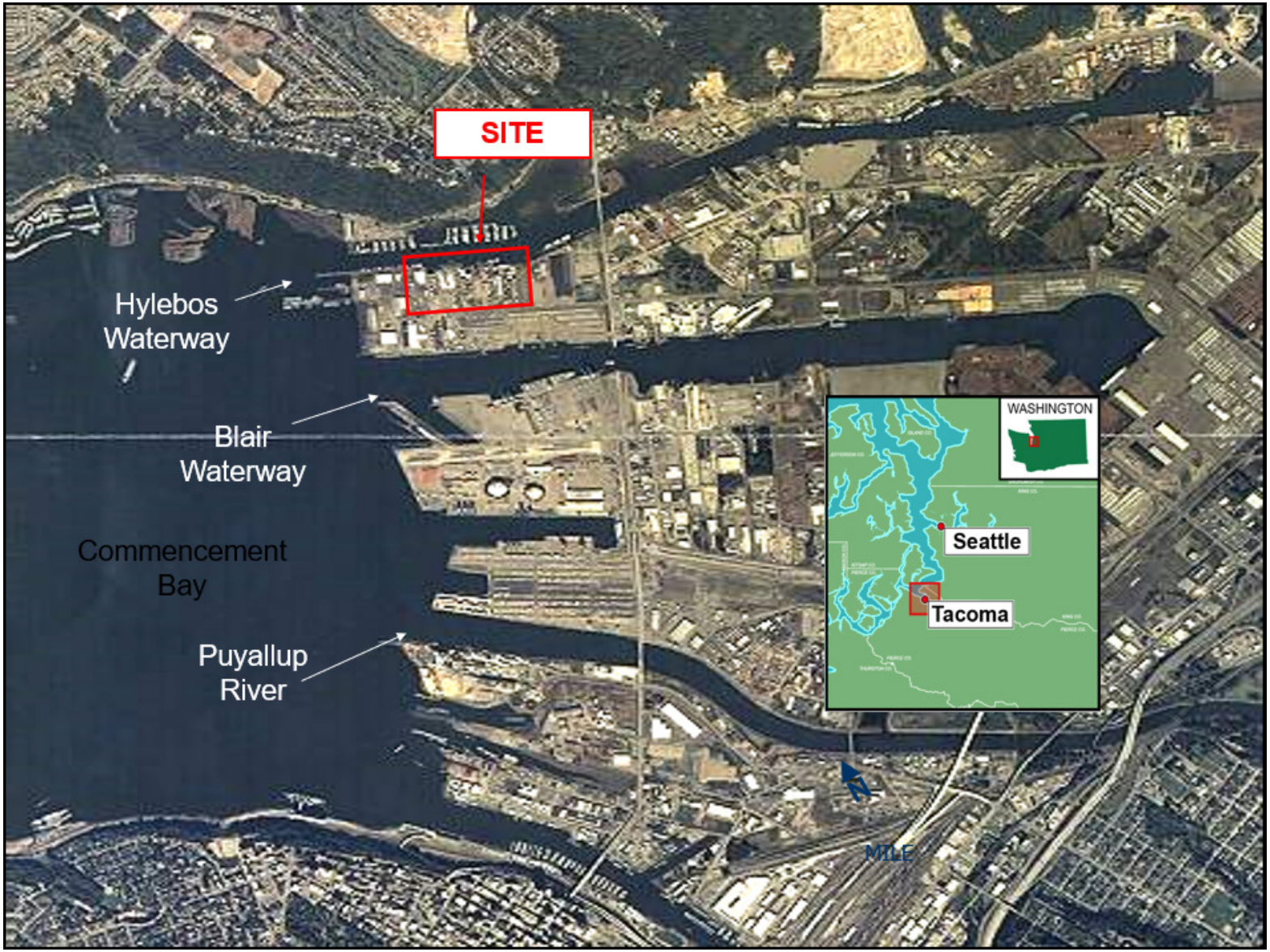
Example of Contaminated Groundwater Discharge to a Marine Waterway

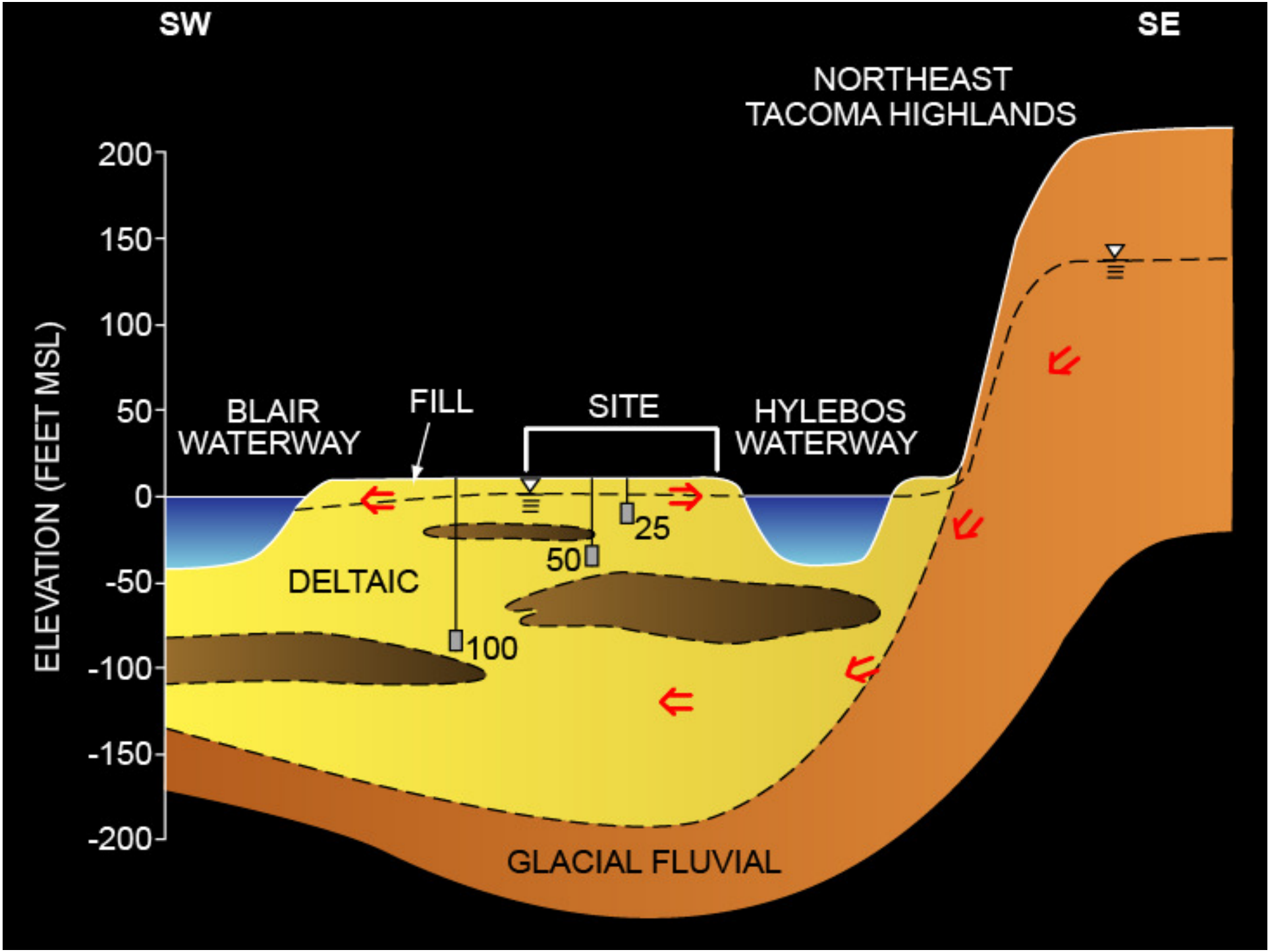
Groundwater and Surface Water Interaction Seminar

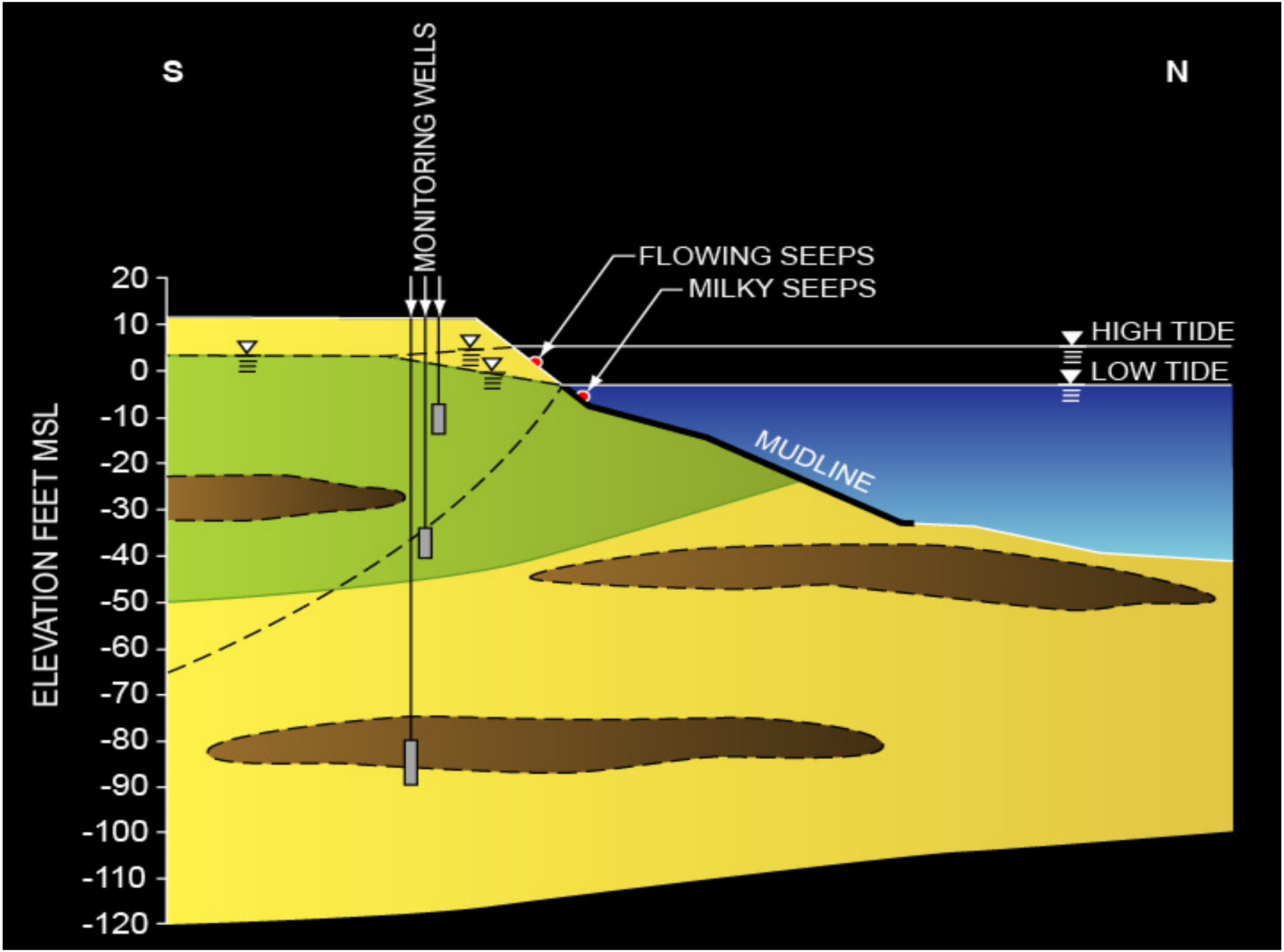
Seattle, WA November 16, 2018

Topics to Cover in 15 Minutes

- Hydrogeologic setting of the industrial site
- Groundwater discharge and tidal stage
- Fluid density and contaminant plumes
- Initial implicit conceptual site model (CSM)
- Contaminated sediment Removal Action results
- Reconnaissance sampling using dive team
- Further response actions and CSM updates


SITE
Hylebos Waterway
Blair Waterway
Commencement Bay
Puyallup River
WASHINGTON
Seattle
Tacoma
N
MILE

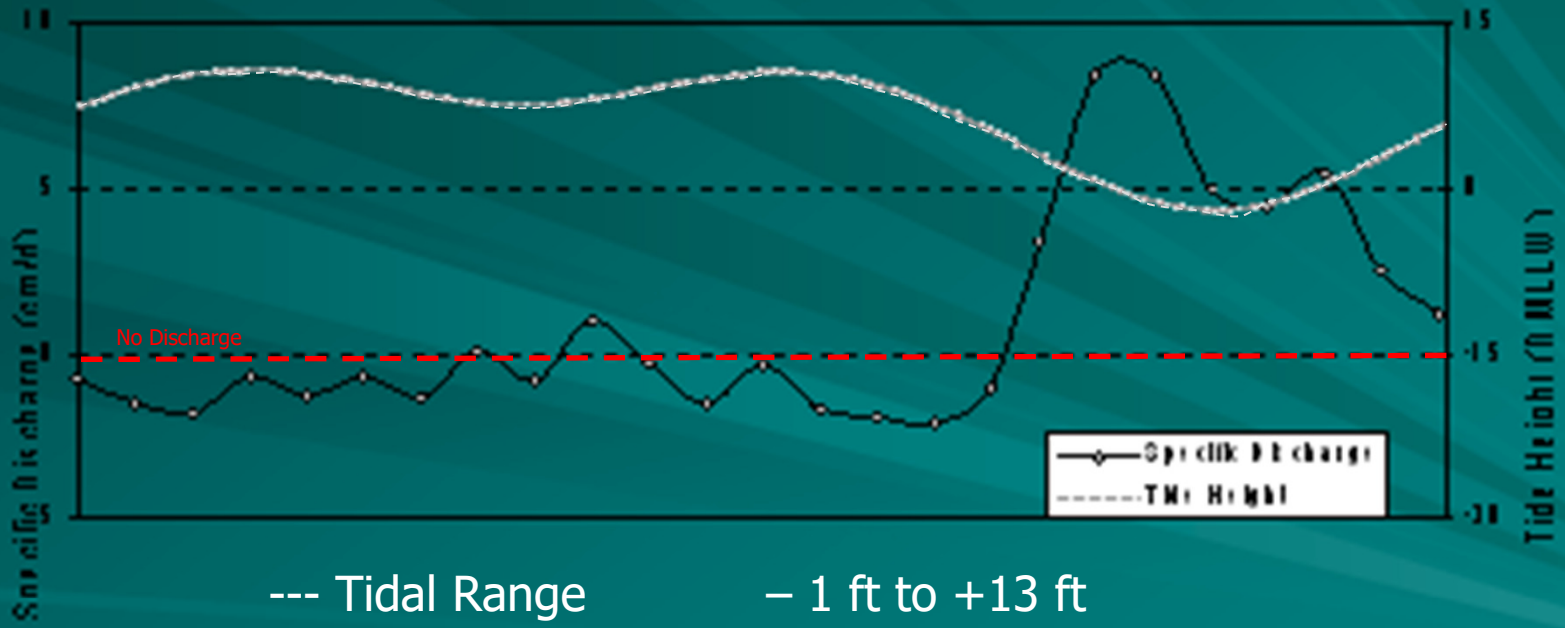

SW
SE
NORTHEAST
TACOMA HIGHLANDS
ELEVATION (FEET MSL)
200
150
100
50
0
-50
-100
-150
-200
BLAIR
WATERWAY
FILL
SITE
HYLEBOS
WATERWAY
25
50
100
DELTAIC
GLACIAL FLUVIAL


S
N
MONITORING WELLS
FLOWING SEEPS
MILKY SEEPS
HIGH TIDE
LOW TIDE
MUDLINE
ELEVATION FEET MSL
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120

Low Tide Seep Sampling

Ground Water Discharge and Tidal Stage within Hylebos Waterway

24 Hour Seepage Meter Test



--- Tidal Range – 1 ft to +13 ft
--- Specific Discharge - 2 cm/day to +9 cm/day
--- No Discharge Line

Site History

- Predevelopment – Mudflat Puyallup River Delta
- Development by dredge and fill – (1920s)
- Chlor-Alkali plant (1929-2002)
- Chlorinated solvents plant (1947-1973)
- Products - Chlorine gas, caustic soda, bleach, TCE, and PCE

Chlorinated Solvents

- TCE and PCE production (1947-1973)
- Upland releases of product, waste liquids, process waste to depths of 100+ feet
- Waterway releases – process waste disposal and spillage and ground water discharge from upland
- Degradation generates vinyl chloride

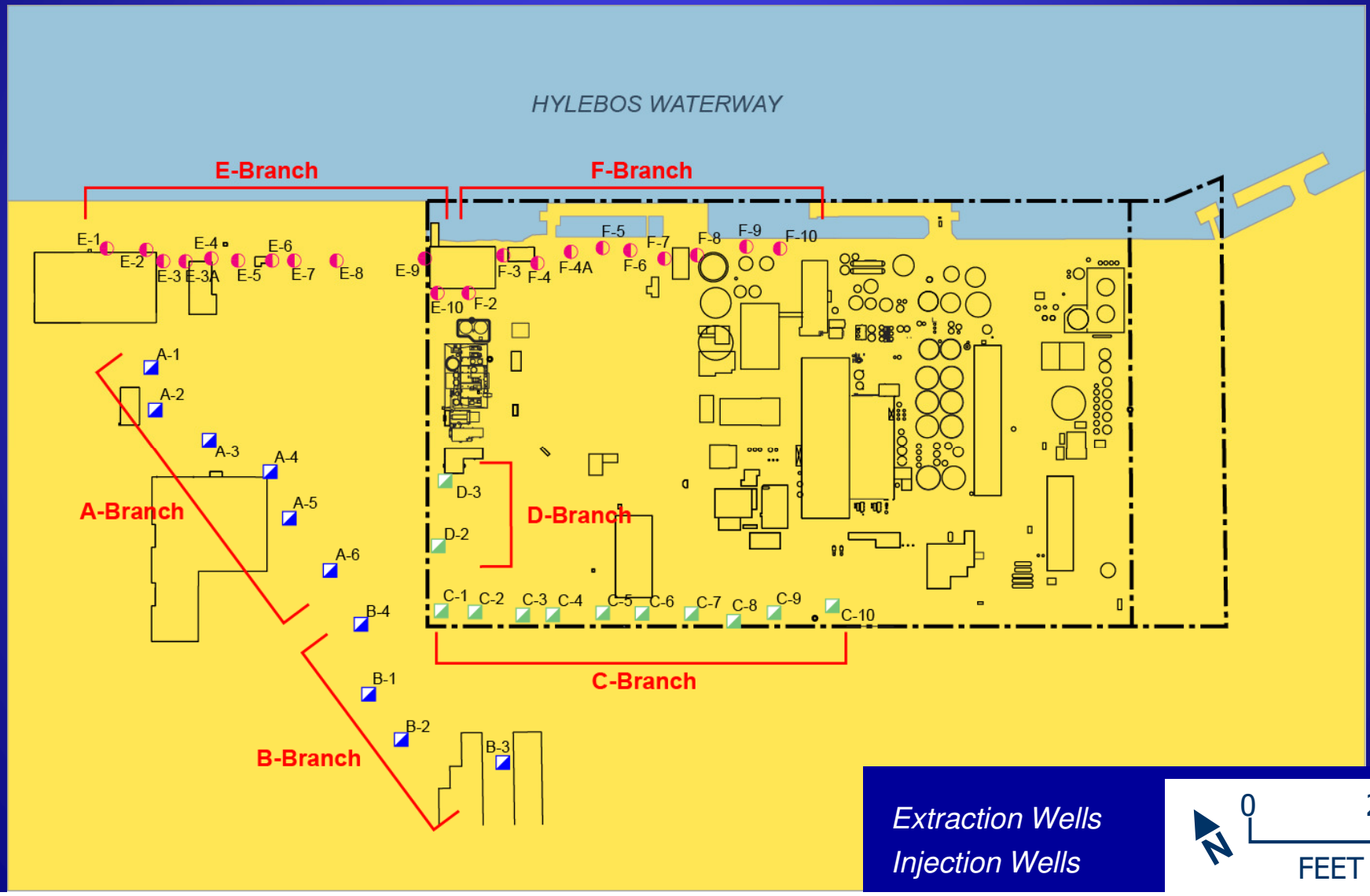
Elevated Density Sources

- **Caustic soda - NaOH**
- **Calcium hydroxide – $Ca(OH)_2$**
- **Lime process waste sludge**
- **Salt brine - NaCl**

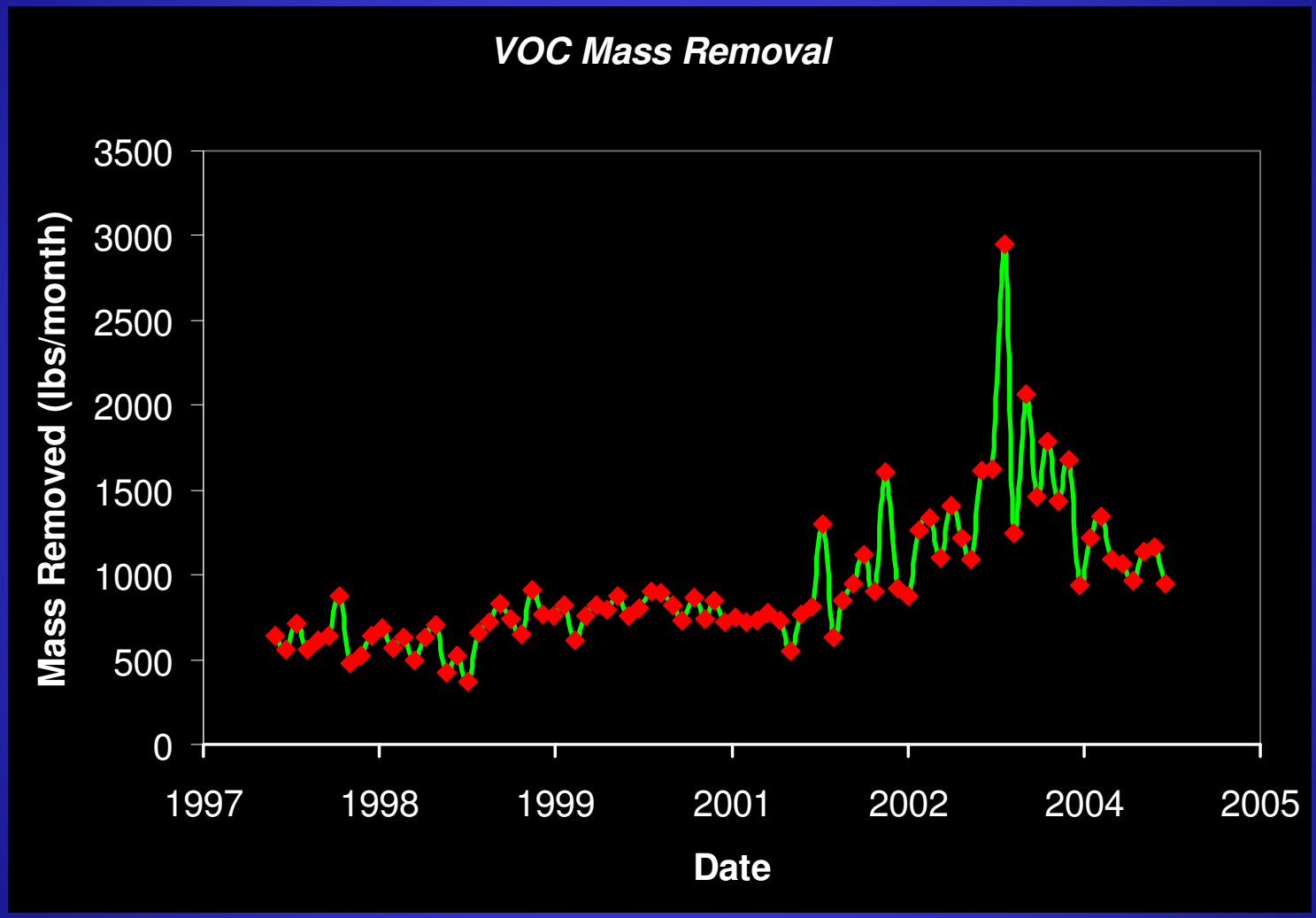
HIGH pH Ground Water Discharge to Hylebos Waterway


Pier 25
Dock 1
Dredged sediment
Dock 2
0 ft MLLW
Bulkhead area with intertidal seeps
CVOC Plume
N

Pump and treat extraction system for VOCs in operation since 1997



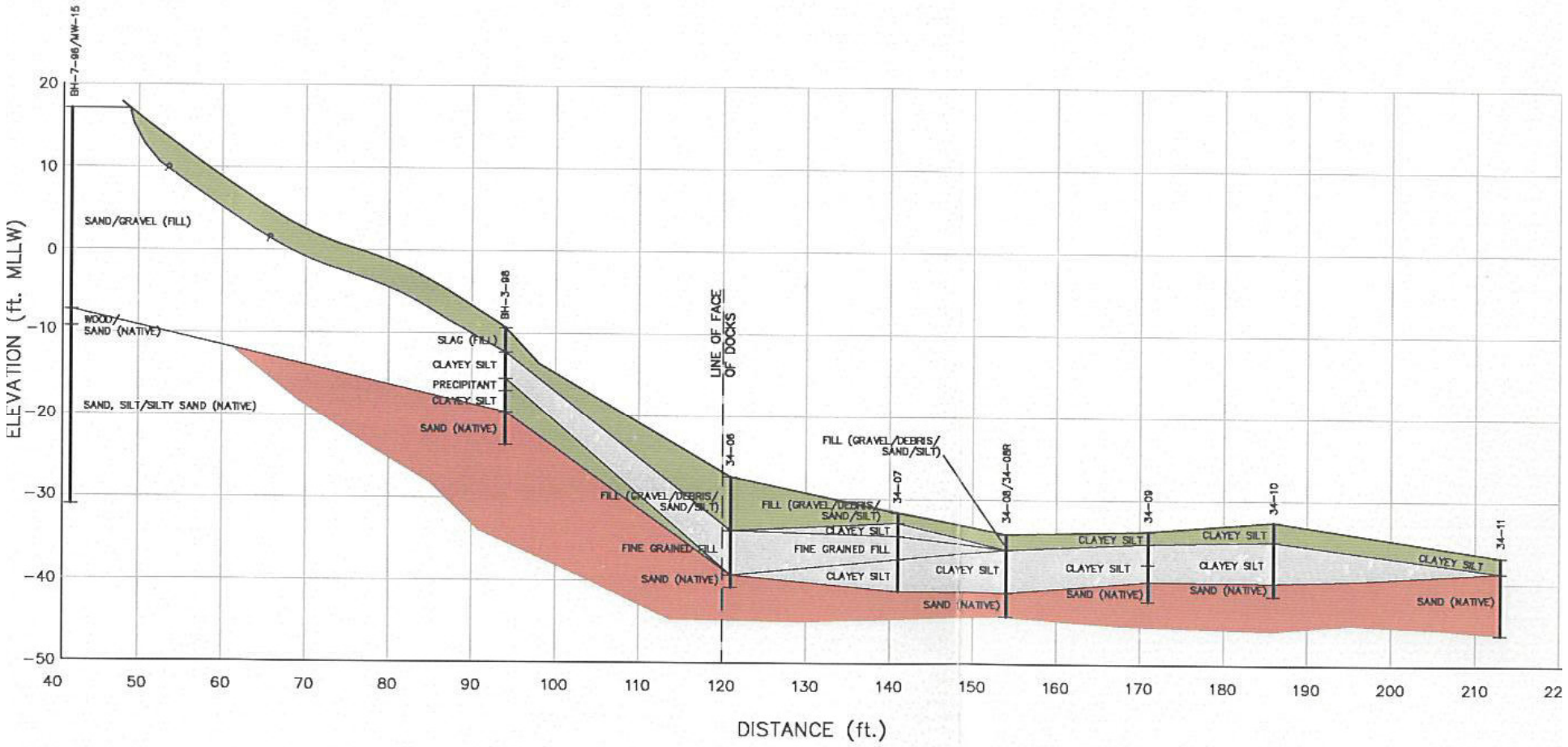
VOC Mass Removal



Total (2004) = 78,000 lbs.

New Information and Insights

- Post-dredge contaminated sediment Removal Action characterization beneath waterway
- Reconnaissance groundwater quality sampling just beneath waterway sediment surface
- Subsequent upland and subtidal drilling/sampling to characterize nature/extent of contamination



CROSS SECTION 3

SCALES: HORIZ. 1"=20'
VERT. 1"=20'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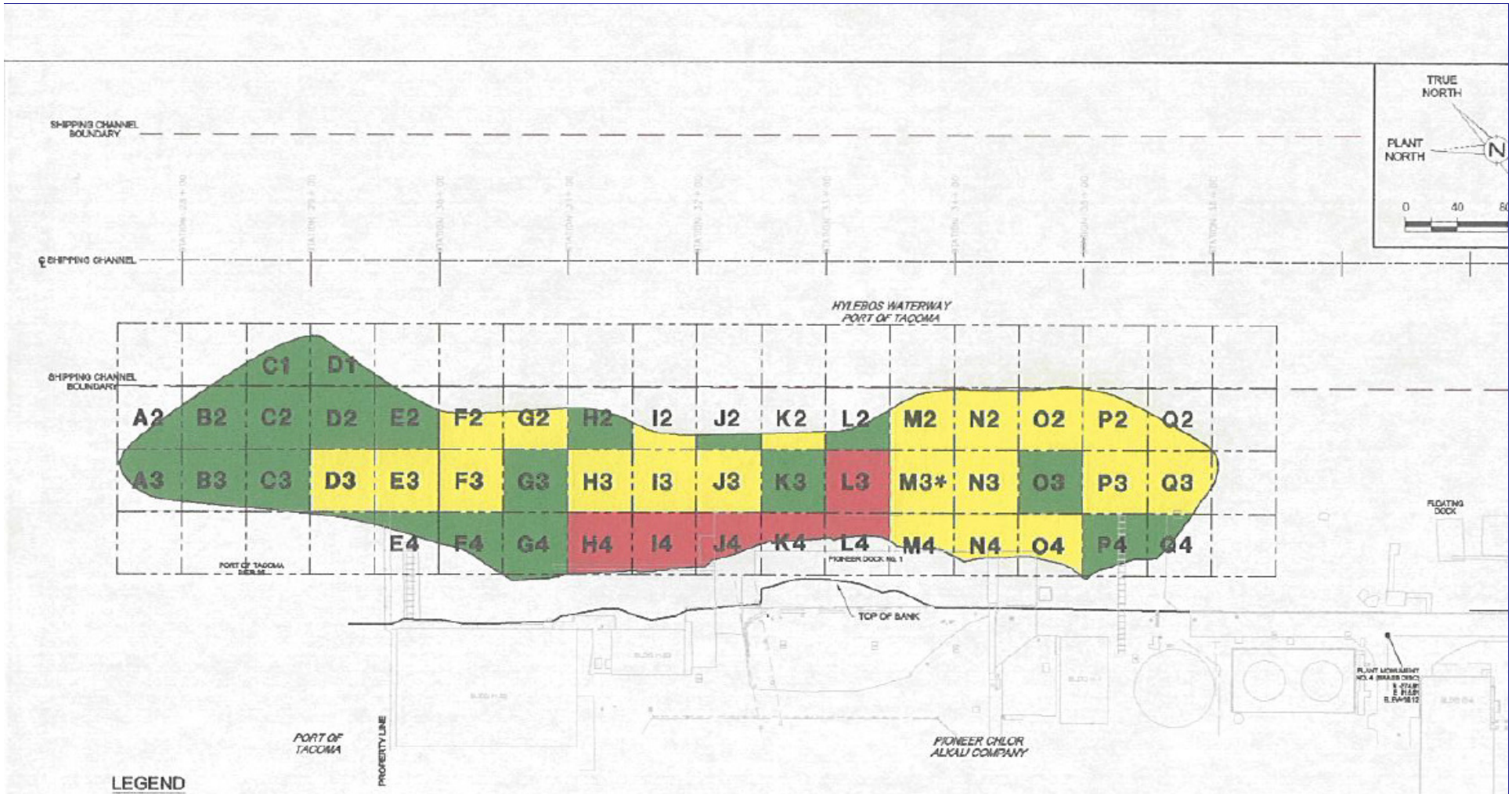


LEGEND

- GRIDS PASSING TREATMENT CRITERIA (TCE < 2.85 mg/kg, PCE < 28.60 mg/kg)
- GRIDS PASSING SLIP 1 DISPOSAL CRITERIA (TCE < 176 mg/kg, PCE < 64 mg/kg)
- GRIDS NOT PASSING SLIP 1 DISPOSAL CRITERIA (TCE > 176 mg/kg, PCE > 64 mg/kg)
- * GRIDS PASSING SLIP 1 DISPOSAL CRITERIA BASED ON CORING DATA

NOTE

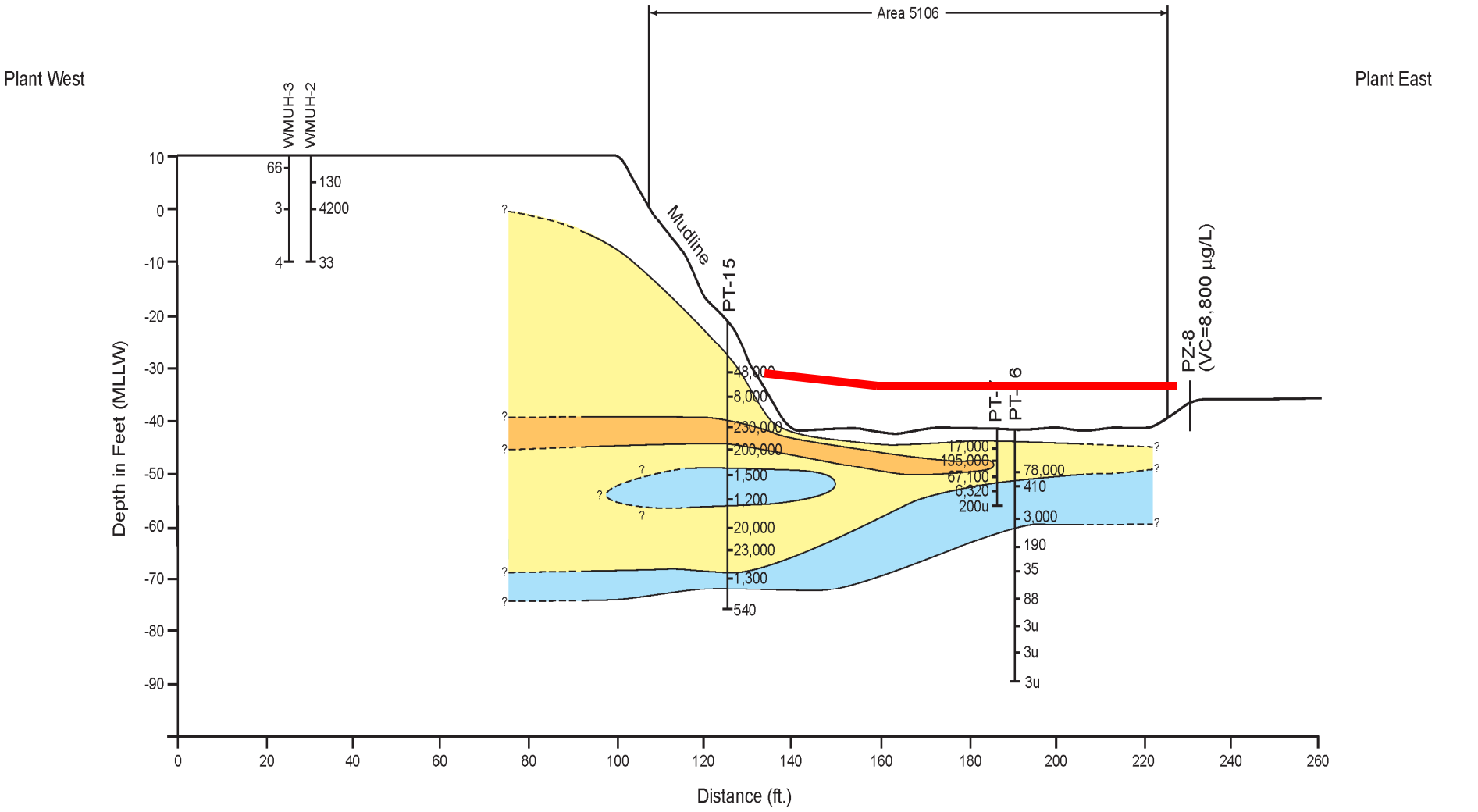
SEE TABLES 1 AND 2 FOR SUMMARY OF ANALYTICAL DATA

figure 2

DREDGING GRID COMPLIANCE
AREA 5106 REMOVAL ACTION
OCC Tacoma, Inc, Tacoma, Washington

07431-00(WILL002)GN-NF001 MAR 06/2003

Post-Removal Action Cross Section of PCE in Sediment



Groundwater Sampling Beneath Waterway

- Conducted during lowest tides June-August 2004
- Collaborative effort between EPA and Ecology
- Nine temporary shallow piezometers installed by divers along subtidal slope with tubing to boat
- Piezometers developed using peristatic pump and field parameters stabilized prior to sampling


US ENVIRONMENTAL PROTECTION AGENCY
RESEARCH
ALMAR
1 12:46 PM

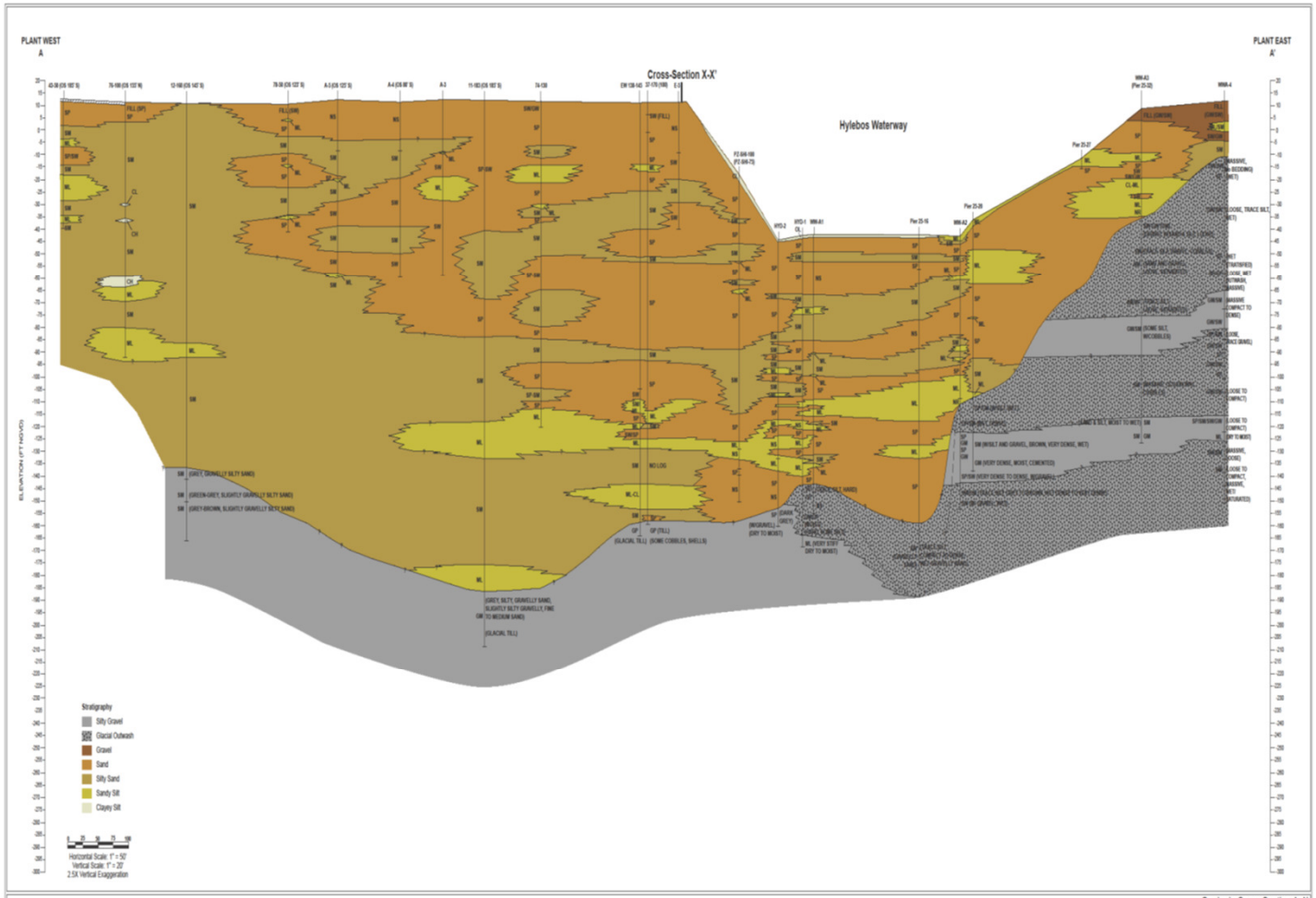

30 2:23 PM

Summary of Results and Interpretation

- One or more groundwater regulatory thresholds exceeded in each temporary piezometer
- Highest concentrations: TCE (180,000 ug/L), PCE (15,000 ug/L), VC (8800 ug/L), HCBD (19 ug/L)
- Flow paths through upland and in-water source materials thought to extend to middle of channel

AOC Statement of Work

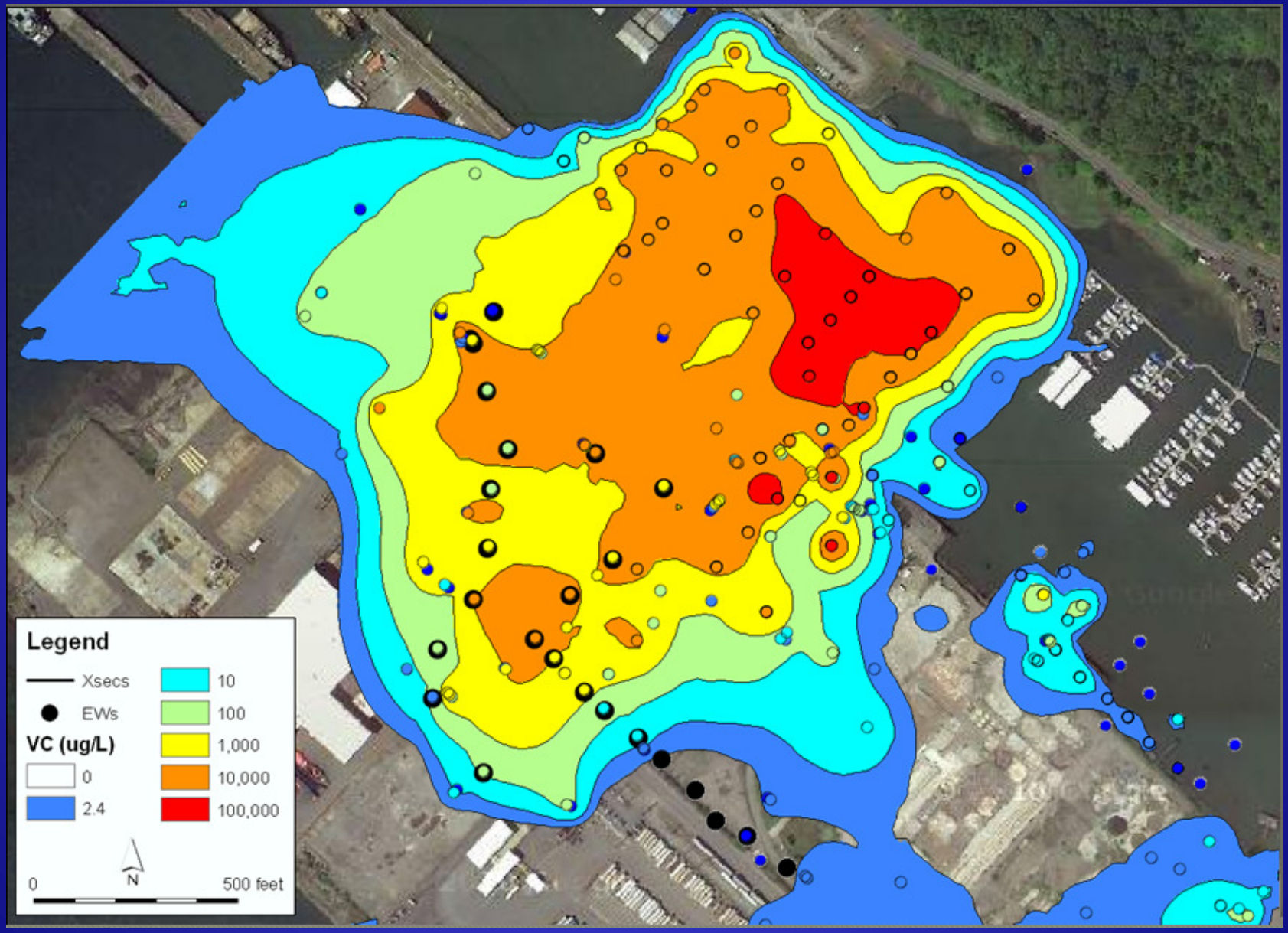
- Determine nature/extent of contamination upland and beneath the waterway
- Characterize the flow of ground water and contaminants to waterway
- Develop remedial alternatives for soil, groundwater and sediment
- Pilot test pH neutralization techniques
- Design remedy selected by the agencies



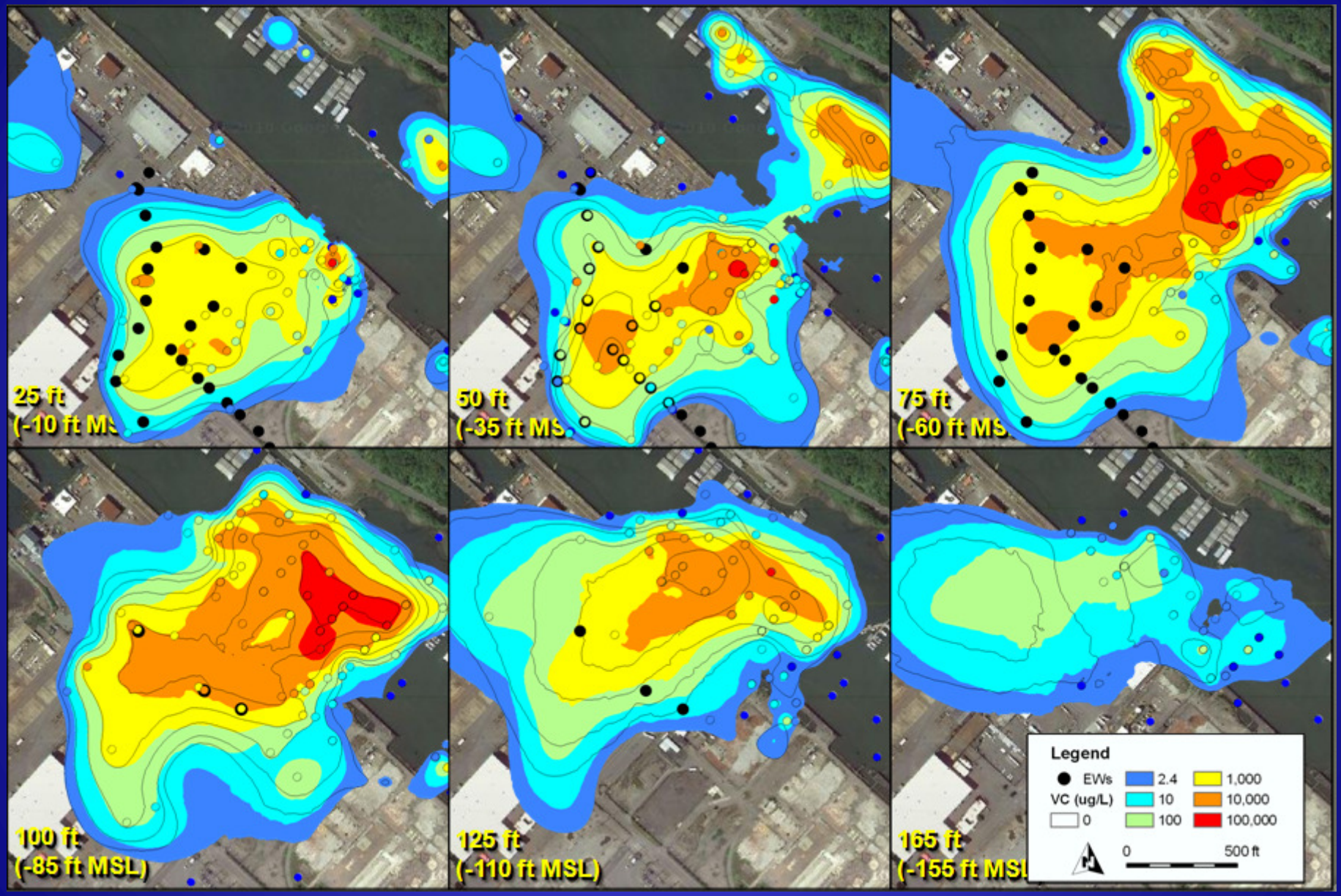
Geologic Cross-Section A-A'

Figure
4

Vinyl chloride contours



DRAFT – contours based on data provided by CRA and contoured by Weston Solutions



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Questions?

Jonathan Williams

(206) 553-1369