Administrative Order on Consent IM Implementation Work Plan

El Paso Merchant Energy – Petroleum Company

Elementis Chromium LP Site Corpus Christi, TX

January 15, 2008

Meeting Agenda

- Introductions
- Goals and Objectives for the Meeting
- Background
- Major Activities Since Last Meeting
- Status of 5 Second Water Bearing Zone Wells
- Proposed IM Implementation Strategy
- IM Implementation Work Plan Format and Schedule

Introductions

Goals and Objectives

Goals and Objectives

- Update EPA on activities since the last meeting including the installation of the 5 new 2nd WBZ MWs
- Provide a detailed overview of the proposed IM Implementation Strategy
- Identify any potential concerns
- Agree upon the path forward

Background

Location Map

IM Implementation WP History

- 3-23-07 IM Implementation Work Plan submitted to EPA
- 4-11-07 Review Meeting with EPA to present and discuss the IM Implementation Work Plan
- 5-10-07 Meeting with EPA to discuss preliminary comments on IM Implementation WP
- 8-29-07 Received draft comments and conditional approval of IM Implementation WP
- 9-18-07 Meeting with EPA – El Paso recommended taking a more aggressive approach and to submit a revised IM Implementation Work Plan rather than responding to comments on existing IM WP

Major Activities Since Last Meeting

Major Activities Since Last Meeting

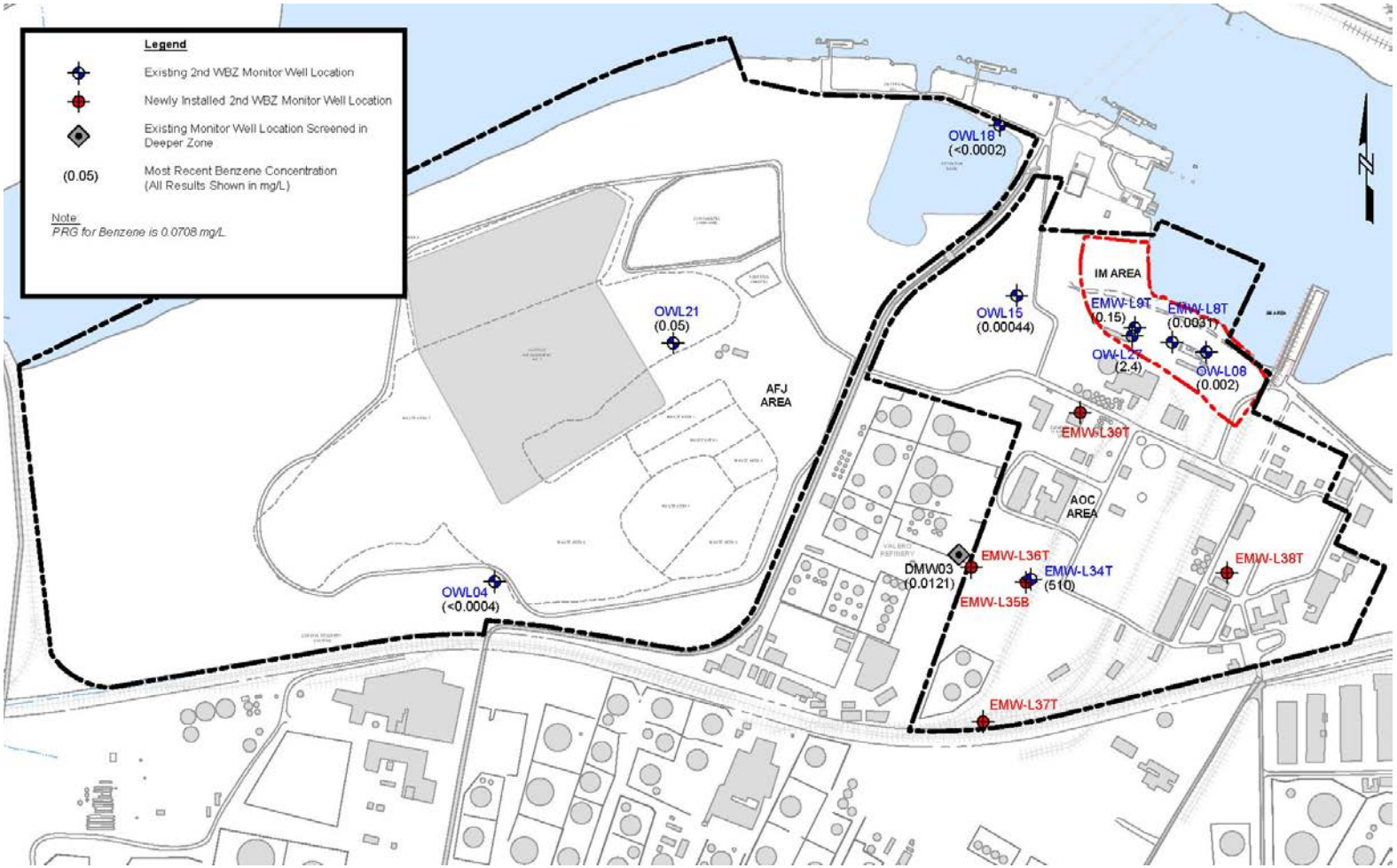
- Installed 5 new Second Water Bearing Zone Monitoring Wells
- Developed a Groundwater Model to help Evaluate Alternative for the IM Area
- Selected a more Aggressive IM Alternative
- Initiated Design of the new Groundwater Treatment System

Second Water Bearing Zone Wells

Second Water Bearing Zone Wells

- Installed 5 monitoring wells in the 2nd WBZ in December 2007
- Development and sampling of all 5 wells will be completed January 18, 2008

Second WBZ Monitoring Well Locations



Well Completion Information

- 4 two-inch wells screened at top of 2nd WBZ
- 1 two-inch well screened at base of 2nd WBZ
- 10” surface casings installed in confining clay to segregated 1st WBZ from 2nd WBZ
- 10-foot stainless steel screen
- PVC riser pipe

Proposed IM Implementation Strategy

Proposed IM Implementation Strategy

- Overview of AOC Requirements
- Overview of Containment Approach
- Overview of Groundwater Model for the IM Area
- Overview of Modeling Results
- Overview of Proposed Monitoring Program
- Overview of Remediation Approach

AOC Requirements for IM Area

Objectives of IM Implementation Work Plan

- Provide sufficient information to support the design and implementation of the IM Containment System
- Present specifications for implementation of the IM Containment System
- Propose a Monitoring Schedule for the IM Containment System

IM Implementation Performance Criteria

- Contain the release of LNAPL to non-detect thickness of LNAPL on top of GW
- Contain the release of IM COCs that exceed IM PRGs in the GW

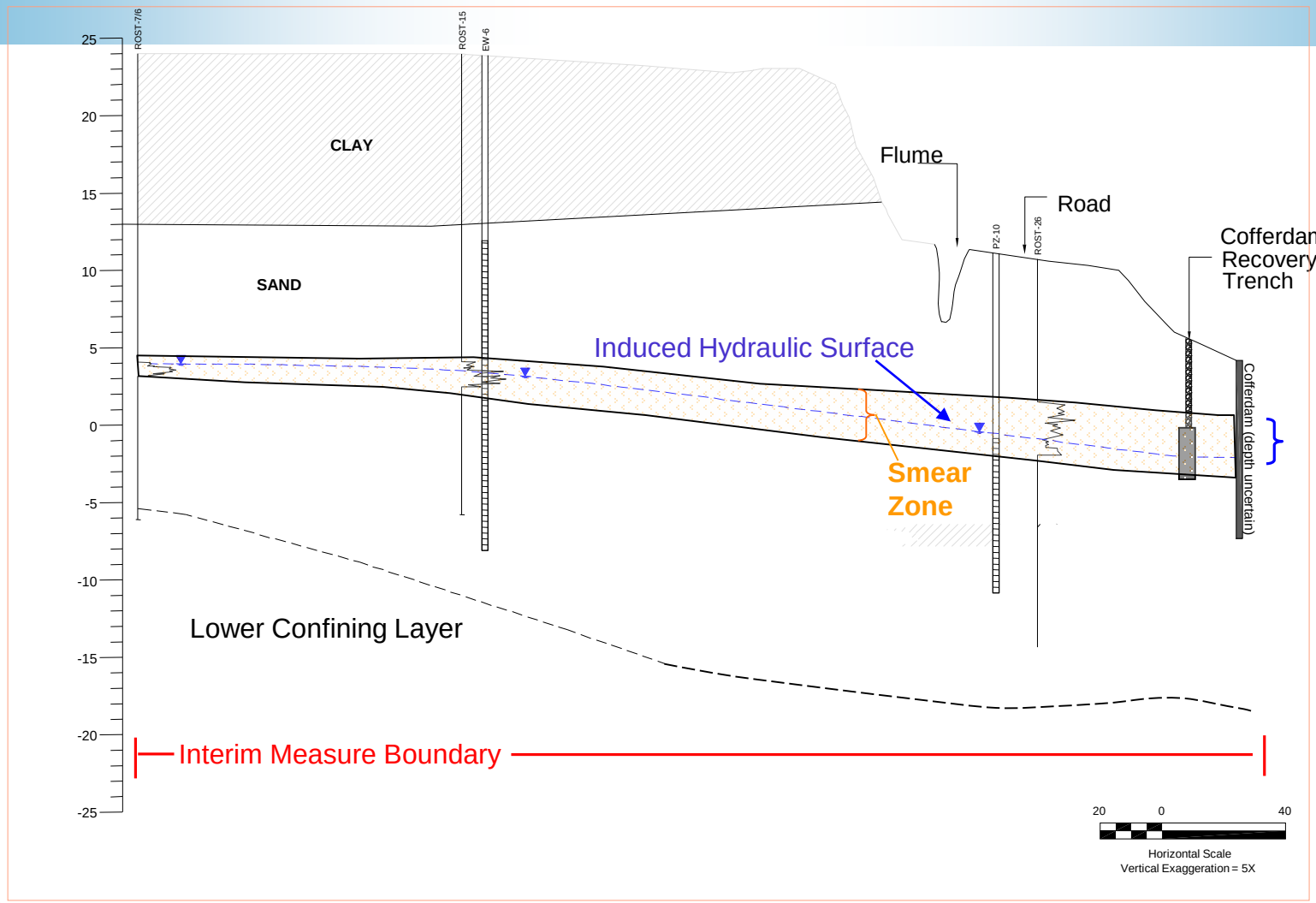
- Performance Criteria to be applied at the Groundwater/Surface Water Interface

Overview of Containment Approach

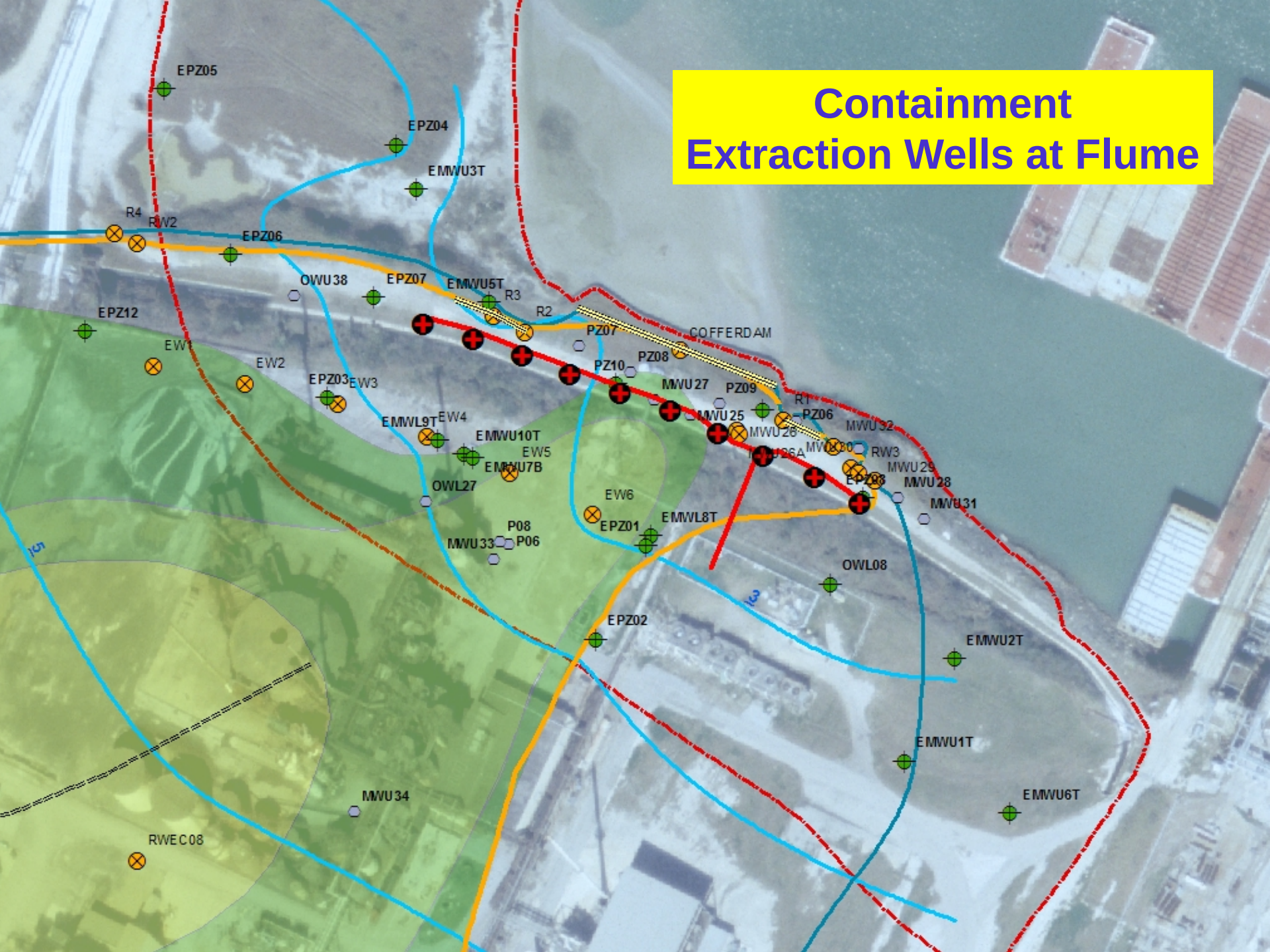
Site Plan

EPZ05
EPZ04
EMWU3T
R4
RW2
EPZ06
OWU38
EPZ07
EMWU5T
R3
R2
EPZ12
EW1
EW2
EPZ03
EW3
PZ07
COFFERDAM
PZ08
PZ10
MWU27
PZ09
R1
PZ06
MWU25
MWU26
MWU26A
MWU32
RW3
MWU29
MWU28
MWU31
EMWL9T
EW4
EMWU10T
EW5
EMWU7B
OWL27
EW6
EPZ01
EMWL8T
P08
MWU33
P06
OWL08
EPZ02
EMWU2T
EMWU1T
EMWU6T
MWU34
RWEC08

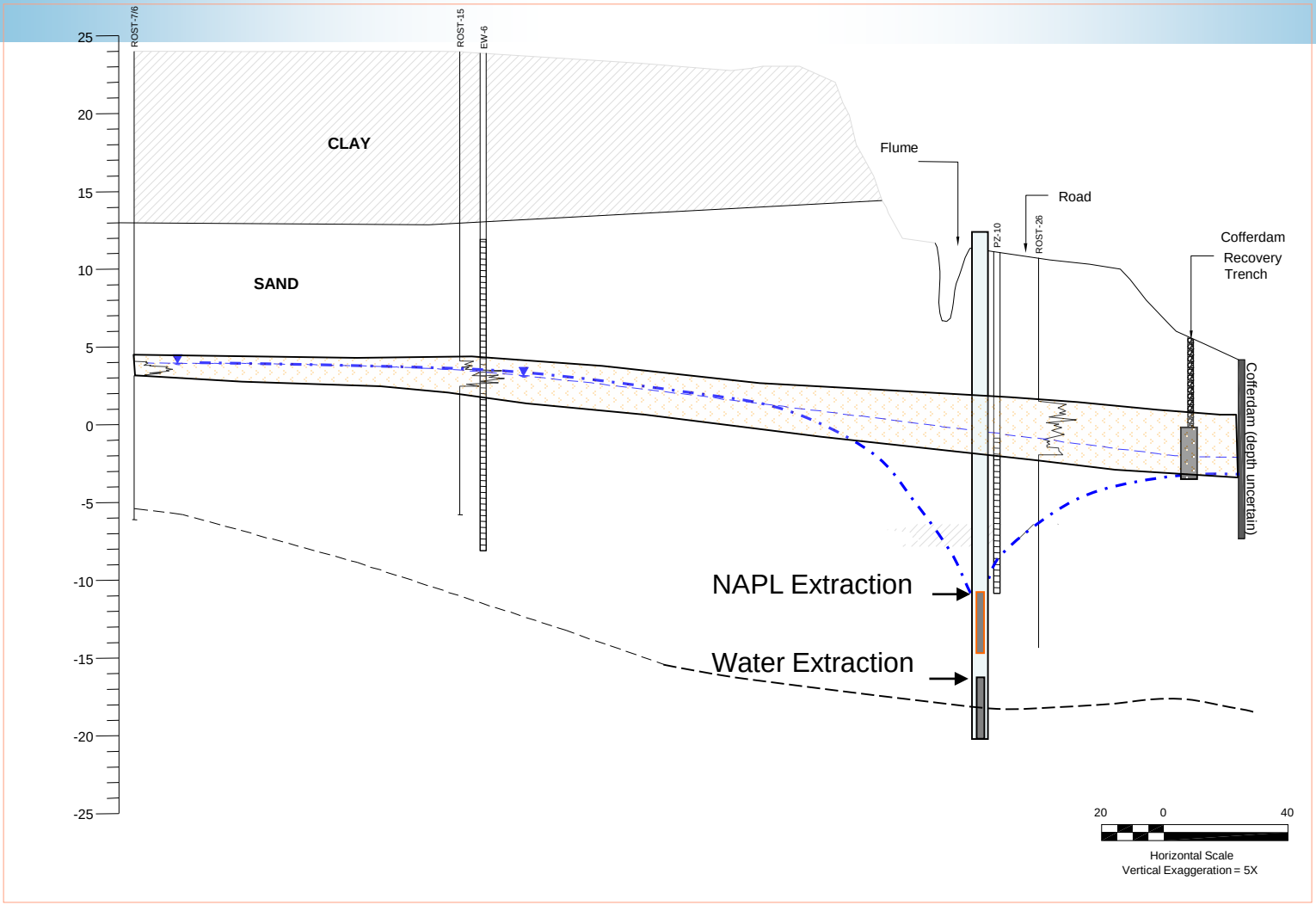
Cross Section of IM Area



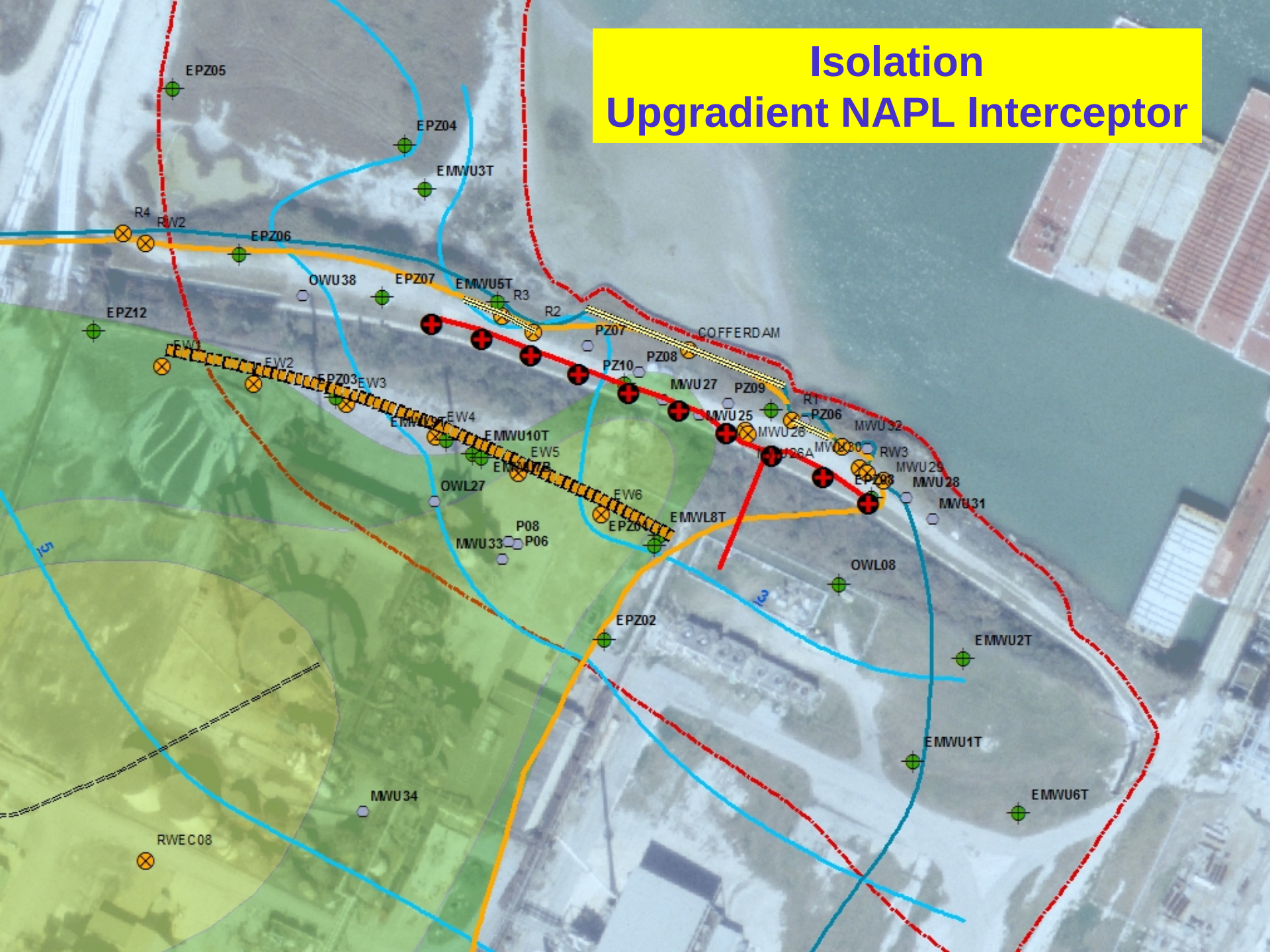
Containment Extraction Wells at Flume



Containment
Extraction Wells at Flume



Isolation
Upgradient NAPL Interceptor



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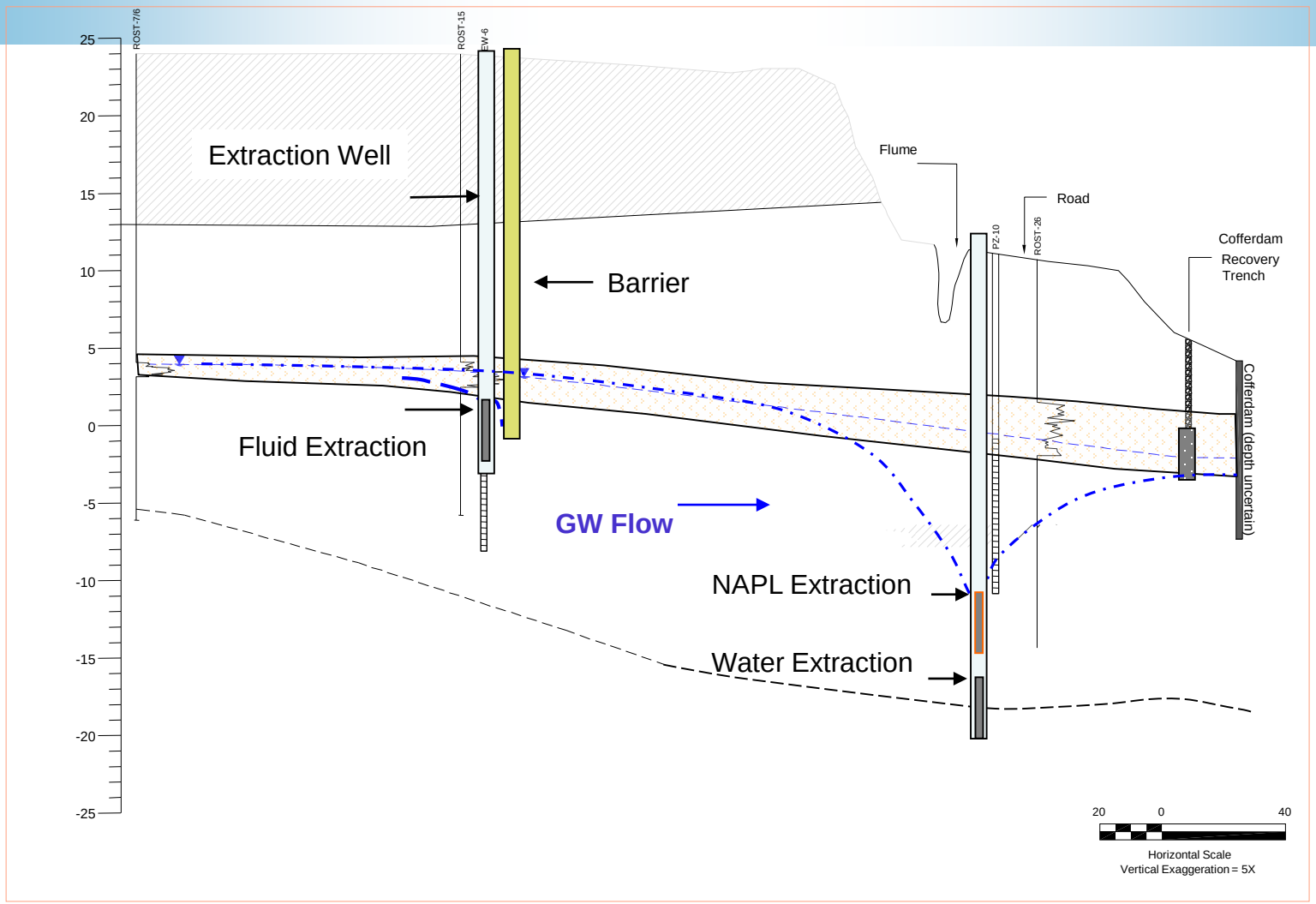
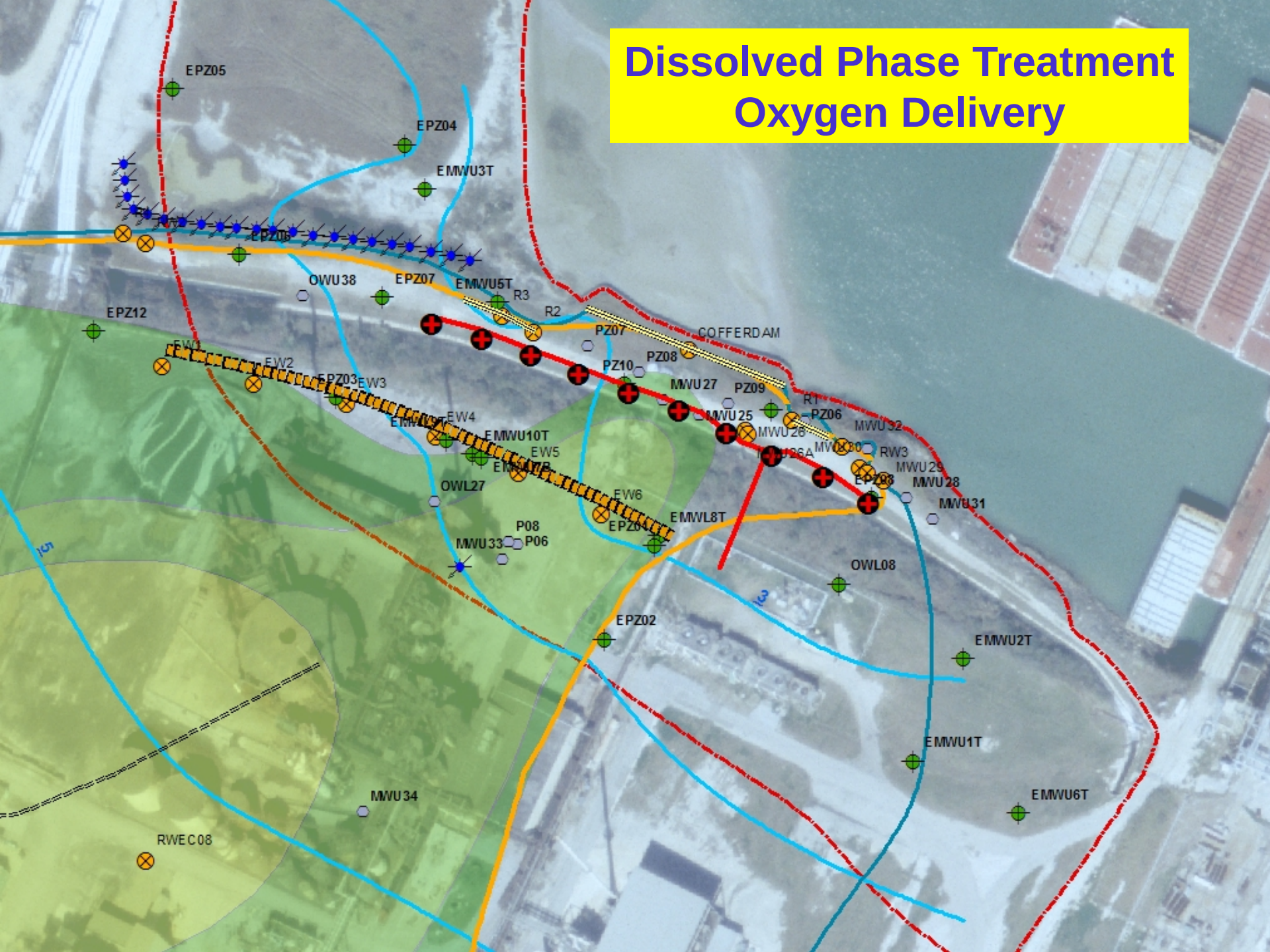


Dissolved Phase Treatment Oxygen Delivery



Overview of Groundwater Model

Discussion Topics

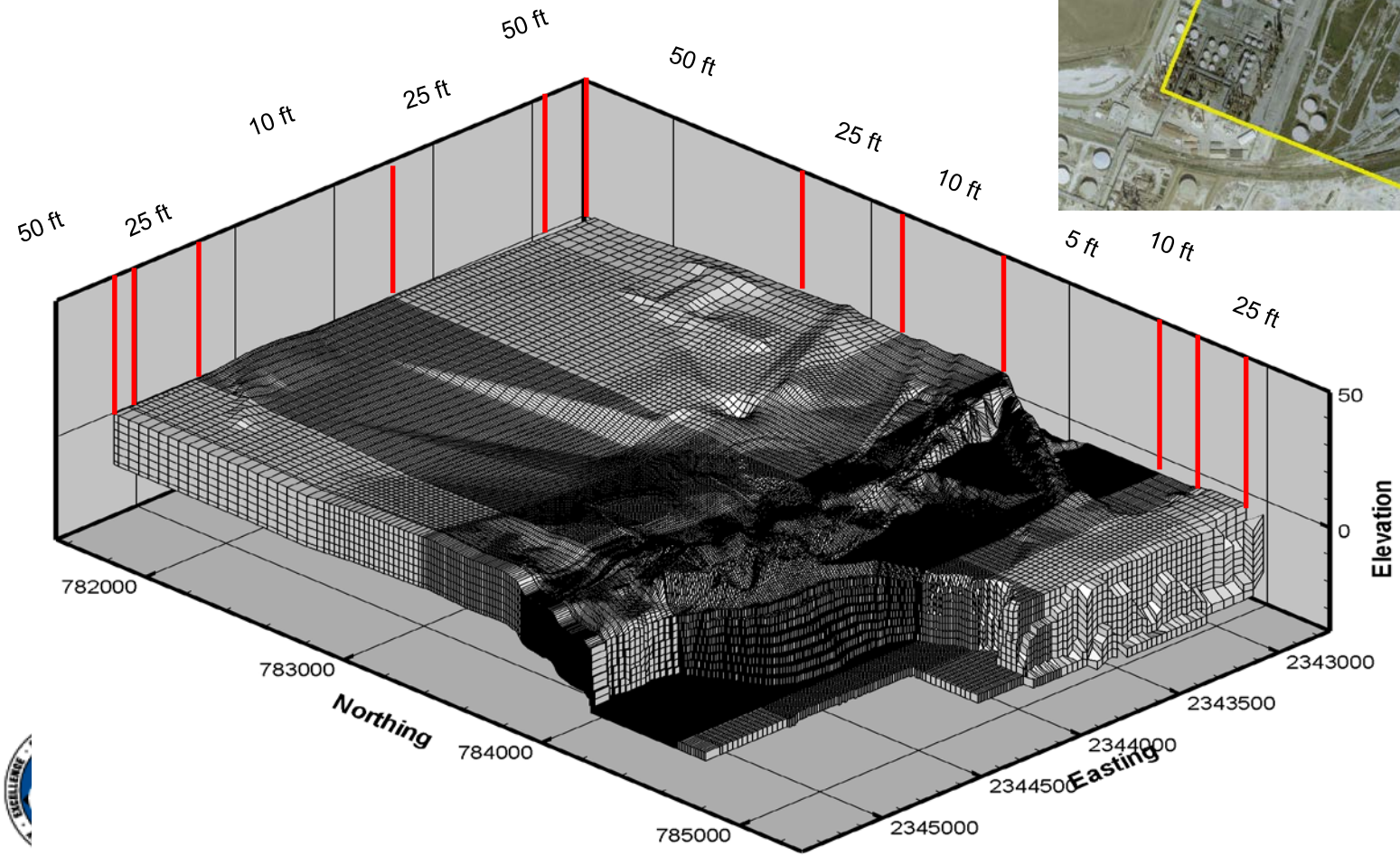
- Modeling Objective
- Model Grid
- Hydraulic Conductivity Measurements
- Pumping Rates
- Hydraulic Head Measurements
- Modeling Assumptions
- Model Calibration

Objective of GW Model Application

- Support design of containment system to prevent release of dissolved benzene above PRG from 1st WBZ
- Support decision-making for:
  - Location of extraction wells
  - Screened intervals of the extraction wells
  - Upper bounds for flow rate capacity of treatment system

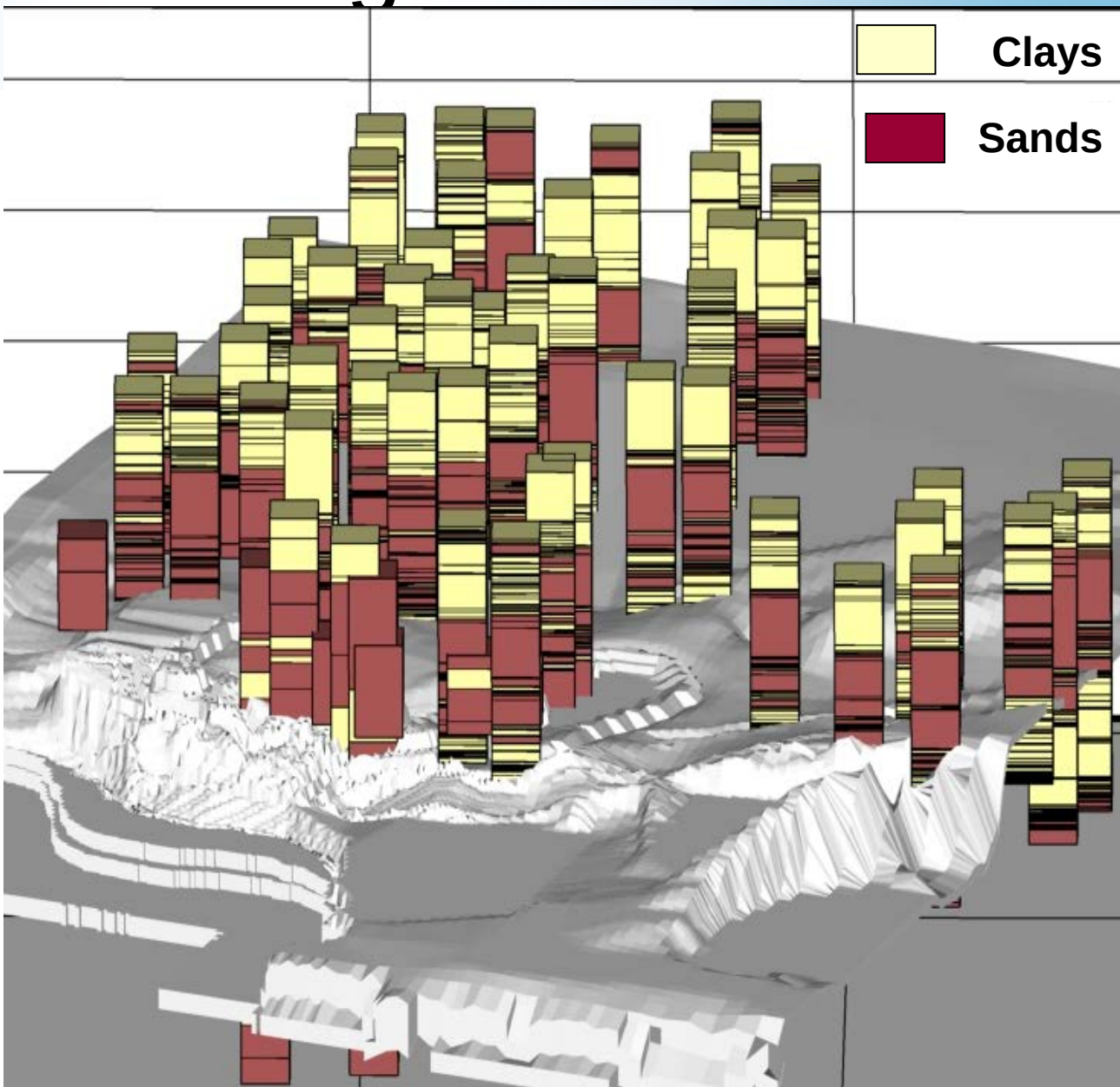
Model Grid

- 150 Columns, 284 Rows
- 10 layers

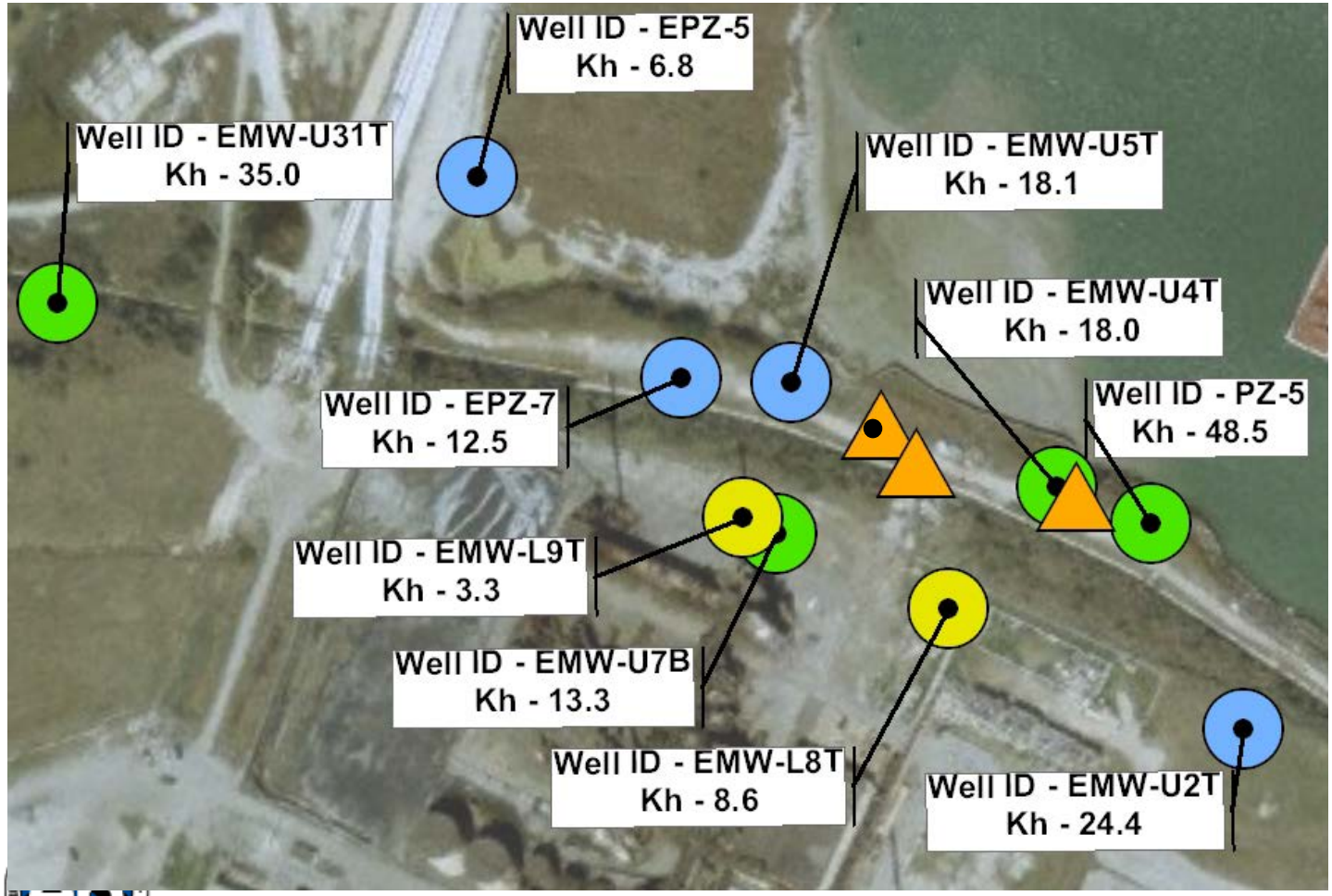


Soil Logs

- 47 Cone Penetrometer Tests
- 10 Soil Logs
- Top and Bottom based on 1st WBZ Surfaces in 2007 Capstone



Hydraulic Conductivity Measurements (ft/day)



2007 Slug Tests

- 100% WBZ2
- 50-60 % WBZ1
- 100% WBZ1

WBZ1 Results

Art Mean = 24.3
Geo Mean = 21.7
Max = 48.5
Min = 6.8

Pumping Test

- **Extraction Well**
- **Observation Well**

Pumping Test Result
Mean = 26

Pumping Estimates for Oct 2007

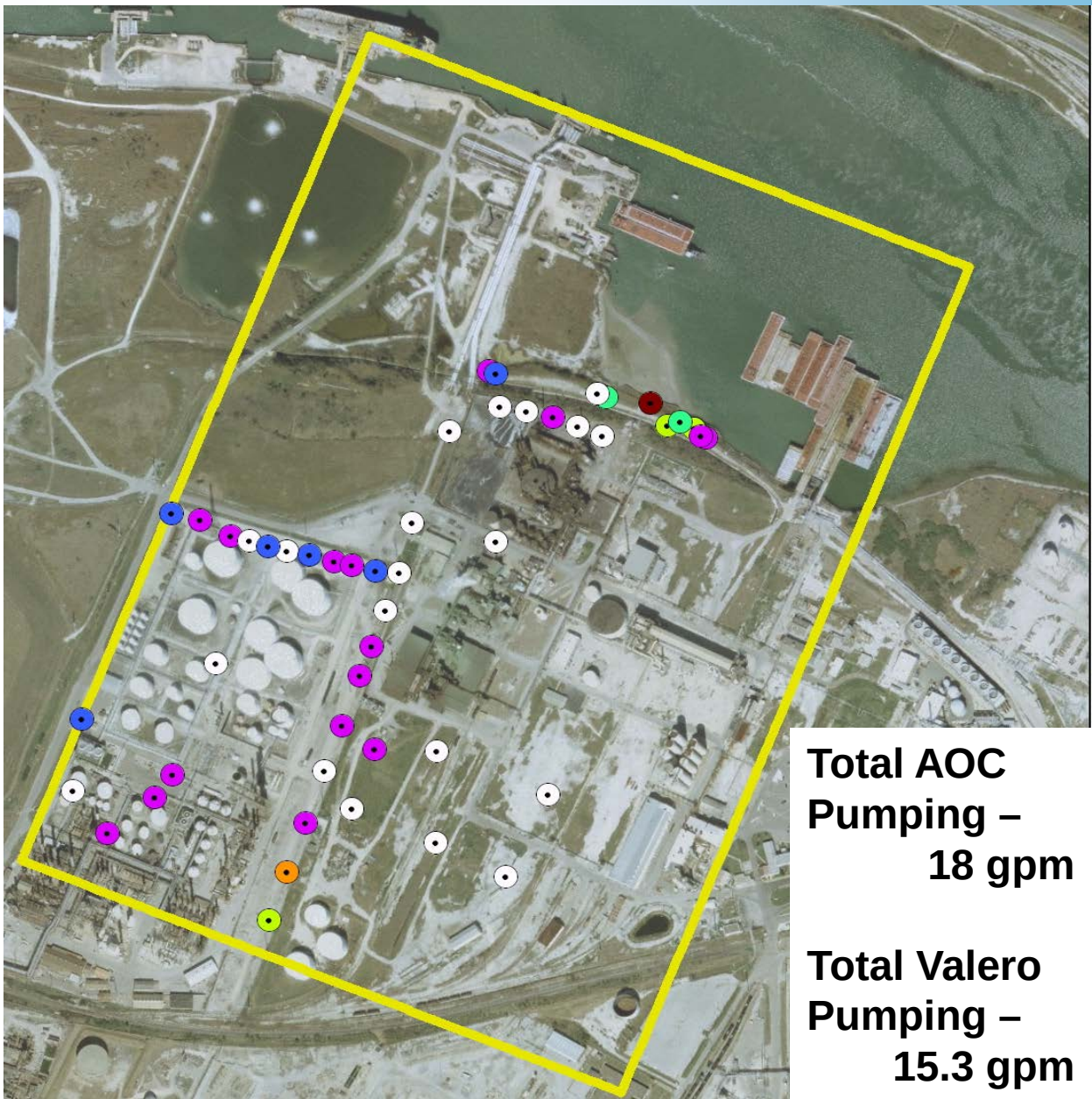
Legend

CalPump2 Events

RATEGPM

- 0.0 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0
- Model Extent

N



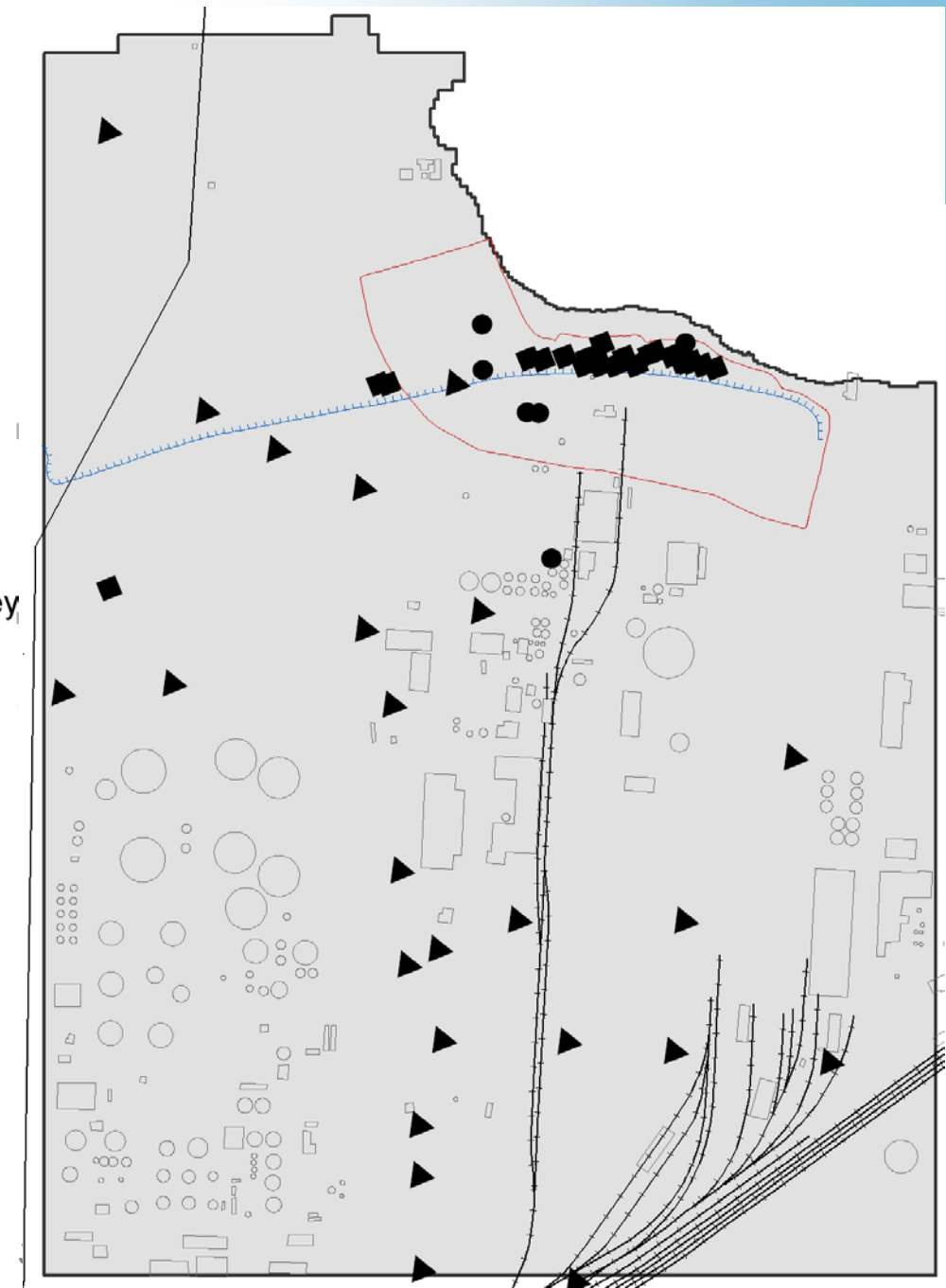
Total AOC Pumping – 18 gpm

Total Valero Pumping – 15.3 gpm

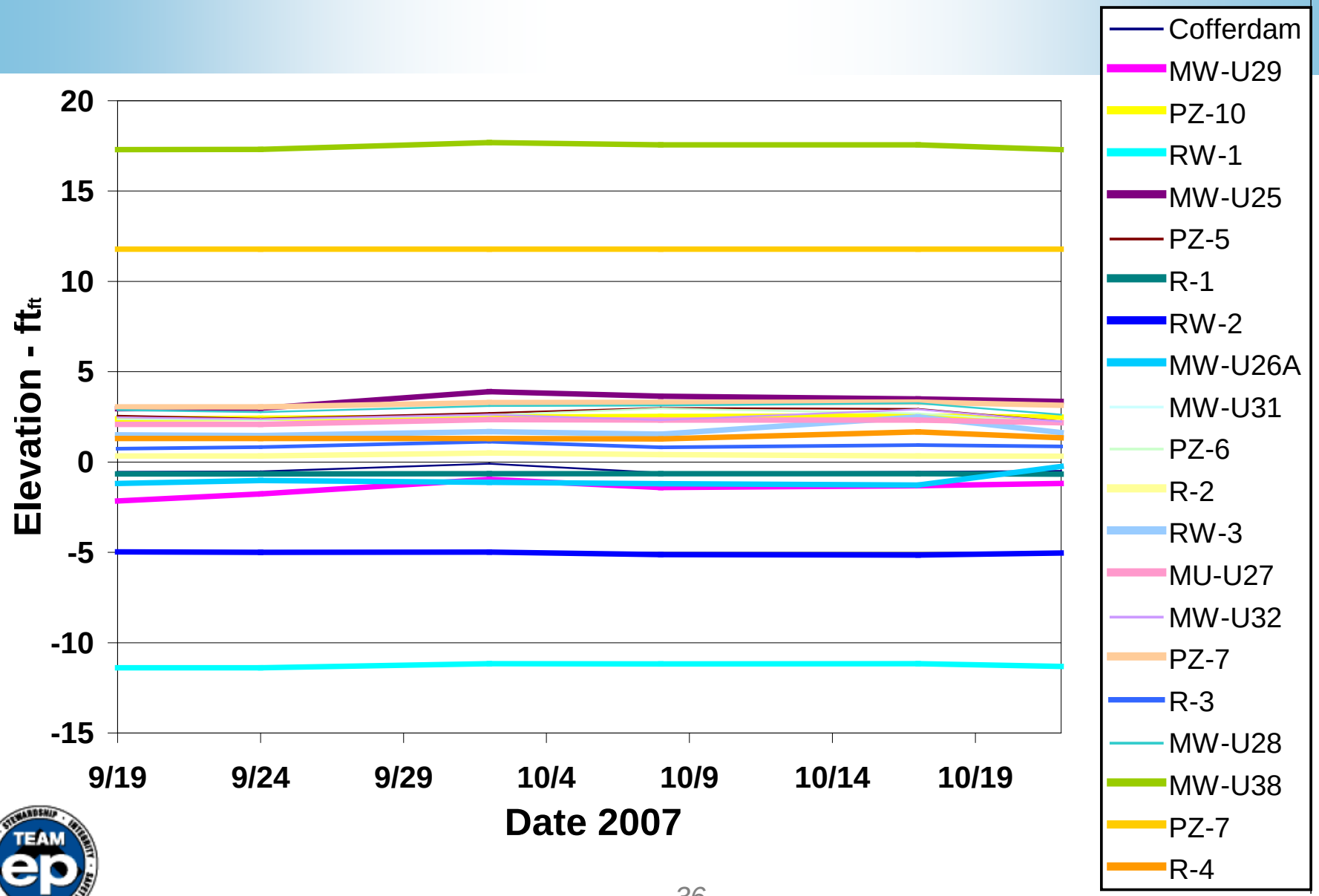
Hydraulic Head Measurements

Legend

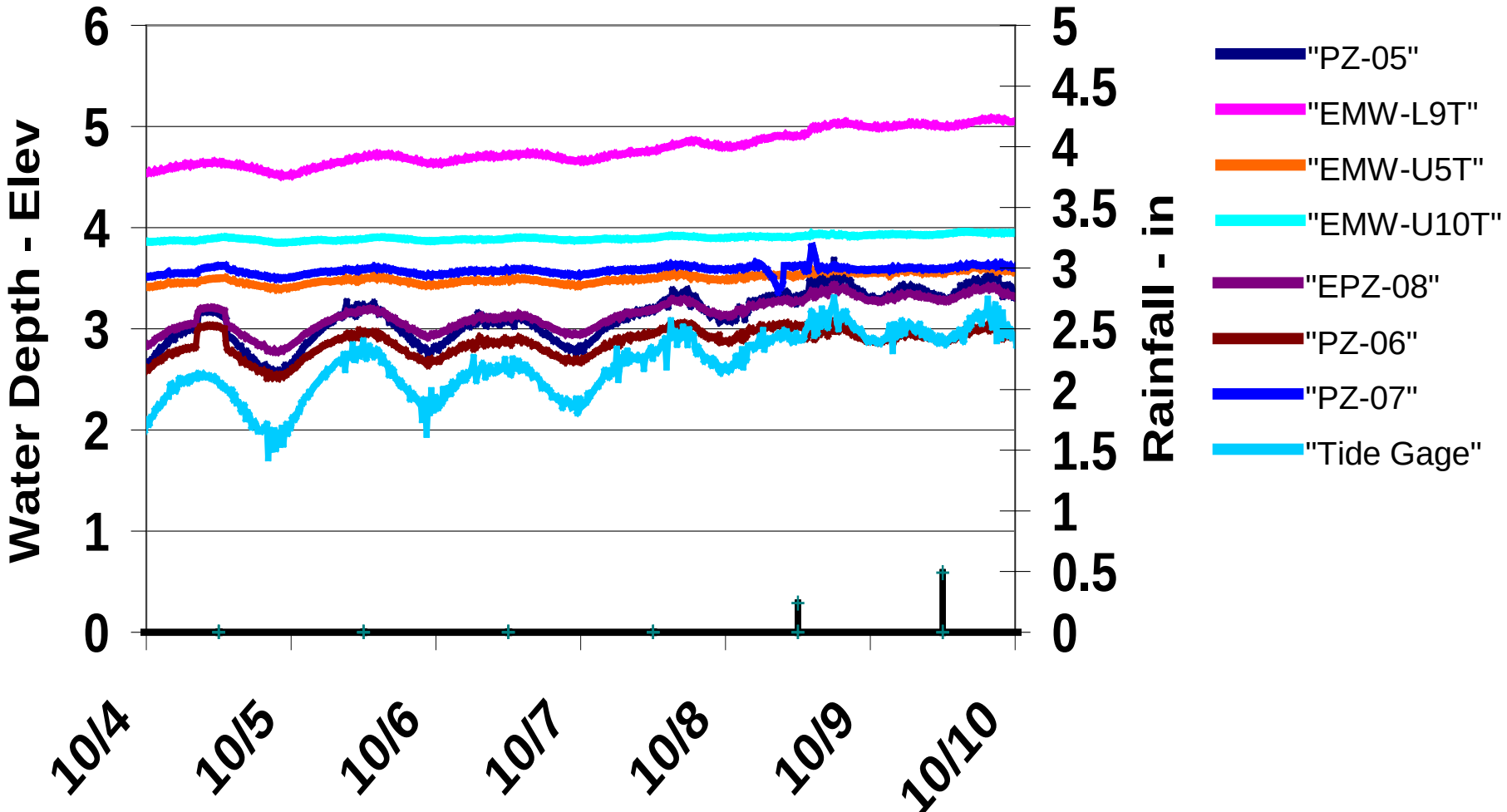
- Locations of Weekly Manual Measurements
- Location of Transducers
- Additional Measurements from Semi-Annual Survey
- Flume
- Rail
- Roads
- IM Boundary
- Building
- Tanks
- Model Domain



Weekly Water Table Measurements

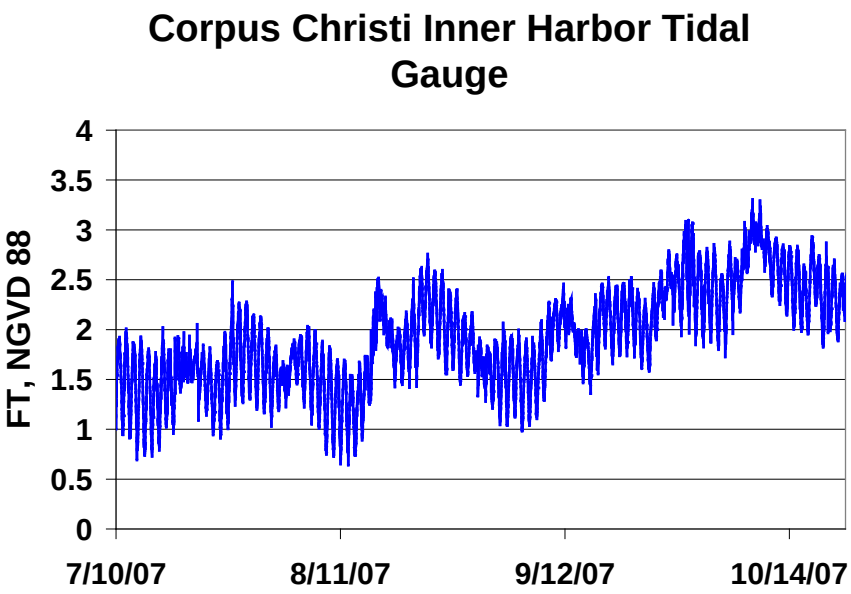


Transducer Data



Transducer Measurements in Harbor

- Installed June 2007
- Data Collected at 15-min Intervals
- 2000 ft from Cofferdam well



Modeling Assumptions

- Steady-state Conditions
- Uniform Hydraulic Properties

  K_h = 25 ft/day, $K_{htrench}$= 200 ft/day

  K_v = 0.5 ft/day, $K_{vtrench}$= 200 ft/day
- Uniform Recharge = 3.1 inch/yr
- Cofferdam Piling

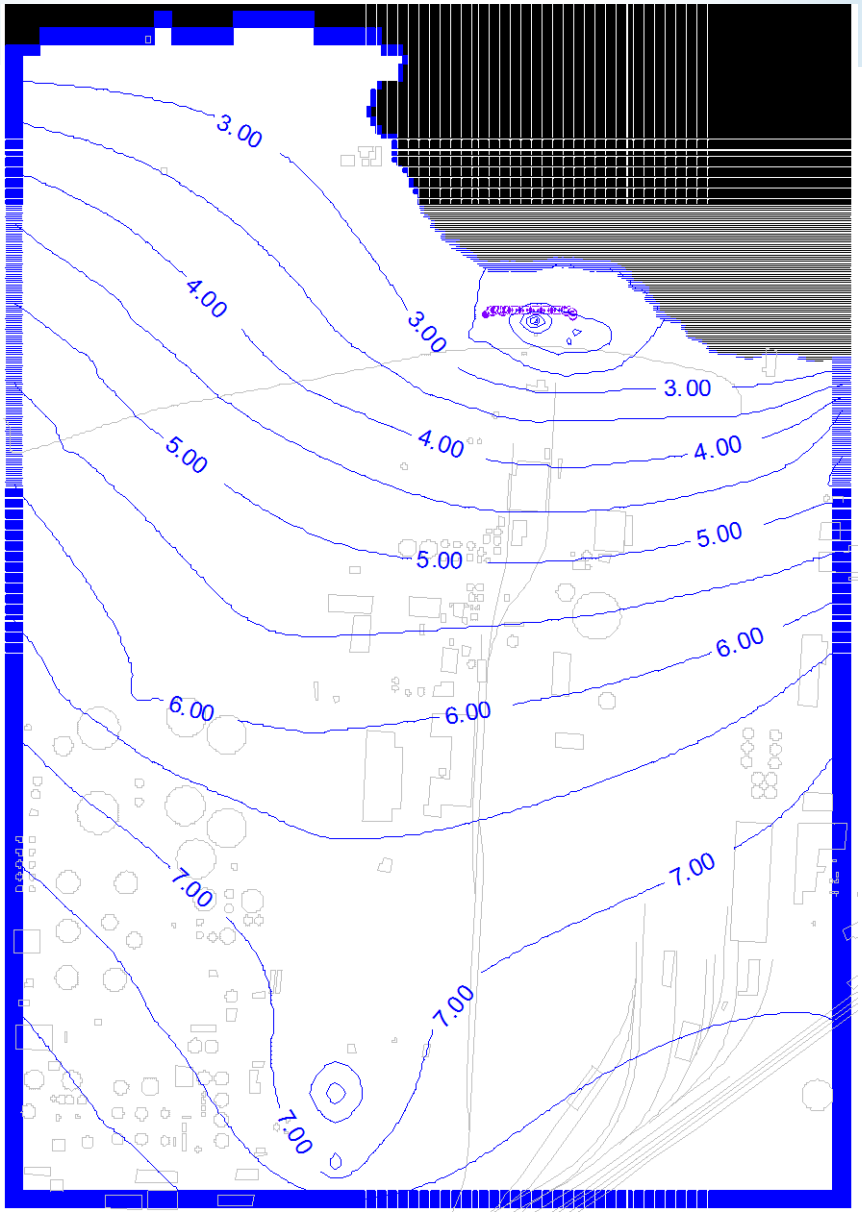
  50% penetration of 1st WBZ

  K_h = 0.5 ft/day
- Constant Heads Around Model Perimeter

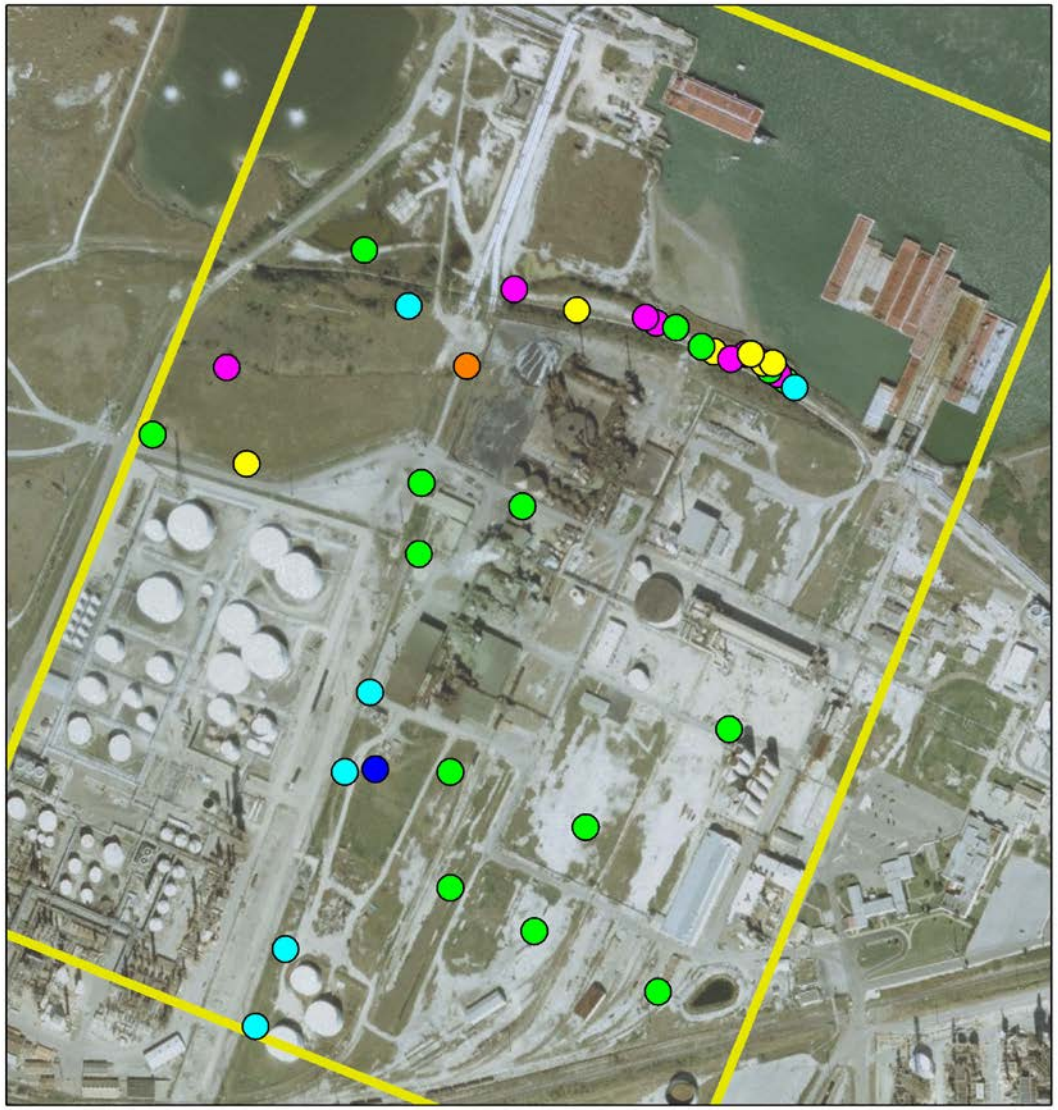
  Harbor set to 2.5 ft

  No vertical gradients

Contours of Hydraulic Head



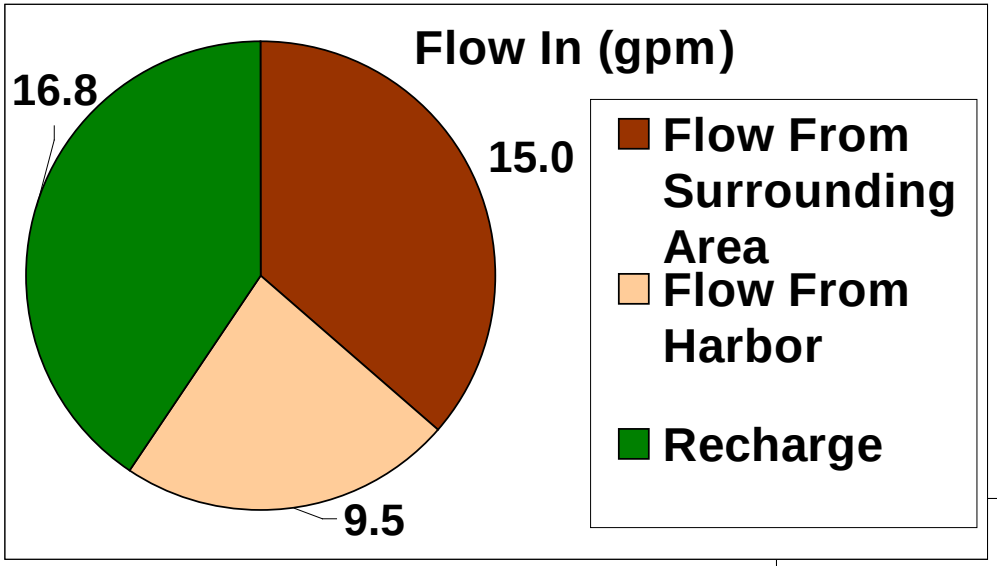
Hydraulic Head Residuals

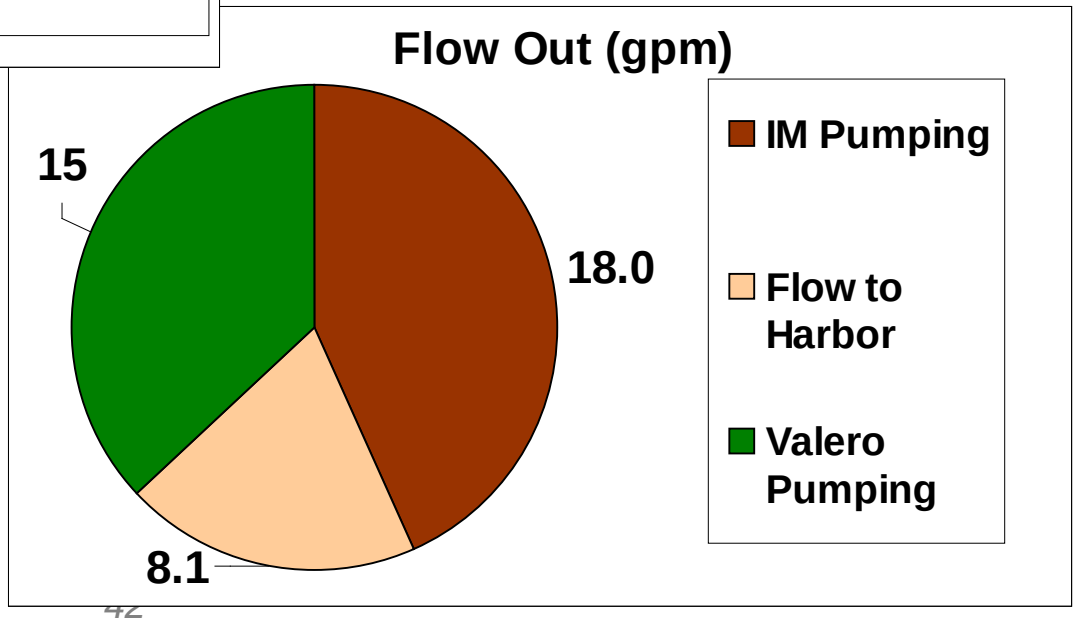


Residuals

< -4	Over Predicted	
-4 - -2	Over Predicted	
-2 - -1	Over Predicted	
-1 - 0	Over Predicted	
0 - 1	Under Predicted	
1 - 2	Under Predicted	
2 - 4	Under Predicted	
> 4	Under Predicted	

Water Budget





Note: Harbor head at 2.5 ft.

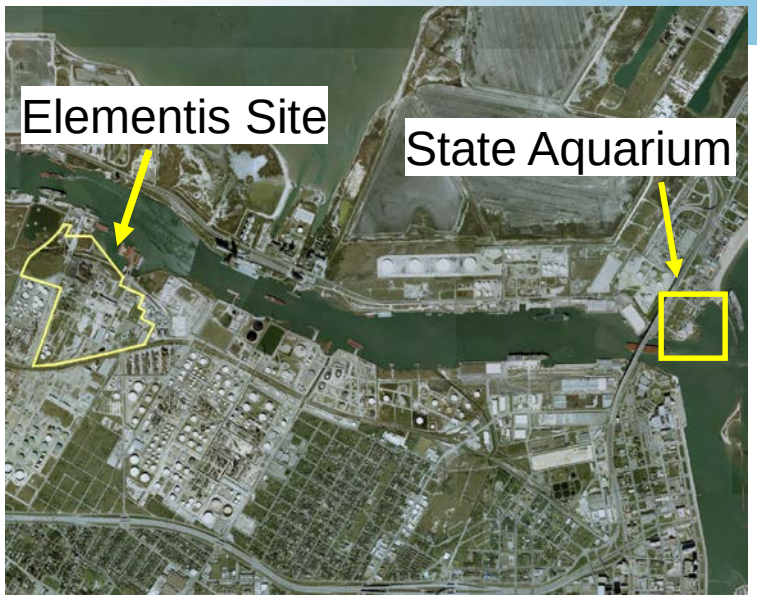
Overview of Containment Approach and Modeling Results

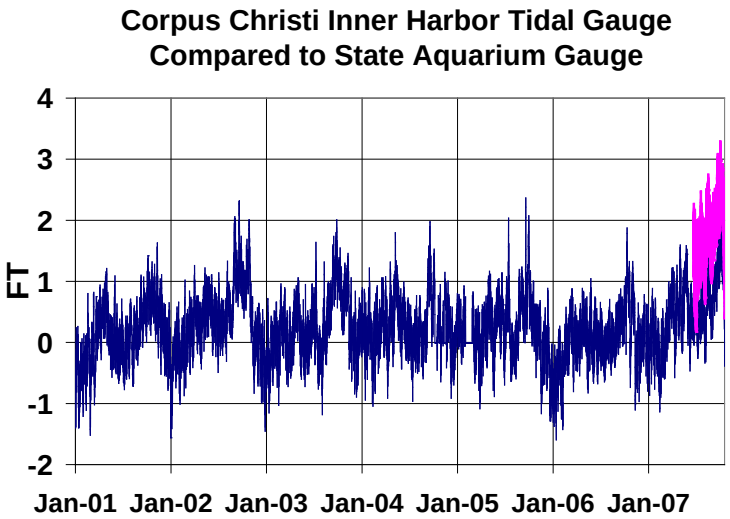
Discussion Topics

- Estimated Harbor Elevations for Design
- Proposed Containment System
- Modeling Approach
- Model Results
  - Performance Statistics
  - Particle Tracking Results
  - Sensitivity Analysis
- Design Parameters

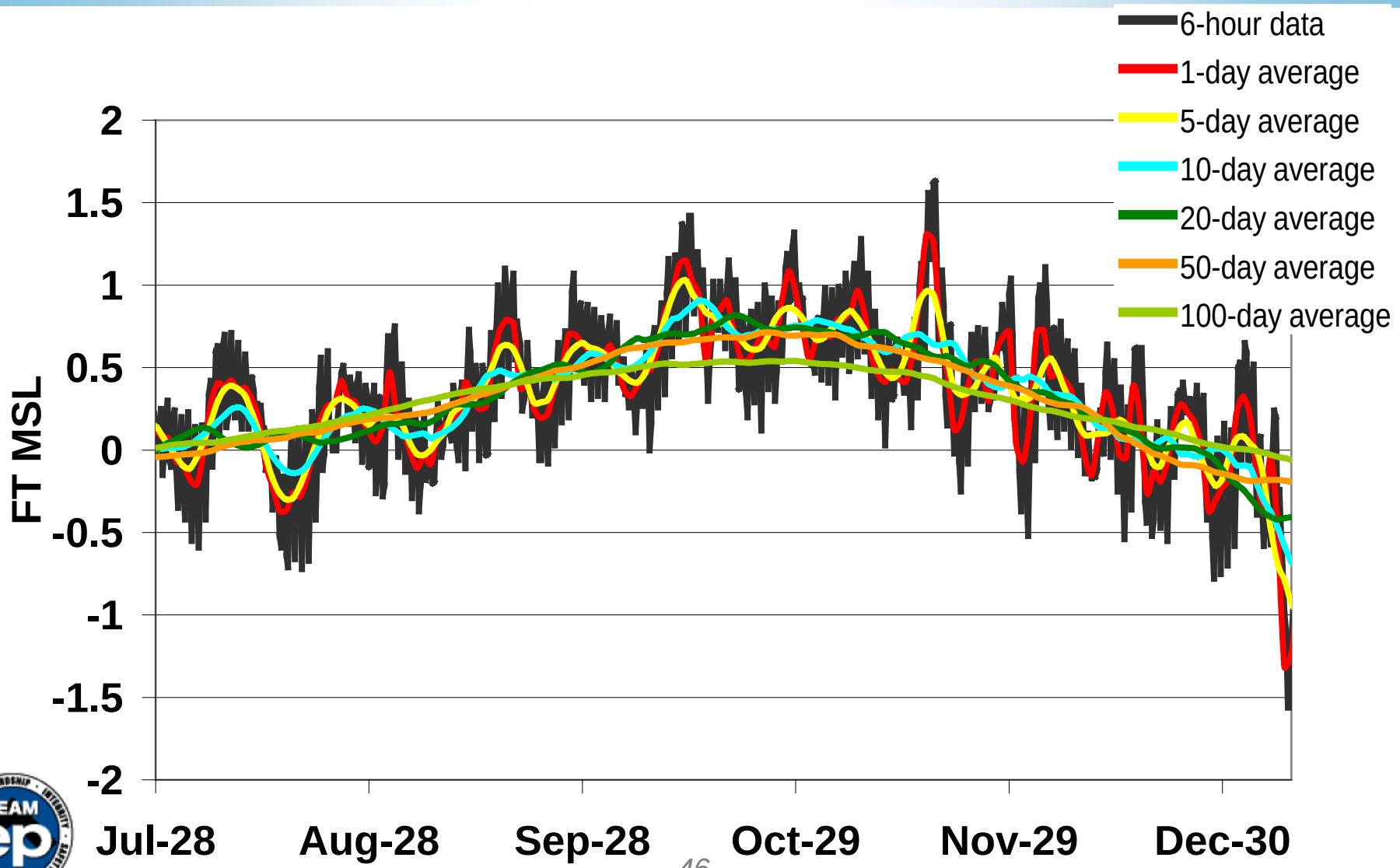
State Aquarium Data

- Data from 2000 is available at State Aquarium of Texas
- Data show that last six month is at a relative high point in the year





Example of Time-weighted Averages for State Aquarium Gauging Data



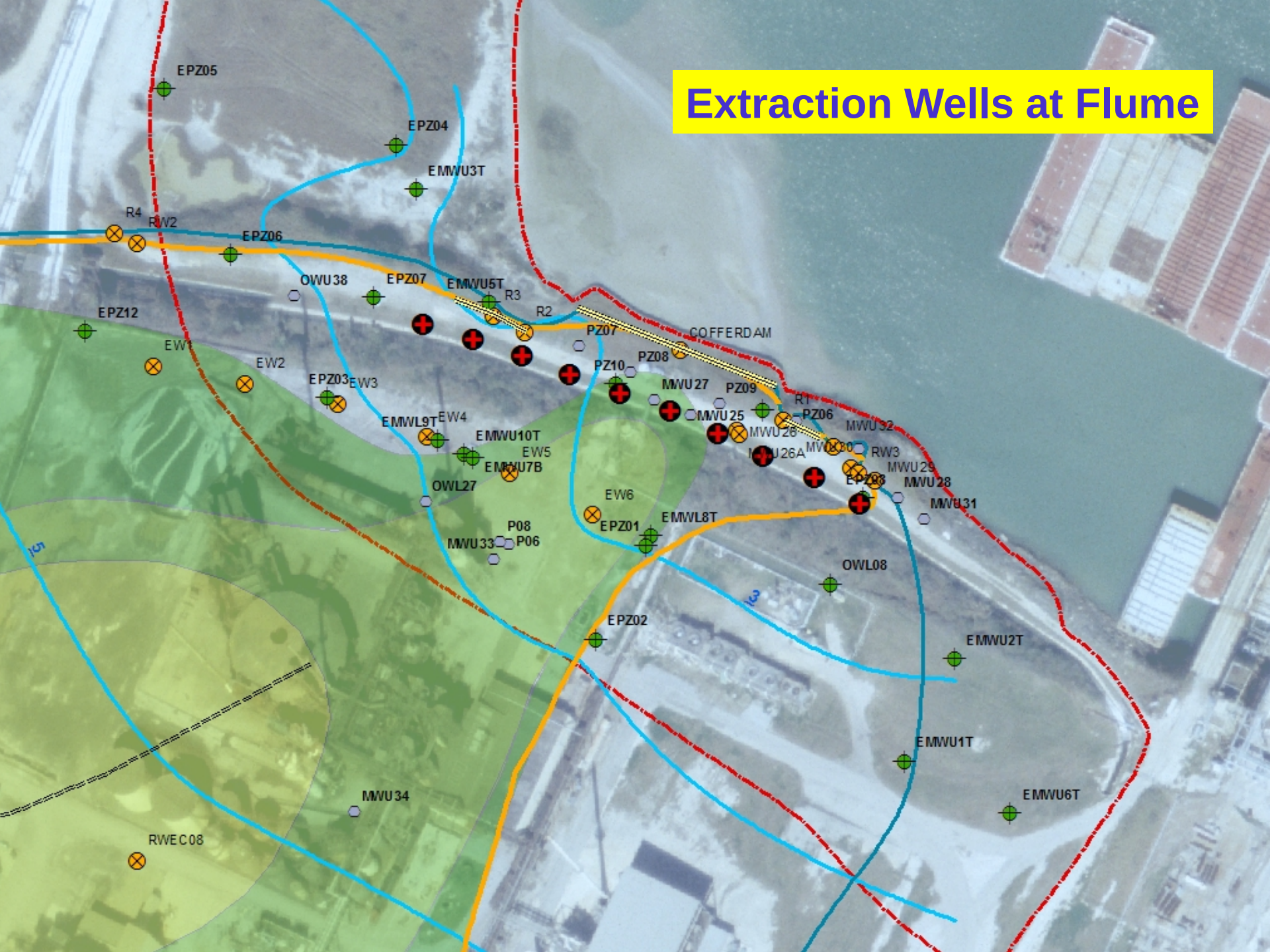
Estimated Lower Bound for Harbor Head

Estimated Value

	Aquarium		Elementis	
	2000-2007	**5-month**	**est. 2000-2007**	**5-month**
Minimum Daily	-1.3	0.04	-0.41	0.93
Minimum 10-day Average	-0.77	0.39	0.23	1.39
Minimum 50-day Average	-0.6	0.44	0.49	1.53
Minimum 100-day Average	-0.39	0.52	0.88	1.79
Average	0.26	0.76	1.40	1.9

Actual Data

Extraction Wells at Flume

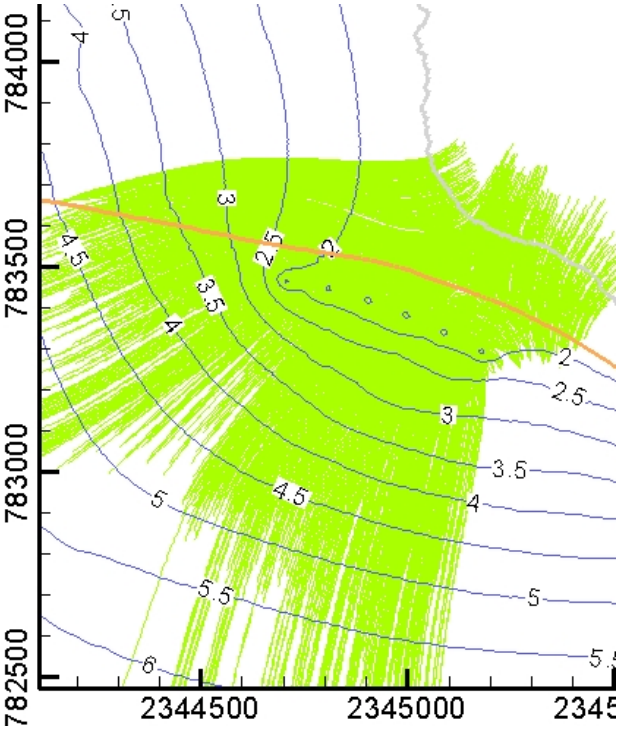


Modeling Approach

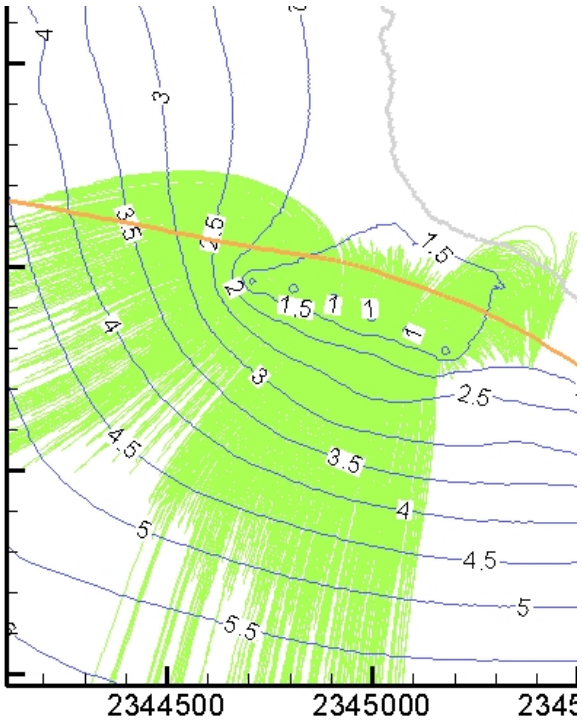
- Design Variables for Extraction Wells
  - Screened Intervals as % of WBZ1 Thickness
  - Fixed Elevation
- Environmental Variables
  - Surface Elevation of Harbor
  - Aquifer Hydraulic Conductivity
- Performance Evaluation Criteria
  - Zone of Capture using Particle Tracking
  - Total Pumping Rate
  - % of Water flow from Harbor

Particle Tracking Results for Harbor Elevation set to 0.5

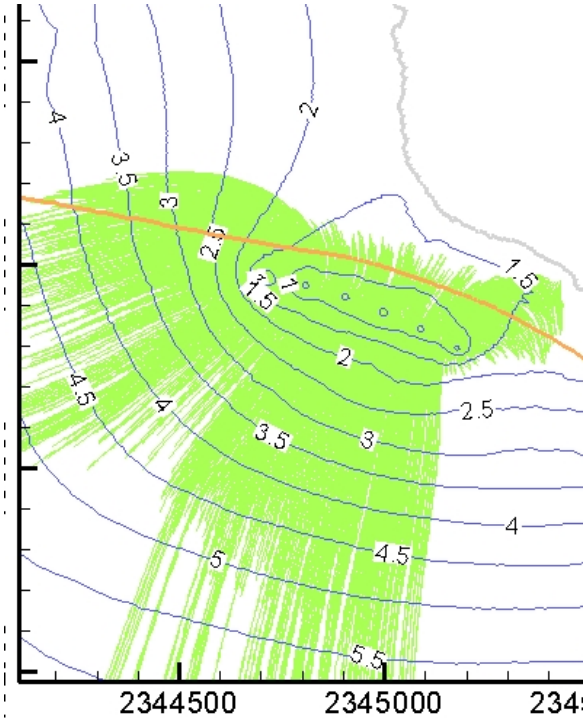
Well Head = 1.0 ft



Well Head = 0.5 ft



Well Head = 0.0 ft



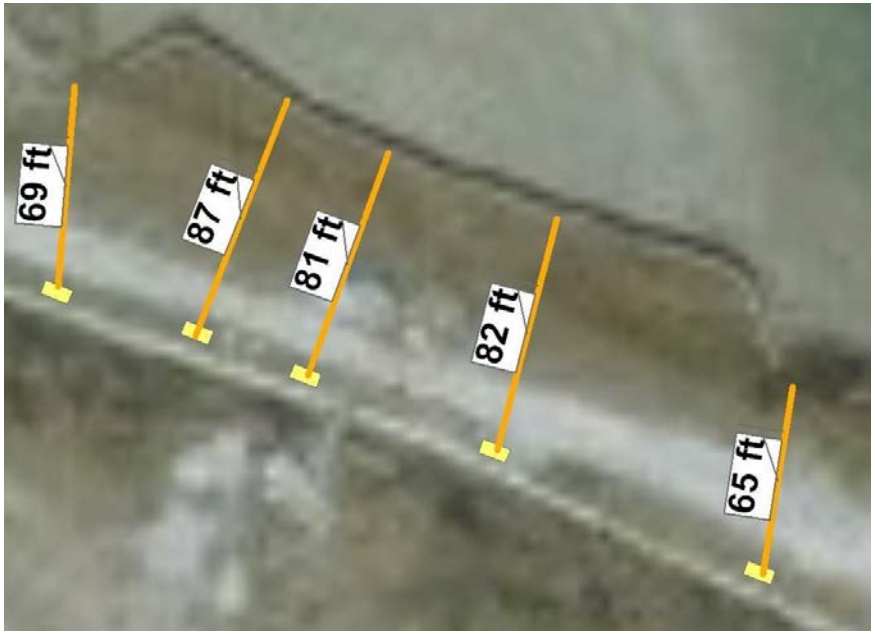
Select Design Criteria for Linear Array of Extraction Wells with Constant Head of 0.0 ft

- 10 fully-penetrating wells, spaced approximately 60 feet apart
- Simulated Results for Different Harbor Heads are:

Harbor Head		% Capture	Total Pumpage (gpm)	% Harbor Water
(ft above Datum)	Rrepresentation			
0.5	Est. Minimum 50-day Average	96	14	13
1		98	18	25
1.5	Est. Average	100	22	33
2		100	27	40
2.8	Measured Maximum Value	100	34	50

Estimated Travel Times

- Use Darcy's Law
- Average Distance = 70 ft
- Uniform K_h = 25 ft/day
- Uniform porosity = 0.3



Head Drop Between Extraction Well and Harbor	Average Gradient	Velocity (ft/day)	Time (days)
0.1	0.0014	0.12	588
0.5	0.0071	0.60	118
1	0.0143	1.19	59

Sensitivity Analysis for the Proposed Fixed Elevation

	Harbor Head	KH	KV	Extraction Well Head	Percent Capture	Percent Harbor Water	GPM	Groundwater Wells (GPM)	Total Fluids Wells (GPM)
Low Harbor Head	0.5	5	0.1	0	0.95	6	5	4	0.6
	0.5	15	0.3	0	0.96	12	10	9	0.2
	0.5	20	0.4	0	0.96	12	12	12	0.0
	0.5	25	0.5	0	0.96	13	14	14	0.0
	0.5	35	0.7	0	0.96	14	19	19	0.0
	0.5	45	0.9	0	0.96	14	24	24	0.0
	0.5	55	1.1	0	0.97	14	29	29	0.0
Lower Harbor Head	1.5	5	0.1	0	0.99	22	7	6	0.8
	1.5	15	0.3	0	0.99	31	15*	14	0.5
	1.5	20	0.4	0	1.00	32	18	18	0.4
	1.5	25	0.5	0	1.00	33	22*	22	0.4
	1.5	35	0.7	0	1.00	34	30*	30	0.3
	1.5	45	0.9	0	1.00	34	38	37	0.2
	1.5	55	1.1	0	1.00	35	45	45	0.1
High Harbor Head	2.8	5	0.1	0	1.00	36	9	8	1.0
	2.8	15	0.3	0	1.00	47	22*	21	1.0
	2.8	20	0.4	0	1.00	48	28	27	1.0
	2.8	25	0.5	0	1.00	49	34*	33	1.1
	2.8	35	0.7	0	1.00	50	45*	44	1.2
	2.8	45	0.9	0	1.00	51	57	56	1.4
	2.8	55	1.1	0	1.00	52	69	67	1.5

Overview of Monitoring Program

IM Implementation Performance Criteria

- Contain the release of LNAPL to non-detect thickness of LNAPL on top of GW
- Contain the release of IM COCs that exceed IM PRGs in the GW

- Performance Criteria to be applied at the Groundwater/Surface Water Interface

IM Implementation Performance Criteria

Performance goal can be satisfied by:

- Sampling and analysis of groundwater in IM wells (at groundwater/surface water interface) for IM COCs.
- Maintaining reversal of hydraulic gradient to achieve total containment of the contaminated ground water

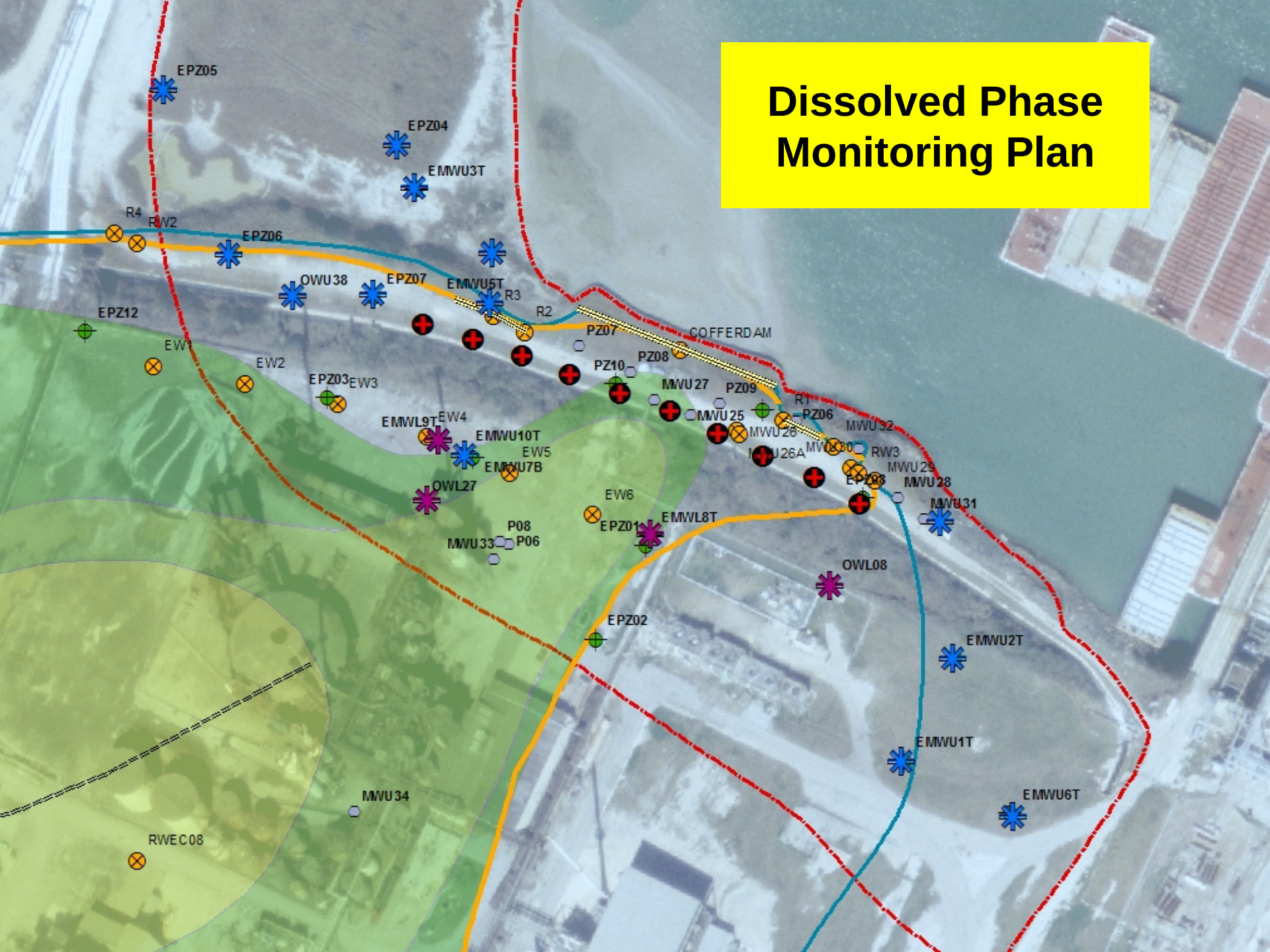
Proposed IM Monitoring System

- Proposed Monitoring Well Network
  - Dissolved Phase Monitoring
  - Hydraulic Gradient Reversal
- Proposed Monitoring Schedule

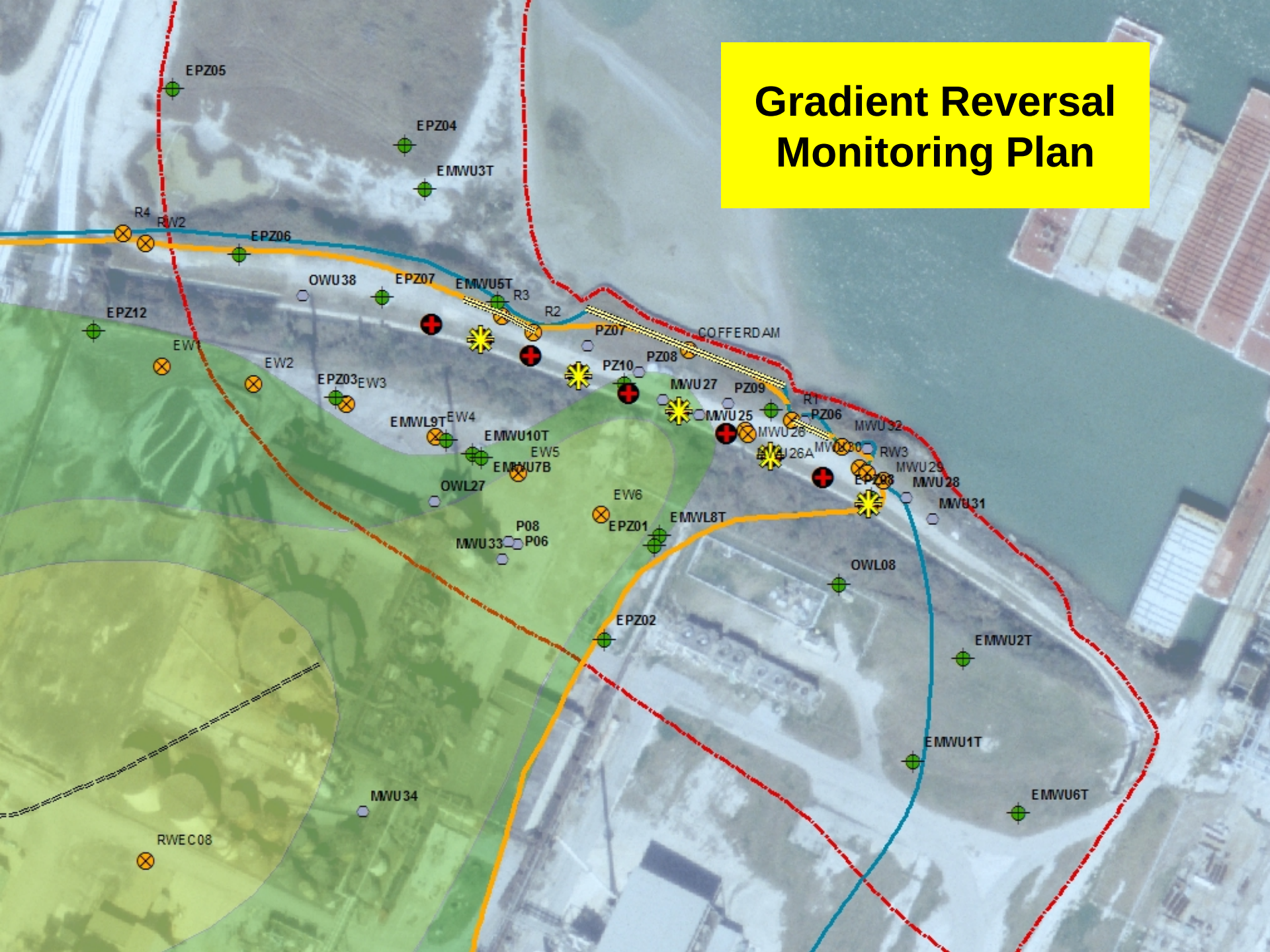
Overview of Monitoring Program

- Measure fluid levels (GW elevation and LNAPL thickness) in all accessible wells (1st and 2nd WBZs)
- Monitor hydraulic gradient using transducer data
- Monitor dissolved phase concentrations within and along the periphery of the plume

Dissolved Phase Monitoring Plan



Gradient Reversal Monitoring Plan

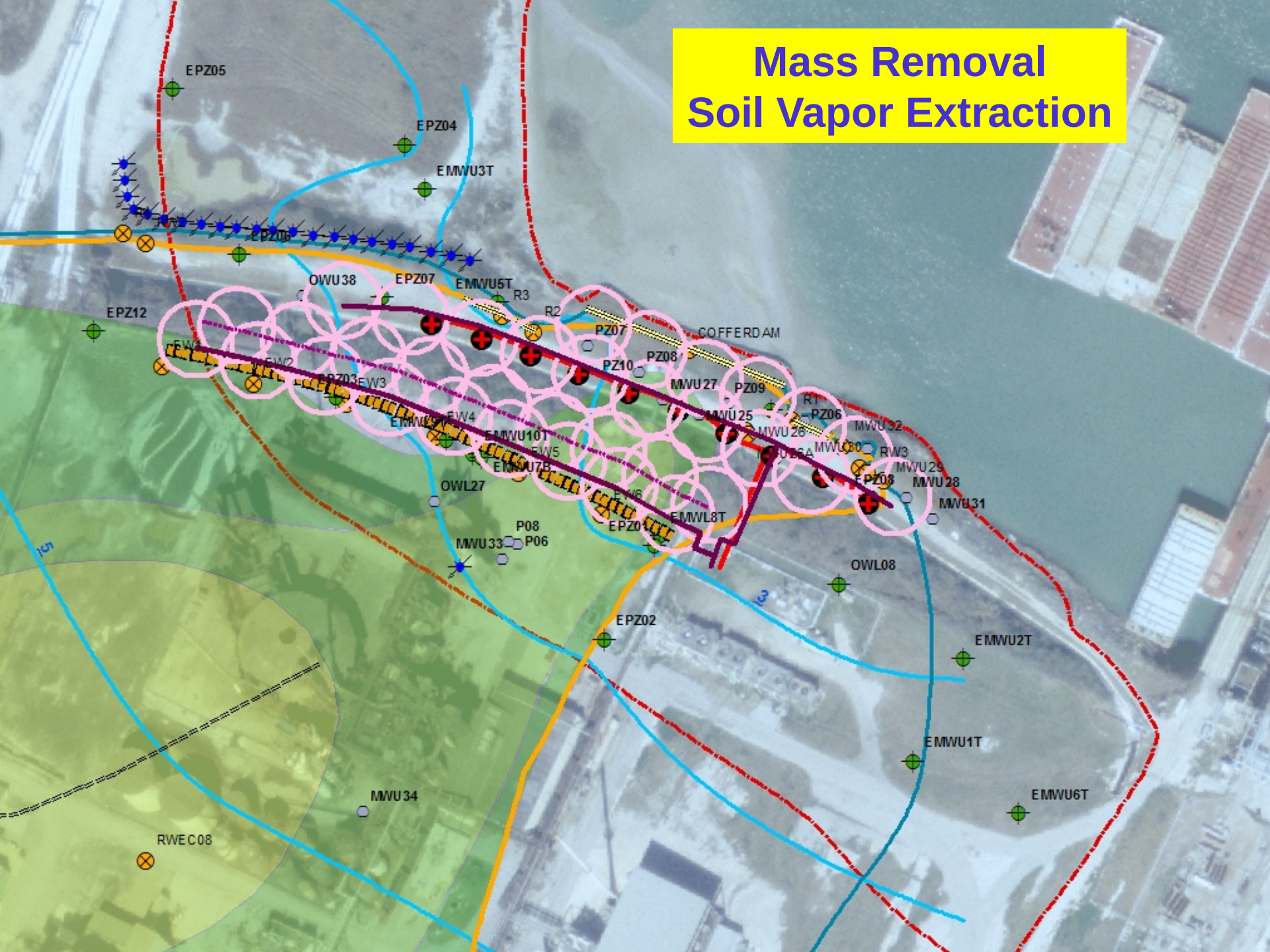


Proposed Monitoring Schedule

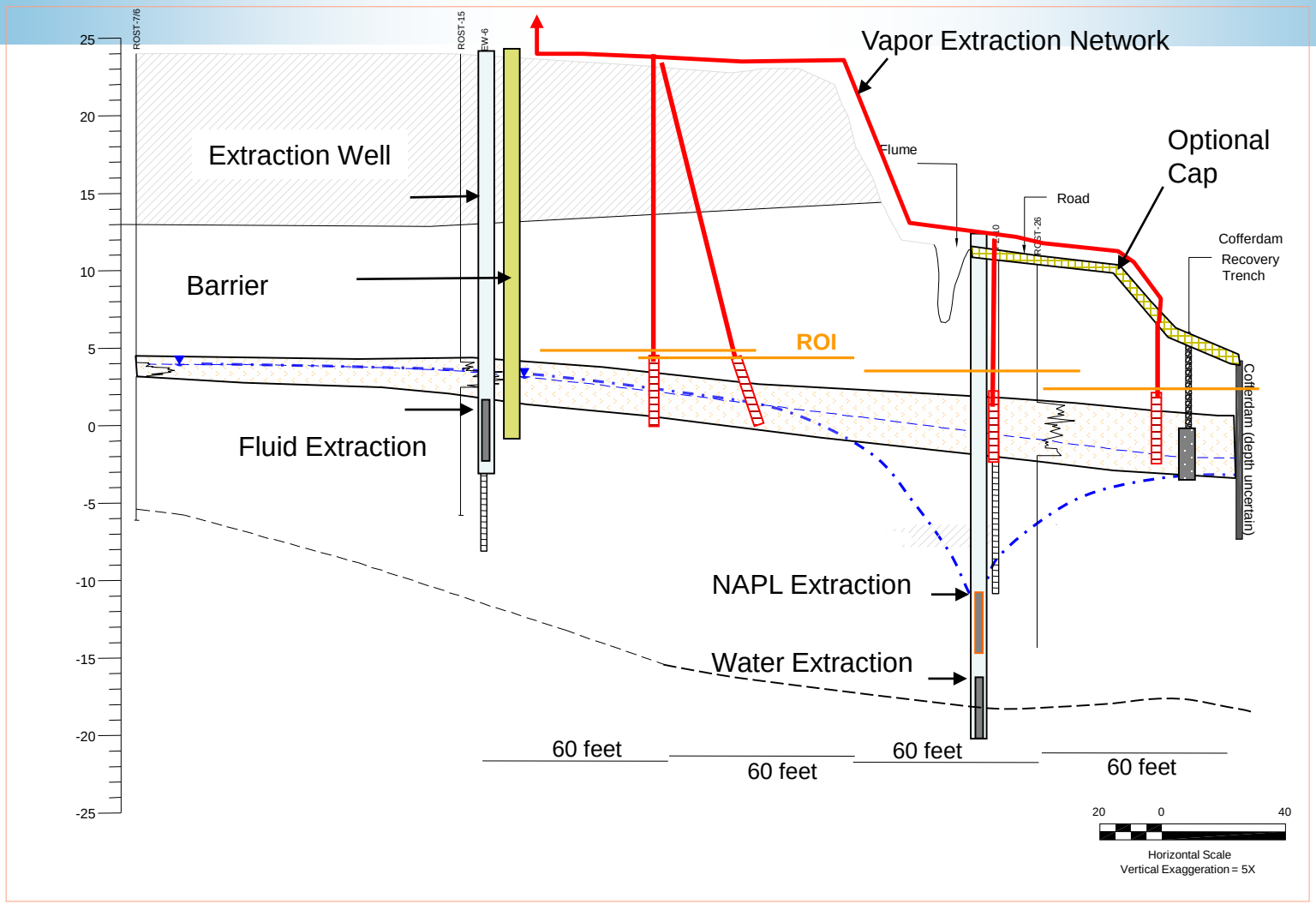
- Hydraulic gradients will be monitored continuously using transducers
- GW quality and LNAPL thickness will be evaluated quarterly for 1 year
- After 1year, semi-annual monitoring until facility final remediation goals are met or less frequent monitoring schedule is approved

Overview of Remediation Approach

Mass Removal
Soil Vapor Extraction



Refined SVE


ROST-7/6
ROST-15
EW-6
Vapor Extraction Network
Extraction Well
Flume
Optional Cap
Road
ROST-26
Cofferdam
Recovery Trench
Barrier
ROI
Cofferdam (depth uncertain)
Fluid Extraction
NAPL Extraction
Water Extraction
60 feet
60 feet
60 feet
60 feet
25
20
15
10
5
0
-5
-10
-15
-20
-25
20
0
40
Horizontal Scale
Vertical Exaggeration = 5X

IM Implementation Work Plan Format and Schedule

IM Implementation Work Plan Format and Schedule

- The IM Implementation Work Plan will be resubmitted as:

  "IM Implementation Work Plan, Rev 1"

- The revised Work Plan will be submitted to EPA on February 14, 2008

Action Items and Follow-up