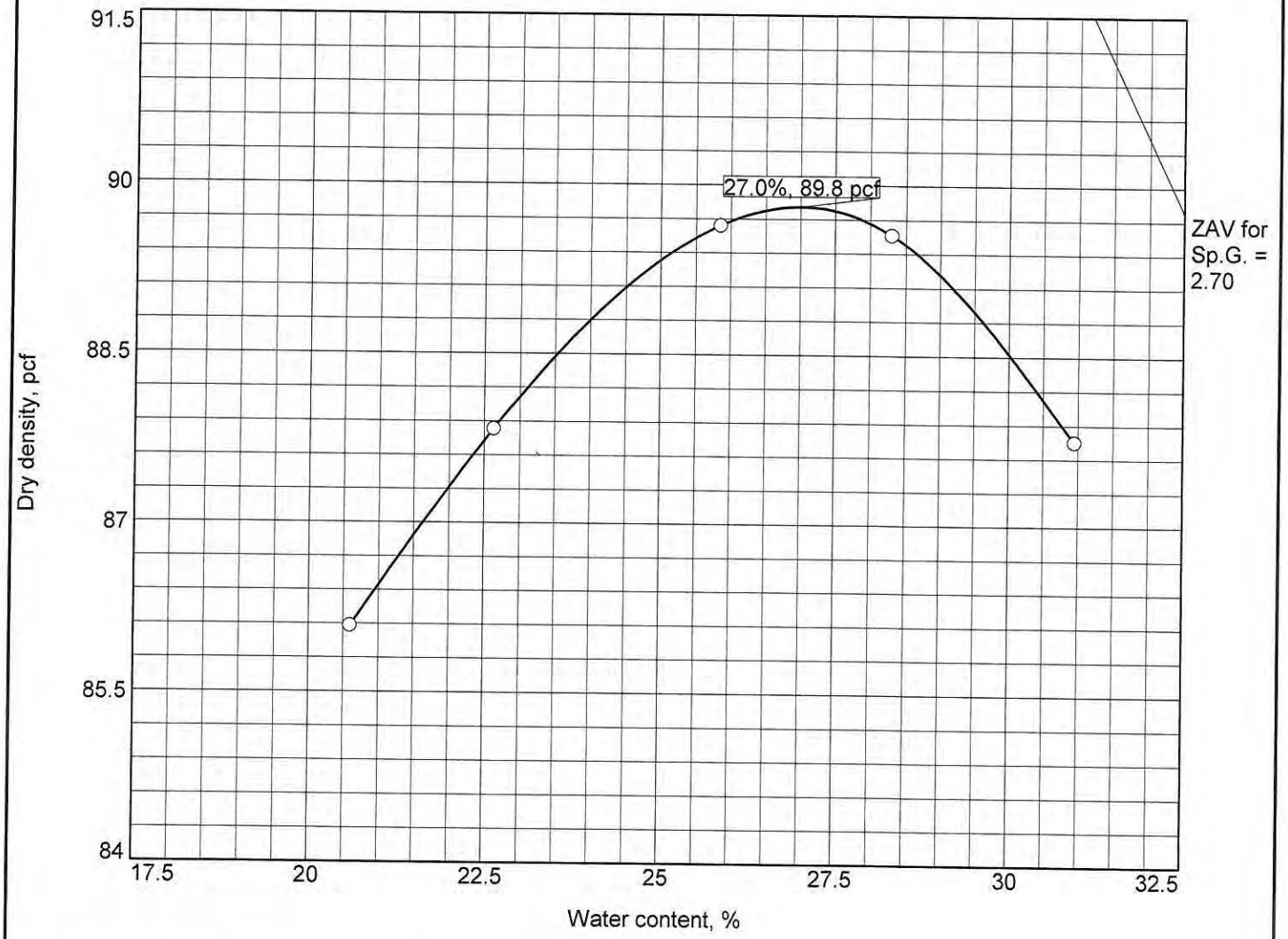
COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CH	A-7-6(58)	36.5	2.70	76	51	0.0	97.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 89.8 pcf Optimum moisture = 27.0 %	GRAY FAT CLAY

Project No. N1155153 **Client:** ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

○ **Source of Sample:** ETP-1 **Sample Number:** G004

Remarks:

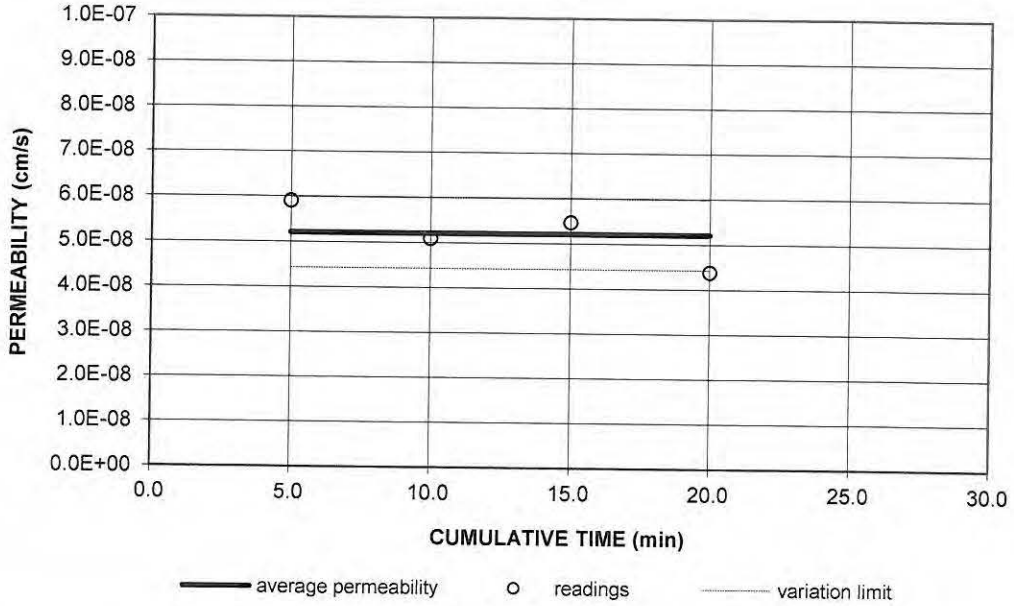
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5249

Tested By: MRE **Checked By:** GS

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	11.11	5.90E-08	
21.00	5.00	10.00	10.37	5.09E-08	
21.00	5.00	15.00	9.63	5.47E-08	**5.2E-08**
21.00	5.00	20.00	9.08	4.38E-08	

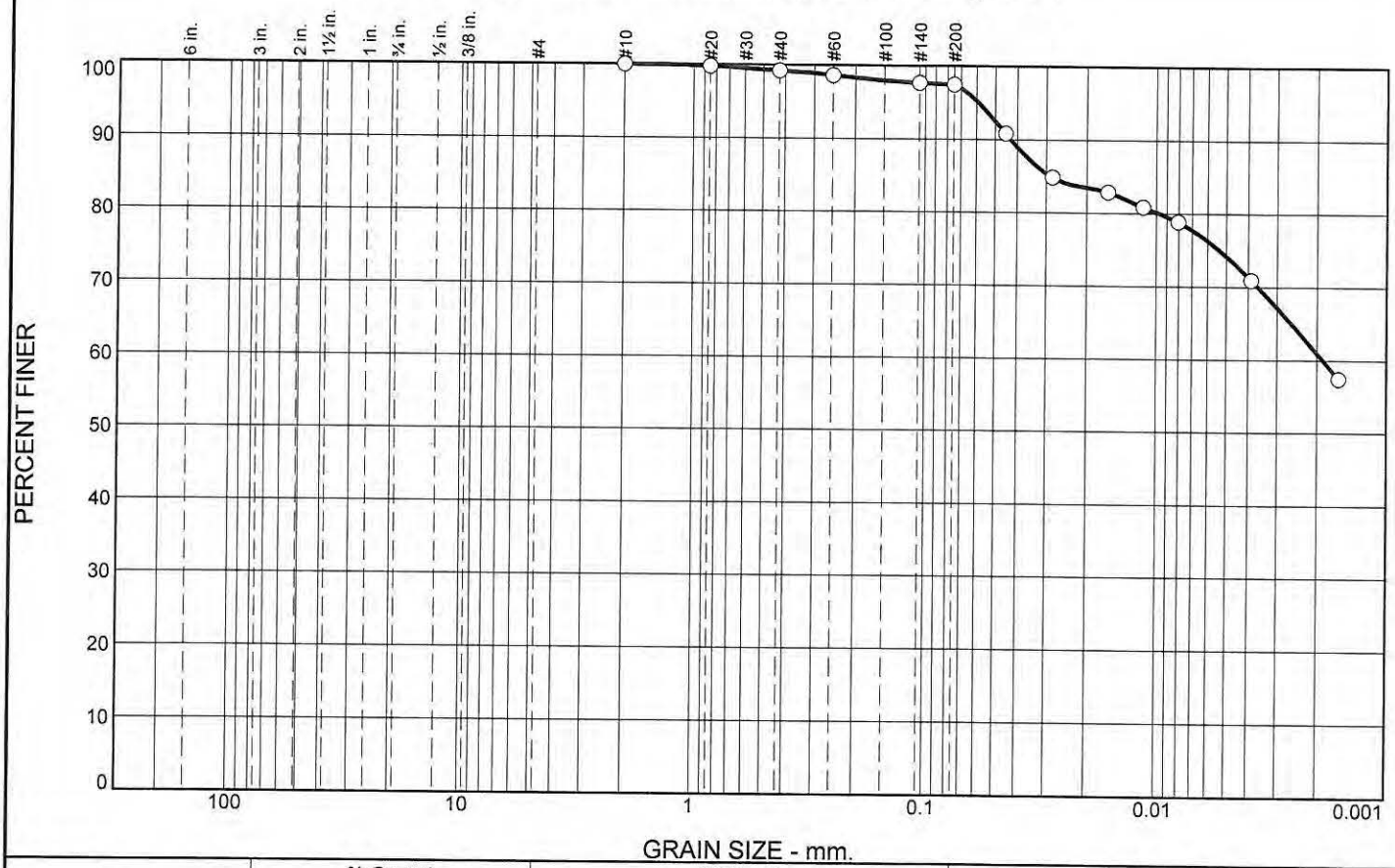
Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	89.8	Specimen Height, (inches)	3.00	3.04
Opti. M.C., (%)	27.0	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	38.18
% Recompct.	95.0	Moisture Content, (%)	27.05	40.64
Test Pressures (psi)		Percent Saturation (%)	74.84	100.00
Backpressure	90.00	Wet Mass Density (pcf)	108.34	118.36
Cell pressure	93.00	Dry Mass Density (pcf)	85.28	84.15
Eff. Stress	**3.00**	Void Ratio	0.98	1.10
Specific Gravity	2.70	Calculated Porosity, %	49.38	52.32

USCS SG Assumed LL PI

Permeant Used: WATER Remarks GRAY FAT CLAY

Project Name	Old American Zinc Site	Tested by	FCE Reviewed by TGG
Client	Arcadis W.O.# N1155153		
Sample Number	ETP-1:G004	FLEXIBLE WALL PERMEABILITY TEST	
Sample Location		Terracon	
Date	7/15/2015 Lab No. 5249		

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	2	36	61

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#20	100		
#40	99		
#60	99		
#140	98		
#200	97		

* (no specification provided)

Material Description

DARK GRAY ELASTIC SILT

Atterberg Limits

PL= 38 LL= 79 PI= 41

Coefficients

D_{90}= 0.0427 D_{85}= 0.0287 D_{60}= 0.0019
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(51)

Remarks

Source of Sample: ETP-2
Sample Number: G0005

Date: 7-8-15

Terracon, Inc.

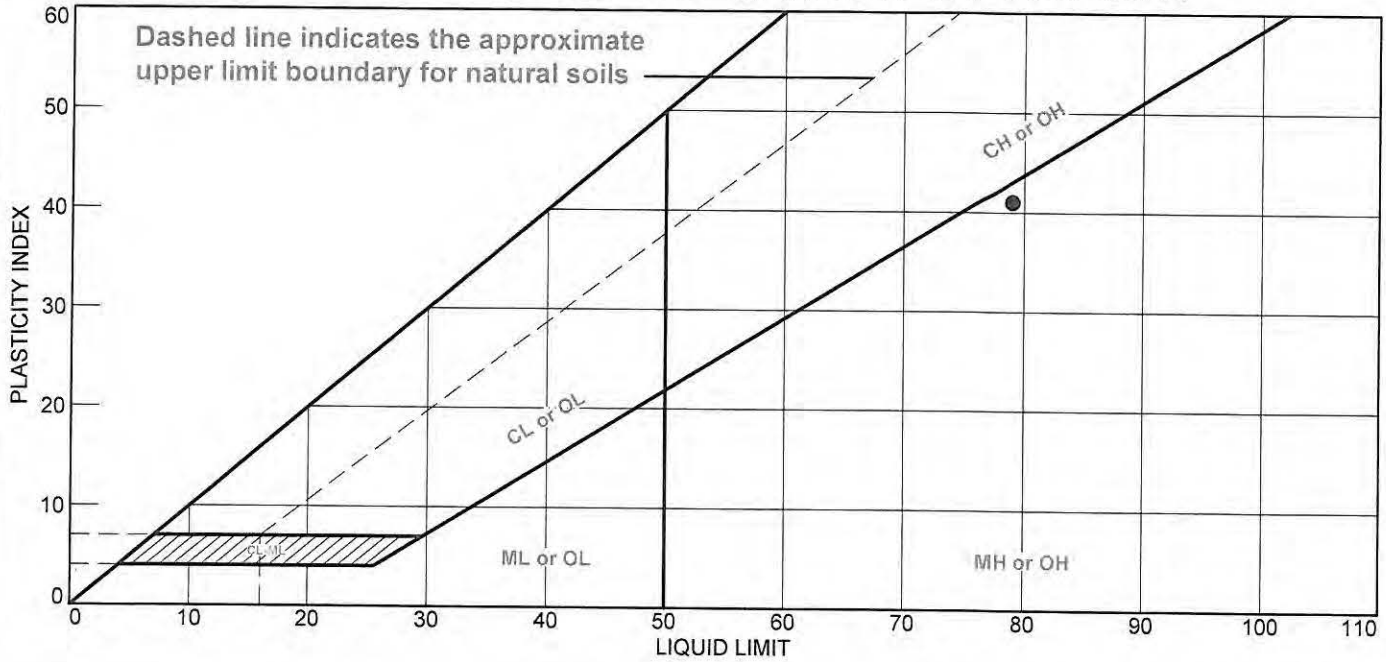
Cincinnati, Ohio

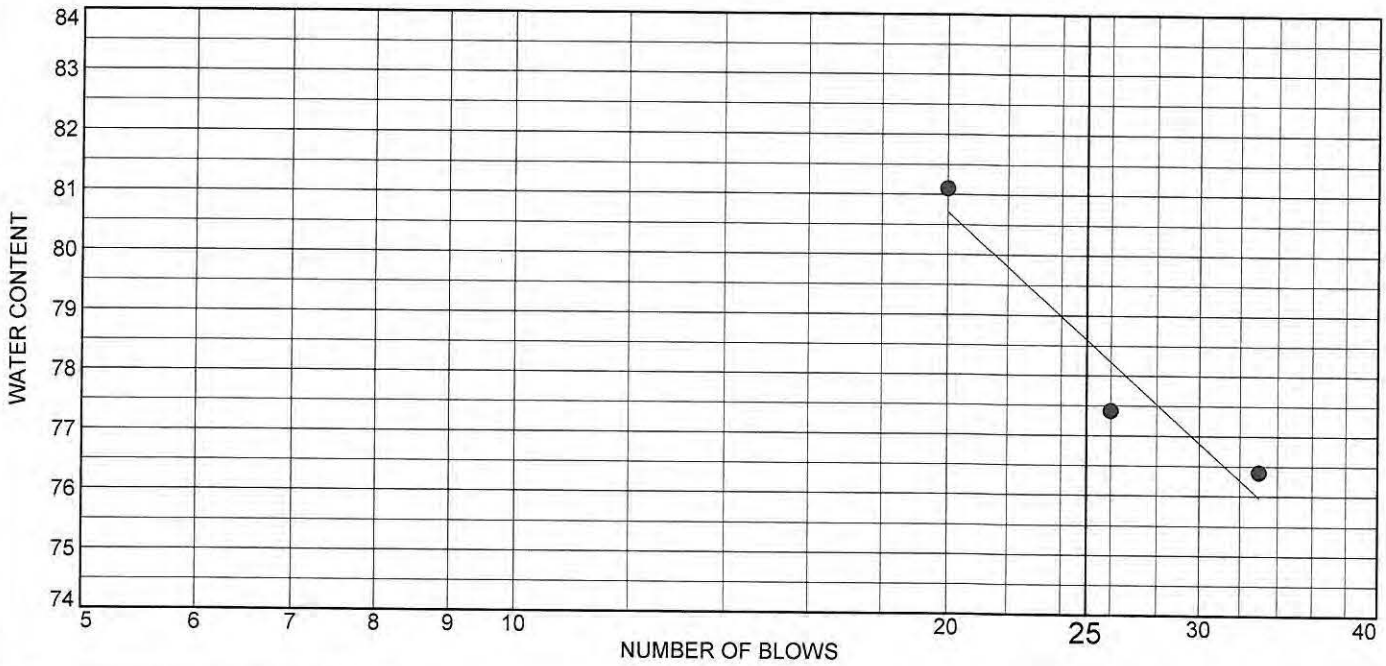
Client: ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

Project No: N1155153 **Exhibit** 5250

Tested By: DR **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK GRAY ELASTIC SILT	79	38	41	99.2	97.5	MH

Project No. N1155153 **Client:** ARCADIS US Inc.

Project: OLD AMERICAN ZINC SITE

Source of Sample: ETP-2
Sample Number: G0005

Remarks:

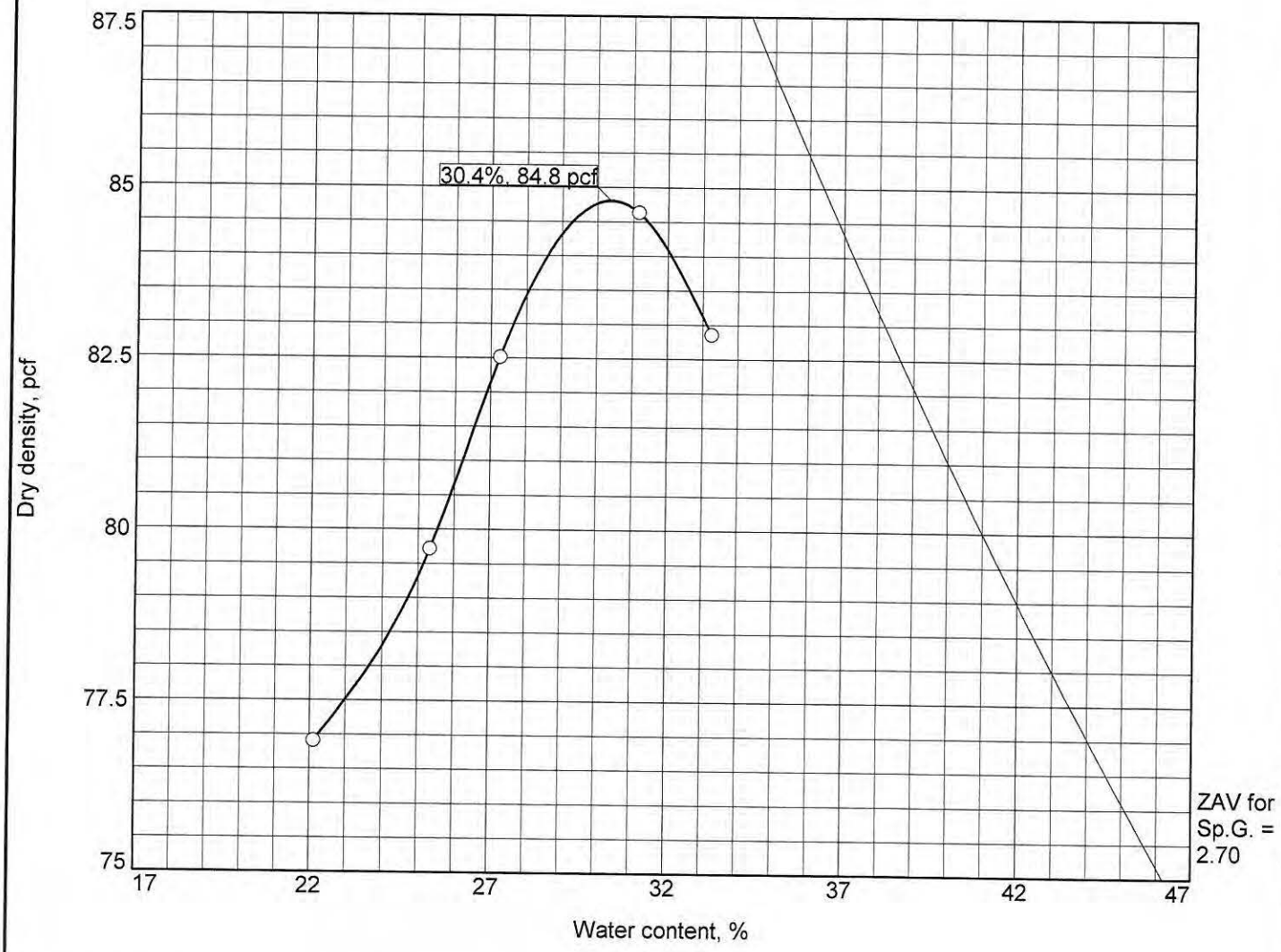
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5250

Tested By: DB **Checked By:** GS

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	MH	A-7-5(51)		2.70	79	41	0.0	97.5

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 84.8 pcf Optimum moisture = 30.4 %	DARK GRAY ELASTIC SILT

Project No. N1155153 **Client:** ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

○ **Source of Sample:** ETP-2 **Sample Number:** G0005

Remarks:

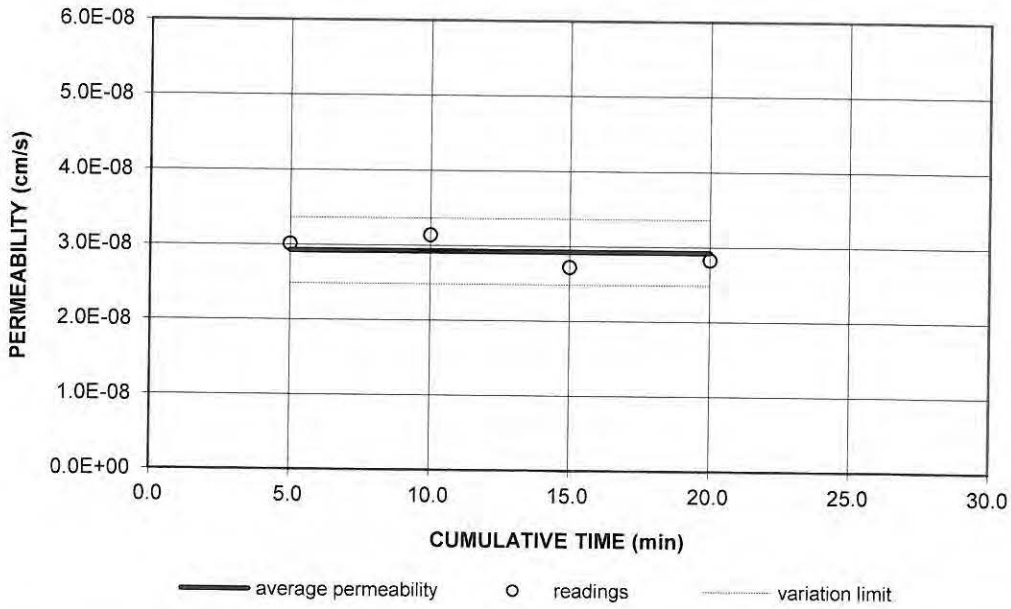
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5250

Tested By: MRE **Checked By:** GS

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

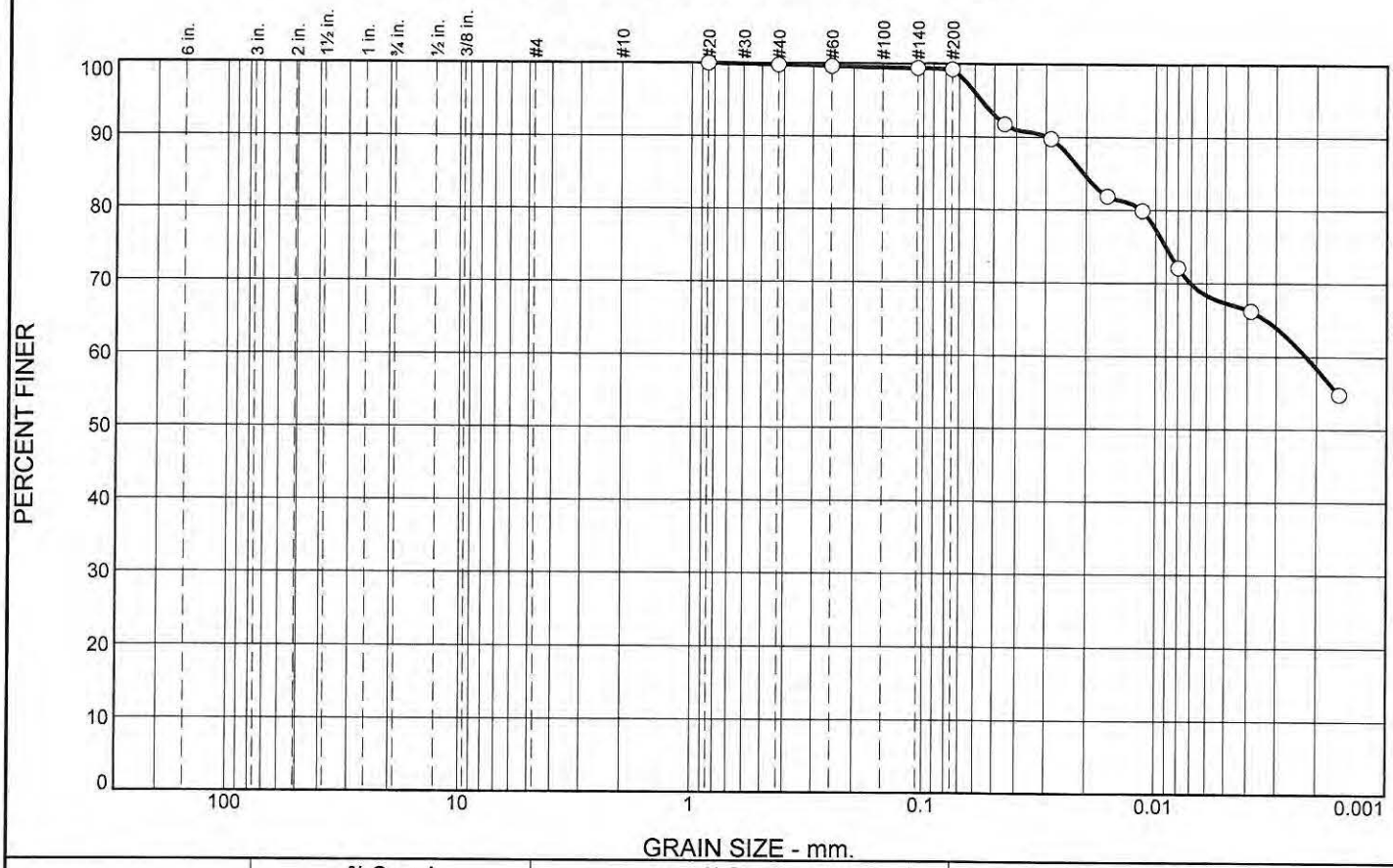
Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	13.34	3.01E-08	
21.00	5.00	10.00	12.78	3.14E-08	
21.00	5.00	15.00	12.32	2.72E-08	**2.9E-08**
21.00	5.00	20.00	11.86	2.83E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	84.8	Specimen Height, (inches)	3.00	3.06
Opti. M.C., (%)	30.4	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	38.43
% Recompct.	95.0	Moisture Content, (%)	29.77	43.45
Test Pressures (psi)		Percent Saturation (%)	73.78	100.00
Backpressure	90.00	Wet Mass Density (pcf)	104.64	113.40
Cell pressure	93.00	Dry Mass Density (pcf)	80.63	79.05
Eff. Stress	**3.00**	Void Ratio	1.09	1.17
Specific Gravity	2.70	Calculated Porosity, %	52.14	53.98

USCS	SG Assumed	LL		PI	
Permeant Used:	WATER	Remarks	GRAY FAT CLAY		

Project Name	Old American Zinc Site			Tested by	FCE Reviewed by TGG
Client	Arcadis	W.O.#	N1155153		
Sample Number	ETP-1:G005			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location					
Date	7/17/2015	Lab No.	5250	Terracon	

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	1	41	58

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#20	100		
#40	100		
#60	100		
#140	99		
#200	99		

* (no specification provided)

Material Description

DARK GRAY FAT CLAY

Atterberg Limits

PL= 35 LL= 76 PI= 41

Coefficients

D_{90}= 0.0293 D_{85}= 0.0205 D_{60}= 0.0022
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-5(50)

Remarks

Source of Sample: CPT-1
Sample Number: G0006

Date: 7-8-15

Terracon, Inc.

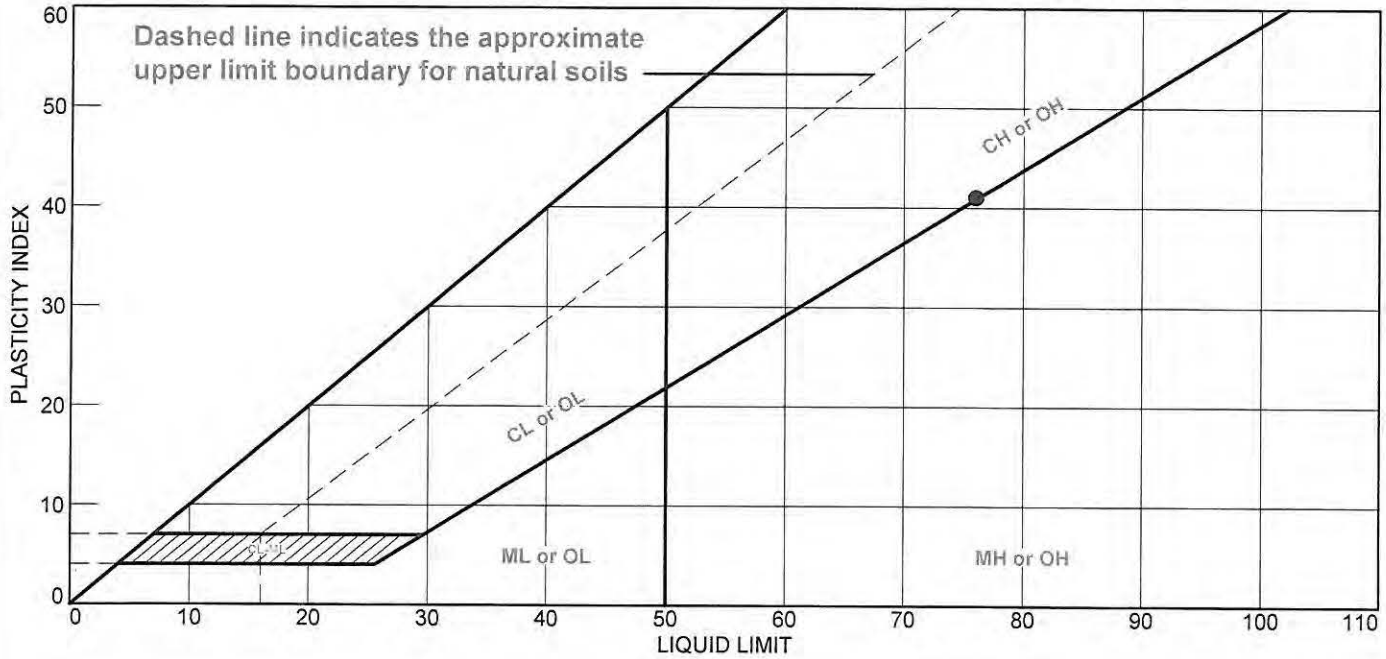
Cincinnati, Ohio

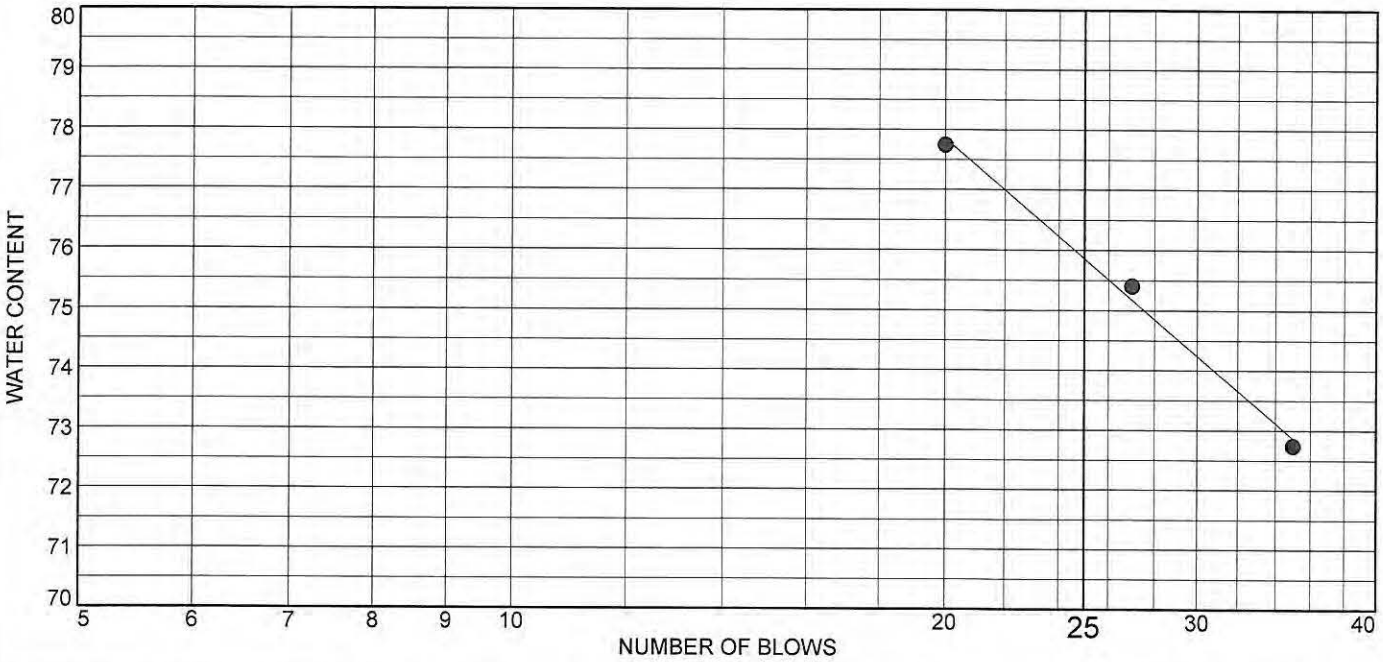
Client: ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

Project No: N1155153 **Exhibit** 5251

Tested By: DR **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK GRAY FAT CLAY	76	35	41	100	99	CH

Project No. N1155153 **Client:** ARCADIS US Inc.

Project: OLD AMERICAN ZINC SITE

Source of Sample: CPT-1
Sample Number: G0006

Remarks:

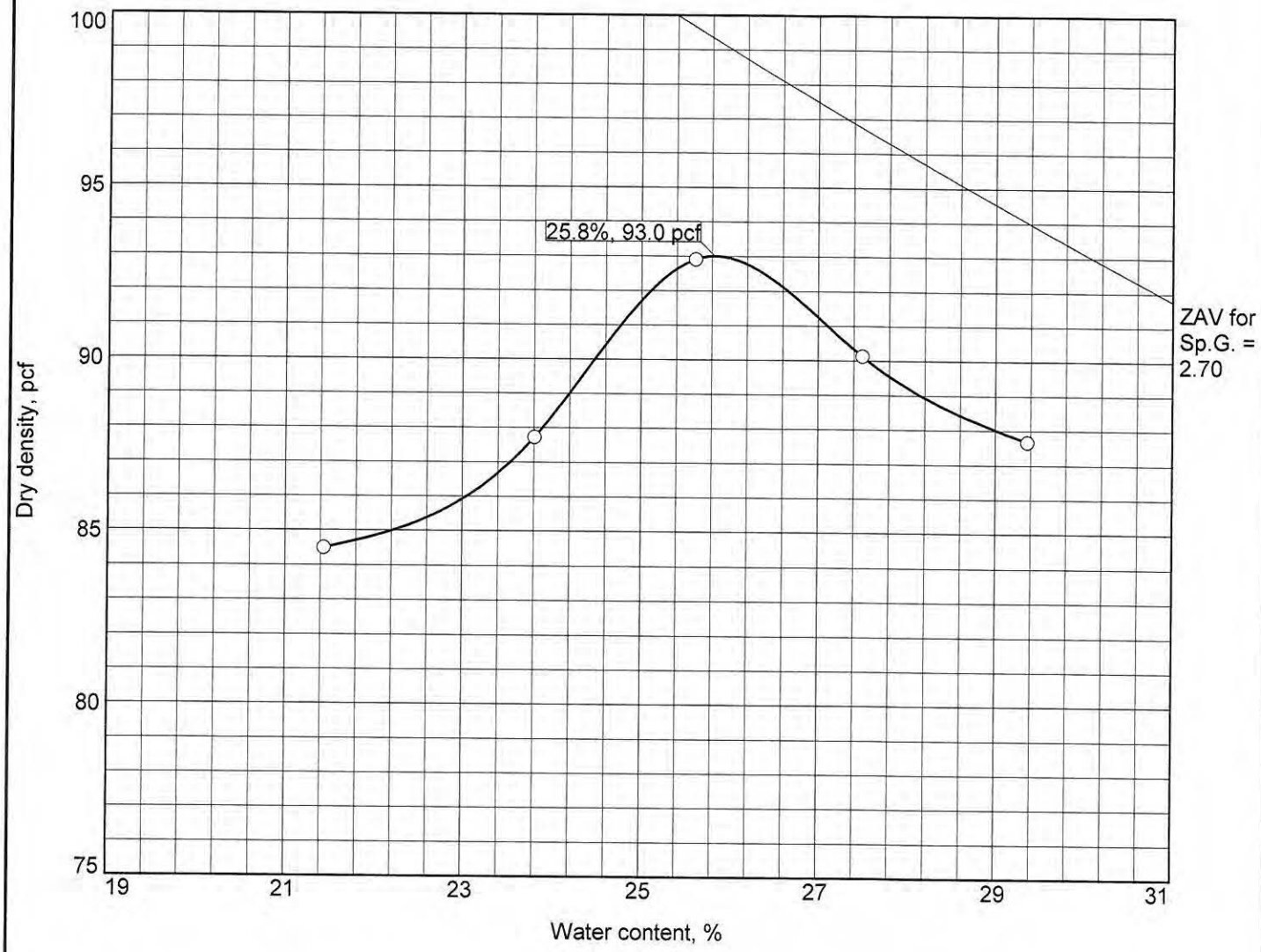
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5251

Tested By: DB **Checked By:** GS

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CH	A-7-5(50)		2.70	76	41	0	99

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 93.0 pcf Optimum moisture = 25.8 %	DARK GRAY FAT CLAY

Project No. N1155153 **Client:** ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

○ **Source of Sample:** CPT-1 **Sample Number:** G0006

Remarks:

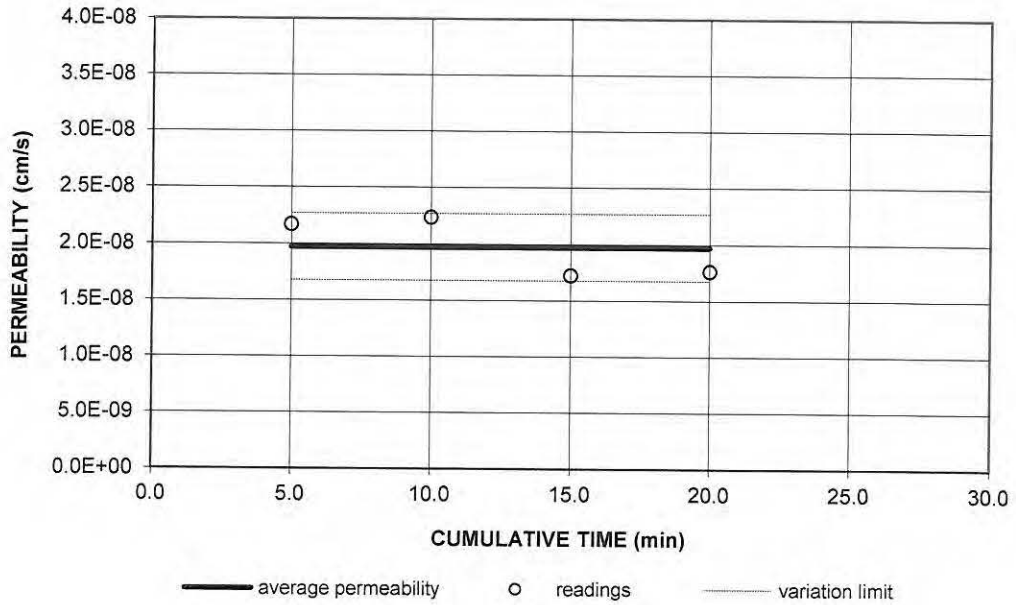
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5251

Tested By: MRE **Checked By:** GS

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	12.41	2.17E-08	
21.00	5.00	10.00	12.04	2.23E-08	
21.00	5.00	15.00	11.76	1.72E-08	**2.0E-08**
21.00	5.00	20.00	11.48	1.76E-08	

Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	93.0	Specimen Height, (inches)	3.00	3.07
Opti. M.C., (%)	25.8	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	38.56
% Recompct.	95.0	Moisture Content, (%)	25.78	39.69
Test Pressures (psi)		Percent Saturation (%)	76.87	100.00
Backpressure	90.00	Wet Mass Density (pcf)	111.21	120.69
Cell pressure	93.00	Dry Mass Density (pcf)	88.42	86.40
Eff. Stress	**3.00**	Void Ratio	0.91	1.07
Specific Gravity	2.70	Calculated Porosity, %	47.52	51.73

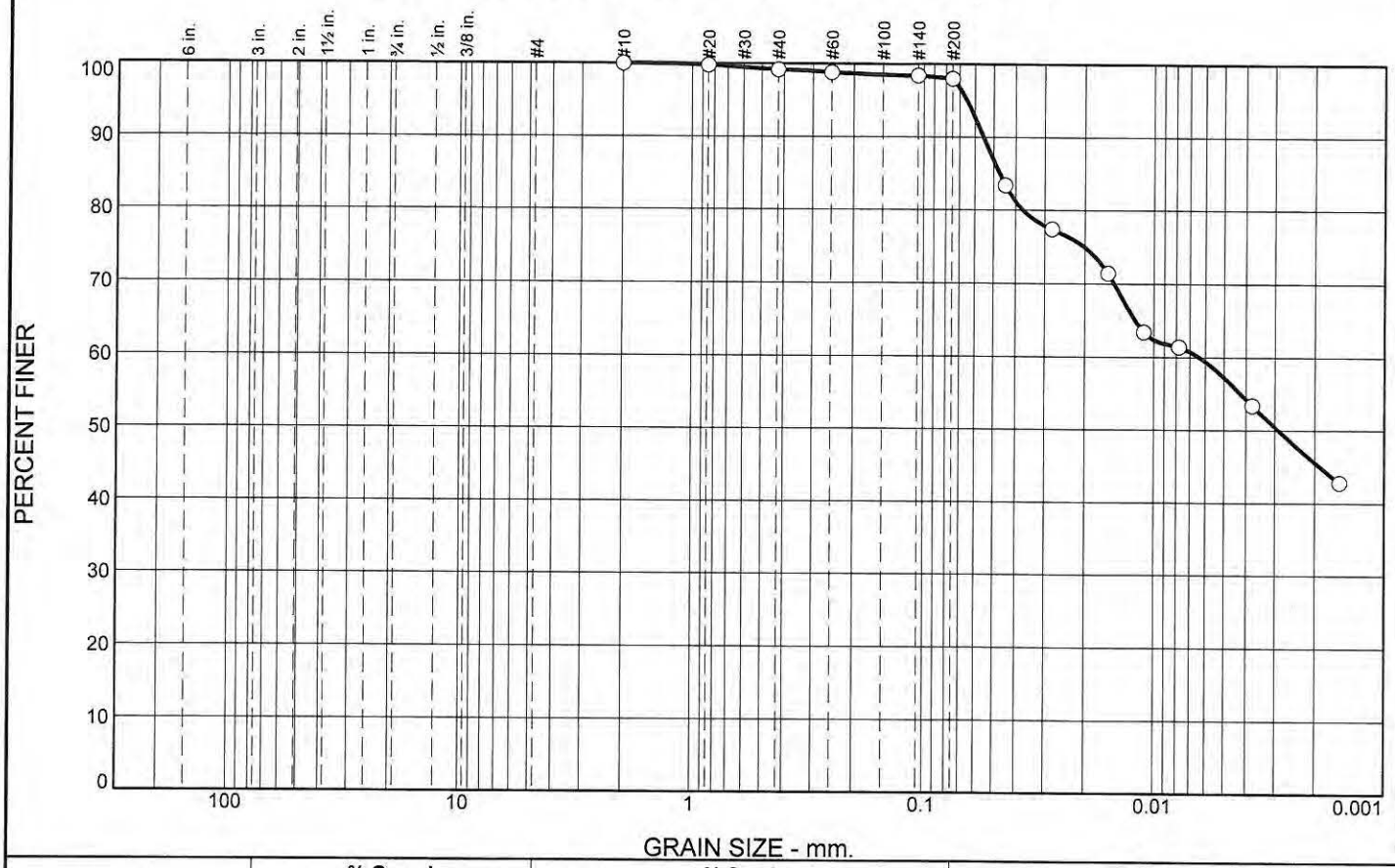
USCS	SG Assumed	LL	PI
Permeant Used:	WATER	Remarks	DARK GRAY FAT CLAY

Project Name	Old American Zinc Site			Tested by	FCE
Client	Arcadis	W.O.#	N1155153	Reviewed by	TGG
Sample Number	CTP-1:G006				
Sample Location					
Date	7/14/2015	Lab No.	5251		

FLEXIBLE WALL PERMEABILITY TEST

Terracon

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	1	52	46

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#20	100		
#40	99		
#60	99		
#140	98		
#200	98		

* (no specification provided)

Material Description

DARK GRAY FAT CLAY

Atterberg Limits

PL= 29 LL= 67 PI= 38

Coefficients

D_{90}= 0.0552 D_{85}= 0.0471 D_{60}= 0.0063
D_{50}= 0.0029 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(44)

Remarks

Source of Sample: CTP-2
Sample Number: G007

Date: 7-8-15

Terracon, Inc.

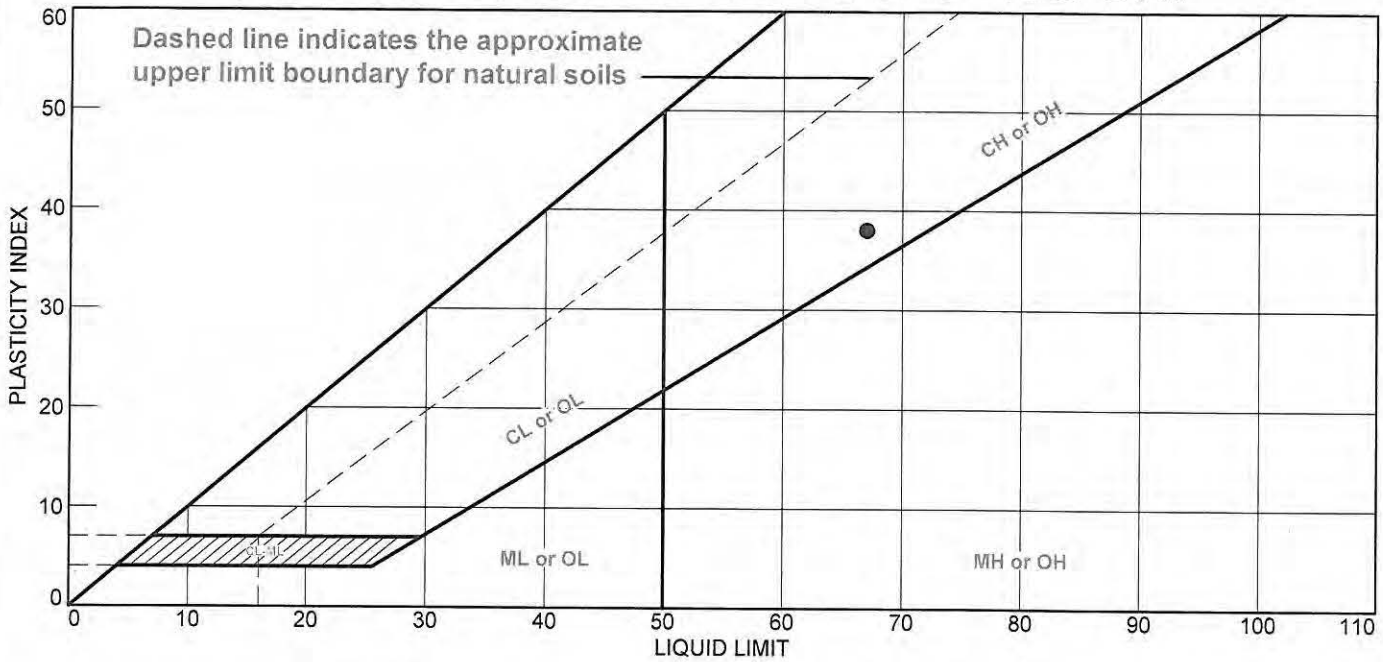
Cincinnati, Ohio

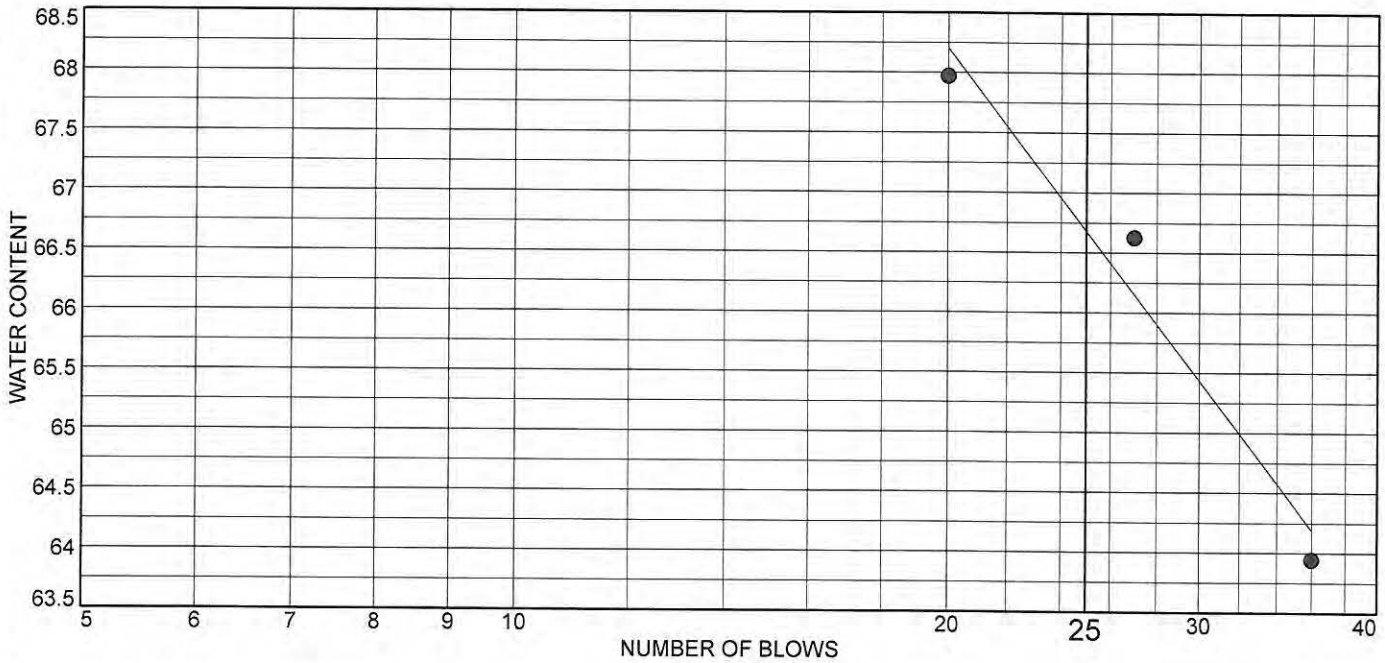
Client: ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

Project No: N1155153 **Exhibit** 5252

Tested By: DR **Checked By:** GS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK GRAY FAT CLAY	67	29	38	99.2	98.0	CH

Project No. N1155153 **Client:** ARCADIS US Inc.

Project: OLD AMERICAN ZINC SITE

Source of Sample: CTP-2
Sample Number: G007

Remarks:

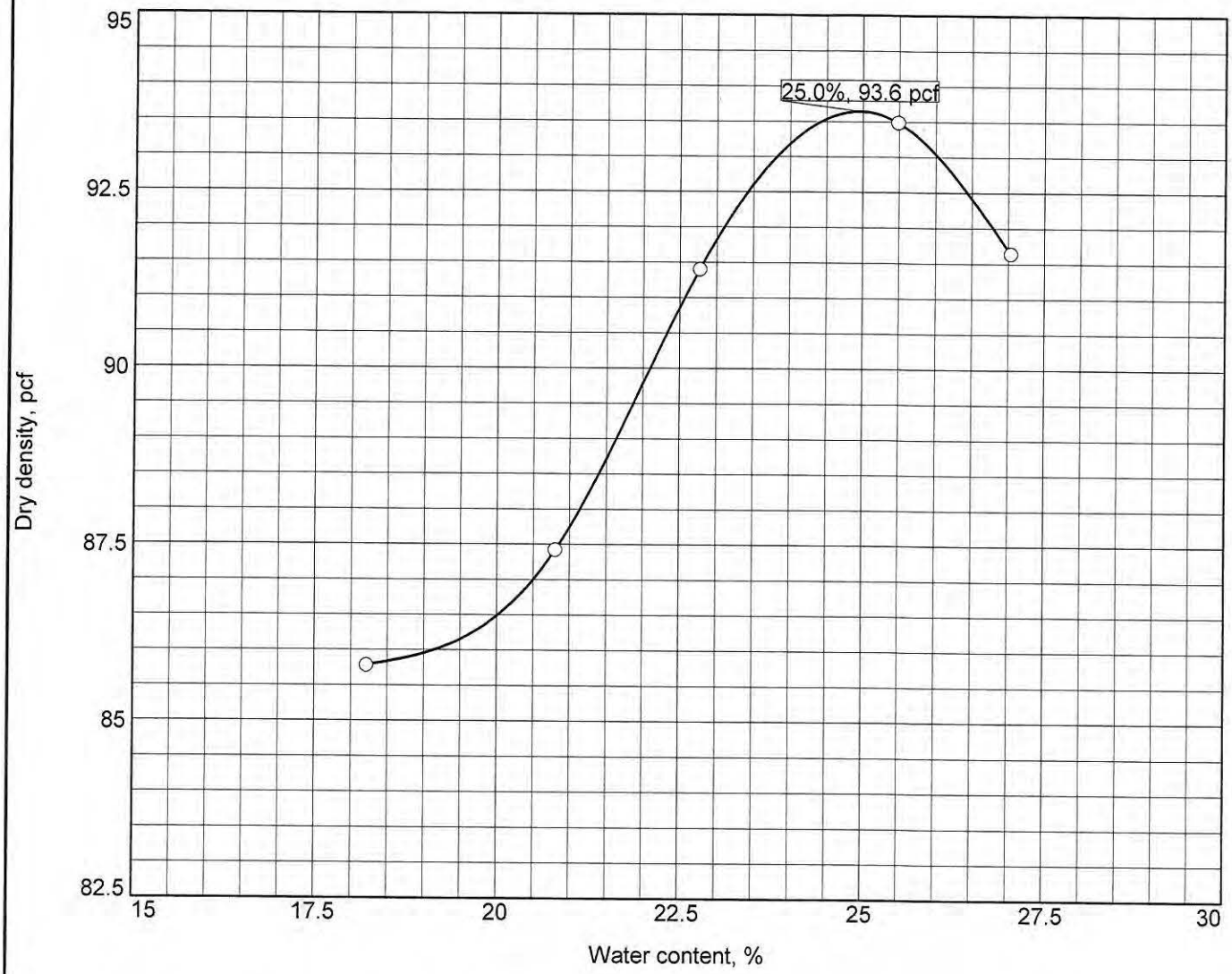
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5252

Tested By: DB **Checked By:** GS

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CH	A-7-6(44)			67	38	0.0	98.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 93.6 pcf Optimum moisture = 25.0 %	DARK GRAY FAT CLAY

Project No. N1155153 **Client:** ARCADIS US Inc.
Project: OLD AMERICAN ZINC SITE

○ **Source of Sample:** CTP-2 **Sample Number:** G007

Remarks:

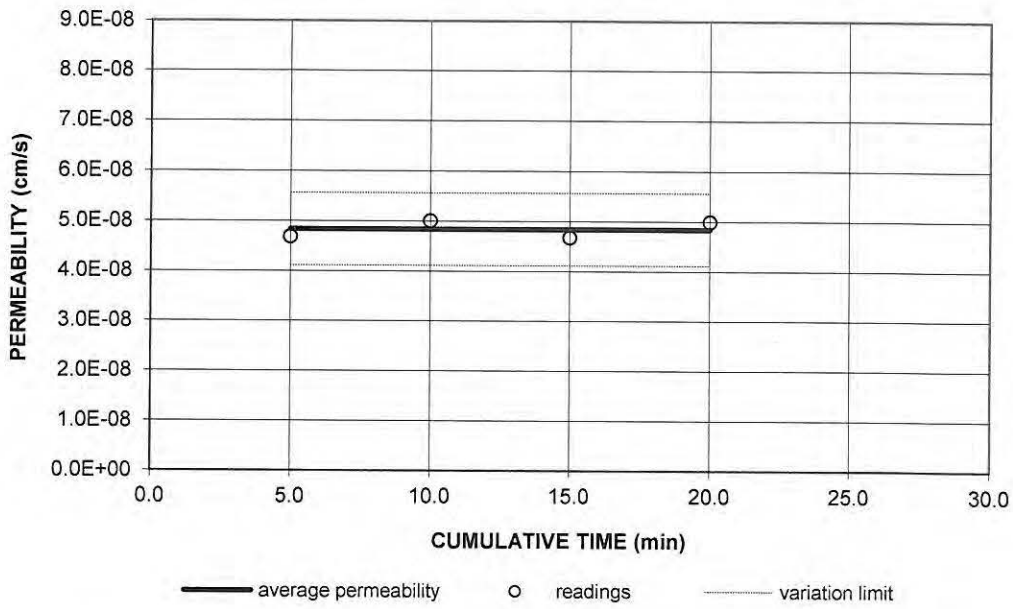
Terracon, Inc.

Cincinnati, Ohio

Exhibit 5252

Tested By: AW **Checked By:** GS

FLEXIBLE WALL PERMEABILITY TEST



Test Specification: ASTM D 5084 Method F

Fluid Temp. (°C)	Elapsed Time (min.)	Cumulative Time (min.)	Gradient (cm-Hg)	Calculated Permeability (cm/sec)	Average Permeability (cm/sec)
21.00	5.00	5.00	11.30	4.68E-08	
21.00	5.00	10.00	10.56	5.00E-08	
21.00	5.00	15.00	9.91	4.67E-08	**4.8E-08**
21.00	5.00	20.00	9.26	4.99E-08	

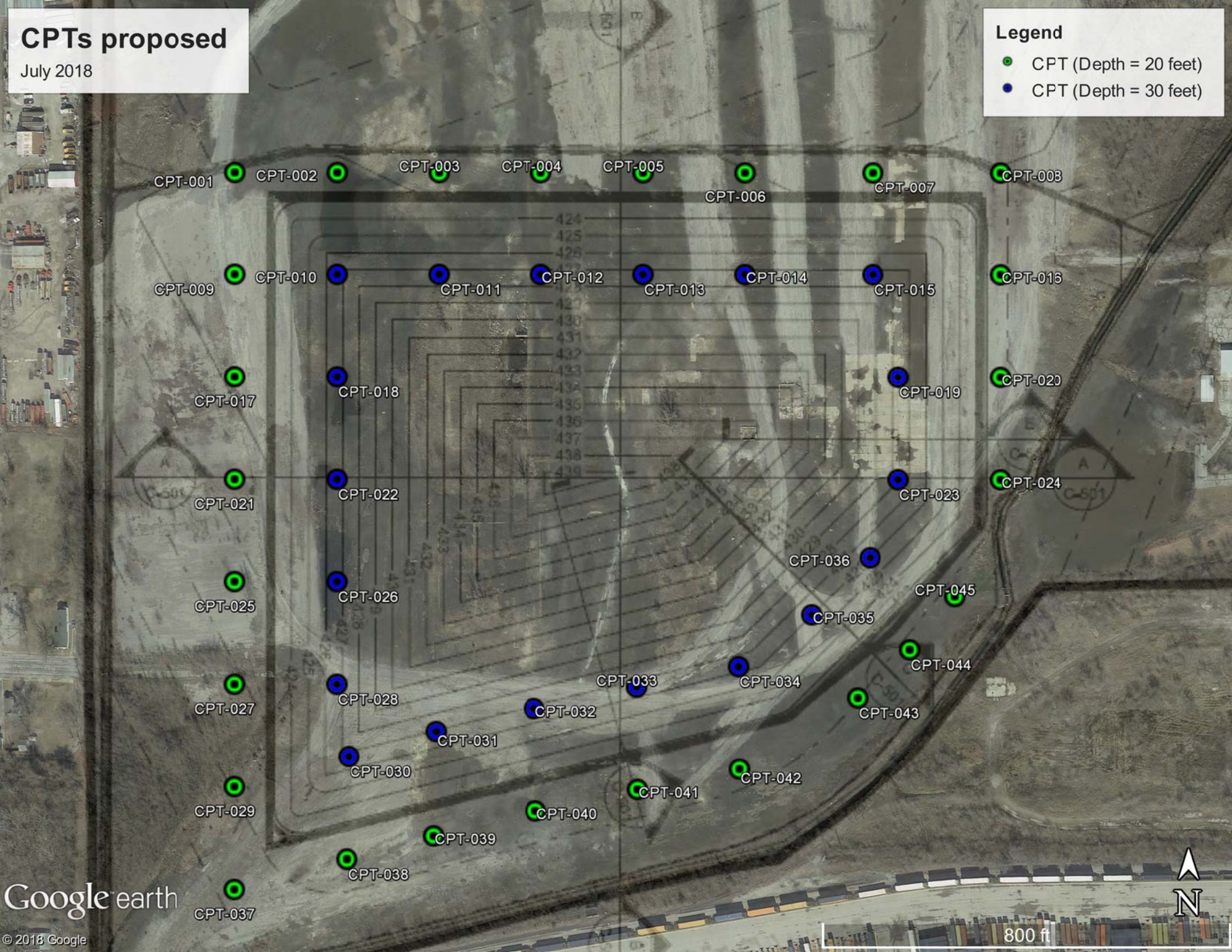
Compaction Data		Sample Data	Initial	Final
Proctor (pcf)	93.6	Specimen Height, (inches)	3.00	3.04
Opti. M.C., (%)	25.0	Specimen Diameter, (inches)	4.00	4.00
Comp. Method		Specimen Volume, (cu. In.)	37.68	38.18
% Recompct.	95.0	Moisture Content, (%)	24.96	32.35
Test Pressures (psi)		Percent Saturation (%)	75.38	95.00
Backpressure	90.00	Wet Mass Density (pcf)	111.15	116.17
Cell pressure	93.00	Dry Mass Density (pcf)	88.95	87.78
Eff. Stress	**3.00**	Void Ratio	0.89	0.92
Specific Gravity	2.70	Calculated Porosity, %	47.21	47.90

USCS	SG Assumed	LL		PI	
Permeant Used:	WATER	Remarks	GRAY FAT CLAY		

Project Name	Old American Zinc Site			Tested by	FCE Reviewed by TGG
Client	Arcadis	W.O.#	N1155153		
Sample Number	CTP-2:0007			FLEXIBLE WALL PERMEABILITY TEST	
Sample Location					
Date	7/17/2015	Lab No.	5252	Terracon	

Attachment F

CPT Sounding Location Grid


CPTs proposed
July 2018
Legend
CPT (Depth = 20 feet)
CPT (Depth = 30 feet)
CPT-001
CPT-002
CPT-003
CPT-004
CPT-005
CPT-006
CPT-007
CPT-008
CPT-009
CPT-010
CPT-011
CPT-012
CPT-013
CPT-014
CPT-015
CPT-016
CPT-017
CPT-018
CPT-019
CPT-020
CPT-021
CPT-022
CPT-023
CPT-024
CPT-025
CPT-026
CPT-027
CPT-028
CPT-029
CPT-030
CPT-031
CPT-032
CPT-033
CPT-034
CPT-035
CPT-036
CPT-037
CPT-038
CPT-039
CPT-040
CPT-041
CPT-042
CPT-043
CPT-044
CPT-045
Google earth
© 2018 Google
N
800 ft

CPT	East	North	Depth
CPT-001	2,315,241	721,368	20
CPT-002	2,315,441	721,368	20
CPT-003	2,315,641	721,368	20
CPT-004	2,315,841	721,368	20
CPT-005	2,316,041	721,368	20
CPT-006	2,316,241	721,368	20
CPT-007	2,316,491	721,368	20
CPT-008	2,316,741	721,368	20
CPT-009	2,315,241	721,168	20
CPT-010	2,315,441	721,168	30
CPT-011	2,315,641	721,168	30
CPT-012	2,315,841	721,168	30
CPT-013	2,316,041	721,168	30
CPT-014	2,316,241	721,168	30
CPT-015	2,316,491	721,168	30
CPT-016	2,316,741	721,168	20
CPT-017	2,315,241	720,968	20
CPT-018	2,315,441	720,968	30
CPT-019	2,316,541	720,968	30
CPT-020	2,316,741	720,968	20
CPT-021	2,315,241	720,768	20
CPT-022	2,315,441	720,768	30
CPT-023	2,316,541	720,768	30
CPT-024	2,316,741	720,768	20
CPT-025	2,315,241	720,568	20
CPT-026	2,315,441	720,568	30
CPT-027	2,315,241	720,368	20
CPT-028	2,315,441	720,368	30
CPT-029	2,315,241	720,168	20
CPT-030	2,315,465	720,227	30
CPT-031	2,315,636	720,276	30
CPT-032	2,315,828	720,321	30
CPT-033	2,316,029	720,363	30
CPT-034	2,316,229	720,403	30
CPT-035	2,316,372	720,504	30
CPT-036	2,316,486	720,616	30
CPT-037	2,315,241	719,968	20
CPT-038	2,315,461	720,027	20
CPT-039	2,315,631	720,072	20
CPT-040	2,315,831	720,121	20
CPT-041	2,316,031	720,163	20
CPT-042	2,316,231	720,203	20
CPT-043	2,316,462	720,342	20
CPT-044	2,316,564	720,436	20
CPT-045	2,316,652	720,540	20

Coordinate System:
IL83-WF
NAD83 Illinois State Planes, West Zone, US Foot

Calculation

Calculation No.: CALC-687729-Soil Loss **Revision No.:** 1

Project: Old American Zinc Superfund Site - Facility Area Remedial Design **Date:** 4/13/2018

Engineering Discipline: Civil Engineering

Title: OAZ Facility Area Remedial Design - Universal Soil Loss Calculation

Description: The Universal Soil Loss Equation was used to calculate annual soil loss rates for the Consolidation Area to be constructed during the OAZ Facility Area Remedial Design before, during, and after construction. Calculations were performed for the greatest slope and slope length under present conditions, bare soil and fully vegetated conditions.

Date Prepared	Rev. No.	Preparer Signature/Date	Checker Signature/Date	*For Professional Seal When Required*
4/13/2018	0	Tony Oxley 4/13/2018		

STC/SME Signature/Date	
LTR Signature/Date (if required)	

Comments:

Information Requiring Confirmation:

OBJECTIVE:

1 To calculate the Soil Loss rate for the Consolidation Area at the OAZ Facility Area under existing, bare, and fully vegetated conditions along the maximum slope - slope length.

METHODS:

The Universal Soil Loss Equation (USLE) is used to calculate annual soil loss rates for the slopes described in the objective statement. The equation is:

$A = RK(LS)CP$ (Ref 1)

where

A = Computed Soil Loss (tons/acre/year)

and

R = Rainfall Energy Factor for Fairmont City, Illinois
K = Soil Erodibility Factor
LS = Slope-Length Factor
C = Cropping Management Factor
P = Erosion Control Practice Factor

ASSUMPTIONS:

1

Assumed Values for the USLE Factors		
USLE Factor	**Value**	**Description of USLE Factor Value**
R	225	The Rainfall Energy Coefficient for Fairmon City, IL. The site is located between the 200 and 250 rainfall energy coefficient contours, on the USDA average annual values of the rainfall erosion index map. (Ref 1)
K	0.05	The existing surface soil of the site consist of compacted and re-worked slag with less than 2% organics. (Ref 2&4)
	0.26	The final proposed top soil is based on locally available borrow soil is assumed to be loam with organic content greater than 5%. (Ref 2&4)
C	1	Bare ground assumed to have a coverage value of 1. (Ref 3)
	0.25	Current coverage factor of 0.25 is based on grassy vegetation with bare areas where slag is present.
	0.02	Vegetated surface to contain a coverage factor of 0.02. A coverage factor of 0.02 was assumed for final fully vegetated conditions. (Ref 2)
P*	1	Erosion control practice factor for landfill design is 1. (Ref 3)
LS	see table below	$LS = (0.065 + 0.0456S + 0.006541S^2)(\text{slope length} / 72.5)^{\text{slope exponent}}$ (Ref 1) where S = Slope (%) slope — slope exponent slope <1% — 0.2 1% <= slope <= 3% — 0.3 3% <= slope <= 5% — 0.4 slope >5% — 0.5

*Not shown in duration of calculation

2 Existing grades are generally less than 1 percent and proposed design final grades are3 percent; therefore the slope exponent will range from 0.2 to 0.3. See design drawings for existing conditions and proposed final design conditions.

ASSUMPTIONS:

3 Soil loss is calculated along the longest steepest section of the cover.

CALCULATIONS:

Calculated Annual Soil Loss and Length Slope Factor							
Land Disturbing Activity	**Rainfall Energy Factor R**	**Soil Erodibility Factor K**	**Cropping Management Factor C**	**Length - Slope Factor LS**	**Maximum Slope Length (Feet)**	**Slope (%)**	**Annual Soil Loss (ton/acre)**
Existing Conditions	225	0.05	0.25	0.40	850	1	1.1
Bare Ground Existing	225	0.05	1.00	0.40	850	1	4.5
Bare Soil Final Grade	225	0.26	1.00	0.89	850	3	52.2
Restored- Completely Vegetated	225	0.26	0.02	0.89	850	3	1.0

CONCLUSION:

Once the Consolidation Area is in place, the restored-completely vegetated conditions yield soil loss is about 1.0 tons/acre/year which does not include the erosion protection netting proposed in the design. Specifications for topsoil are to contain > 5% organic material and seeding, mulching, and fertilization practices at the very least would be required for restoration. Also, mowing should be conducted at least two times per year. In general, soil loss quantity less than 2 tons/acre/year is acceptable. During construction, erosion control measures are required to manage the high volumes of soil loss. Refer to the design drawings for details for soil erosion control during construction and for final restoration.

REFERENCES:

1 Wischmeier, W H and D D Smith. "Predicting rainfall erosion losses-a guide to conservation planning." *Agriculture Handbook No. 537* . 1978.

2 Ontario Ministry of Agriculture, Food and Rural Affairs. *Universal Soil Loss Equation Fact Sheet* . n.d. 1 7 2014.

3 Qian, X and R M Koerner. *Geotechnical Aspects of Landfill Design and Construction* . 2002

4 USDA Custom Soil Report, Web Soil Suvey. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Map Scale: 1:9,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Clair County, Illinois
Survey Area Data: Version 9, Sep 21, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 13, 2014—Jun 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
533	Urban land	230.1	75.2%
1071A	Darwin silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	4.3	1.4%
1248A	McFain silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	0.0	0.0%
2183A	Shaffton-Urban land complex, 0 to 2 percent slopes, occasionally flooded	60.7	19.9%
8183A	Shaffton clay loam, 0 to 2 percent slopes, occasionally flooded	6.0	2.0%
8304B	Landes very fine sandy loam, 2 to 5 percent slopes, occasionally flooded	4.6	1.5%
Totals for Area of Interest		**305.8**	**100.0%**

K Factor, Whole Soil—St. Clair County, Illinois

Map Scale: 1:9,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Clair County, Illinois
Survey Area Data: Version 9, Sep 21, 2017

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Date(s) aerial images were photographed: Jun 13, 2014—Jun 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
533	Urban land		230.1	75.2%
1071A	Darwin silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	.24	4.3	1.4%
1248A	McFain silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	.28	0.0	0.0%
2183A	Shaffton-Urban land complex, 0 to 2 percent slopes, occasionally flooded		60.7	19.9%
8183A	Shaffton clay loam, 0 to 2 percent slopes, occasionally flooded	.20	6.0	2.0%
8304B	Landes very fine sandy loam, 2 to 5 percent slopes, occasionally flooded	.32	4.6	1.5%
Totals for Area of Interest			**305.8**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Appendix B
Stormwater Design Caculations

Old American Zinc Facility Remediation Stormwater Design Calculations

PREPARED BY: Megan Bender/MKE

REVIEWED BY: Patrick Gervais/ATL

DATE: May 14, 2018

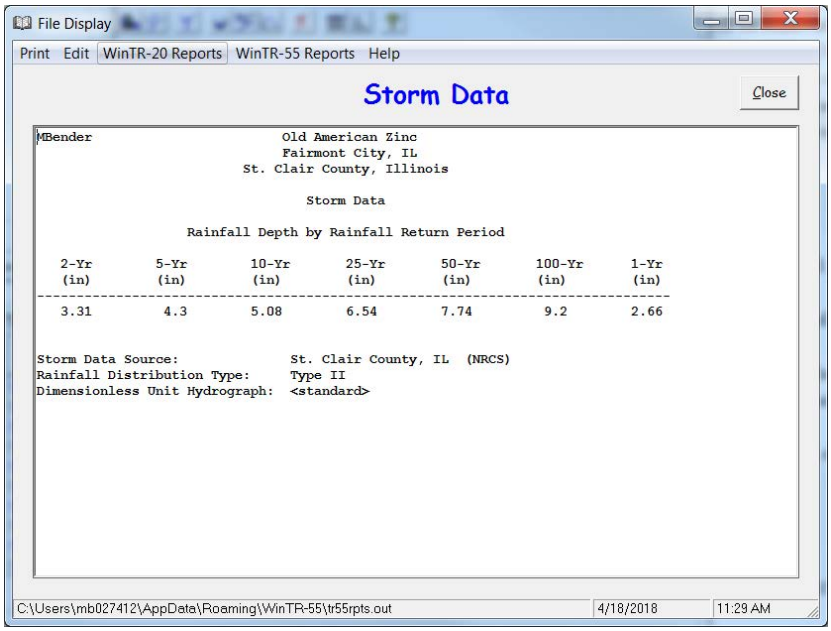
Objectives

The following report and calculations demonstrate the design of the stormwater conveyance channels. The objectives of the stormwater calculations are as follows:

1. Estimate the stormwater runoff reaching each proposed stormwater conveyance channel during the 25- and 100-year/24-hour rainfall events.
2. Determine the peak water surface elevations within each stormwater conveyance channel for the 25- and 100-year/24-hour rainfall events.
3. Size the channels to adequately convey runoff from the 25-year/24-hour storm event without overtopping and determine the extents of stormwater overtopping the conveyance channels during the 100-year/24-hour storm event.

Given

1. Natural Resources Conservation Service rainfall data for St. Clair County, Illinois. See Figure 1.



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Storm Data

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MBender                          Old American Zinc
                                 Fairmont City, IL
                            St. Clair County, Illinois

                                   Storm Data

                      Rainfall Depth by Rainfall Return Period

   2-Yr        5-Yr        10-Yr       25-Yr       50-Yr       100-Yr      1-Yr
   (in)        (in)        (in)        (in)        (in)        (in)        (in)
-------------------------------------------------------------------------------
   3.31         4.3        5.08        6.54        7.74         9.2        2.66


Storm Data Source:              St. Clair County, IL  (NRCS)
Rainfall Distribution Type:     Type II
Dimensionless Unit Hydrograph:  <standard>
```

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Figure 1. Natural Resources Conservation Service Rainfall Depth by Return Period

Assumptions

1. The Hydrologic Soil Group for the site area is D. Both Hydrologic Soil Group D and B/D soils surround the project site, which is considered “urban land” according to the U.S. Department of Agriculture Web Soil Survey. Since urban land is not assigned a Hydrologic Soil Group, and D soils are present in the area of the project site, D soils were assumed for post-development land covers to be conservative.
2. A Curve Number of 84 (fair grass) was assumed for areas of proposed final cover.
3. A maximum sheet flow length of 100 feet was applied.
4. All channels were assumed to have a Manning’s Number of 0.04 (assume the swales will be fully vegetated), side slopes of 3H:1V, and a bottom width of 15 feet.

Procedure

The Soil Conservation Service Unit Hydrograph method implemented through the WIN TR-55 modeling program was used to estimate the runoff hydrographs produced by the 2-, 10-, 25-, 50-, and 100-year/24-hour storm events for ditches 1–8. The ditch drainage area map can be seen in Figure 2.

Figure 2. Drainage Area and Drainage Ditch Overview Map

The overland slopes, drainage areas, and channel slopes were all determined from the Overview Map in Figure 2. A summary of those values is found in Tables 1a and 1b.

Table 1a. Drainage Area Characteristics

	Slope	Area (ft^2)	L (ft)	Area (ac)	mi^2
DA_1	0.003846	1132370	700	25.9958	0.040618
DA_2	0.007143	691651	700	15.8782	0.02481
DA_3	0.007143	519363	960	11.923	0.01863
DA_4	0.00625	451039	800	15.0313	0.023486
DA_5	0.005	431160	500	9.89812	0.015466
DA_6	0.00625	775873	700	17.8117	0.027831
DA_7	0.033333	1007760	580	23.1351	0.036149
DA_8	0.033333	654759	600	10.3545	0.016179
DA_9	0.033333	186653	540	4.28499	0.006695
DA_10	0.033333	366094	560	8.40439	0.013132
DA_11	0.008333	87462	220	2.00785	0.003137

Table 1b. Drainage Ditch Characteristics

	Ditch_length ft	Slope, ft/ft
Ditch_1	1761	0.0020
Ditch_2	1041	0.0017
Ditch_3	723	0.0011
Ditch_4	1741	0.0025
Ditch_5	687	0.0023
Ditch_6	2458	0.0011
Ditch_7	2249	0.0033
Ditch_8	1130	0.0011

These values were entered into the WIN TR-55 program along with the curve numbers discussed above to determine the time of concentration (T_c) and ultimately the peak flow (Q, in cubic feet per second [cfs]). These numbers were double checked with hand calculations to ensure the values were in the right range. Ditches were modeled as reaches in WIN TR-55 to appropriately model all stormwater runoff reaching each ditch. The WIN TR-55 results are shown in Table 2, and the TR-55 hand calculations can be found in Attachment A.

Table 2. WIN TR-55 Peak Flows

	Q_2 cfs	Q_{10} cfs	Q_{25} cfs	Q_{50} cfs	Q_{100} cfs
Ditch_1	28.32	42.24	74.98	92.67	113.99
Ditch_2	41.15	63.08	114.11	141.6	176.09
Ditch_3	51.38	79.33	144.55	180.02	224.53
Ditch_4	33.75	50.32	89.11	110.14	135.62
Ditch_5	89.42	136.52	249.13	310.23	385.23
Ditch_6	101.45	156.68	291.58	365.62	457.94
Ditch_7	33.82	50.67	89.76	110.79	136.35
Ditch_8	2.54	3.99	5.33	6.6	8.14

These values were used to determine ditch depths that could capture the 25-year/24-hour flow. The velocity was kept below an erosive velocity of 5 feet per second as well. The depth was calculated using Manning's formula, where:

$$Q = \left(\frac{1.49}{n}\right) A * R^{2/3}\sqrt{S}$$

Where: Q = flow (cfs)

N = unitless Manning's roughness

A = area (ft^2)

R = hydraulic radius (ft)

S = slope (ft/ft)

See Table 3 for the depth of each ditch required to capture the 25-year/24-hour storm event with 1 foot of freeboard added. The calculations can be found in Attachment B.

Table 3. Ditch Depth, with Freeboard

Ditch_name	Depth, w/1' Freeboard:
Ditch_1	2.784
Ditch_2	3.354
Ditch_3	3.969
Ditch_4	2.845
Ditch_5	4.271
Ditch_6	5.247
Ditch_7	2.711
Ditch_8	1.500

The ditch depth, plus freeboard values from Table 3, were used as input for channel geometry in the United States Army Corps Hydraulic Engineering Center River Analysis System (HEC-RAS) to determine the extents of overtopping of the 100-year flood elevation. The results were similar between HEC-RAS 4.1.0

and WIN TR-55, only Ditch 6 had overtopping during the 100-year/24-hour storm event with the designed depth. For HEC-RAS profiles and output, see Attachment C.

Conclusion

Proposed Ditches 1 through 4, and 7 should be constructed to a depth of 4.0 feet and Ditch 8 should be constructed to a depth of 1.5 feet to capture the 25-year/24-hour storm event with a minimum of 1 foot of freeboard. Ditches 5 and 6 should be constructed to a depth of 5.25 feet to capture the 25-year/24-hour event with 1 foot of freeboard. All proposed ditches would pass the 100-year/24-hour storm event without overtopping, except for Ditch 6, which overtops during that event even with the foot of freeboard. To capture the 100-year/24-hour flow in Ditch 6, the ditch would need to be constructed to a depth of at least 5.31 feet.

Attachment A

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_1 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0038				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.63	+		=	0.63

Shallow concentrated flow		**Segment ID**	DA_2 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	600				
9.) Watercourse slope, s		*ft/ft*	0.0038				
10.) Average velocity, v (figure 3-1)		*ft/s*	1.2				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.14	+		=	0.14

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft^2*					
13.) Wetted Perimeter, P_w		*ft*					
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*					
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*					
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*		+		=	0.00

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.77

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_2 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0071				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.49	+		=	0.49

Shallow concentrated flow		**Segment ID**	DA_2 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	600				
9.) Watercourse slope, s		*ft/ft*	0.0071				
10.) Average velocity, v (figure 3-1)		*ft/s*	1.3				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.13	+		=	0.13

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft^2*					
13.) Wetted Perimeter, P_w		*ft*					
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*					
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*					
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*		+		=	0.00

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.62

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_3_upper			
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		*ft*	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12			
5.) Land Slope, s		*ft/ft*	0.0071			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.49	+	=	0.49

Shallow concentrated flow		**Segment ID**	DA_3 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		*ft*	860			
9.) Watercourse slope, s		*ft/ft*	0.0071			
10.) Average velocity, v (figure 3-1)		*ft/s*	1.3			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.18	+	=	0.18

Channel Flow		**Segment ID**				
12.) Cross sectional flow area, a		*ft²*	0			
13.) Wetted Perimeter, P_w		*ft*	0			
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0			
15.) Channel Slope, s		*ft/ft*				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0			
18.) Flow Length, L		*ft*				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.68

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_4 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0063				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.52	+		=	0.52

Shallow concentrated flow		**Segment ID**	DA_4 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	700				
9.) Watercourse slope, s		*ft/ft*	0.0063				
10.) Average velocity, v (figure 3-1)		*ft/s*	1.2				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.16	+		=	0.16

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft^2*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.68

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_5 upper			
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		*ft*	100			
4.) Two-yr 24-hr rainfall, P_2 bulletin 71		*in*	3.12			
5.) Land Slope, s		*ft/ft*	0.005			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.57	+	=	0.57

Shallow concentrated flow		**Segment ID**	DA_5 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		*ft*	400			
9.) Watercourse slope, s		*ft/ft*	0.005			
10.) Average velocity, v (figure 3-1)		*ft/s*	1.2			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.09	+	=	0.09

Channel Flow		**Segment ID**				
12.) Cross sectional flow area, a		*ft²*	0			
13.) Wetted Perimeter, P_w		*ft*	0			
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0			
15.) Channel Slope, s		*ft/ft*				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0			
18.) Flow Length, L		*ft*				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.66

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_6 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0063				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.52	+		=	0.52

Shallow concentrated flow		**Segment ID**	DA_6 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	600				
9.) Watercourse slope, s		*ft/ft*	0.0063				
10.) Average velocity, v (figure 3-1)		*ft/s*	1.2				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.14	+		=	0.14

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft²*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.66

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_7 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.033				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.27	+		=	0.27

Shallow concentrated flow		**Segment ID**	DA_7 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	480				
9.) Watercourse slope, s		*ft/ft*	0.033				
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.05	+		=	0.05

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft²*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.31

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_8 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.033				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.27	+		=	0.27

Shallow concentrated flow		**Segment ID**	DA_8 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	500				
9.) Watercourse slope, s		*ft/ft*	0.033				
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.05	+		=	0.05

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft²*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.32

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_9 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.033				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.27	+		=	0.27

Shallow concentrated flow		**Segment ID**	DA_9 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	440				
9.) Watercourse slope, s		*ft/ft*	0.033				
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.04	+		=	0.04

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft²*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.31

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_10 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.033				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.27	+		=	0.27

Shallow concentrated flow		**Segment ID**	DA_10 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	460				
9.) Watercourse slope, s		*ft/ft*	0.033				
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.05	+		=	0.05

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft²*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.31

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_11				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0083				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.46	+		=	0.46

Shallow concentrated flow		**Segment ID**					
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	120				
9.) Watercourse slope, s		*ft/ft*	0.0083				
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.01	+		=	0.01

Channel Flow		**Segment ID**					
12.) Cross sectional flow area, a		*ft^2*	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, r = a/P_w	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.47

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Peak Flow Calculation Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development — Curve number of 85 chosen - open space with C/D soils in an urban area
By: Megan Bender/MKE
Date: 3/21/2018

*note that anything below 0.10

	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_1	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.77	**400**	**26**	**1.0**	26.25	27.79
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.77	**410**	26	1.0	47.06	27.79
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.77	**410**	26	1.0	62.76	27.79
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.77	**410**	26	1.0	77.73	27.79
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.77	**410**	26	1.0	95.94	27.79
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_2	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.62	**460**	**15.88**	**1.0**	18.44	22.36
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.62	**450**	15.88	1.0	31.55	22.36
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.62	**450**	15.88	1.0	42.07	22.36
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.62	**450**	15.88	1.0	52.10	22.36
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.62	**450**	15.88	1.0	64.31	22.36
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_3	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.68	**440**	**11.92**	**1.0**	13.24	24.36
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.68	**430**	11.92	1.0	22.63	24.36
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.68	**430**	11.92	1.0	30.18	24.36
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.68	**430**	11.92	1.0	37.37	24.36
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.68	**430**	11.92	1.0	46.13	24.36
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_4	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.68	**440**	**15.03**	**1.0**	16.69	24.45
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.68	**430**	15.03	1.0	28.53	24.45
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.68	**430**	15.03	1.0	38.05	24.45
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.68	**430**	15.03	1.0	47.12	24.45
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.68	**430**	15.03	1.0	58.16	24.45
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_5	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.66	**435**	**9.9**	**1.0**	10.87	23.75
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.66	**425**	9.9	1.0	18.58	23.75
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.66	**425**	9.9	1.0	24.77	23.75
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.66	**425**	9.9	1.0	30.68	23.75
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.66	**425**	9.9	1.0	37.87	23.75
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_6	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.66	**435**	**17.81**	**1.0**	19.56	23.61
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.66	**425**	17.81	1.0	33.42	23.61
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.66	**425**	17.81	1.0	44.56	23.61
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.66	**425**	17.81	1.0	55.19	23.61

	100	**7.65**	84	1.90	0.38	5.76	0.05	0.66	**425**	17.81	1.0	68.12	23.61
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_7	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.31	**660**	**23.14**	**1.0**	38.55	11.31
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.31	**650**	23.14	1.0	66.41	11.31
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.31	**650**	23.14	1.0	88.55	11.31
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.31	**650**	23.14	1.0	109.67	11.31
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.31	**650**	23.14	1.0	135.36	11.31
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_8	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.32	**660**	**10.35**	**1.0**	17.24	11.38
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.32	**650**	10.35	1.0	29.70	11.38
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.32	**650**	10.35	1.0	39.61	11.38
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.32	**650**	10.35	1.0	49.05	11.38
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.32	**650**	10.35	1.0	60.55	11.38
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_9	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.31	**660**	**4.28**	**1.0**	7.13	11.17
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.31	**650**	4.28	1.0	12.28	11.17
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.31	**650**	4.28	1.0	16.38	11.17
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.31	**650**	4.28	1.0	20.28	11.17
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.31	**650**	4.28	1.0	25.04	11.17
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_10	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.31	**660**	**8.4**	**1.0**	13.99	11.24
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.31	**650**	8.4	1.0	24.11	11.24
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.31	**650**	8.4	1.0	32.14	11.24
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.31	**650**	8.4	1.0	39.81	11.24
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.31	**650**	8.4	1.0	49.14	11.24
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_11	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.47	**530**	**2.01**	**1.0**	2.69	17.10
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.47	**510**	2.01	1.0	4.53	17.10
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.47	**510**	2.01	1.0	6.04	17.10
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.47	**510**	2.01	1.0	7.47	17.10
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.47	**510**	2.01	1.0	9.23	17.10

Attachment B

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_2

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00167
Manning's n:	0.040
Depth (ft.):	2.354
Area:	51.93
W.P.:	29.89
Flow (cfs):	114.15
Velocity (ft./sec.):	2.20
Top Width (ft.):	29.12
Hydraulic Depth (ft.):	1.78
Froude Number:	0.29
Conjugate Depth (ft.):	0.35
Shear Stress (lb/ft^2):	0.24

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	114.11	depth to ca	2.354
Q100:	176.09	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_3

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00111
Manning's n:	0.040
Depth (ft.):	2.97
Area:	70.98
W.P.:	33.78
Flow (cfs):	144.59
Velocity (ft./sec.):	2.04
Top Width (ft.):	32.81
Hydraulic Depth (ft.):	2.16
Froude Number:	0.24
Conjugate Depth (ft.):	0.32
Shear Stress (lb/ft^2):	0.21

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	144.55	depth to ca	2.97
Q100:	224.53	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_4

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00250
Manning's n:	0.040
Depth (ft.):	1.85
Area:	37.89
W.P.:	26.67
Flow (cfs):	89.18
Velocity (ft./sec.):	2.35
Top Width (ft.):	26.07
Hydraulic Depth (ft.):	1.45
Froude Number:	0.34
Conjugate Depth (ft.):	0.36
Shear Stress (lb/ft^2):	0.29

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	89.11	depth to ca	1.85
Q100:	135.62	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_5

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00227
Manning's n:	0.040
Depth (ft.):	3.27
Area:	81.16
W.P.:	35.69
Flow (cfs):	249.26
Velocity (ft./sec.):	3.07
Top Width (ft.):	34.63
Hydraulic Depth (ft.):	2.34
Froude Number:	0.35
Conjugate Depth (ft.):	0.68
Shear Stress (lb/ft^2):	0.46

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	249.13	depth to ca	3.27
Q100:	385.23	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_6

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00111
Manning's n:	0.040
Depth (ft.):	4.247
Area:	117.82
W.P.:	41.86
Flow (cfs):	291.62
Velocity (ft./sec.):	2.48
Top Width (ft.):	40.48
Hydraulic Depth (ft.):	2.91
Froude Number:	0.26
Conjugate Depth (ft.):	0.50
Shear Stress (lb/ft^2):	0.29

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	291.58	depth to ca	4.247
Q100:	457.94	with freeb	NO

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_7

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00333
Manning's n:	0.040
Depth (ft.):	1.71
Area:	34.45
W.P.:	25.82
Flow (cfs):	89.78
Velocity (ft./sec.):	2.61
Top Width (ft.):	25.27
Hydraulic Depth (ft.):	1.36
Froude Number:	0.39
Conjugate Depth (ft.):	0.42
Shear Stress (lb/ft^2):	0.36

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	89.76	depth to ca	1.71
Q100:	136.35	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area Ditch_8

Ideal Conditions

z1:	3
z2:	3
b:	15
Slope (ft./ft.):	0.00110
Manning's n:	0.040
Depth (ft.):	0.5
Area:	8.25
W.P.:	18.16
Flow (cfs):	6.02
Velocity (ft./sec.):	0.73
Top Width (ft.):	18.00
Hydraulic Depth (ft.):	0.46
Froude Number:	0.19
Conjugate Depth (ft.):	0.03
Shear Stress (lb/ft^2):	0.03

z1 = ditch side slope 1
z2 = ditch side slope 2
b = bottom width
Slope = slope along flow line of ditch
Manning's n = Manning's roughness factor
Depth = depth of flow in the ditch
Area = cross-sectional area of flow in ditch
W.P. = wetted perimeter of ditch
Flow = flow through ditch using Manning's equation
Velocity = velocity of flow in the ditch
Top Width = top width water flowing in ditch
Hydraulic Depth = defined as Area/Top width
Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Shear Stress = (62.4)*depth*slope

Q25	5.33	depth to ca	0.5
Q100:	8.14	with freeb	YES

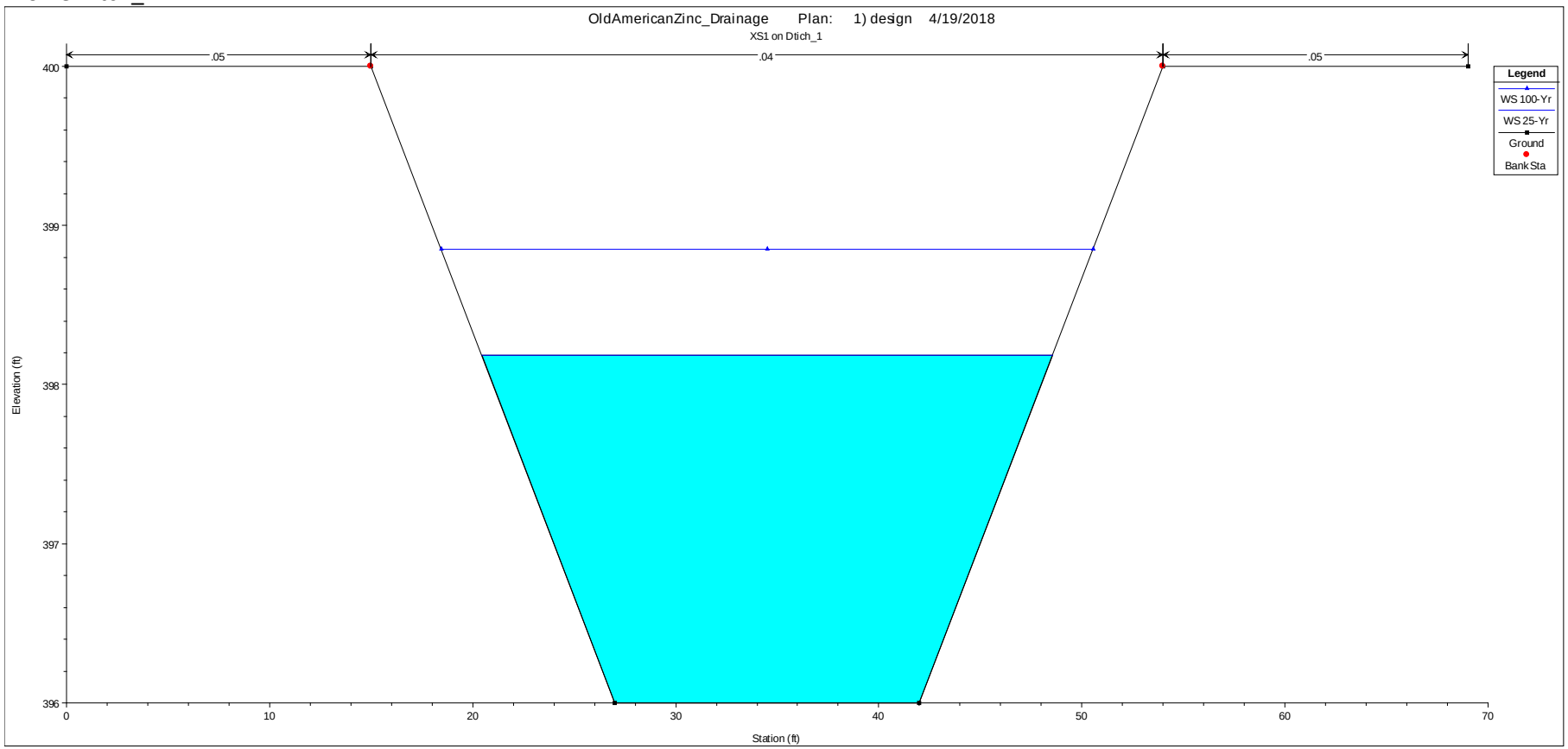
Attachment C

Reach	River Sta	Profile	Q Total (cfs)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Chl Dpth (ft)	Vel Chnl (ft/s)
Ditch_1	6600	25-Yr	74.98	36.39	25.72	0.31	1.79	2.06
Ditch_1	6600	100-Yr	113.99	48.83	28.48	0.31	2.25	2.33
Ditch_1	6100	25-Yr	74.98	36.33	25.71	0.31	1.78	2.06
Ditch_1	6100	100-Yr	113.99	49.12	28.54	0.31	2.26	2.32
Ditch_1	5600	25-Yr	74.98	37.22	25.92	0.3	1.82	2.01
Ditch_1	5600	100-Yr	113.99	52.81	29.3	0.28	2.38	2.16
Ditch_1	5100	25-Yr	74.98	47.1	28.11	0.22	2.19	1.59
Ditch_1	5100	100-Yr	113.99	67.1	32.1	0.21	2.85	1.7
Ditch_2	4620	25-Yr	114.11	54.46	29.64	0.27	2.44	2.1
Ditch_2	4620	100-Yr	179.06	77.18	33.93	0.27	3.15	2.32
Ditch_2	4280	25-Yr	114.11	57.98	30.34	0.25	2.56	1.97
Ditch_2	4280	100-Yr	179.06	82.5	34.86	0.25	3.31	2.17
Ditch_2	4040	25-Yr	114.11	62.29	31.18	0.23	2.7	1.83
Ditch_2	4040	100-Yr	179.06	88.16	35.82	0.23	3.47	2.03
Ditch_3	3800	25-Yr	144.55	67.9	32.25	0.26	2.87	2.13
Ditch_3	3800	100-Yr	224.53	95	36.95	0.26	3.66	2.36
Ditch_3	3480	25-Yr	144.55	65.2	31.74	0.27	2.79	2.22
Ditch_3	3480	100-Yr	224.53	93.33	36.67	0.27	3.61	2.41
Ditch_3	3060	25-Yr	144.55	57.09	30.17	0.32	2.53	2.53
Ditch_3	3060	100-Yr	224.53	89.9	36.11	0.28	3.52	2.5
Ditch_5	2700	25-Yr	249.13	108.11	39.02	0.24	4	2.3
Ditch_5	2700	100-Yr	385.23	152.23	45.3	0.24	5.05	2.53
Ditch_6	2420	25-Yr	291.58	117.96	40.5	0.26	4.25	2.47
Ditch_6	2420	100-Yr	457.94	164.87	76.5	0.26	5.3	2.8
Ditch_6	2000	25-Yr	291.58	118.02	40.51	0.26	4.25	2.47
Ditch_6	2000	100-Yr	457.94	165.01	76.5	0.26	5.3	2.8
Ditch_6	1500	25-Yr	291.58	118.24	40.55	0.25	4.26	2.47
Ditch_6	1500	100-Yr	457.94	165.5	76.5	0.26	5.3	2.79
Ditch_6	1000	25-Yr	291.58	118.17	40.53	0.25	4.26	2.47
Ditch_6	1000	100-Yr	457.94	165.29	76.5	0.26	5.3	2.79

Reach	River Sta	Profile	Q Total (cfs)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Chl Dpth (ft)	Vel Chnl (ft/s)
Ditch_6	500	25-Yr	291.58	118.43	40.58	0.25	4.26	2.46
Ditch_6	500	100-Yr	457.94	165.87	76.5	0.26	5.31	2.79
Ditch_7	2580	25-Yr	89.76	34.47	25.27	0.39	1.71	2.6
Ditch_7	2580	100-Yr	136.35	46.07	27.89	0.41	2.15	2.96
Ditch_7	2080	25-Yr	89.76	34.57	25.3	0.39	1.72	2.6
Ditch_7	2080	100-Yr	136.35	46.21	27.93	0.4	2.16	2.95
Ditch_7	1780	25-Yr	89.76	34.45	25.27	0.39	1.71	2.61
Ditch_7	1780	100-Yr	136.35	46.19	27.92	0.4	2.15	2.95
Ditch_7	1480	25-Yr	89.76	34.56	25.3	0.39	1.72	2.6
Ditch_7	1480	100-Yr	136.35	46.22	27.93	0.4	2.16	2.95
Ditch_7	980	25-Yr	89.76	34.45	25.26	0.39	1.71	2.61
Ditch_7	980	100-Yr	136.35	46.26	27.93	0.4	2.16	2.95
Ditch_7	480	25-Yr	89.76	34.63	25.31	0.39	1.72	2.59
Ditch_7	480	100-Yr	136.35	46.34	27.95	0.4	2.16	2.94
Ditch_4	1360	25-Yr	89.11	37.94	26.08	0.34	1.85	2.35
Ditch_4	1360	100-Yr	135.62	50.93	28.91	0.35	2.32	2.66
Ditch_4	1020	25-Yr	89.11	37.93	26.08	0.34	1.85	2.35
Ditch_4	1020	100-Yr	135.62	50.92	28.91	0.35	2.32	2.66
Ditch_4	620	25-Yr	89.11	37.95	26.08	0.34	1.85	2.35
Ditch_4	620	100-Yr	135.62	50.93	28.91	0.35	2.32	2.66
Ditch_4	200	25-Yr	89.11	37.93	26.08	0.34	1.85	2.35
Ditch_4	200	100-Yr	135.62	50.92	28.91	0.35	2.32	2.66
Ditch_8	700	25-Yr	5.33	7.69	17.81	0.19	0.47	0.69
Ditch_8	700	100-Yr	8.14	9.99	18.57	0.2	0.6	0.81
Ditch_8	200	25-Yr	5.33	7.64	17.8	0.19	0.47	0.7
Ditch_8	200	100-Yr	8.14	10.03	18.58	0.19	0.6	0.81

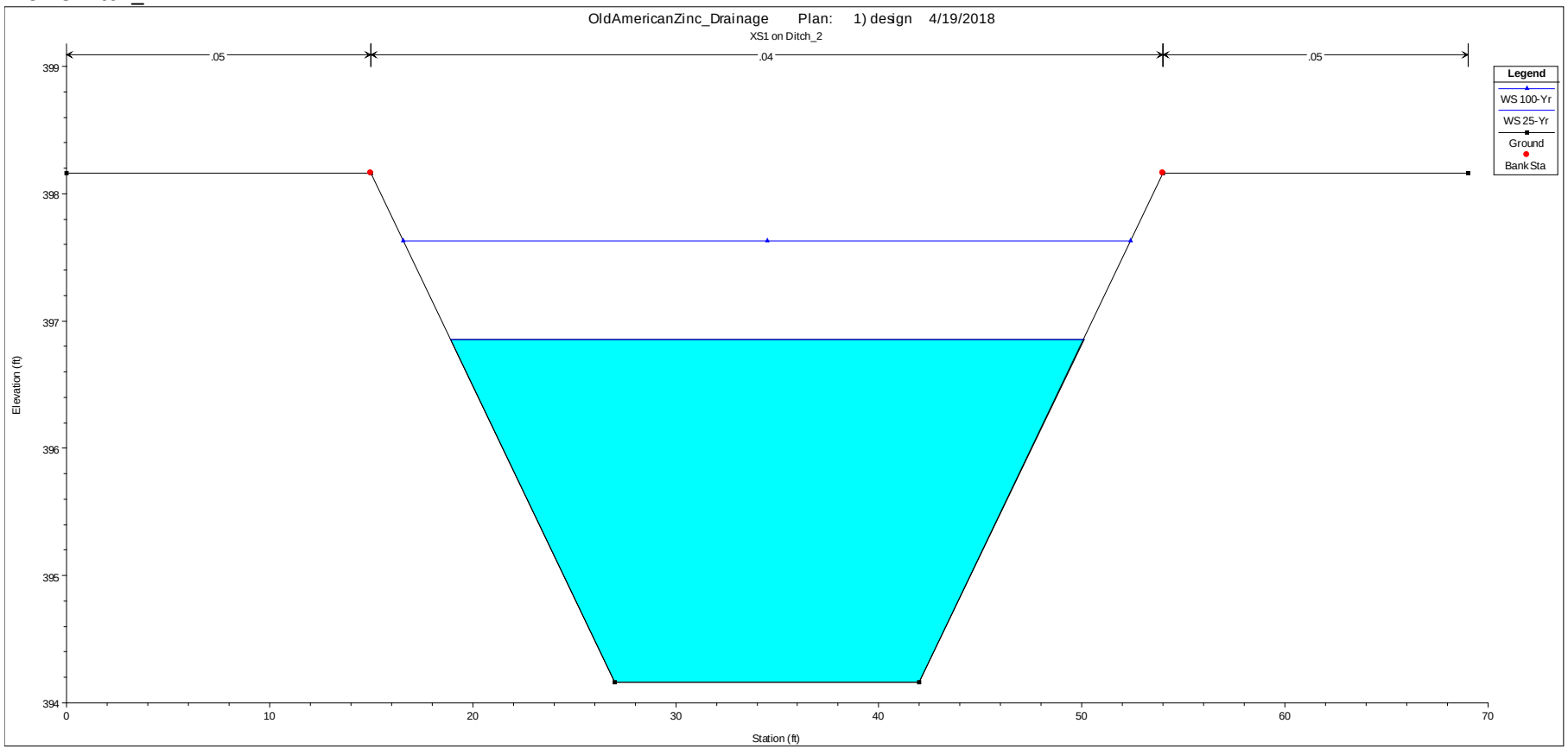
HEC-RAS Geometry Overview

Profile Ditch_1



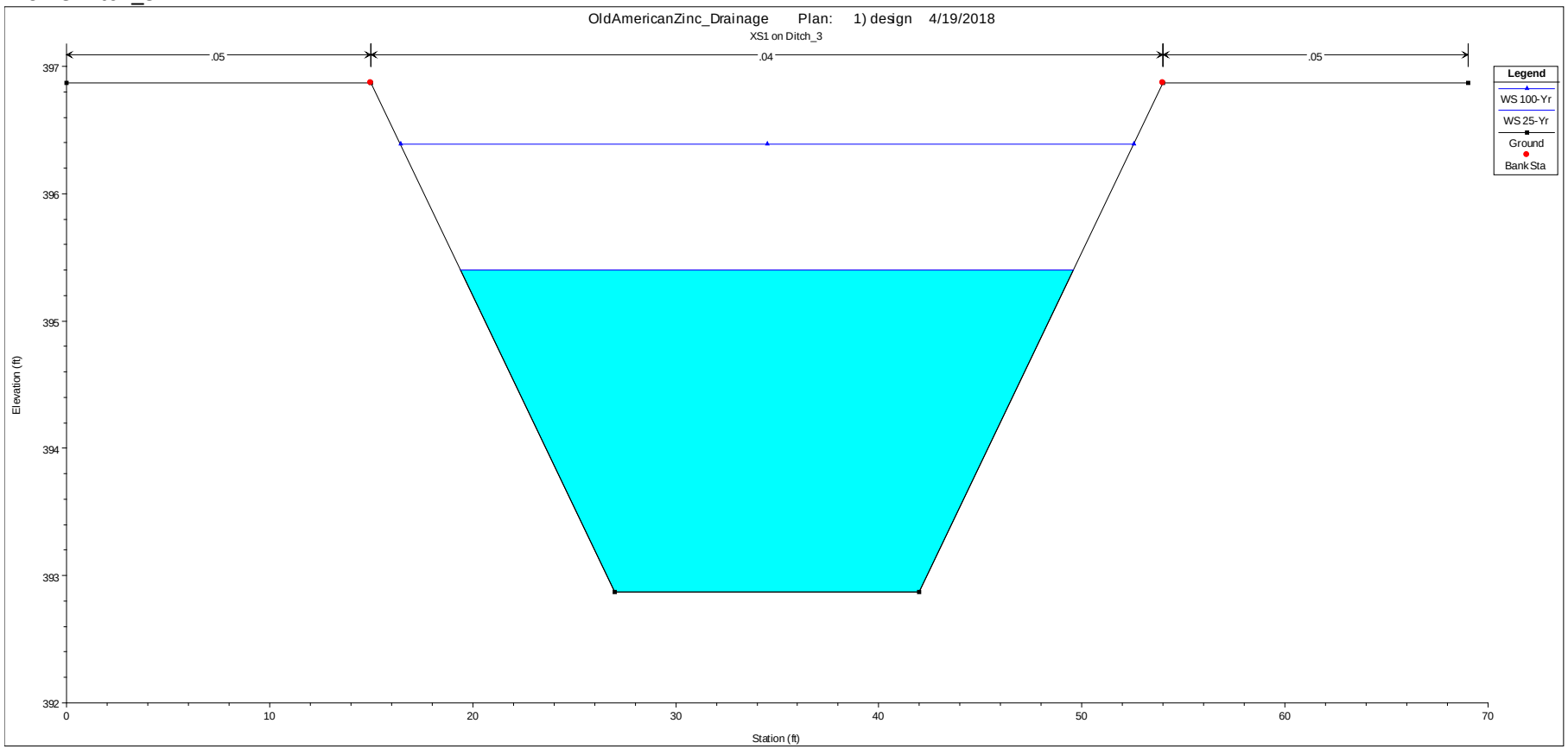
Note: elevations on y-axis are not real

Profile Ditch_2



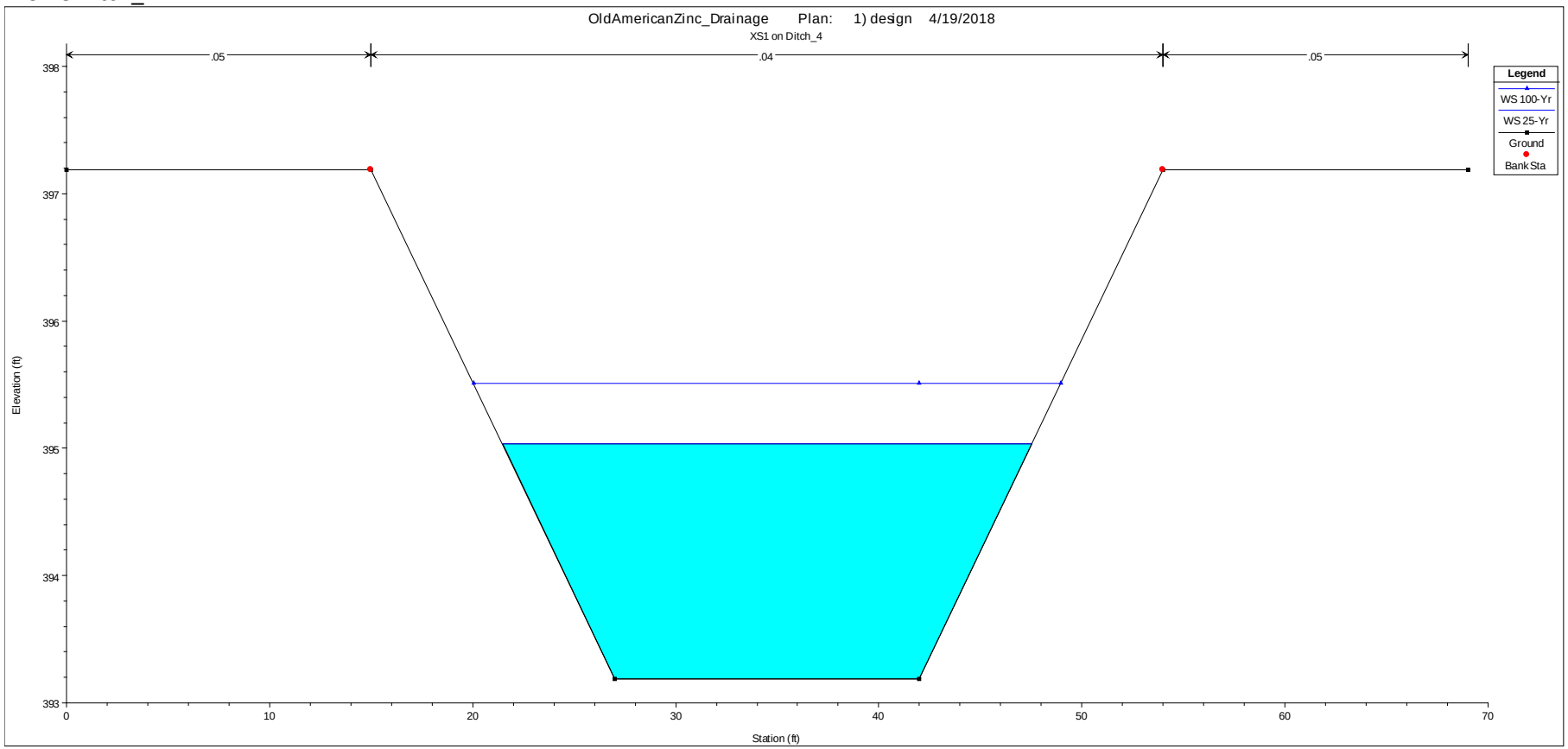
Note: elevations on y-axis are not real

Profile Ditch_3



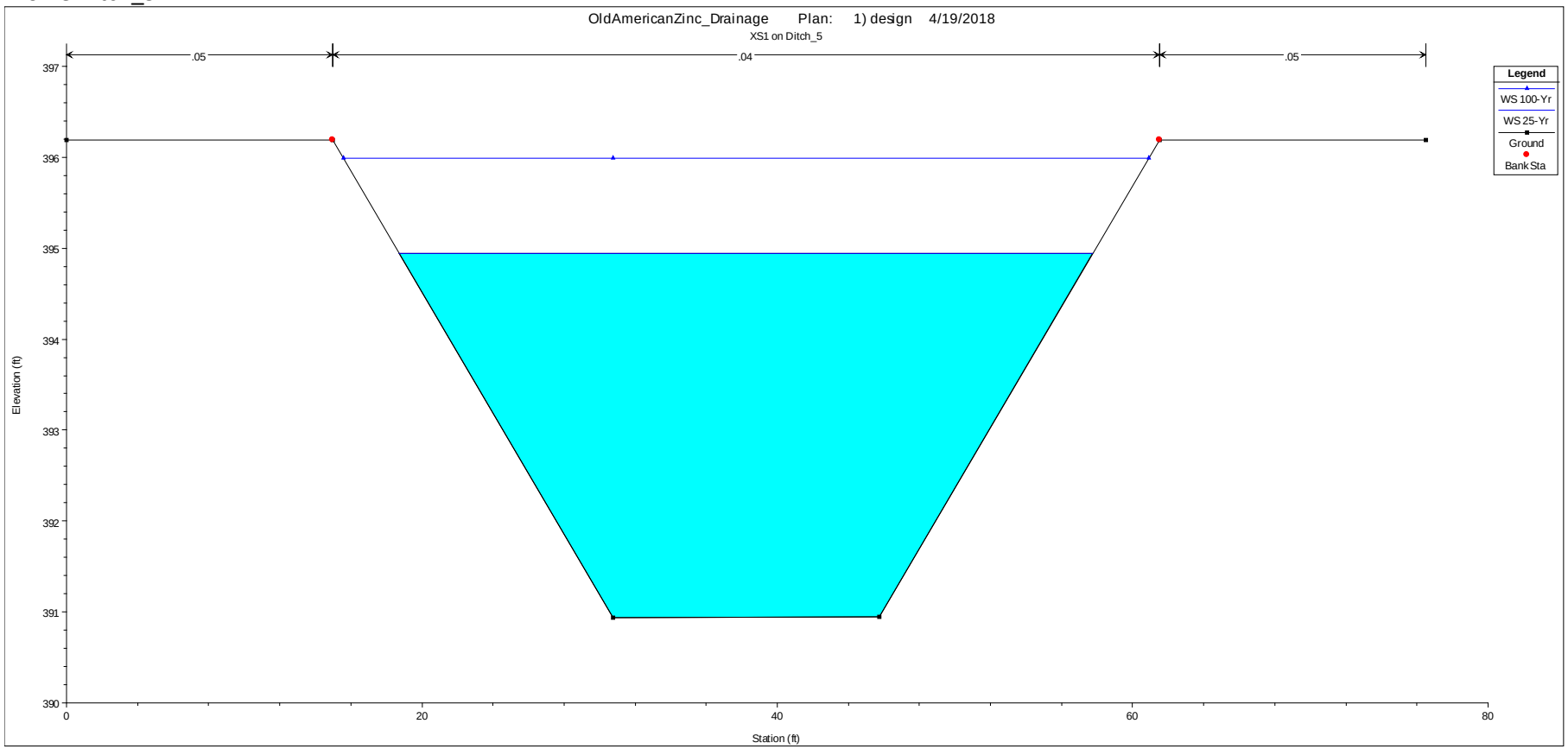
Note: elevations on y-axis are not real

Profile Ditch_4



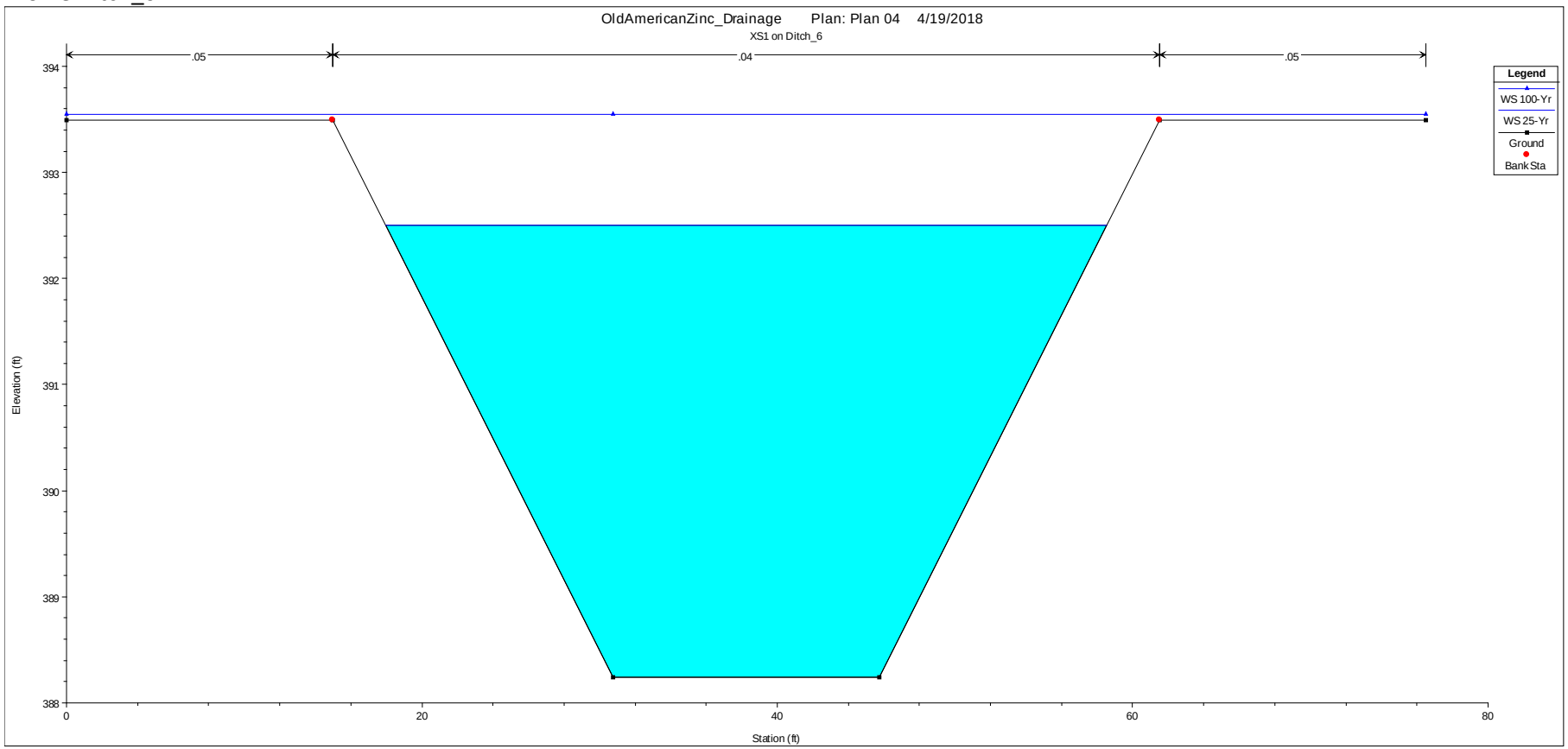
Note: elevations on y-axis are not real

Profile Ditch_5



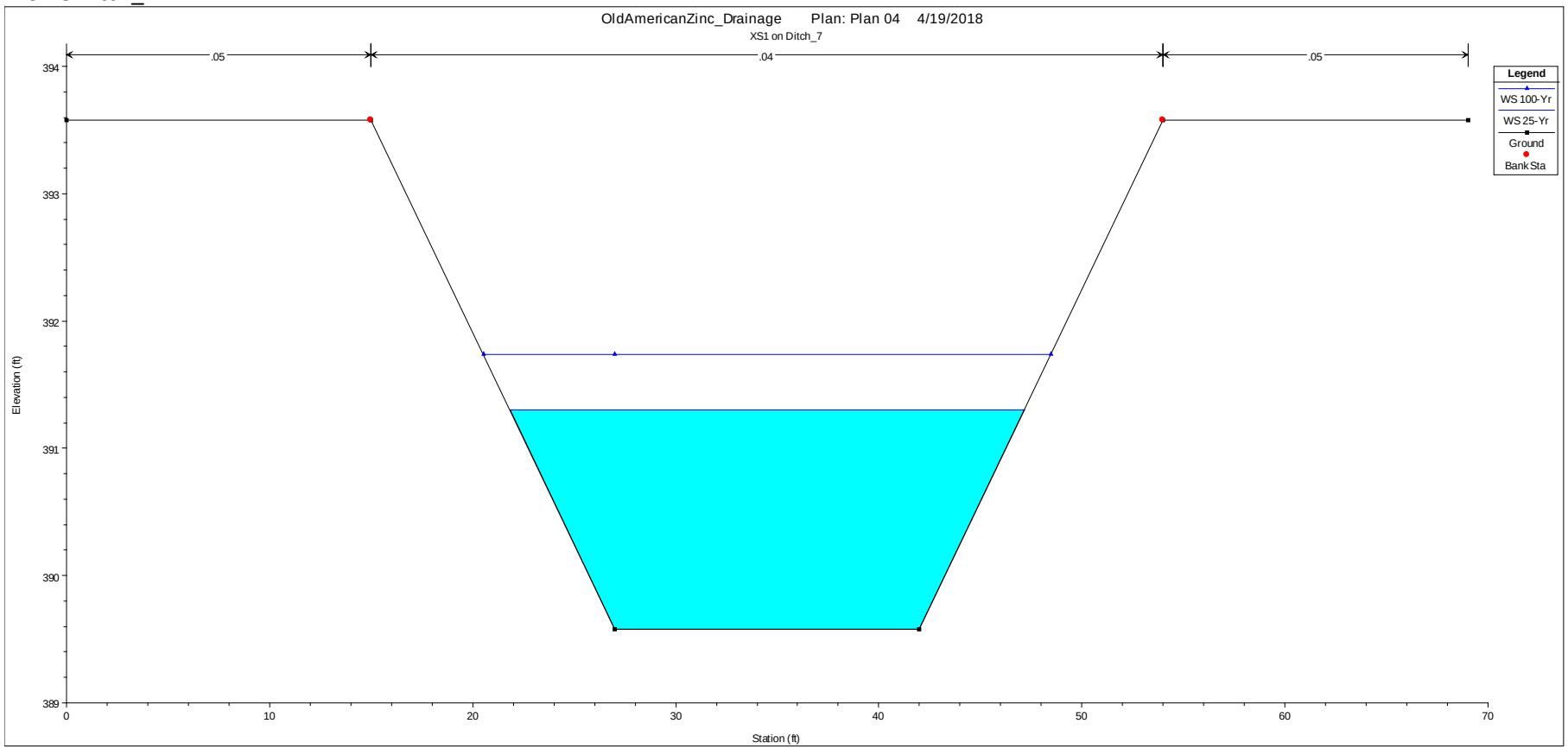
Note: elevations on y-axis are not real

Profile Ditch_6



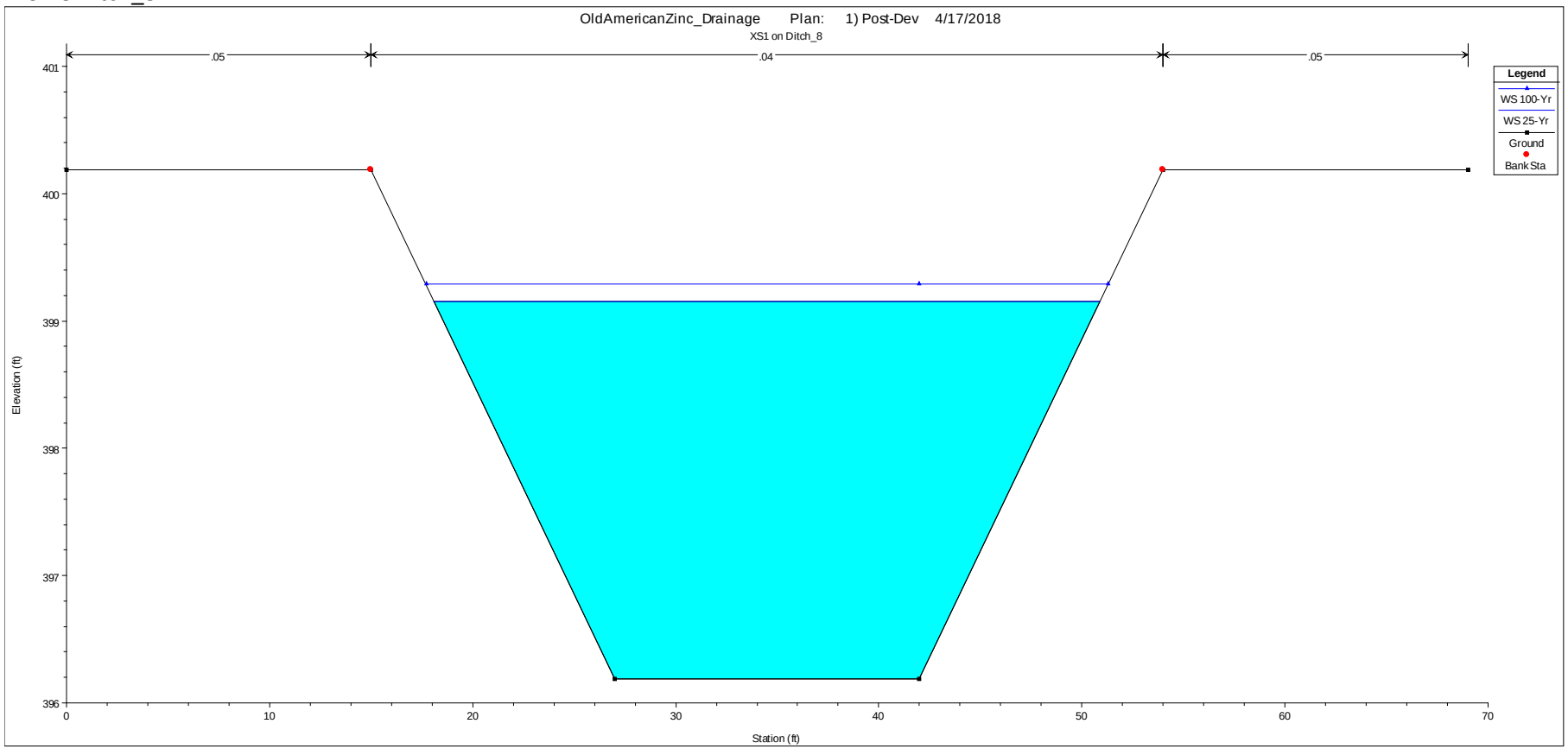
Note: elevations on y-axis are not real

Profile Ditch_7



Note: elevations on y-axis are not real

Profile Ditch_8



Note: elevations on y-axis are not real

Appendix C
Facility Area Remedial Design Specifications

Final Design for

U.S. Environmental Protection Agency
Fairmount City
St. Clair County, Illinois

Old American Zinc Plant Superfund Site
Facility Design

Specifications

Project Number 687729

February 2019

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END OF SECTION

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SPECIFICATIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUBMITTALS

A. Action Submittals:

1. Operations Plan:
   a. Submit an Operations Plan for approval that includes, but is not limited to:
      1) Description and list of operations that will be performed in connection with work to be performed at the site.
      2) Description of equipment and crew that will be used.
      3) Sequence of work.
      4) Means and methods for construction.
      5) Sources of imported materials.
      6) Stormwater Pollution Prevention Plan, which will include a soil erosion and sedimentation control plan.
      7) Excavation Plan, Detailing:
         a) Utility Clearance.
         b) Methods and sequencing of excavation.
         c) Numbers, types, and sizes of equipment proposed to perform excavations.
         d) Anticipated difficulties and proposed resolutions.
      8) Dewatering Plan.
      9) Restoration Plan if required by Section 02 24 00, Delineation of Wetlands and Other Waters of the United States.
      10) Performance Standard Verification Plan.
      11) Field Sampling Plan.
2. Health and Safety Plan.
3. Quality Control Plan.
4. Environmental Protection Plan.
5. Quality Assurance Project Plan (QAPP): The QAPP must be developed in accordance with EPA Requirements for Quality Assurance Project Plans, QA/R-5, EPA/240/B-01/003 (March 2001, reissued May 2006); Guidance for Quality Assurance Project Plans., QA/G-5, EPA/240/R 02/009 (December 2002); and Uniform Federal Policy for Quality Assurance Project Plans, Parts 1 3, EPA/505/B-04/900A though 900C (March 2005).
6. Waste/Hazardous Waste Management Plan.

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7. After completion of RA:
    a. Surface Water Monitoring and Groundwater Monitoring Plan.
    b. Updated Long Term Maintenance Plan.
    c. Updated Institutional Controls and Implementation Plan.
    d. Project Completion Report/Closure Report.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Facility Area Remedial Action:

1. Mobilization.
2. Surveying to document existing site conditions.
3. Performance of a wetland delineation in accordance with USACE protocols as described in Section 02 24 00, Delineation of Wetlands and other Waters of the United States.
4. Installation of new erosion/runoff control measures.
5. Clear and Grub site. Implement conservation measures for endangered species and migratory bird protocols per Section 31 10 00, Site Clearing if clearing and grubbing occurs between April 1 and September 30.
6. General clearing required to construct the site improvements as shown in the Drawings.
7. Installation of Contractor staging areas and coordination of staging area location(s) with other Contractors.
8. Implement the Unanticipated Discovery Plan (UDP) where indicated by Owner and as described in Section 31 23 16, Excavation.
9. Dewatering Plan.
10. Excavate slag from the Consolidation Area and clay stockpile areas as shown in the Drawings.
11. Excavate sediment from ditches as shown in the Drawings.
12. Excavate clay from the Consolidation Area.
    a. Stockpile suitable clay for the Consolidation Area in the eastern portion of the site as shown in the Drawings.
    b. Stockpile other excavated soil for general site fill in the northern portion of the site as shown in the Drawings.
13. Place stockpiled slag, excavated sediment from ditches, and excavated material from off-site residential properties consisting of soil potentially mixed with slag from northwestern portion of site into the Consolidation Area.
14. Excavate slag from the remainder of the Facility Area site and place into Consolidation Area.
15. Place 2-foot thick clay cover over Consolidation Area.
16. Fill site to design grades using stockpiled soil for general site fill.

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17. Place half-a-foot (6 inches) of topsoil over the site except on the Consolidation Area. Place one-foot (12 inches) of topsoil over the Consolidation Area.
18. Install seed, mulch, and erosion control for the entire site.
19. Restore wetland areas and other waters of the United States, if required based on input from EPA, USACE and other regulatory agencies based on the results of the wetlands and other waters delineation that Contractor performs per Section 02 24 00, Delineation of Wetlands and Other Waters of the United States.
20. Surveying to document remediated site conditions.
21. Demobilization.

1.03 WORK NOT COVERED BY CONTRACT DOCUMENTS

A. Remedial work performed at adjacent residential properties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on form approved by Owner's Representative .
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 CASH ALLOWANCES

A. Consult with Engineer in selection of products or services. Obtain proposals from Suppliers and installers, and offer recommendations.

B. Cash allowances will be administered in accordance with paragraph 13.02 of General Conditions.

C. Submit, with application for payment, invoice showing date of purchase, from whom the purchase was made, the date of delivery of the product or service, and the price, including delivery to the Site and applicable taxes.

1.03 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. Reflect specified cash and contingency allowances and alternates, as applicable.

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2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
   b. Include item(s) for monthly progress schedule update and maintenance of Engineer's trailer.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

G. Submit Schedule of Values on a CD in a spreadsheet format compatible with latest version of MS Excel.

1.04 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.05 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form suitable to Engineer.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

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F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.06 MEASUREMENT—GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.

E. Haul materials that are specified for measurement by the cubic yard measured in the vehicle in transport vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Load vehicles to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.

G. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

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H. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.07 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install the following items.

1.08 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

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1.09 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.10 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:

1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
4. Authorization has been provided for access to storage Site for Engineer and Owner.
5. Equipment meets applicable Specifications of these Contract Documents.

B. Payment of 15 percent of manufacturer’s quoted price for undelivered, Project-specific manufactured equipment will be made following Shop Drawing approval. Thereafter, monthly payments will be made based on progress of fabrication as determined by Engineer, but in no case will total of payments prior to delivery exceed 75 percent of manufacturer’s quoted price.

C. Failure of Contractor to continue compliance with above requirements shall give cause for Owner to withhold payments made for such equipment from future partial payments.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or civil engineer.
2. Statement of Qualification (SOQ) for professional photographer and videographer.
3. Statement of Qualification (SOQ) for wetland delineation specialist.
4. Photographs:
   a. Digital Images: Submit one copy of a DVD disc containing images within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.
5. Video Recordings: Submit one copy, including updated copy of project video log, within 5 days of being taken.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

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1.04 PROJECT MILESTONES

A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.

1.05 FACILITY OPERATIONS

A. Operations on site are no longer active.

1.06 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the construction contract and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
3. Excavation will occur on the north side of Maryland Avenue which may result in the road becoming damaged. The contractor shall take precautions to minimize damage to roadway, and any damage incurred shall be repaired at no cost to the Owner or government.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs and Article Audio-Video Recordings.
2. Upon receipt, Engineer will review, sign, and return one record copy of documentation to Contractor to be kept on file in field office.
3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor’s operations, and is for the protection of adjacent property owners, Contractor, and Owner.

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1.07 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Photography shall be by a professional commercial photographer, experienced in shooting exterior construction photos, in daylight and nighttime conditions, and in good and inclement weather.
3. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
4. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.
3. Format: Digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.
2. Weekly: Take 48 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.
3. Monthly: Take 50 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
   c. Label each disk with Project and Owner’s name, and month and year images were produced.

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1.08 AUDIO-VIDEO RECORDINGS

A. Prior to beginning the Work on Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, video-graph Site and property adjacent to Site.

B. In the case of preconstruction recording, no work shall begin in the area prior to Engineer's review and approval of content and quality of video for that area.

C. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.

D. Video recording shall be by a professional commercial videographer, experienced in shooting exterior construction videos, in both good and inclement weather.

E. Video Format and Quality:

1. DVD format, with sound.
2. Video:
   a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.
   b. Electronically, and accurately display the month, day, year, and time of day of the recording.
3. Audio:
   a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
   b. Indicate date, project name, and a brief description of the location of recording, including:
      1) Facility name.
      2) Street names or easements.
      3) Addresses of private property.
      4) Direction of coverage, including engineering stationing, if applicable.

F. Documentation:

1. DVD Label:
   a. DVD number (numbered sequentially, beginning with 001).
   b. Project name.
   c. Name of street(s) or easement(s) included.
   d. Applicable location by engineering stationing.
   e. Date and time of coverage.

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2. Project Video Log: Maintain an ongoing log that incorporates above noted label information for DVDs on Project.

1.09 REFERENCE POINTS AND SURVEYS

A. Contractor's Responsibilities:

1. Establish bench marks convenient to Work and at least every 500 feet on pipelines and roads.
2. Establish horizontal reference points or coordinate system with bench marks and reference points as necessary to lay out Work.
3. Provide additional survey and layout required to layout the Work.
4. Notify Engineer at least 3 working days in advance of time when grade and line to be provided by Owner will be needed.
5. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
6. Retain professional land surveyor or civil engineer registered in state of Illinois who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
7. Maintain complete accurate log of survey work as it progresses as a Record Document.
8. On request of Engineer, submit documentation.
9. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
   a. Establish control points, lines, and easement boundaries.
   b. Check layout, survey, and measurement work performed by others.
   c. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Contractor shall schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor’s safety plan and representative.
9. Private utilities on site.

B. Attendees will include:

1. Owner’s representatives.
2. Contractor’s office representative.
3. Contractor’s resident superintendent.
4. Contractor’s quality control representative.
5. Subcontractors’ representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer’s representatives.
7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

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1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 QUALITY CONTROL MEETINGS

A. Scheduled by Engineer on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.

B. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and Suppliers, as necessary.
4. Engineer's representatives.

1.06 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 4 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

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1.07 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Detailed Progress Schedule:
   a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
   b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
   a. Contractor's certification that Progress Schedule submission is actual schedule being used for execution of the Work.
   b. Electronic file compatible with latest version of Project Planner (P6) by Primavera Systems, Inc., unless otherwise approved by Engineer.
   c. Progress Schedule: Four legible copies.
   d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
   e. Progress Quantity Chart(s).
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits or substantive requirements compliance.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Earthwork.
7. Specified Work sequences and construction constraints.

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8. Contract Milestone and Completion Dates.
9. Owner-furnished products delivery dates or ranges of dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—CRITICAL PATH NETWORK

A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.

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B. Contents:

1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
5. Reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project Milestones set forth in the Agreement and Section 01 31 13, Project Coordination.
6. Include as applicable, at a minimum:
   a. Obtaining permits, or permit-equivalent approvals where required, submittals for early product procurement, and long lead time items.
   b. Mobilization and other preliminary activities.
   c. Initial Site work.
   d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s) Subcontract Work.
   e. Sitework.
   f. Project closeout and cleanup.
   g. Demobilization.
7. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day nor more than 14 days, unless otherwise approved.
8. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Engineer.

C. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 22 inches by 34 inches, unless otherwise approved.
2. Title Block: Show name of Project, Owner, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across top of schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.

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7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by Engineer.
9. Provide a legend to describe standard and special symbols used.

D. Schedule Report:

1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including at a minimum:
   a. Activity Identification Number.
   b. Activity Description.
   c. Original Duration.
   d. Remaining Duration.
   e. Early Start Date (Actual start on Updated Progress Schedules).
   f. Early Finish Date (Actual finish on Updated Progress Schedules).
   g. Late Start Date.
   h. Late Finish Date.
   i. Total Float.
3. Sort reports, in ascending order: Activity number sequence with predecessor and successor activity.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed sub-schedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

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C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor’s plan for management of Site (for example, lay down and staging areas, construction traffic), use of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

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1.07 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Access restrictions are accurately reflected.
   d. Startup and testing times are as specified.
   e. Submittal review times are as specified.
   f. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

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1.08 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Deferred Submittal: Information, in accordance with 2009 IBC Section 107.3.4.2, submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

A. Direct submittals to the Owner's Representative at the address, which will be determined and provided during the Preconstruction Conference, unless specified otherwise.

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.
5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.

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7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Engineer will reject submittal that is not electronically submitted, unless specifically accepted.
9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by Engineer.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title and Engineer's project number.
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

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D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on Engineer's receipt of submittal.
2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.
   c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Engineer will keep one copy and return submittal to Contractor.

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1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Copies: Six, and one reproducible, except copyrighted documents.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Deferred Submittal: See Drawings for list of deferred submittals.
   a. Contractor-design drawings and product data related to permanent construction.
      1) Written and graphic information.
      2) Drawings.
      3) Cut sheets.
      4) Data sheets.
      5) Action item submittals requested in individual specification section.
   b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
6. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

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C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.
2. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
   a. Manufacturer name.
   b. Model number.
   c. Material.
   d. Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
   a. Size as indicated in individual specification section.
   b. Prepared from same materials to be used for the Work.
   c. Cured and finished in manner specified.
   d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
   a. Contractor may incorporate product(s) or implement Work covered by submittal.
   b. Distribution: Electronic.
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
2. Approved as Noted:
   a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   b. Distribution: Electronic.
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
3. Partial Approval, Resubmit as Noted:
   a. Make corrections or obtain missing portions, and resubmit.
   b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   c. Distribution: Electronic.
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.

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d. Revise and Resubmit:
e. Contractor may not incorporate product(s) or implement Work covered by submittal.
f. Distribution: Electronic.
   1) One copy furnished Resident Project Representative.
   2) One copy retained in Engineer's file.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Submit three copies, unless otherwise indicated in individual specification section.
2. Refer to individual specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

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C. Construction Photographs and Video in accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual specification section.

F. Deferred Submittals: See Drawings for list of deferred submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions.
   b. List of performance and design criteria.
   c. Summary of loads or load diagram, if applicable.
   d. Calculations.
   e. List of applicable codes and regulations.
   f. Name and version of design software.
   g. Factory test results.
   h. Informational submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

G. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.

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H. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

I. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

J. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

K. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

M. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

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N. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   e. Provide interpretation of test results, when requested by Engineer.
   f. Other items as identified in individual specification sections.
3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.
      3) Record of temperature and weather conditions.
      4) Identification of product and specification section.
      5) Type and location of test, Sample, or inspection, including referenced standard or code.
      6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      8) Provide interpretation of test results, when requested by Engineer.
      9) Other items as identified in individual specification sections.

1.05 SUPPLEMENTS

A. The supplements listed below, following “End of Section”, are part of this specification.

1. Forms: Transmittal of Contractor’s Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
(ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: _____	Submittal No.: _____
_____	☐ New Submittal ☐ Resubmittal
_____	Project: _____
_____	Project No.: _____
_____	Specification Section No.: _____ **(Cover only one section with each transmittal)**
FROM: _____ Contractor	Schedule Date of Submittal: _____
_____	
_____	
_____	

SUBMITTAL TYPE:	☐ Shop Drawing	☐ Sample	☐ Informational
	☐ Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

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SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures;
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
3. Constitute or imply acceptance; or
4. Affect the continuing rights of Owner after acceptance of the completed Work.

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C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Engineer.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

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3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may not perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

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3.04 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
   a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
   b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
   c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
   d. Perform prior to beginning Work on each definable feature of Work:
      1) Review applicable Contract Specifications.
      2) Review applicable Contract Drawings.
      3) Verify that all materials and/or equipment have been tested, submitted, and approved.
      4) Verify that provisions have been made to provide required control inspection and testing.
      5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
      6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
      7) Review the appropriate activity hazard analysis to verify safety requirements are met.
      8) Review procedures for constructing the Work, including repetitive deficiencies.
      9) Document construction tolerances and workmanship standards for that phase of the Work.
      10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.
2. Initial Phase:
   a. Accomplish at the beginning of a definable feature of Work:
      1) Notify Owner at least 48 hours in advance of beginning the initial phase.

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2) Perform prior to beginning Work on each definable feature of Work:
   a) Review minutes of the preparatory meeting.
   b) Check preliminary Work to verify compliance with Contract requirements.
   c) Verify required control inspection and testing.
   d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
   e) Resolve all differences.
   f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3. Follow-up Phase:
   a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
   b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
   c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

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3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
   a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
   b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
   c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
   d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
   e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

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