 65,792	Includes: Remedial Action Work Plan, APP/SSHP, EPP, CQC Plan, SAP, RACR
TOTAL PROJECT CAPITAL COST			**TOTAL PROJECT CAPITAL COST =**		**$ 1,381,635**	**Includes Distributive Costs**
Total Construction Cost					$ 1,315,842	
Total Management/Planning/Reporting Cost					$ 65,792	

Note:

General Assumptions:

Work will be performed in Level D PPE

15% Equipment/Subcontractor/Material Fee

Table H-2. Miscellaneous Site Completion Activities - General Labor Classifications and Rates
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Labor Classification	Position	Labor Rate (per hour)	Level of Effort (% on Project)	Staff Required (number)	Unit Cost (per project hour)
Professional/Technical					
	Senior Project Manager	$ 180.00	10	1	$ 18.00
	Project Manager	$ 165.00	50	1	$ 82.50
	Senior Engineer, Geologist or Scientist	$ 165.00	10	1	$ 16.50
	Biologist	$ 130.00	5	1	$ 6.50
	Project Engineer, Geologist or Scientist	$ 125.00	100	1	$ 125.00
	Quality Control Officer	$ 115.00	100	1	$ 115.00
	Health and Safety Officer	$ 115.00	100	1	$ 115.00
	Assistant (Junior) Project Engineer, Geologist or Scientist (Soil segregation, profiling)	$ 90.00	100	2	$ 180.00
	Drafter/Designer	$ 75.00	50	1	$ 37.50
Field/Construction Operations					
	Superintendent	$ 125.00	100	1	$ 125.00
	Foreman	$ 110.00	100	1	$ 110.00
	Laborer LB01	$ 70.00	varies		
	Equipment Operator EQ02	$ 105.00	varies		
	Equipment Operator EQ03	$ 101.00	varies		
	Equipment Operator EQ04	$ 98.00	varies		
	Equipment Operator EQ06	$ 92.00	varies		
	Equipment Operator EQ07	$ 89.00	varies		
	Truck Driver TM02	$ 76.00	varies		
	Truck Driver TM03	$ 77.00	varies		
Radiological/MEC Screening					
	Radiological Screening/Field Technician	$ 100.00	100	8	$ 800.00
	UXO Screening/Field Technician	$ 100.00	100	8	$ 800.00
Clerical/Administrative					
	Procurement Specialist	$ 125.00	100	1	$ 125.00
	Project Accountant/Billing	$ 60.00	50	1	$ 30.00
	Administrative Assistant/General Clerical	$ 55.00	50	1	$ 27.50

Notes:

1. Equipment operator rates are included in equipment operation estimates
2. Labor rates are based on a 2017 rate schedule

Table H-3. Miscellaneous Site Completion Activities - Lab Analyses Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Analysis[1]	Cost per Sample	
Encore Samplers for TPH-purgeable range (3 per sample)	**$**	**39.00**
Analysis (for excavation chemicals only)	**$**	**420.00**
Volatile Organic Compounds (VOCs)	$	180.00
Semivolatile Organic Compounds (SVOCs)	$	210.00
Pesticides	$	138.00
Polychlorinated Biphenyls (PCBs)	$	78.00
Total Petroleum Hydrocarbons (TPH), purgeable range	$	54.00
Total Petroleum Hydrocarbons (TPH), extractable range	$	54.00
Gamma Radium-226, Cesium-137, Cobalt-60	$	108.00
Strontium-90	$	142.80
Total Threshold Limit Concentration (TTLC), CA Title 22 Metals (Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, N, Se, Ag, Tl, V, Zn)	$	156.00
Toxic Characteristic Leaching Procedure (TCLP), CA Title 22 Metals	$	90.00
Soluble Threshold Limit Concentration (STLC), CA Title 22 Metals	$	90.00
Total Cost/Pre-Excavation Characterization Sample:	**$**	**753.00**
Total Cost/Post-Excavation Confirmation Sample:	**$**	**1,003.80**
Total Cost/Waste Characterization Sample:	**$**	**586.80**

Analysis[2]	Cost per Sample	
Analysis (Geotechnical for import fill only)		
Modified Proctor (1 every 5,200 CY)	$	260.00
Sieve Analysis (1 every 2,000 CY)	$	109.00
Atterberg Limits (1 every 2,000 CY)	$	163.00

Notes:

[1] Analytical costs provided by C&T 2017

[2] Geotechnical costs provided by Cooper Testing Labs 2017

Table H-4. Miscellaneous Site Completion Activities - Site Preparation Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Area For Trailers, support equipment and temp facilities			
	Units	Quantity	Notes
Lay Down Area	Acres	0.5	This locations will be used as a support area
Around disturbed Area			
	Units	Quantity	Notes
Temp Fence	LF	10,000.00	Will fence around the lay down area

Table H-5. Miscellaneous Site Completion Activities - Quantities

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Service Road		Notes
Service Road at IR-02	19,447 SF	ACAD and Quantity Takeoffs
Class II AB For Service Road	480 CY	ACAD and Quantity Takeoffs
Filter Fabric	23,337 SF	ACAD and Quantity Takeoffs
Well Installations		**Notes**
Install New Wells	22 EA	Table 11 of the DBR (less new wells at VOC plumes; to be installed during GW treatment task)
Extend Existing Wells	97 EA	Table 11 of the DBR
Install Soil Gas Probes	40 EA	1 probe/acre over 40-acre area (50-acre multi-use area less 10-acre area covered by VOC plume monitoring)
Perimeter Fencing, Signs and Monuments		**Notes**
Permanent Fence	4,795 LF	ACAD and Quantity Takeoffs
Gates	1 EA	ACAD and Quantity Takeoffs
Warning Signs	24 EA	ACAD and Quantity Takeoffs
Entrance Signs	1 EA	ACAD and Quantity Takeoffs
Settlement Monuments	2 EA	ACAD and Quantity Takeoffs

Table H-6. Miscellaneous Site Completion Activities - Site Preparation Cost Detail
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Grade Lay Down Area	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 808.00		$ 808.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	See "LABOR" Worksheet for detail
Cover Lay Down Area with Crushed Rock	21,780	SF				
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B RA
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Fuel For heavy Equipment	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B RA
Equipment Operator EQ03	1.0	Day	$ 800.00		$ 800.00	See "LABOR" Worksheet for detail
Truck Driver TM02	1.0	Day	$ 1,000.00		$ 1,000.00	See "LABOR" Worksheet for detail
1.5" Drain Rock	605	Ton	$ 35.00	15%	$ 24,351.25	Quote from Kevin Lawson (Stevens Creek Quarry)
Install Temp Fence and 6 Month Rental	10,000	LF	$ 3.29	15%	$ 37,835.00	Costs from HPNS projects
TOTAL					$ 68,277	

Note:

Soil staging area volumes and areas:

Lay Down Area	0.5	ACRE
Lay Down Area in SF	21,780	SF
1.5" Rock over Lay Down Area (6" thick)	403	CY
1.5" Rock over Lay Down Area (6" thick) converted to tons	605	Tons

Table H-7. Service Road Installation - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Service Road	19,447.4	SF				
Excavate Surface Road	480.2	BCY				
John Deere 225 Excavator	1.0	Day	$ 850.00	15%	$ 977.50	Costs from HPNS Parcel B & C
CAT 730 Haul Truck	1.0	Day	$ 1,600.00	15%	$ 1,840.00	Costs from HPNS Parcel B & C
CAT D5 Dozer	1.0	Day	$ 650.00	15%	$ 747.50	Costs from HPNS Parcel B & C
2000 Gallon Water Truck	1.0	Day	$ 300.00	15%	$ 345.00	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	1.0	Day	$ 350.00	15%	$ 402.50	Costs from HPNS Parcel B & C
(2) Equipment Operator EQ03	1.0	Day	$ 1,616.00		$ 1,616.00	Costs from HPNS Parcel B & C
Truck Driver TM02	1.0	Day	$ 608.00		$ 608.00	Costs from HPNS Parcel B & C
Truck Driver TM03	1.0	Day	$ 616.00		$ 616.00	Costs from HPNS Parcel B & C
Install Filter Fabric	23,336.9	SF				
(4) Laborer LB01	1.0	Day	$ 2,240.00		$ 2,240.00	Costs from HPNS Parcel B & C
Filter Fabric Material (500X woven)	23,336.9	SF	$ 0.17	15%	$ 4,651.81	Costs from HPNS Parcel B & C
Place and Compact Class II AB 8" Thick	19,447	SF				
(1) CAT 14H Blade	2.0	Day	$ 1,600.00	15%	$ 3,680.00	Costs from HPNS Parcel B & C
(1) Trimble Cab Kits	2.0	Day	$ 666.67	15%	$ 1,533.33	Costs from HPNS Parcel B & C
8 Ton Smooth Single Drum Roller	2.0	Day	$ 350.00	15%	$ 805.00	Costs from HPNS Parcel B & C
2000 Gallon Water Truck	2.0	Day	$ 300.00	15%	$ 690.00	Costs from HPNS Parcel B & C
Fuel For heavy Equipment	2.0	Day	$ 350.00	15%	$ 805.00	Costs from HPNS Parcel B & C
(1) Equipment Operator EQ02	2.0	Day	$ 840.00		$ 1,680.00	See "LABOR" Worksheet for detail
Equipment Operator EQ07	2.0	Day	$ 1,424.00		$ 2,848.00	See "LABOR" Worksheet for detail
Truck Driver TM02	2.0	Day	$ 608.00		$ 1,216.00	See "LABOR" Worksheet for detail
Class II AB Import	864.3	Tons	$ 25.00	15%	$ 24,849.43	Costs from HPNS Parcel B & C
TOTAL					$ 52,151	

Note:

Material volumes and areas:

Service Road Area	19,447	SF	
Excavate Roadway	480	BCY	
Road Fabric Area	23,337	SF	
Class II AB Surface Area	19,447	SF	
Class II AB Volume	480	BCY	
Class II AB Tons	864.33	Tons	1.8 BCY to Ton Factor

Table H-8. Monitoring Well Installation - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install New Groundwater Monitoring Wells	22.0	EA	$ 4,000.00	15%	$ 101,200.00	Quote from Gregg Drilling
Extend Existing Groundwater Monitoring Wells	97.0	EA				
Walk Behind Concrete Saw	17.0	Day	$ 270.00	15%	$ 5,278.50	Costs from HPNS Parcel B & C
Roto Hammer & Bits	17.0	Day	$ 270.00	15%	$ 5,278.50	Costs from HPNS Parcel B & C
Fuel for Heavy Equipment	17.0	Day	$ 60.00	15%	$ 1,173.00	Costs from HPNS Parcel B & C
Concrete	16.2	CY	$ 150.00	15%	$ 2,788.75	Costs from HPNS Parcel B & C
Pipe Extension Materials	97.0	EA	$ 25.00	15%	$ 2,788.75	Costs from HPNS Parcel B & C
Well Boxes & Lids	97.0	EA	$ 175.00	15%	$ 19,521.25	Costs from HPNS Parcel B & C
(6) Laborer LB01	17.0	Day	$ 3,360.00		$ 57,120.00	See "LABOR" Worksheet for detail
TOTAL					$ 195,149	

Note:

Material volumes and areas:

Install New Ground Water Wells	22	EA
Extend Existing Ground Water Wells	97	EA
Concrete needed to extend GW wells	16	CY

Table H-9. Soil Gas Survey - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Install New Gas Monitoring Probes	40.0	EA	$ 3,500.00	15%	$ 161,000.00	Quote from Gregg Drilling
Soil Gas Sampling/Analysis	1.0	Events				
Soil Gas Sample Analysis (Organic Chemicals)	46.0	EA	$ 750.00	15%	$ 39,675.00	Costs from HPNS Parcel UC-1/2
Soil Sample Analysis (Geotechnical Parameters)	10.0	EA	$ 400.00	15%	$ 4,600.00	Costs from HPNS Parcel UC-1/2
PID	5.0	Days	$ 75.00	15%	$ 431.25	Costs from HPNS Parcel B
IDW Disposal	1.0	Events	$ 1,000.00	15%	$ 1,150.00	Costs from HPNS Parcel UC-1/2
(1) Project Scientist - for data compilation	80.0	Hour	$ 125.00		$ 10,000.00	See "LABOR" Worksheet for detail
(1) Senior Scientist - for risk evaluation	40.0	Hour	$ 165.00		$ 6,600.00	See "LABOR" Worksheet for detail
(2) Laborer LB01 - for sampling	5.0	Day	$ 1,120.00		$ 5,600.00	See "LABOR" Worksheet for detail
TOTAL					$ 229,056	

Note:

Material volumes and areas:

Install New Gas Monitoring Probes	40	EA
Duration to Install Gas Monitoring Probes	14	Days
Sampling Events	1	EA
Duration for Sampling Probes	5	Days

Table H-10. Fence and Sign Installation - Cost Detail

Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Description	Quantity	Unit	Unit Price	Fee	Cost	Remarks
Permanent Fence Installation (8' Tall)	4,795.1	LF	$ 32.00	15%	$ 176,458.94	Quote from North American Fence
Fence Gate Installation	1.0	EA	$ 3,000.00	15%	$ 3,450.00	Quote from North American Fence
Warning Signs & Entrance Signs	25.0	EA				
(4) Laborer LB01	1.0	Day	$ 3,360.00		$ 3,360.00	See "LABOR" Worksheet for detail
Warning Signs	24.0	EA	$ 300.00	15%	$ 8,280.00	Quote from Priority Graphics
Entrance Signs	1.0	EA	$ 400.00	15%	$ 460.00	Quote from Priority Graphics
Install Settlement Monuments	2.0	EA	$ 1,200.00	15%	$ 2,760.00	Quote from ESP Surveying
TOTAL					$ 194,769	

Note:

Material volumes and areas:

Permanent Fence Installation	4,795	LF
Gates	1	EA
Warning Signs	24	EA
Entrance Signs	1	EA
Settlement Monuments	2	EA

Table H-11. Miscellaneous Site Completion Activities - Production Rate Assumptions
Remedial Action for Parcel E, Hunters Point Naval Shipyard, San Francisco, California

Activity	Daily Production Rate	Total Amount	Days to Complete	Assumptions
SITE PREP				
Grade Laydown area (0.5 acres)	40,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B & C
Cover over laydown area with 1.5" Rock (6" thick)	20,000 SF/day	21,780 SF	1 days	Production rate from HPNS Parcel B & C
Service Road				
Excavate Service Road	500 CY/day	480 CY	1 days	Production rate from HPNS Parcel B & C
Place Class II AB For Service Road	300 CY/day	480 CY	2 days	Production rate from HPNS Parcel B & C
Filter Fabric	30000 SF/day	23,337 SF	1 days	Production rate from HPNS Parcel B & C
Well Installation				
Install New Wells	3 EA/day	22 EA	8 days	Production rate from HPNS Parcel B & C
Extend Existing Wells	6 EA/day	97 EA	17 days	Production rate from HPNS Parcel B & C
Soil Gas Survey				
Install Soil Gas Probes	3 EA/day	40 EA	14 days	Production rate from HPNS Parcel B & UC-1/2
Soil Gas Probe Sampling	5 Day/event	1 EA	5 days	Production rate from HPNS Parcel B & UC-1/2
Perimeter Fence, Signs and Monuments				
Permanent Fence	170 LF/day	4,795 LF	29 days	Production rate from HPNSB & C
Gates	2 EA/day	1 EA	1 days	Production rate from HPNSB & C
Warning Signs & Entrance Signs	25 EA/day	25 EA	1 days	Production rate from HPNSB & C
Settlement Monuments	2 EA/day	2 EA	1 days	Production rate from HPNSB & C
SURVEY/DEMOBILIZATION				
Survey Crew			10 day	Misc Survey
Demobilization			5 day	
		TOTAL	**35 days**	