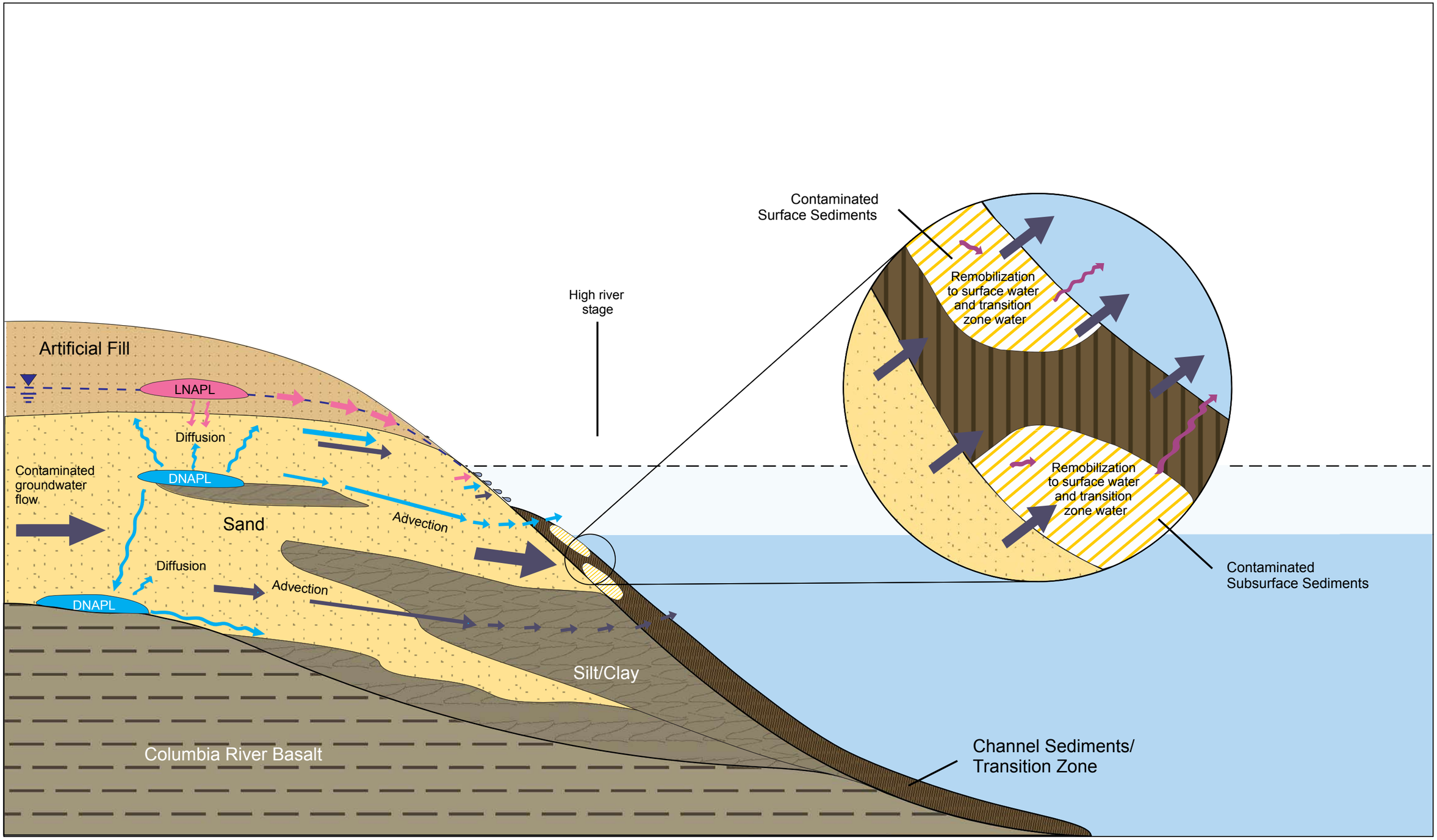
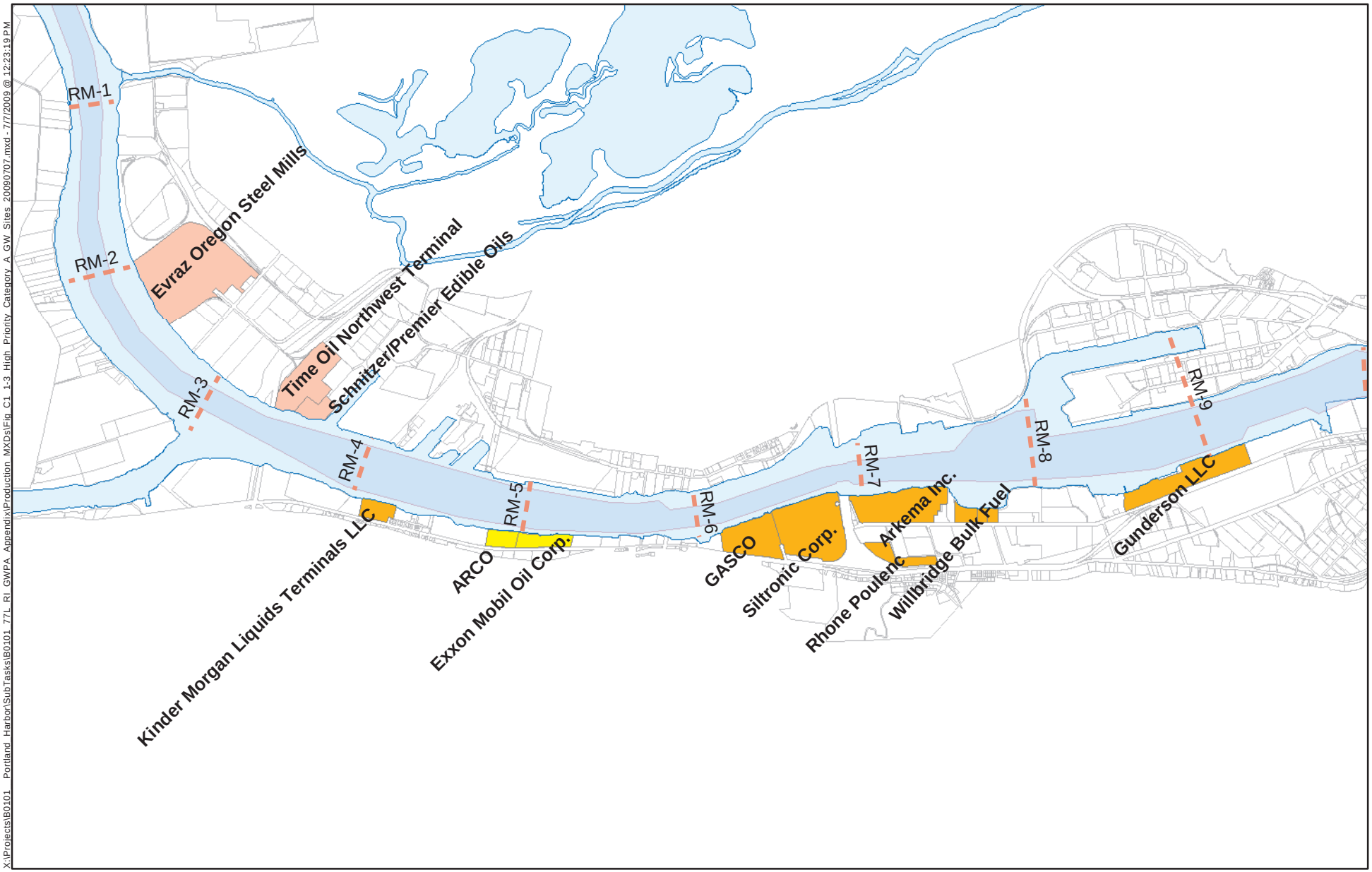


Transport of LNAPL and dissolved LNAPL constituents
Transport of DNAPL
Groundwater flow paths

Figure C1.1-1
Portland Harbor RI/FS
Remedial Investigation Report
Physical Conceptual Model of Transport Processes to the River



FEATURE SOURCES:
Transportation, Property, or Boundaries: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

0 1,500 3,000
Feet

N

Member Site
Non-member Site
Site Not Investigated in the GWPA

Figure C1.3-1
Portland Harbor RI/FS
Remedial Investigation Report
High Priority Category A Sites

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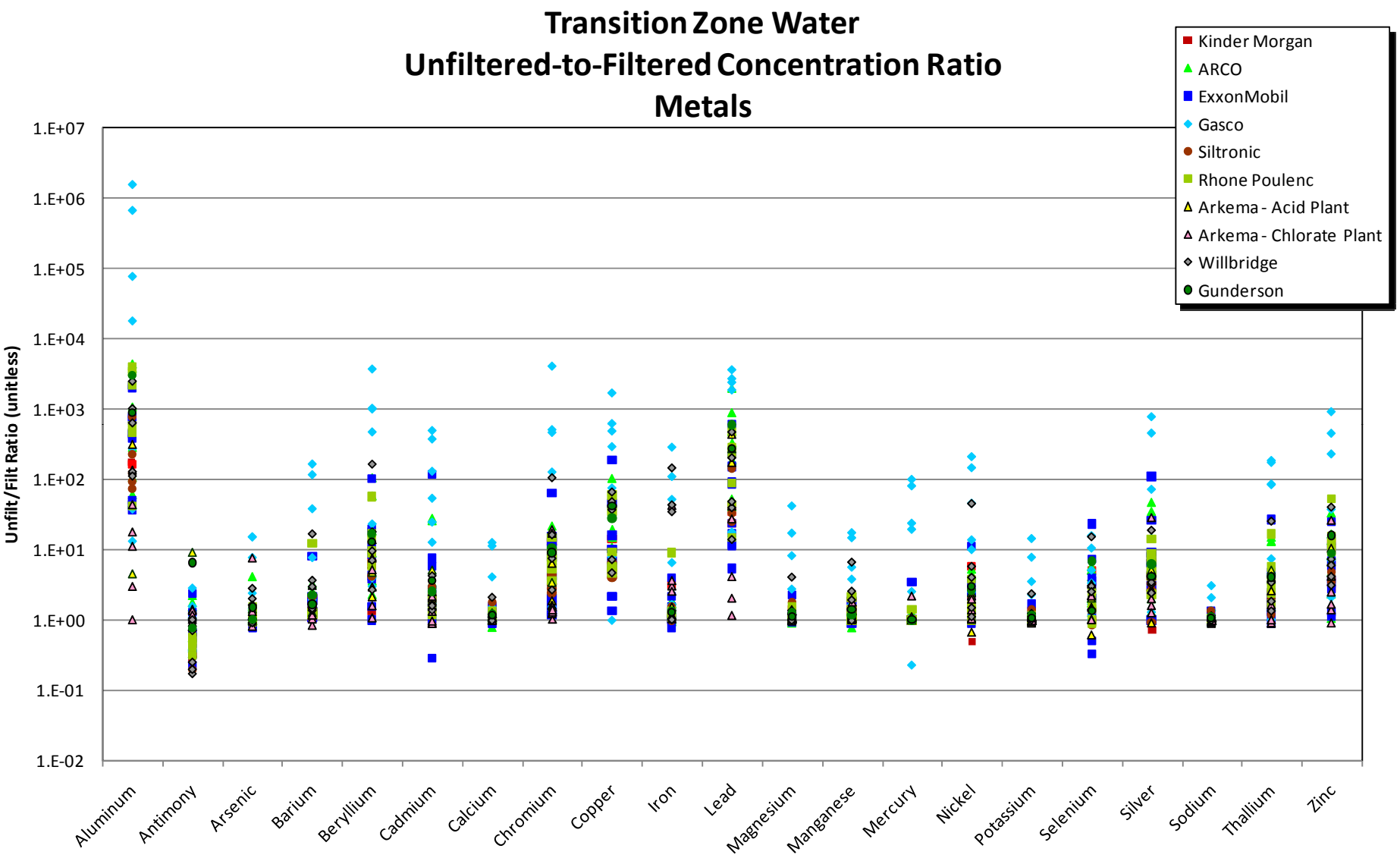


Figure C3.0-1
Portland Harbor RI/FS
Remedial Investigation Report
Scatter Plot of Unfiltered/Filtered Concentration Ratios
Metals – All TZW Sites

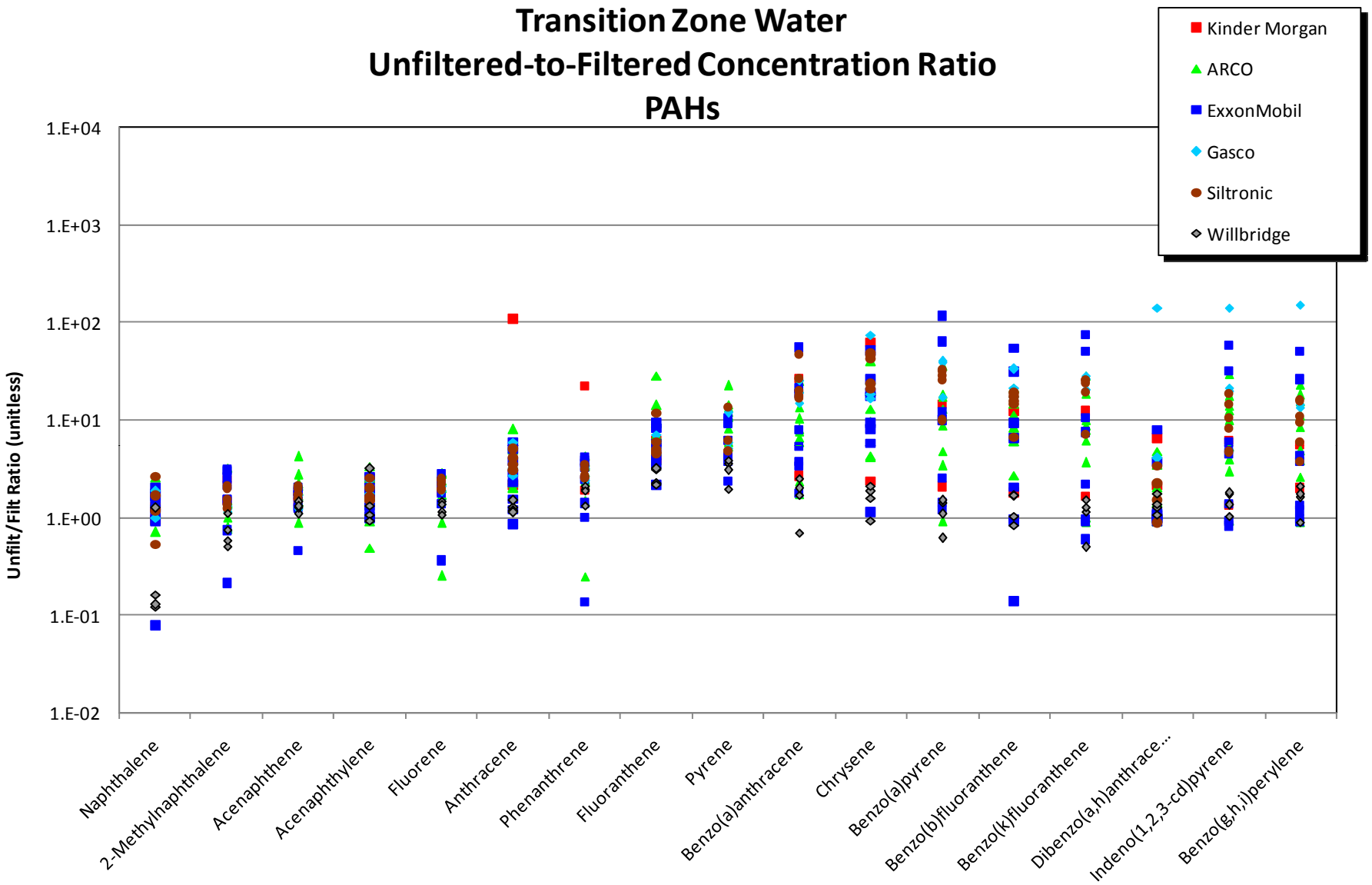


Figure C3.0-2
Portland Harbor RI/FS
Remedial Investigation Report
Scatter Plot of Unfiltered/Filtered Concentration Ratios
PAHs – All TZW Sites

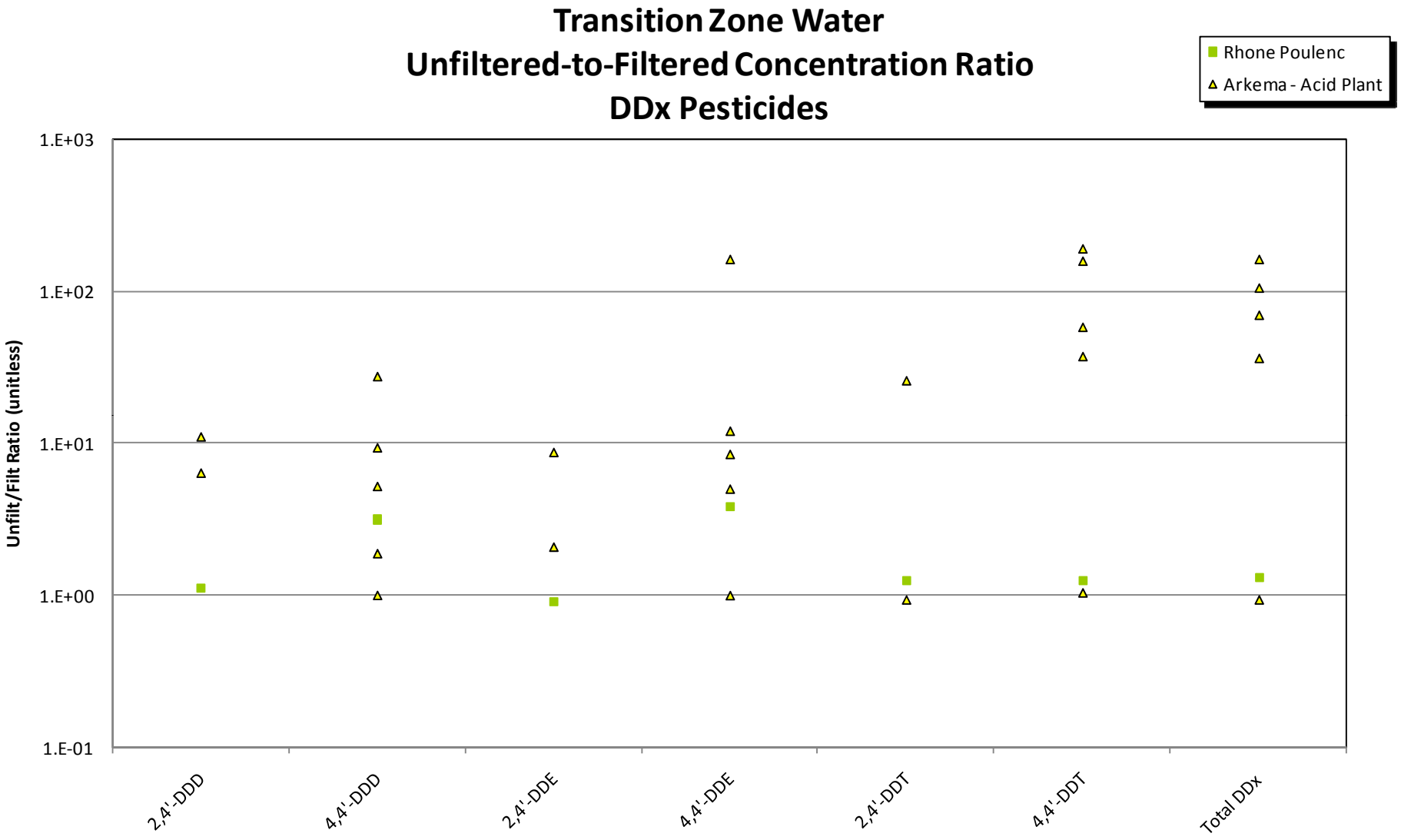
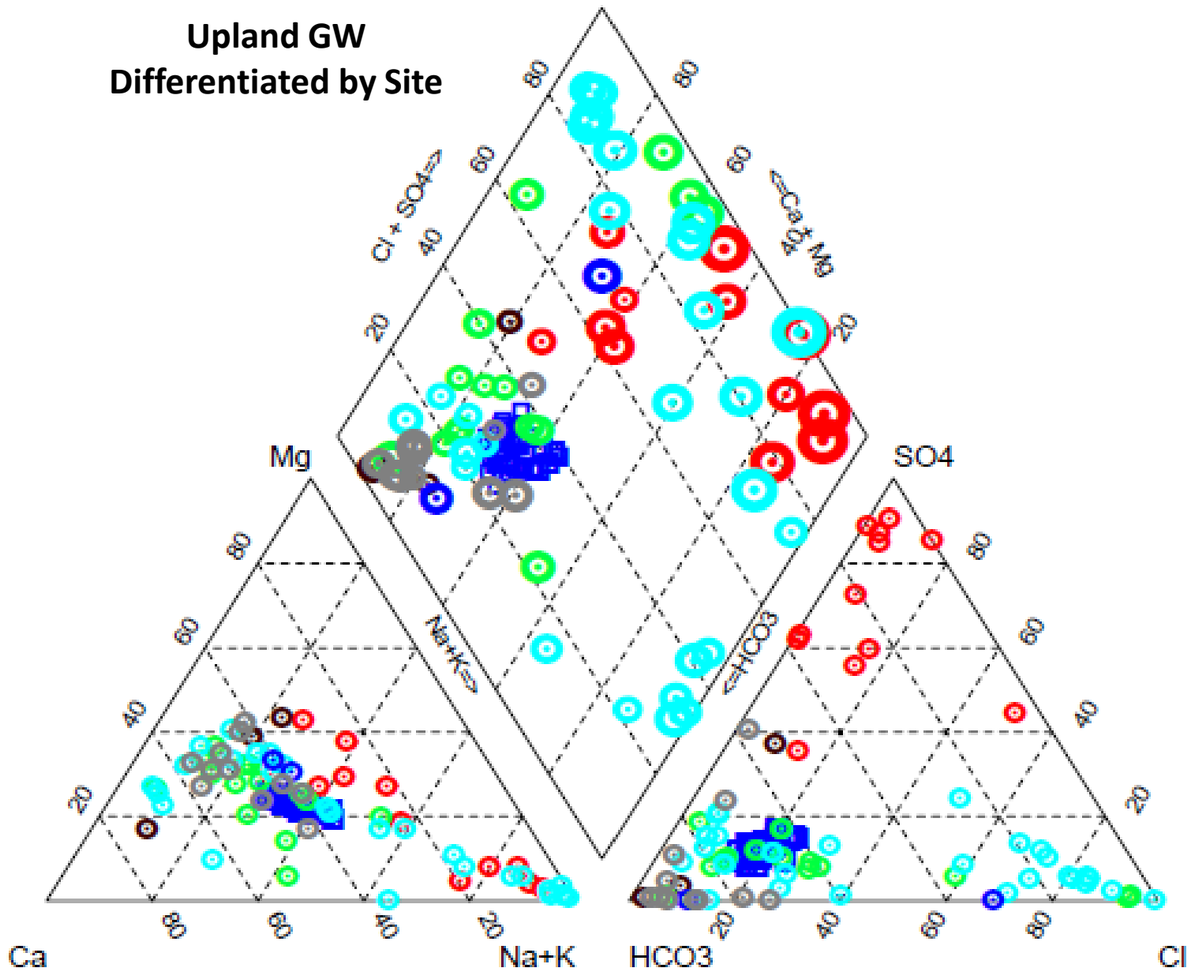
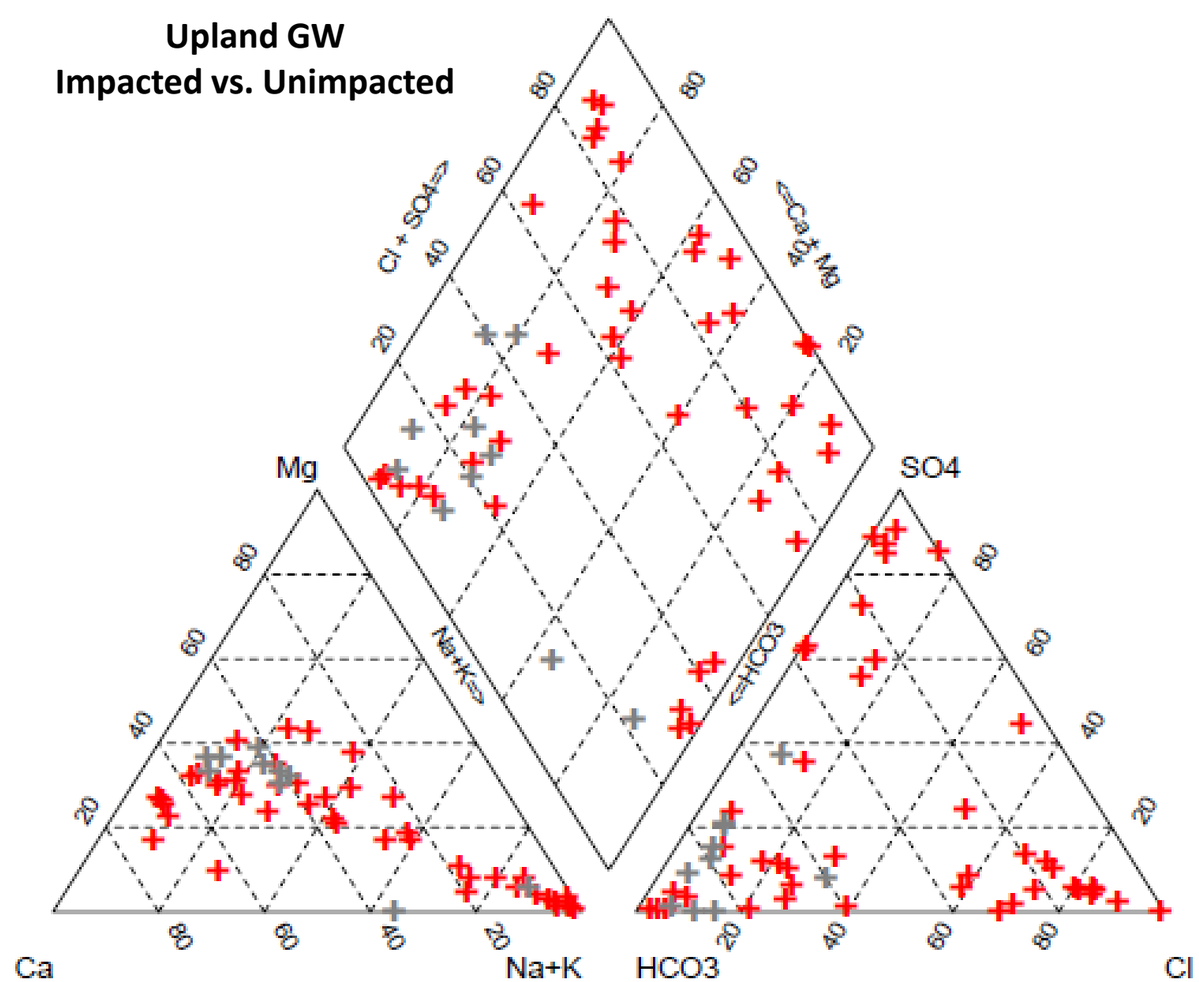


Figure C3.0-3
Portland Harbor RI/FS
Remedial Investigation Report
Scatter Plot of Unfiltered/Filtered Concentration Ratios
Pesticides – All TZW Sites





- ARCO
- Arkema
- ExxonMobil
- Gasco
- Gunderson
- Kinder Morgan
- Rhone Poulenc
- Siltronic
- Willbridge
- Willamette R. Surface Water

Scale of radii log-proportional to TDS: (mg/L)

10 – 1,000,000

- GW with Undetected COIs
- GW with Detected COIs

Figure C3.0-4
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram – Comparison of Major Ion Chemistry in Upland Groundwater, All Sites

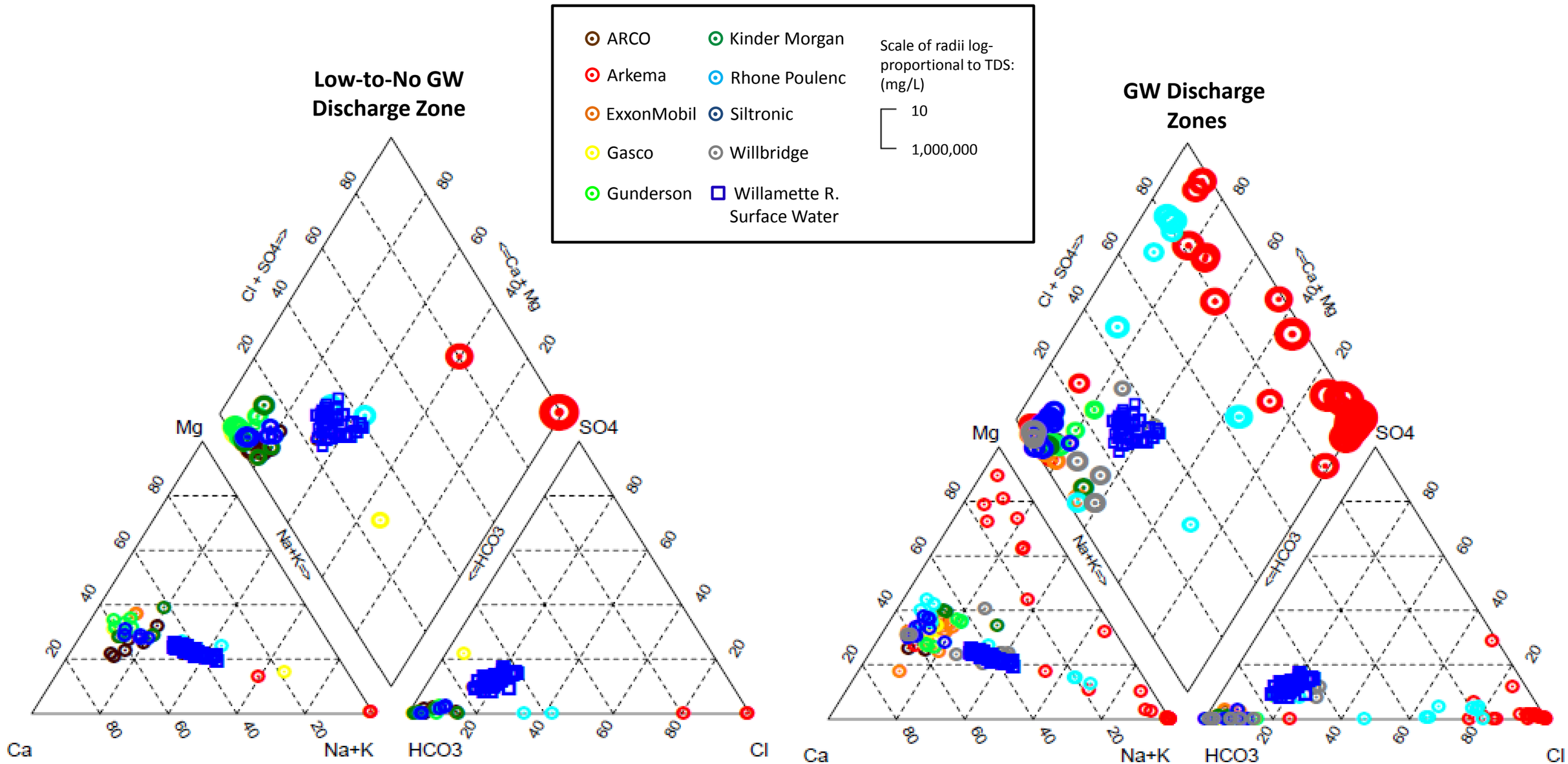
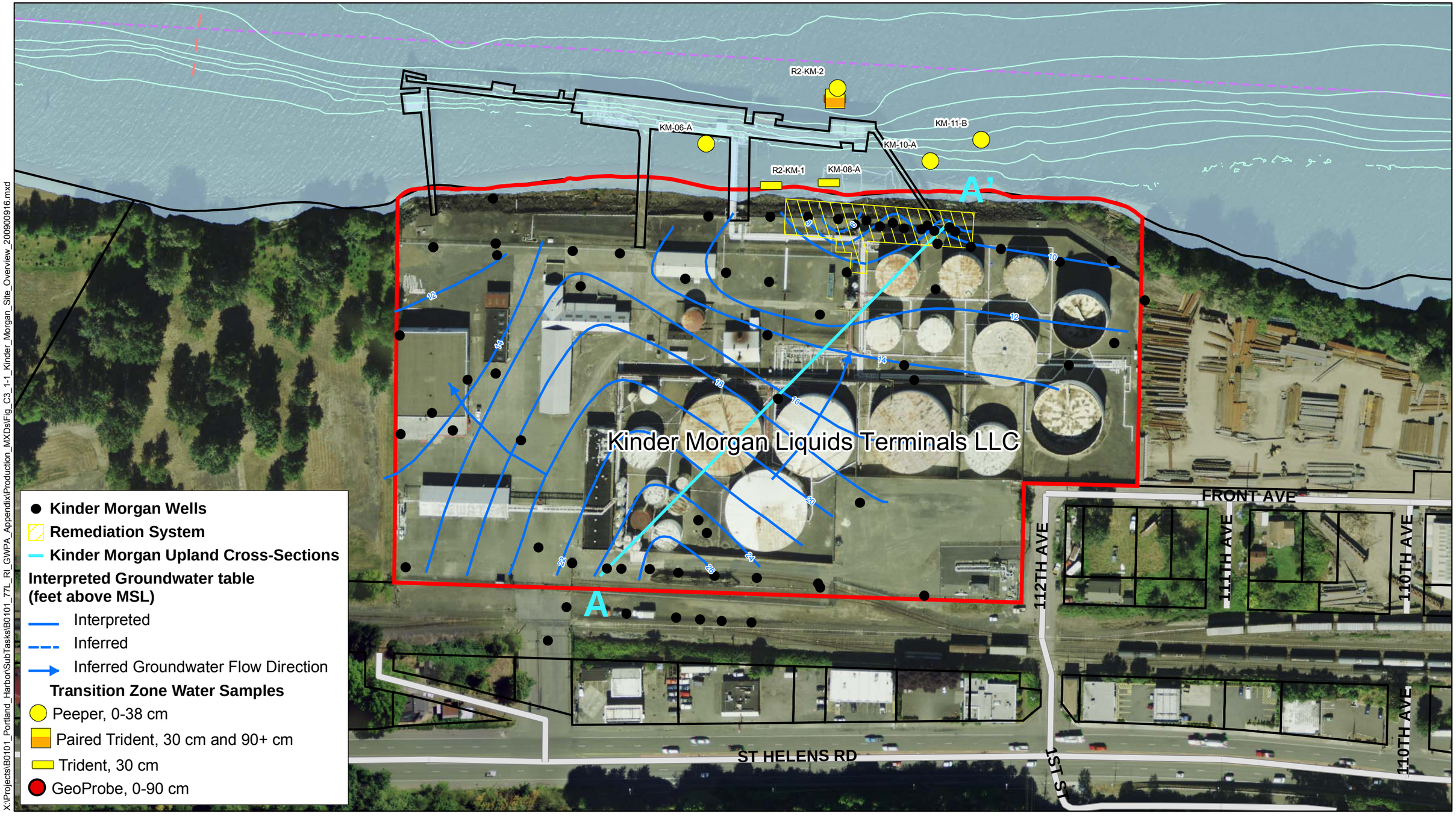


Figure C3.0-5
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram – Comparison of Major Ion Chemistry in TZW, All Sites



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LEGEND

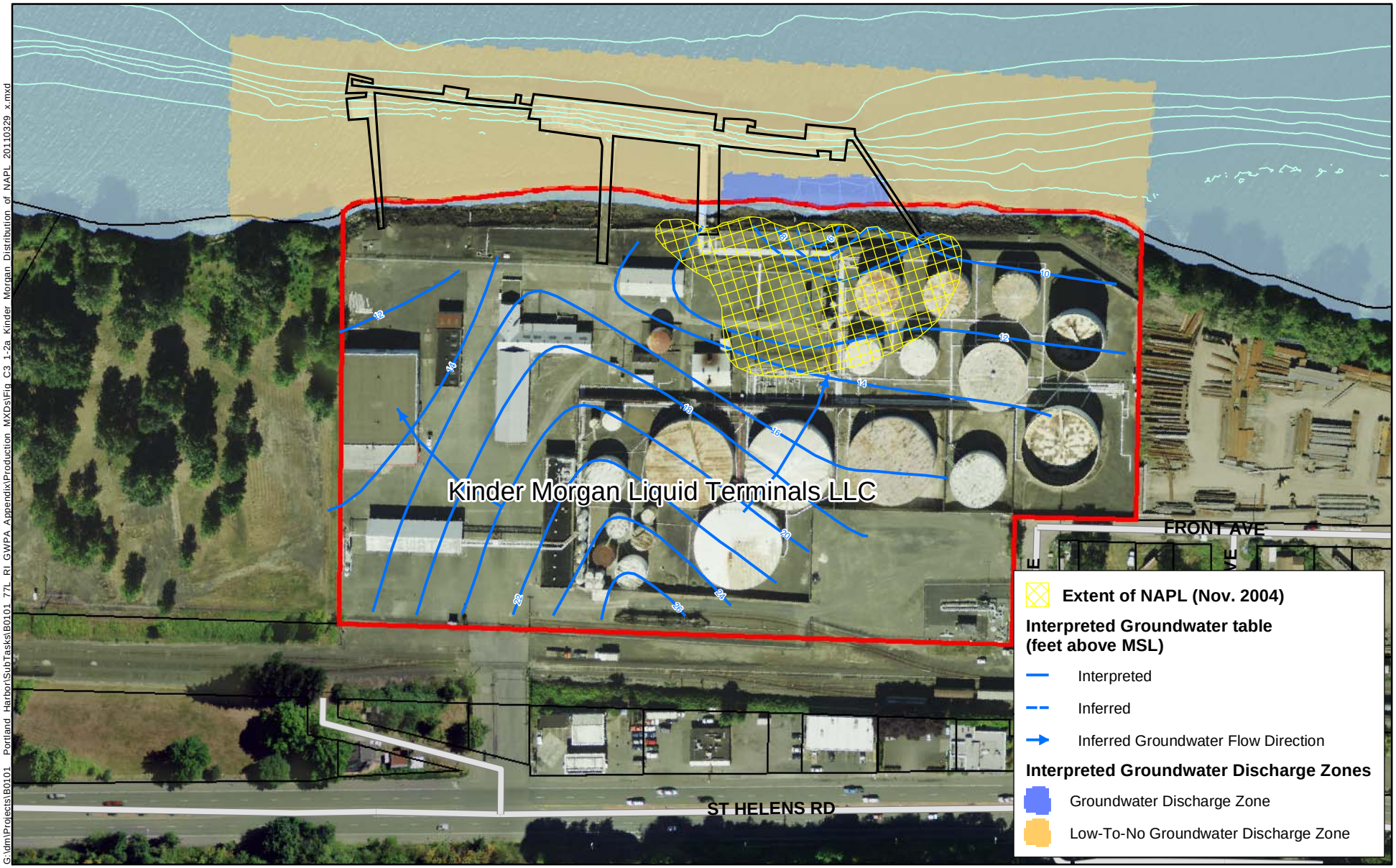
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Remediation System: locations are approximate and drawn from Delta (Delta Environmental Consultants, Inc.). 2005b. Lower Willamette Group Round 2 Groundwater Pathway Assessment FSP – Data Request, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal (DEQ ECSI Number 1096). March 4, 2005.
Groundwater Contours: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-1
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Overview and Cross Section Location



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Well Data: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-2a
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Distribution of NAPL in Upland Groundwater

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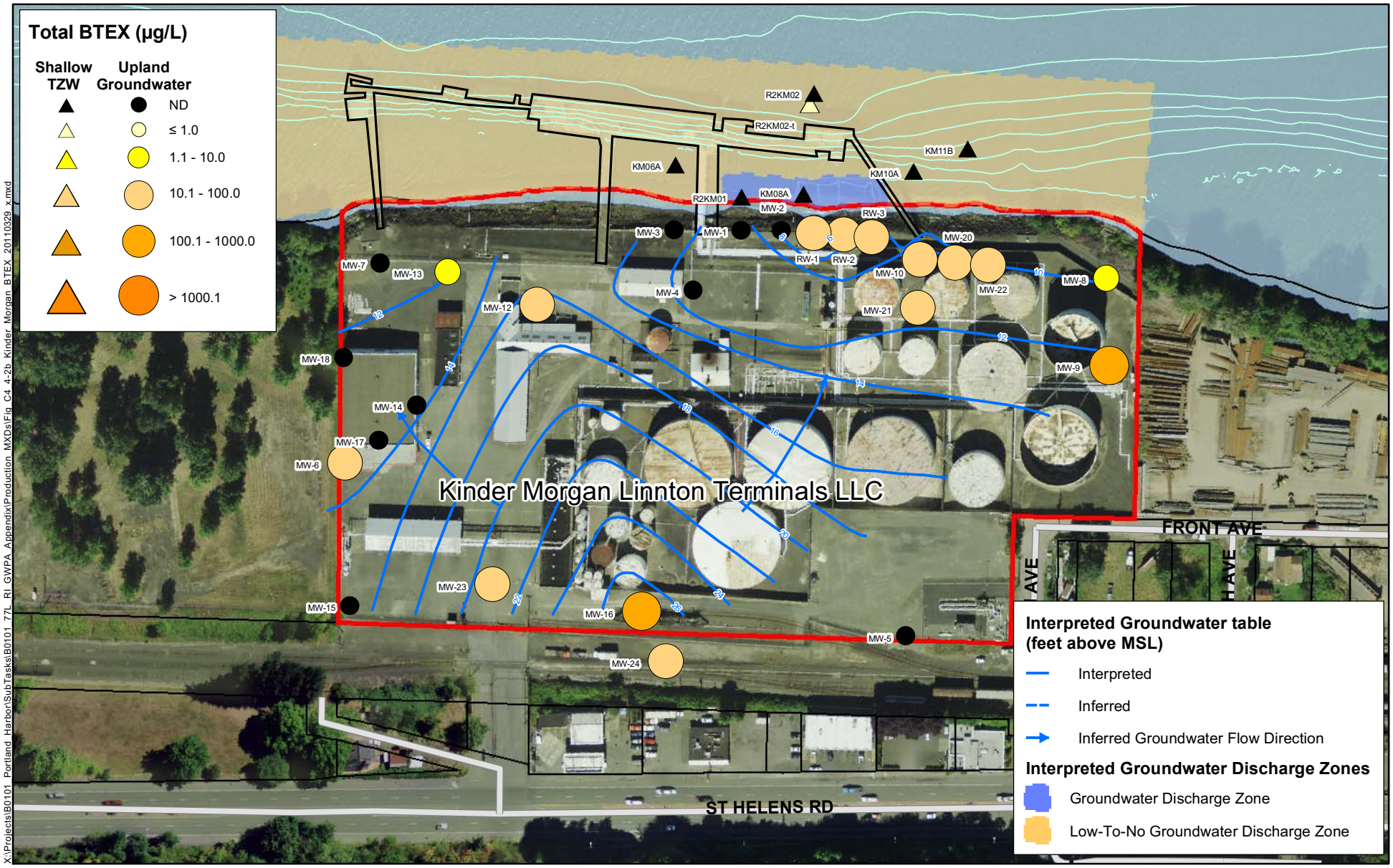

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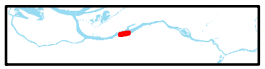
LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

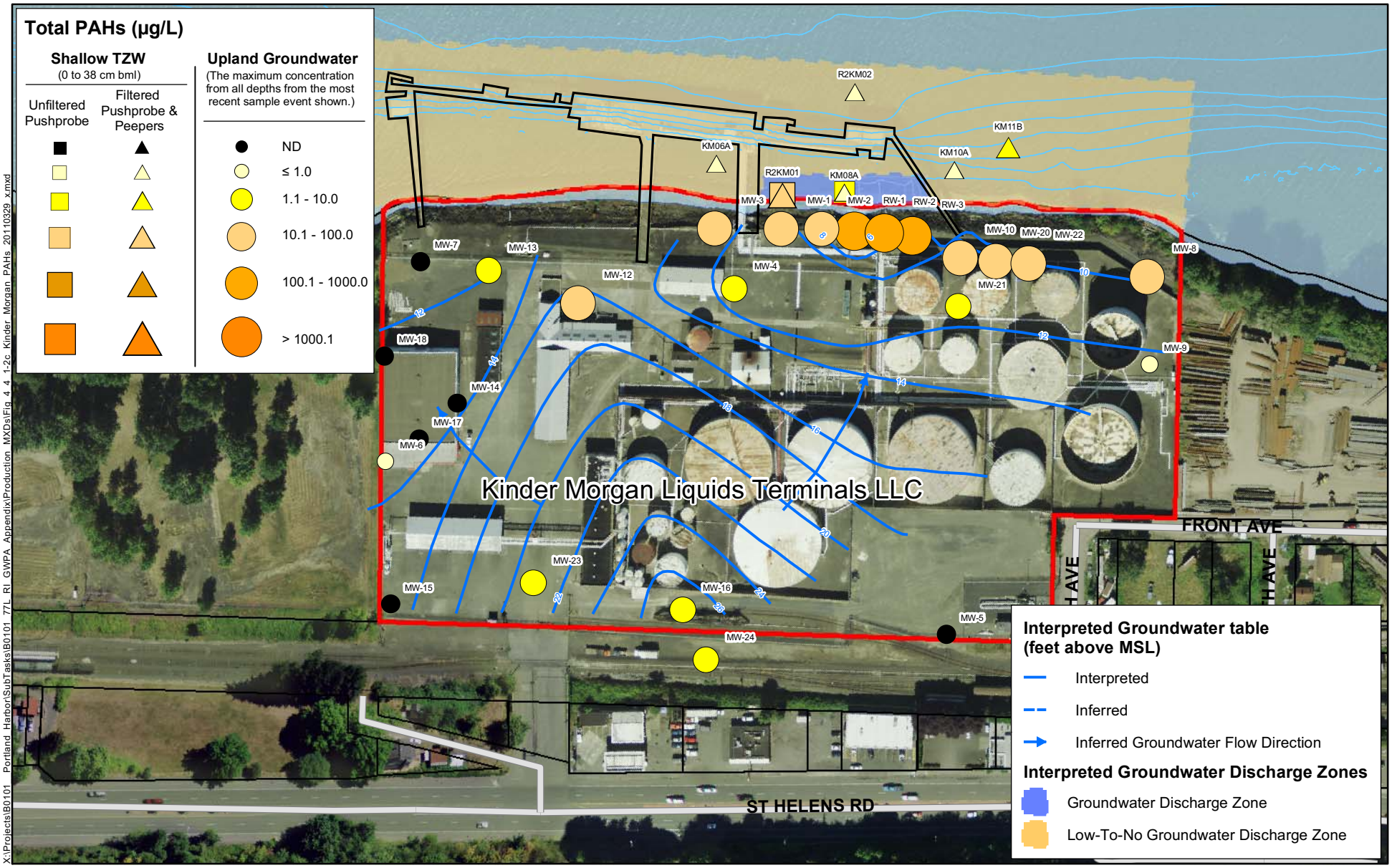
0 50 100
Feet

N



FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Well Data: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-2b
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Total BTEX in Upland Groundwater and Shallow TZW



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

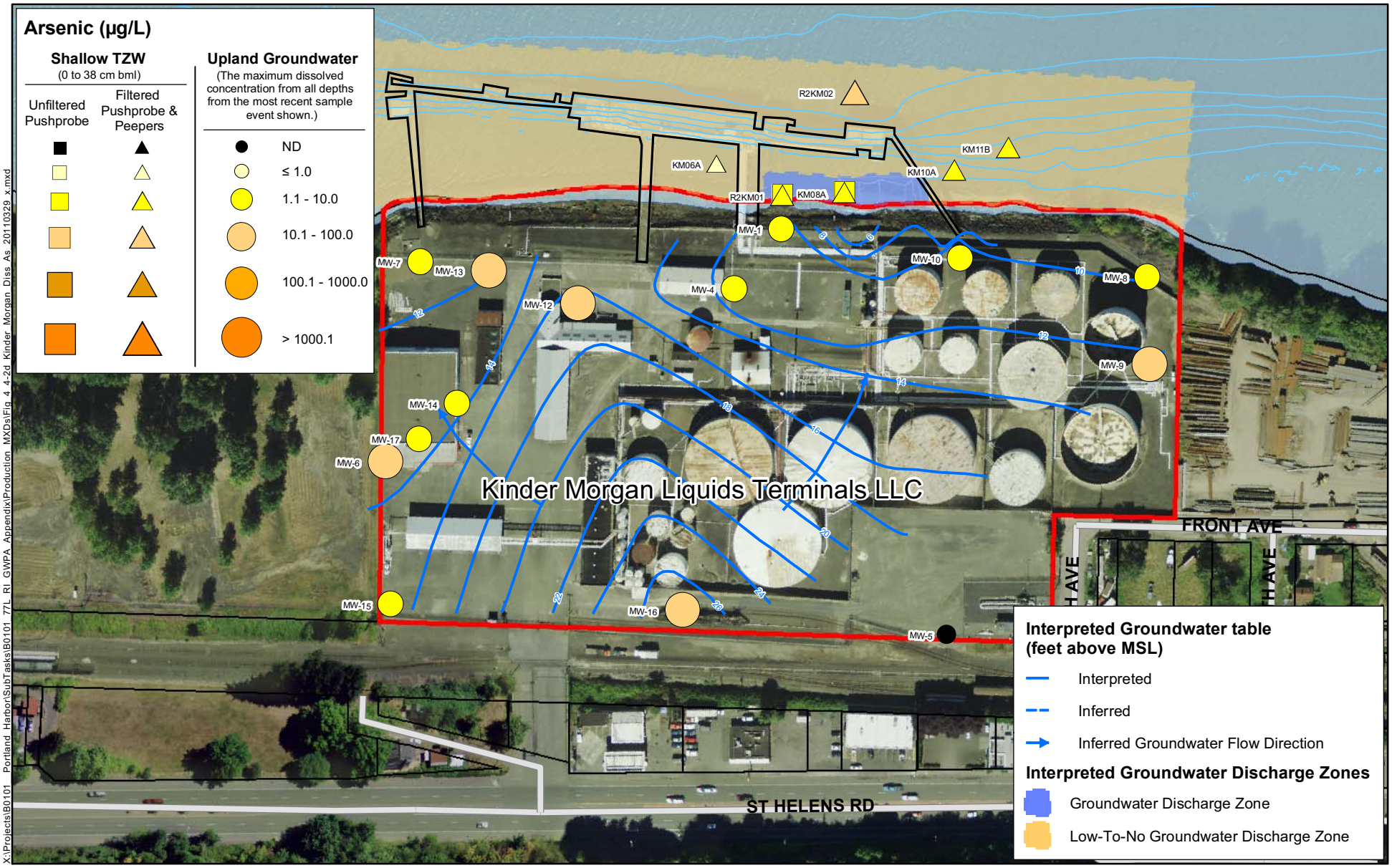
Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Well Data: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-2c
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Total PAHs in Upland Groundwater and Shallow TZW



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

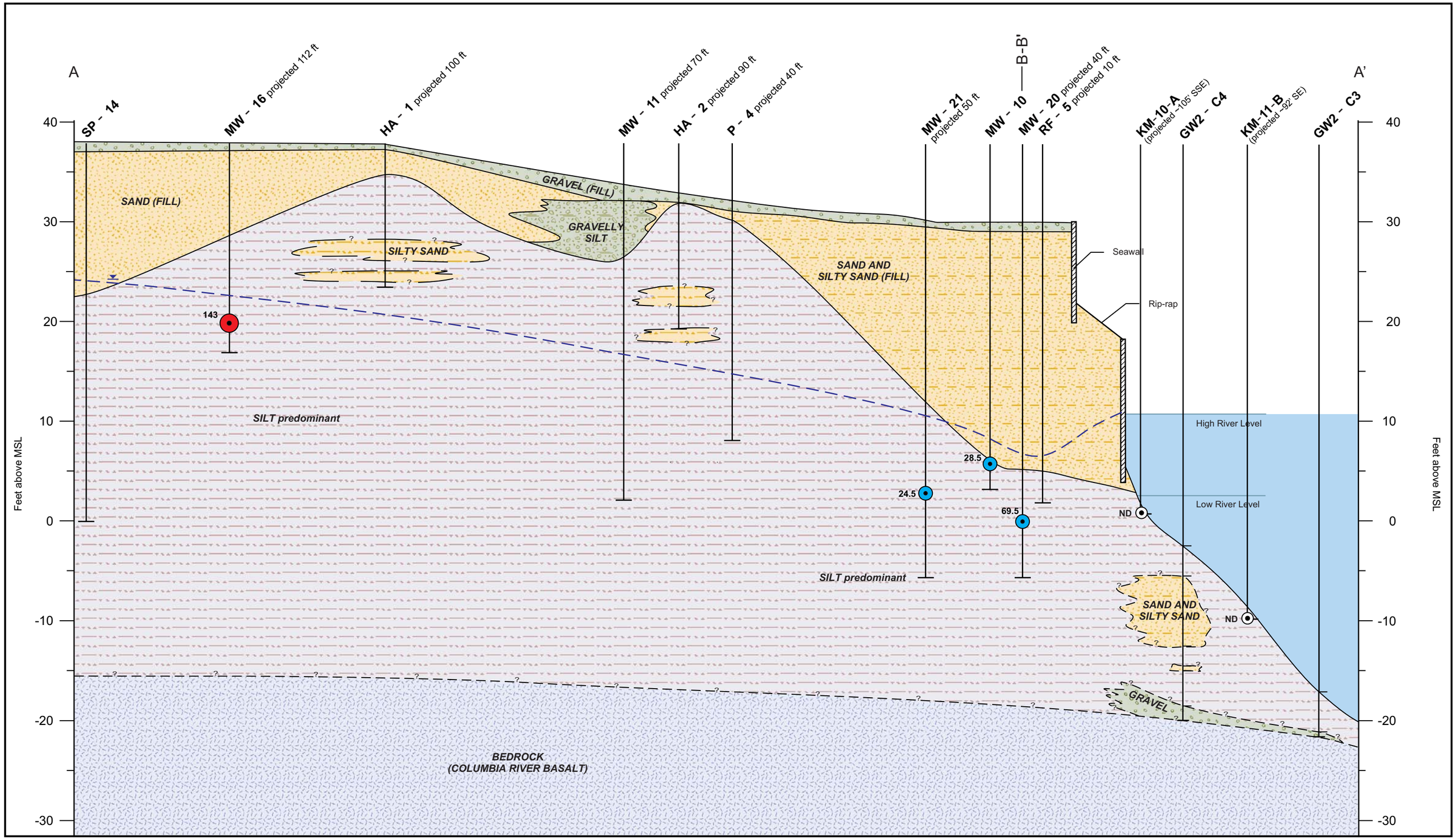
0 50 100

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Well Data: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-2d
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Arsenic in Upland Groundwater
and Shallow TZW



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

0 5 10 Feet
Vertical scale

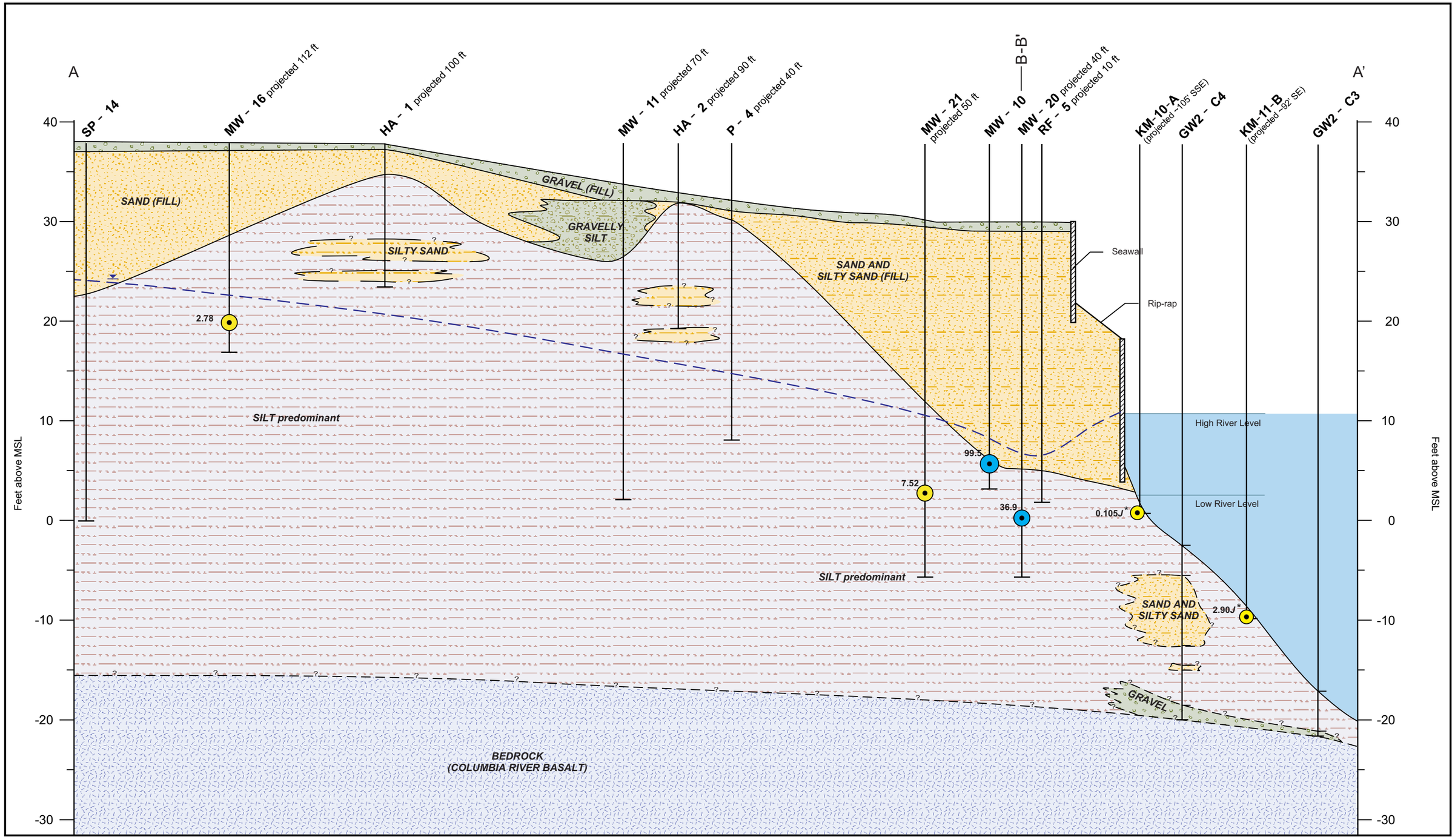
0 50 100 Feet
Horizontal scale

Sample Concentration Range:

- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
ND - Not Detected
DL - Detection Limit

Figure C3.1-3a
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Stratigraphic Cross Section A-A' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

0 5 10 Feet
Vertical scale

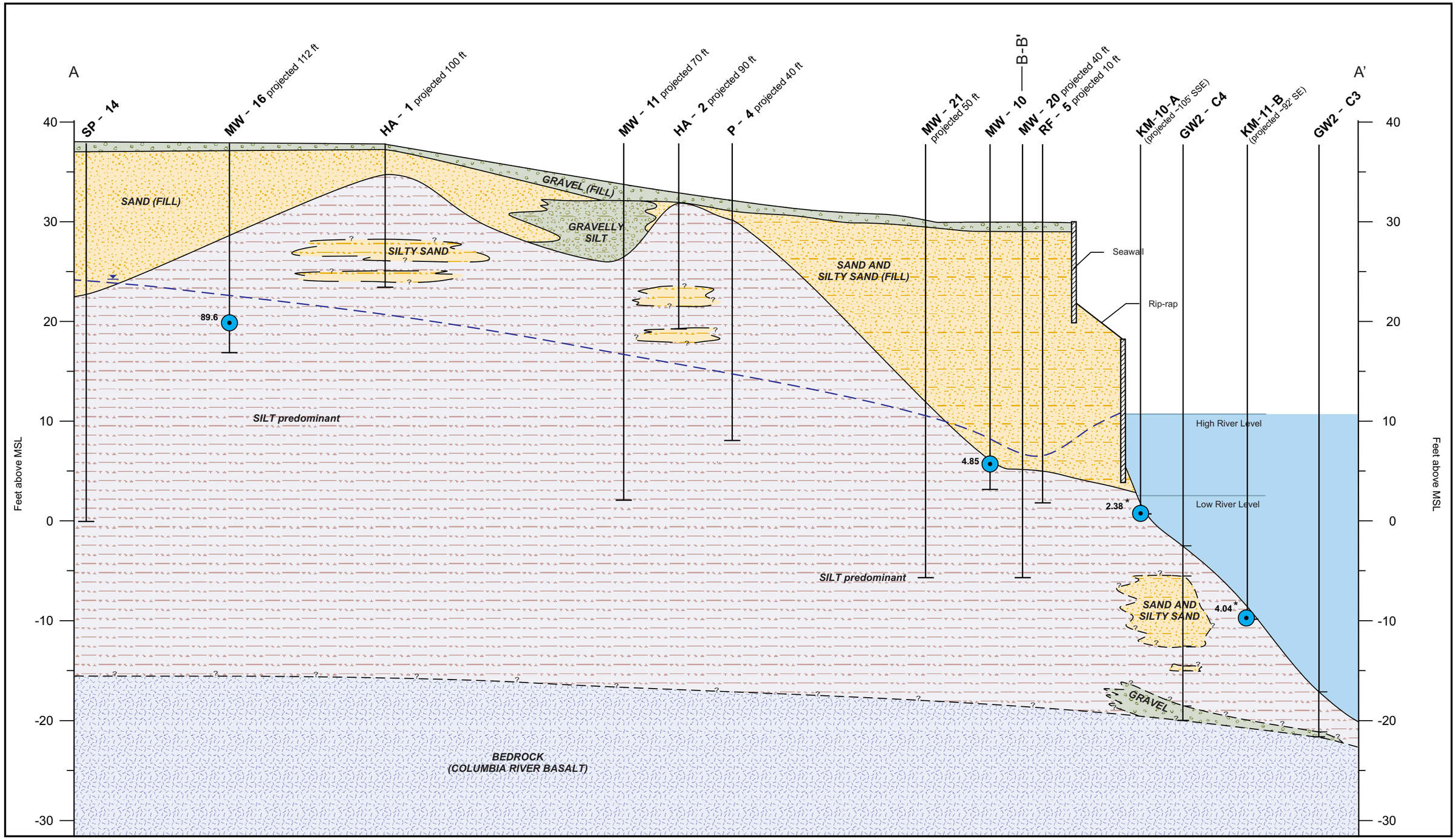
0 50 100 Feet
Horizontal scale

Sample Concentration Range:

- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
ND - Not Detected
DL - Detection Limit
J - Estimated
* - Sample collected with peeper method.
Upland groundwater data assumed to be unfiltered.

Figure C3.1-3b
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Stratigraphic Cross Section A-A' and Concentrations of Total PAHs in Nearshore Groundwater and Transition Zone Water



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

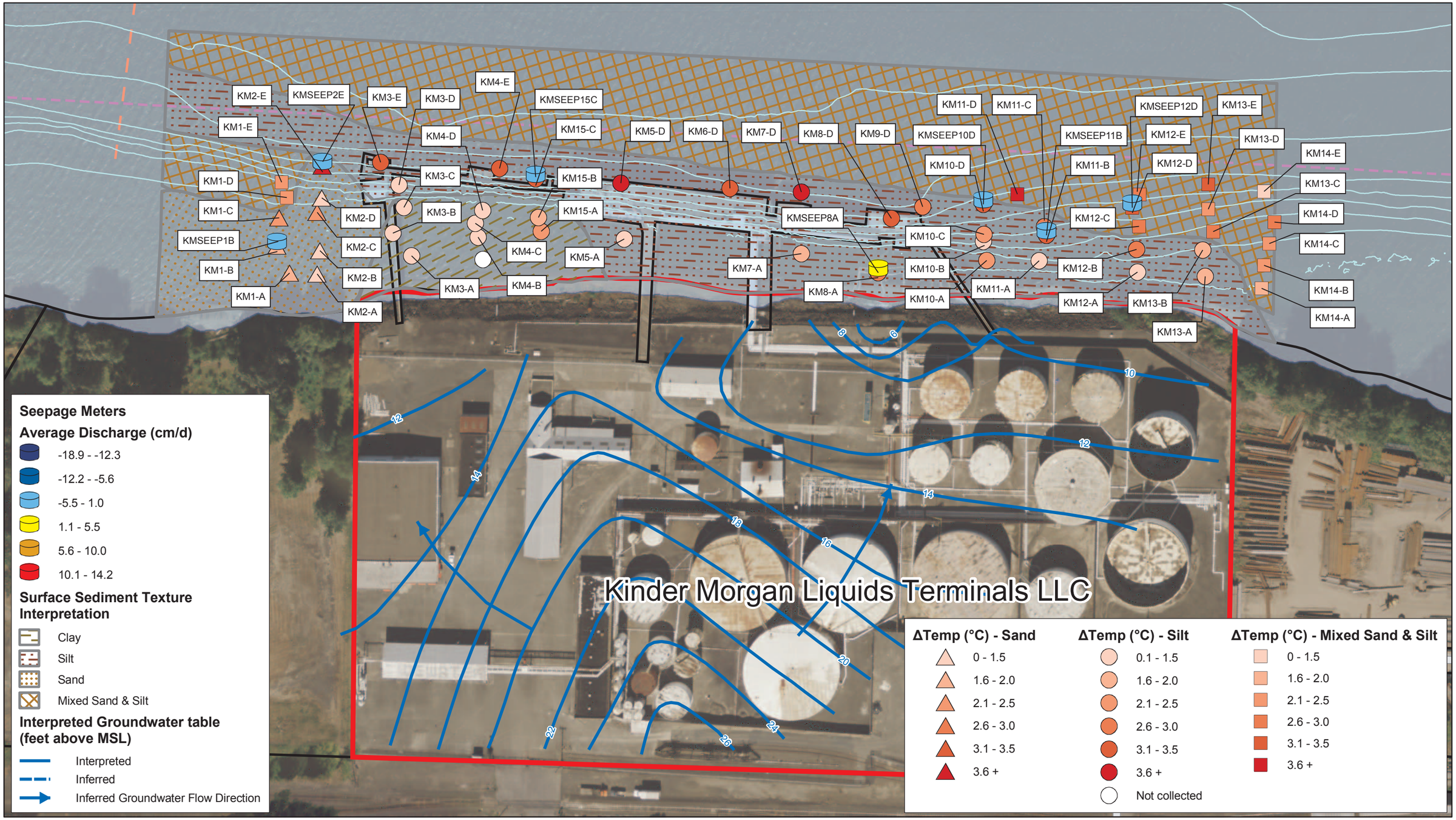
0 5 10 Feet
Vertical scale

0 50 100 Feet
Horizontal scale

Sample Concentration Range:
As < detection limit
As > detection limit

Approximate groundwater elevation
All units are µg/L
J - Estimated
* - Sample collected with peeper method.

Figure C3.1-3c
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Stratigraphic Cross Section A-A' and Concentrations of Dissolved Arsenic in Nearshore Groundwater and Transition Zone Water



X:\Projects\B0101__Portland_Harbor\SubTasks\B0101_77L_RI_GWPA_Appendix\Production_MXDs\Fig_C3_1-4_Kinder_Morgan_Discharge_20090630.mxd

LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Remediation System: locations are approximate and drawn from Delta (Delta Environmental Consultants, Inc.). 2005b. Lower Willamette Group Round 2 Groundwater Pathway Assessment FSP – Data Request, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal (DEQ ECSI Number 1096). March 4, 2005.
Groundwater Contours: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-4
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Trident Probe and Seepage Meter Results

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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Remediation System: locations are approximate and drawn from Delta (Delta Environmental Consultants, Inc.). 2005b. Lower Willamette Group Round 2 Groundwater Pathway Assessment FSP – Data Request, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal (DEQ ECSI Number 1096). March 4, 2005.
Groundwater Contours: locations are approximate and drawn from Delta. 2005a. Groundwater Monitoring/Project Status Update Report, Third Quarter 2004, Kinder Morgan Liquid Terminals, LLC, Linnton Terminal, Portland, Oregon. January 11, 2005.

Figure C3.1-5
Portland Harbor RI/FS
Remedial Investigation Report
Kinder Morgan Linnton Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

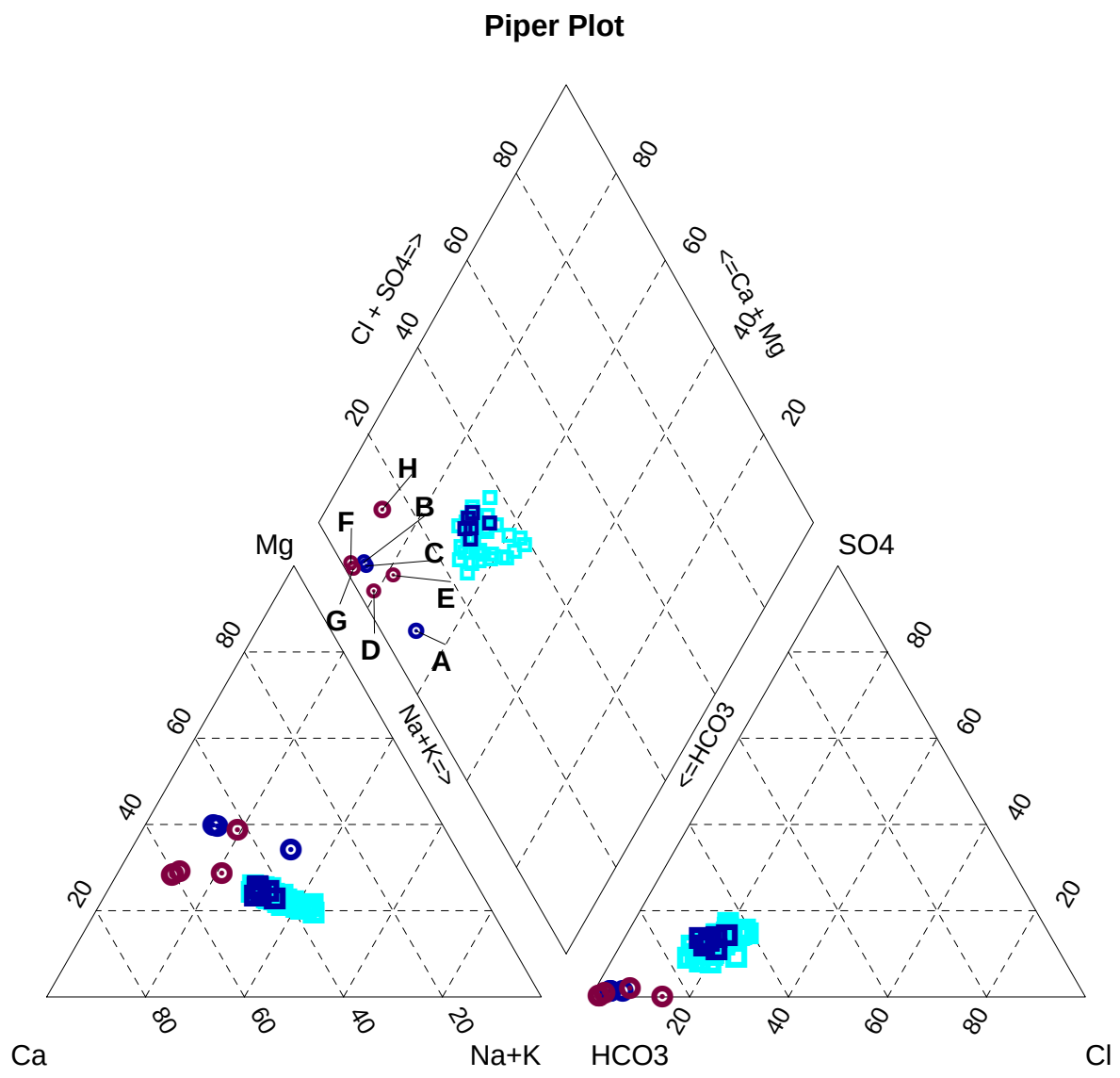
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	KM-08-A, Trident 30 cm	280	9.9	3.1	43.7	3.05	41.4	25.5	7.26	407
B	Groundwater Discharge Zone	R2-KM-01, Trident 30 cm	240	4.6	2.6	18.8	3.41	61.4	31.8	6.94	363
C	Groundwater Discharge Zone	R2-KM-01, Trident 30 cm; FR	240	4.6	2.6	16.5	2.87	49.6	26.1	6.89	342
D	Low-to-No Groundwater Discharge Zone	KM-06-A, Peeper 0 - 38 cm	114	1.5	0.9	9.97	0.67	19.9	11.1	7.24	158
E	Low-to-No Groundwater Discharge Zone	KM-10-A, Peeper 0 - 38 cm	85	3.7	1.4	8.85	0.845	19.4	6.69	7.69	126
F	Low-to-No Groundwater Discharge Zone	KM-11-B, Peeper 0 - 38 cm	162	1.6	0.13	3.39	1.04	18.9	5.33	6.88	192
G	Low-to-No Groundwater Discharge Zone	KM-11-B, Peeper 0 - 38 cm; FR	148	1.3	0.14	3.22	0.6	14.7	4.42	7.46	172
H	Low-to-No Groundwater Discharge Zone	R2-KM-02, Peeper 0 - 38 cm	321	30.5	0.17	13.2	1.665	65.8	18.7	7.36	451

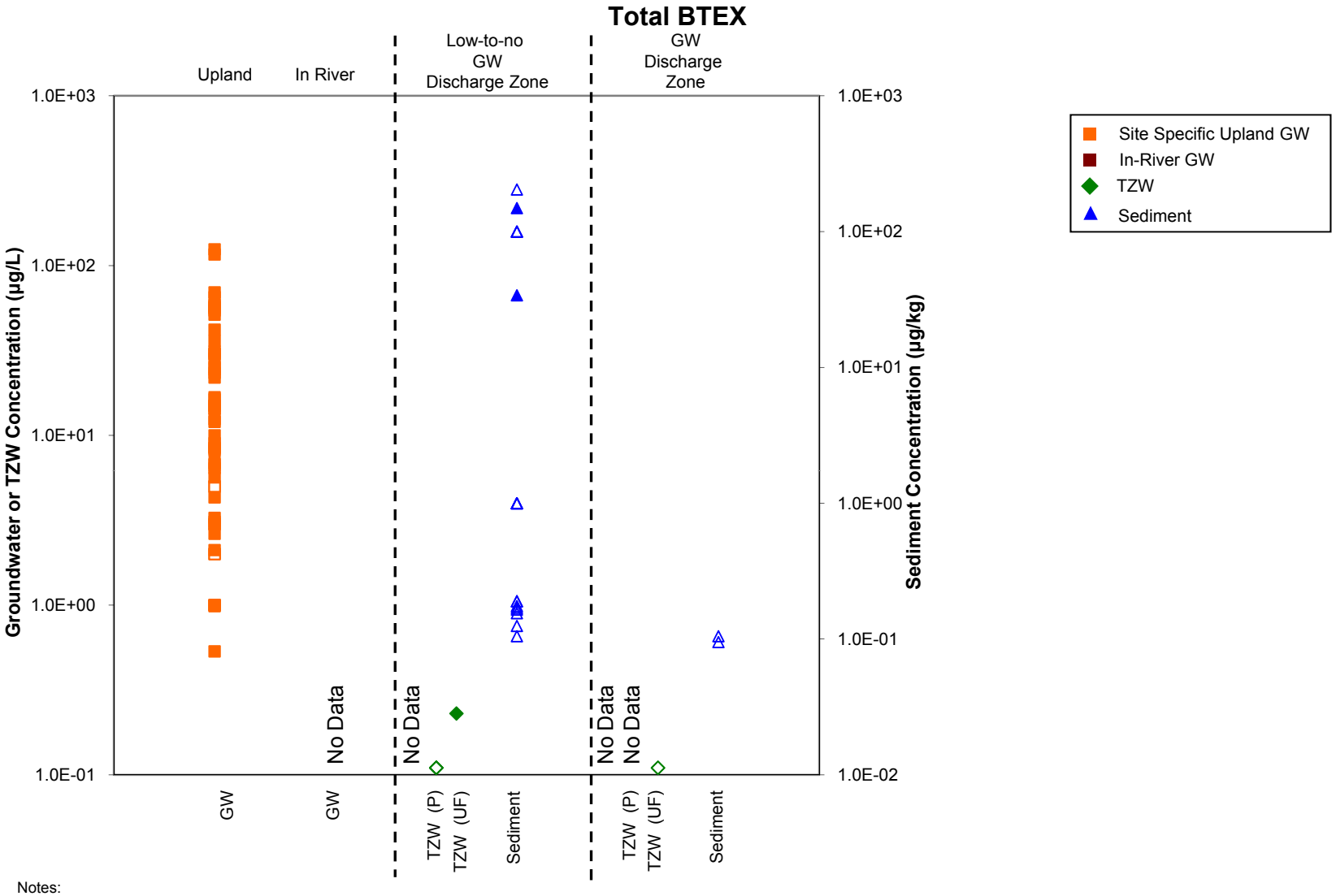
Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

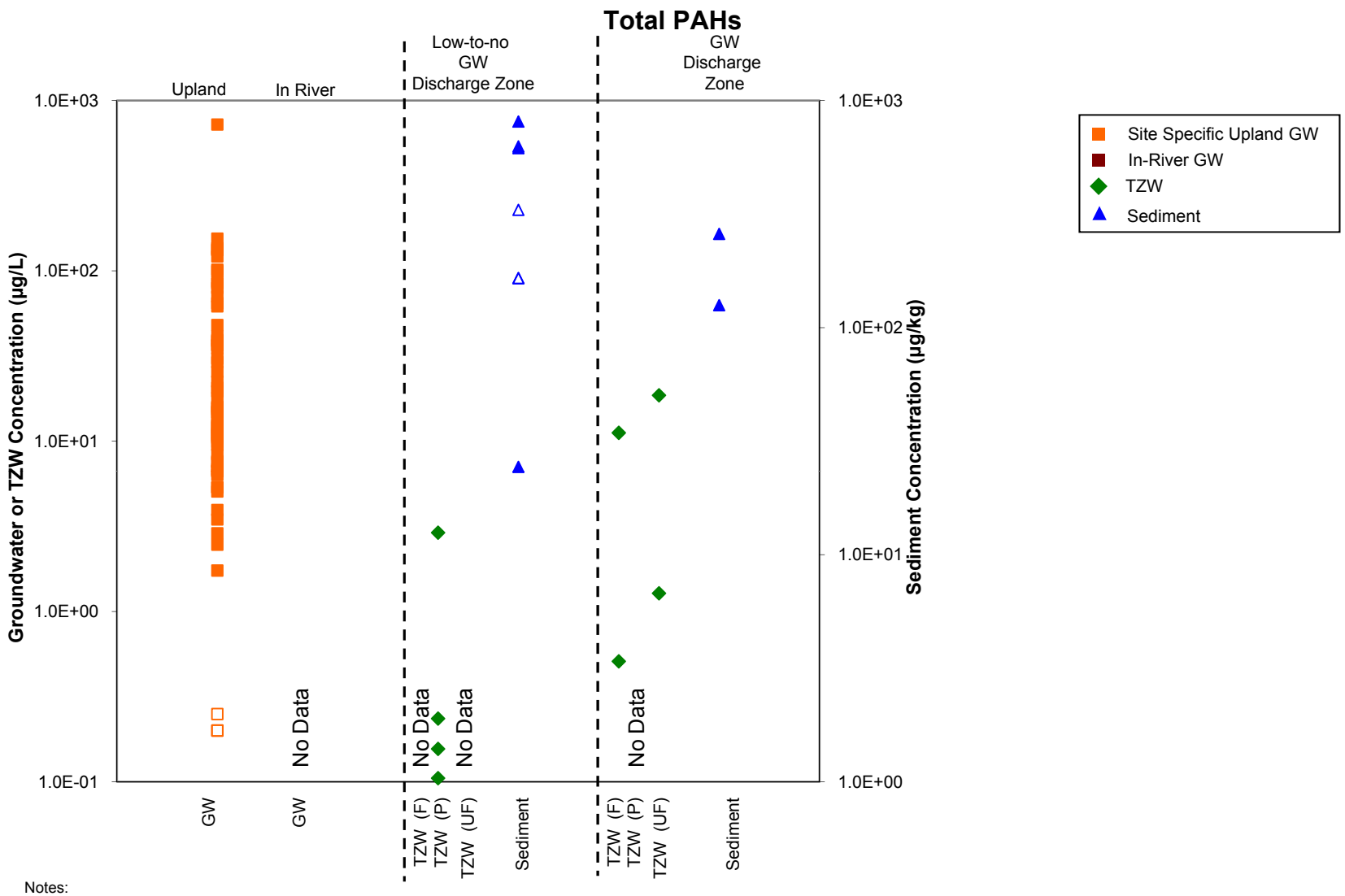
All concentrations as mg/L; pH in s.u.

Figure C3.1-6
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Kinder Morgan Linnton



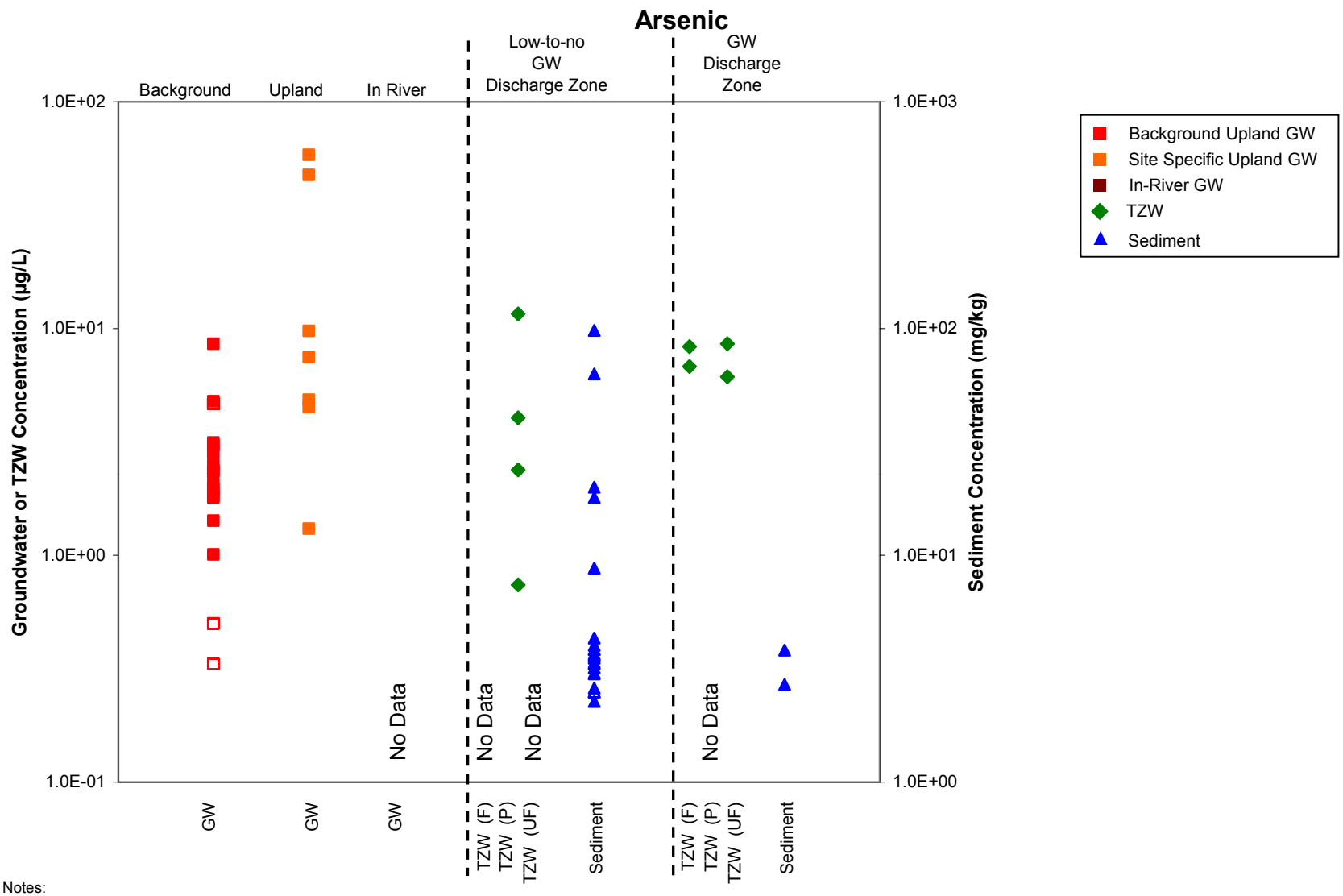
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MW-1,MW-2,MW-3,MW-4,MW-7,MW-8,MW-10,MW-12,MW-13,MW-20,MW-21.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.1-7a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
BTEX - Kinder Morgan Linnton



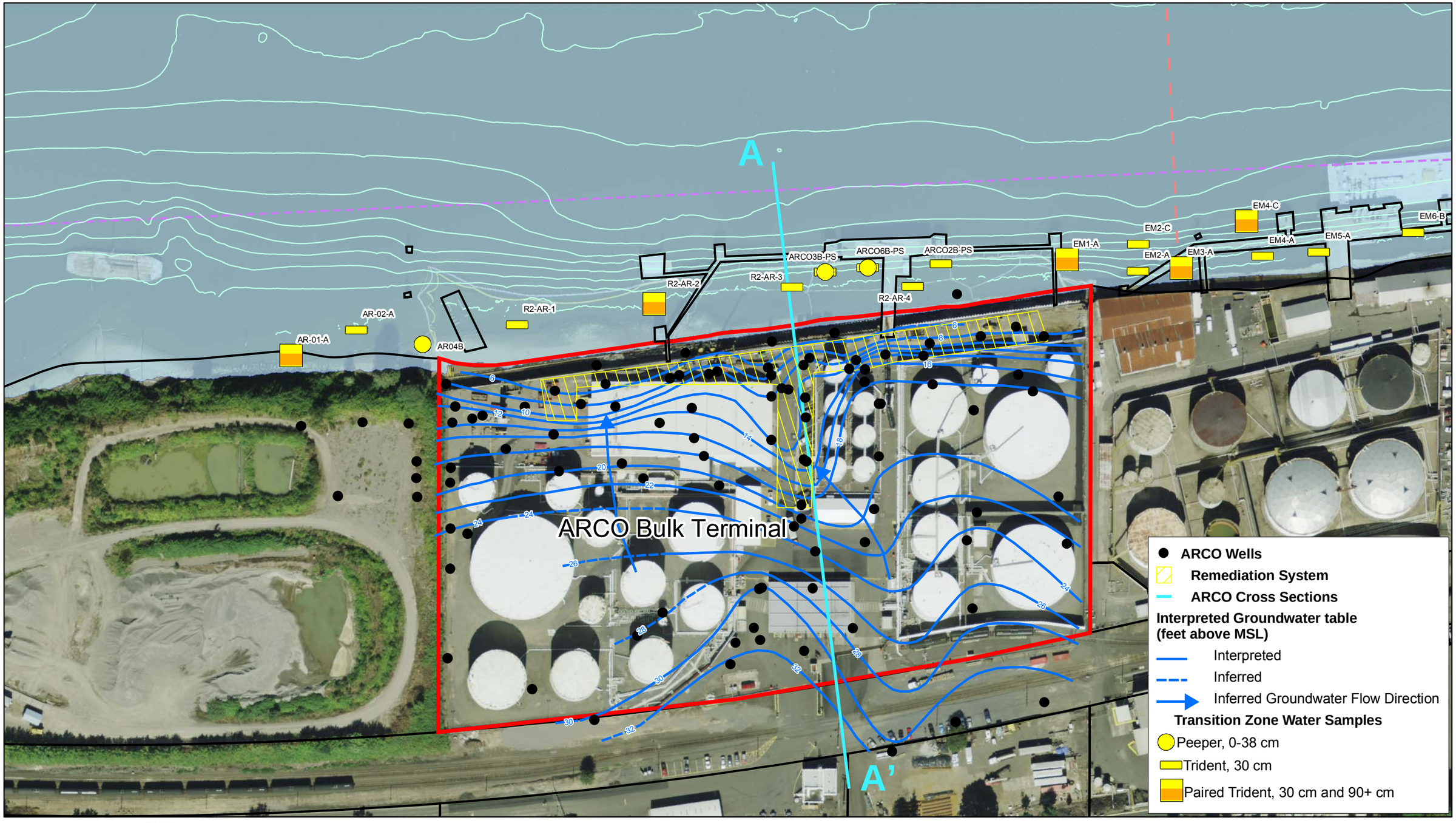
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MW-1,MW-2,MW-3,MW-4,MW-7,MW-8,MW-10,MW-12,MW-13,MW-20,MW-21.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.1-7b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total PAHs - Kinder Morgan Linnton



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MW-1,MW-2,MW-3,MW-4,MW-7,MW-8,MW-10,MW-12,MW-13,MW-20,MW-21.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.1-7c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Arsenic - Kinder Morgan Linnton



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LEGEND

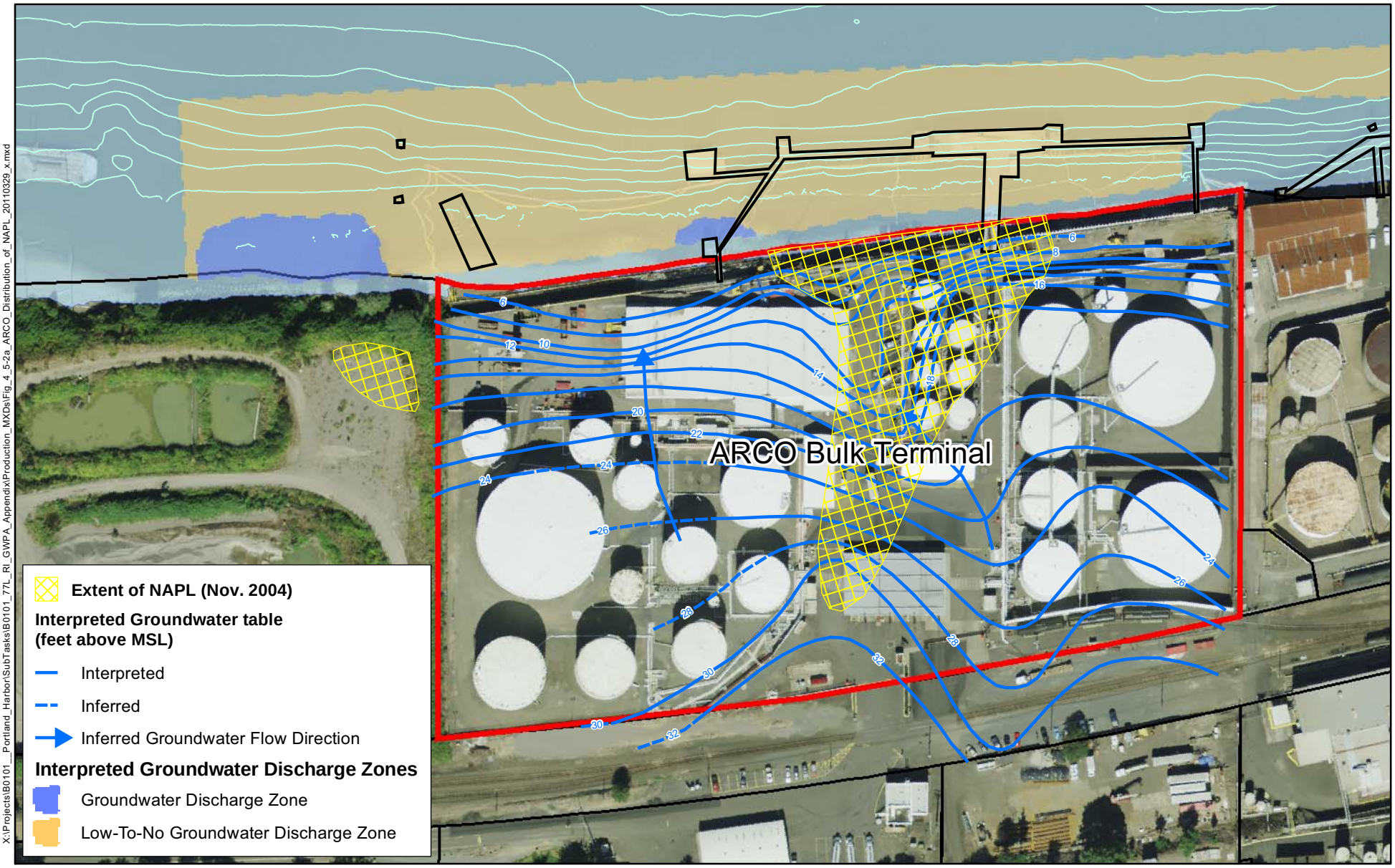
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-1
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Overview and Cross Section Location



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

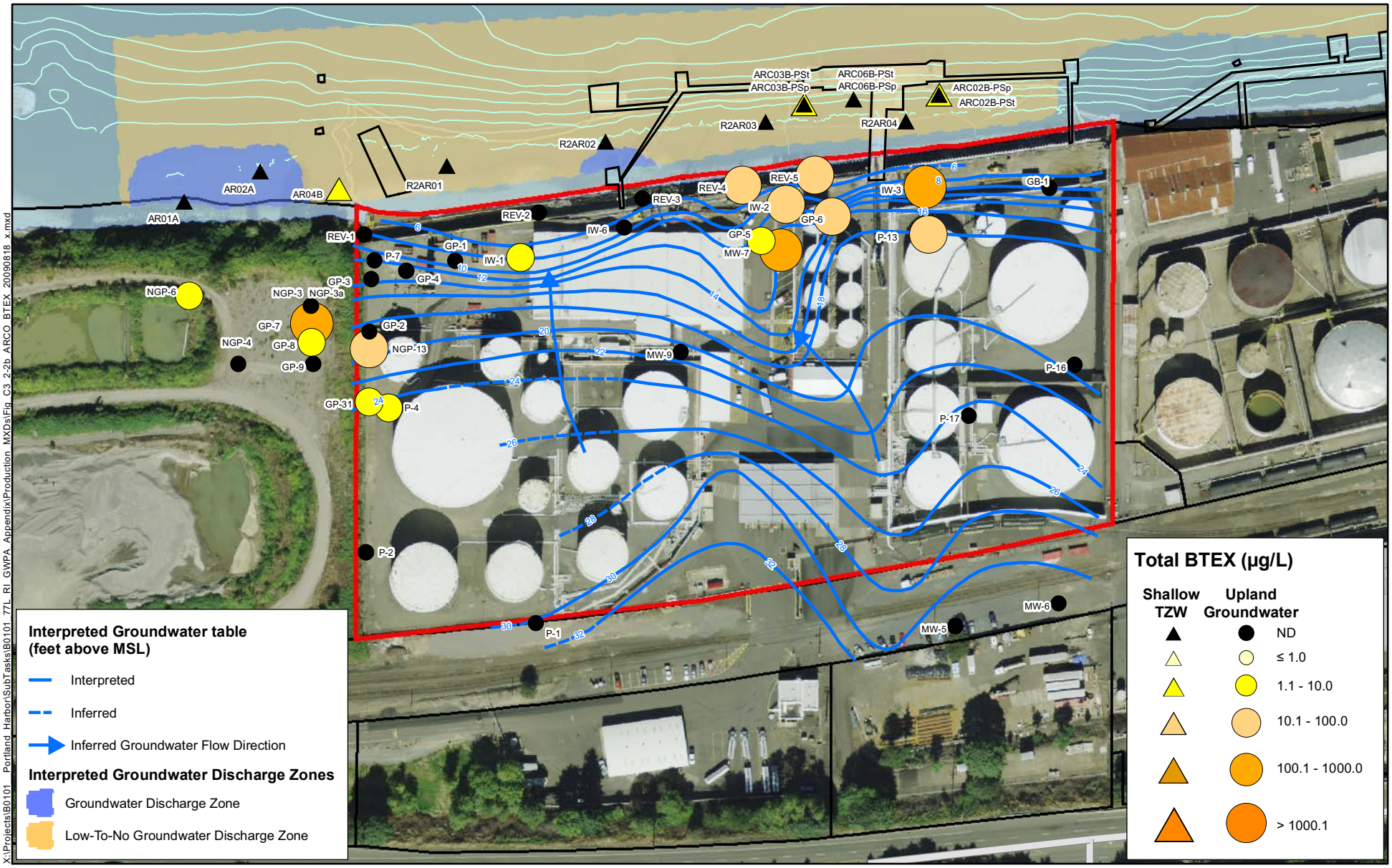
Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-2a
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Distribution of NAPL in Upland Groundwater



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

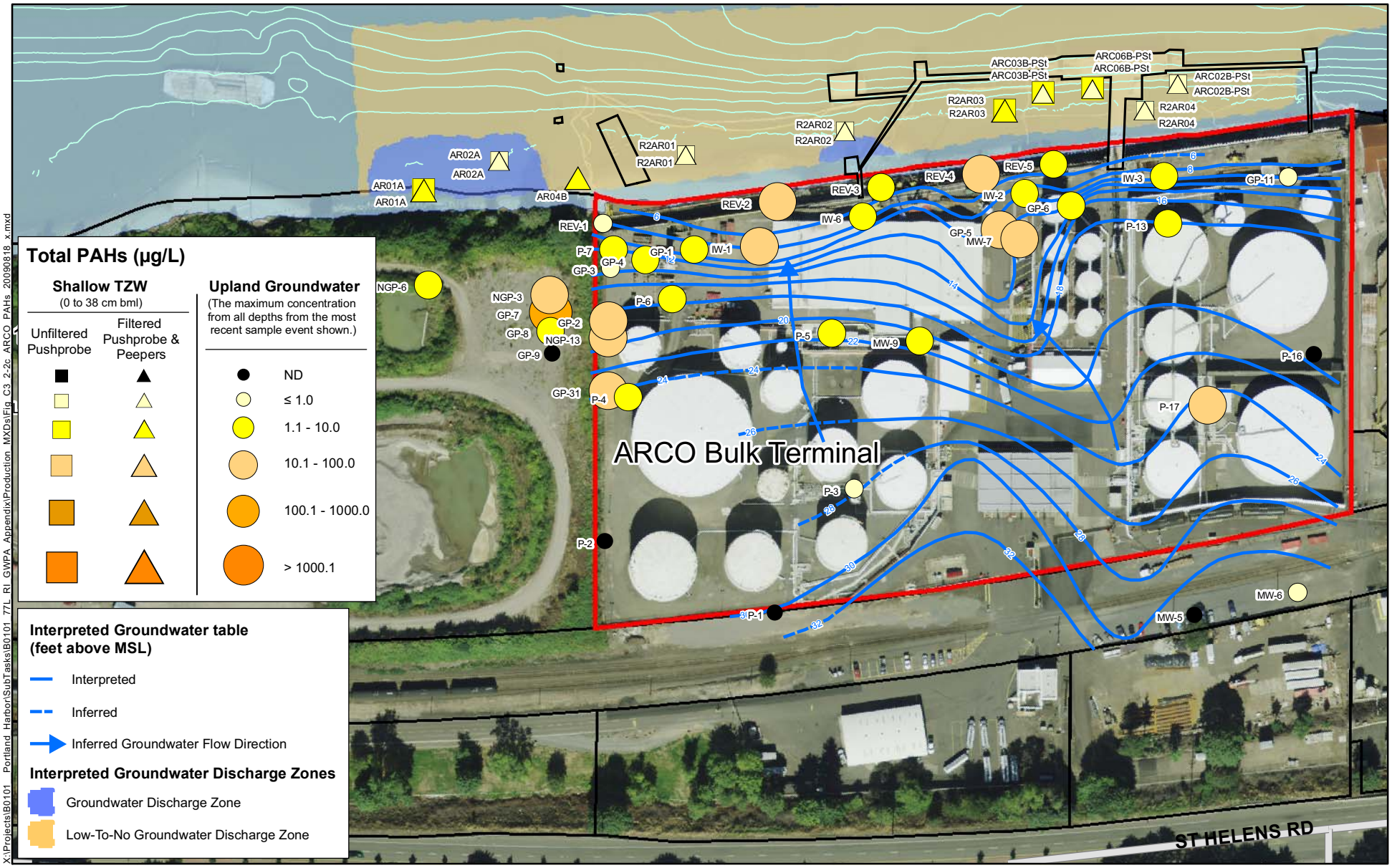
0 50 100

Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-2b
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Total BTEX in Upland Groundwater and Shallow TZW

X:\Projects\B0101 Portland Harbor\SubTasks\B0101 77L RI GWPA Appendix\Production MXDs\Fig C3 2-2b ARCO BTEX 20090818 x.mxd



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LEGEND

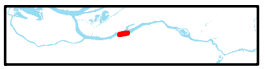
2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100

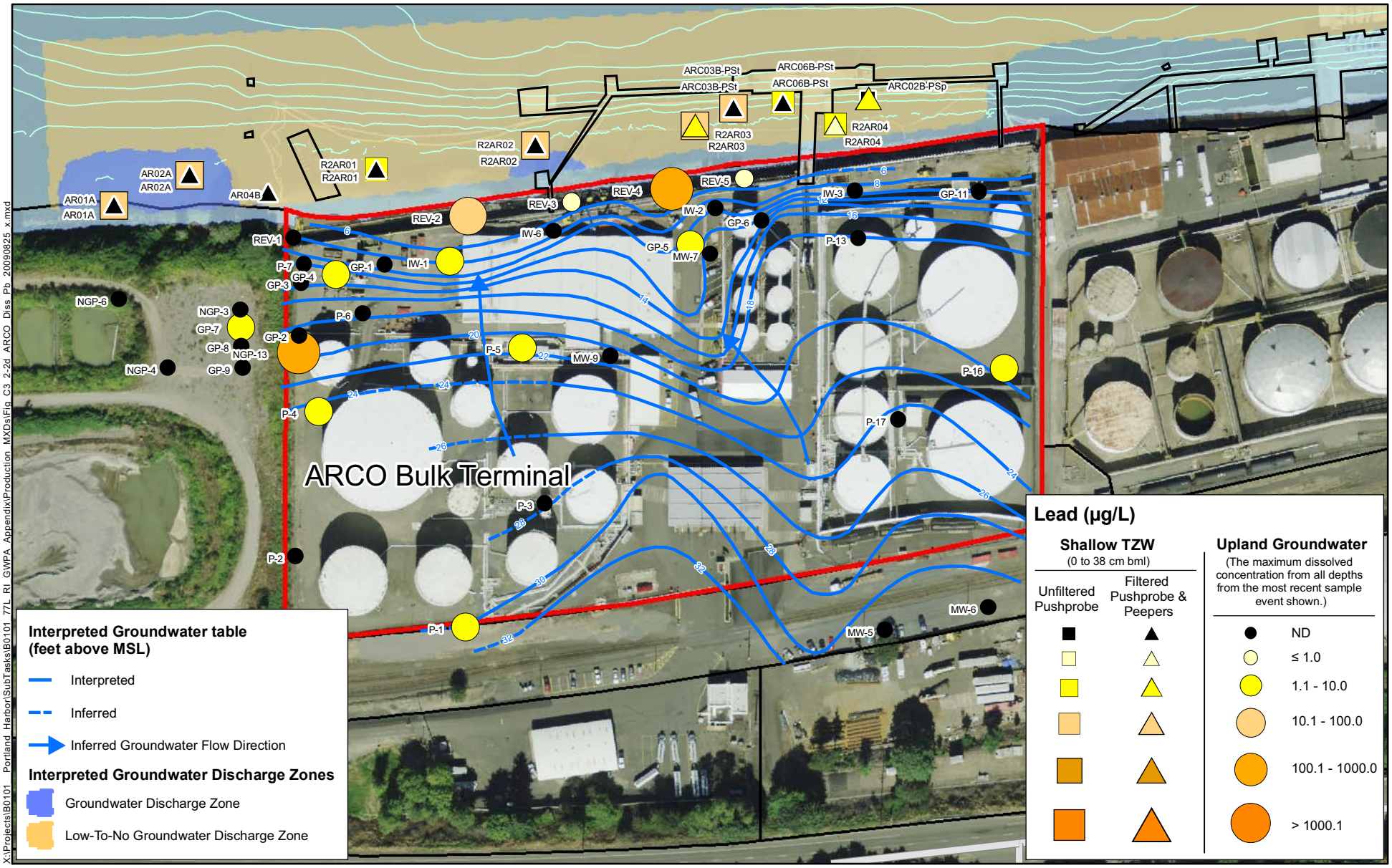
Feet

N



FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-2c
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Total PAHs in Upland Groundwater and Shallow TZW



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100

Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-2d
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Lead in Upland Groundwater and Shallow TZW

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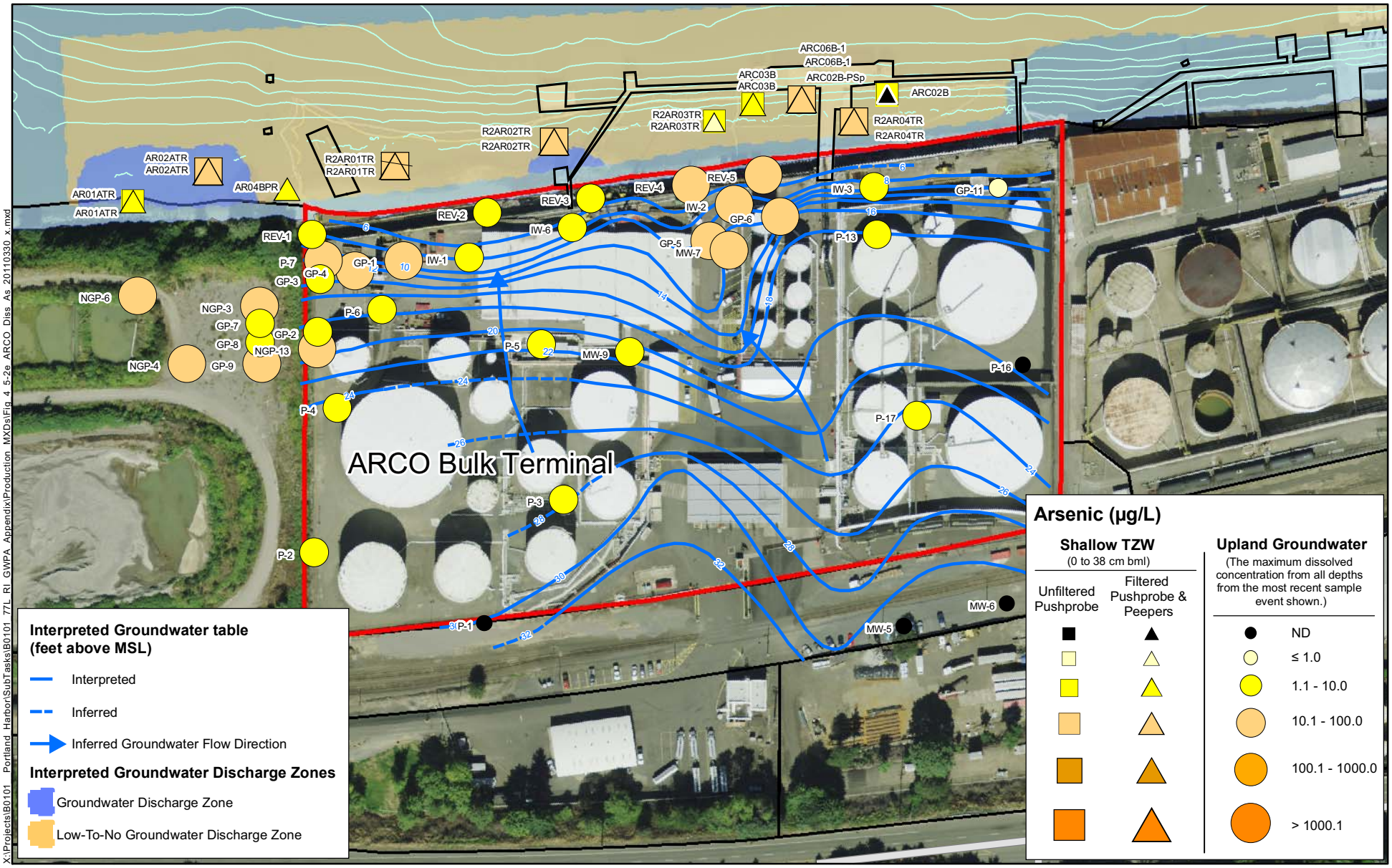

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-2e
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Arsenic in Upland Groundwater and Shallow TZW

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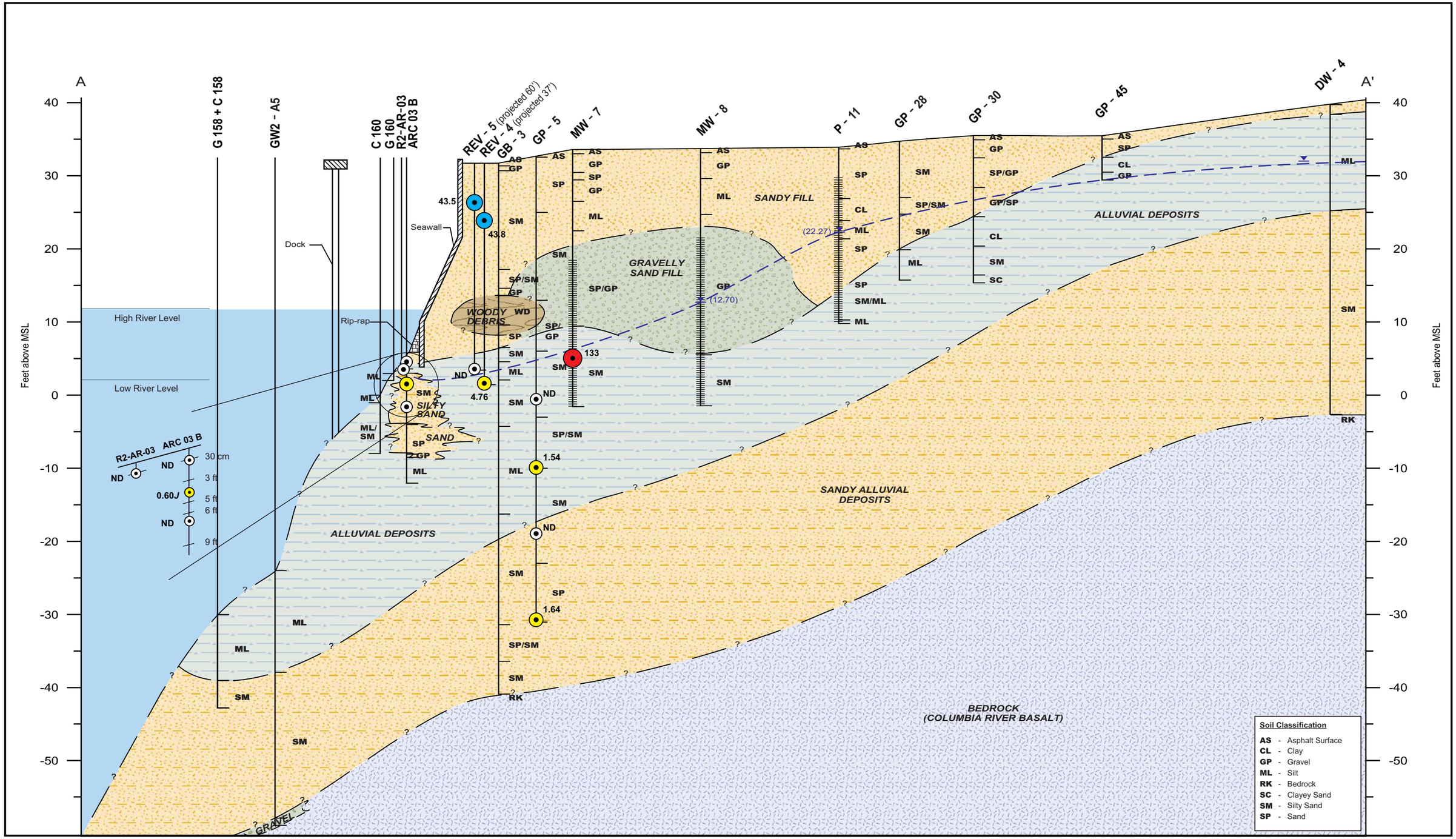


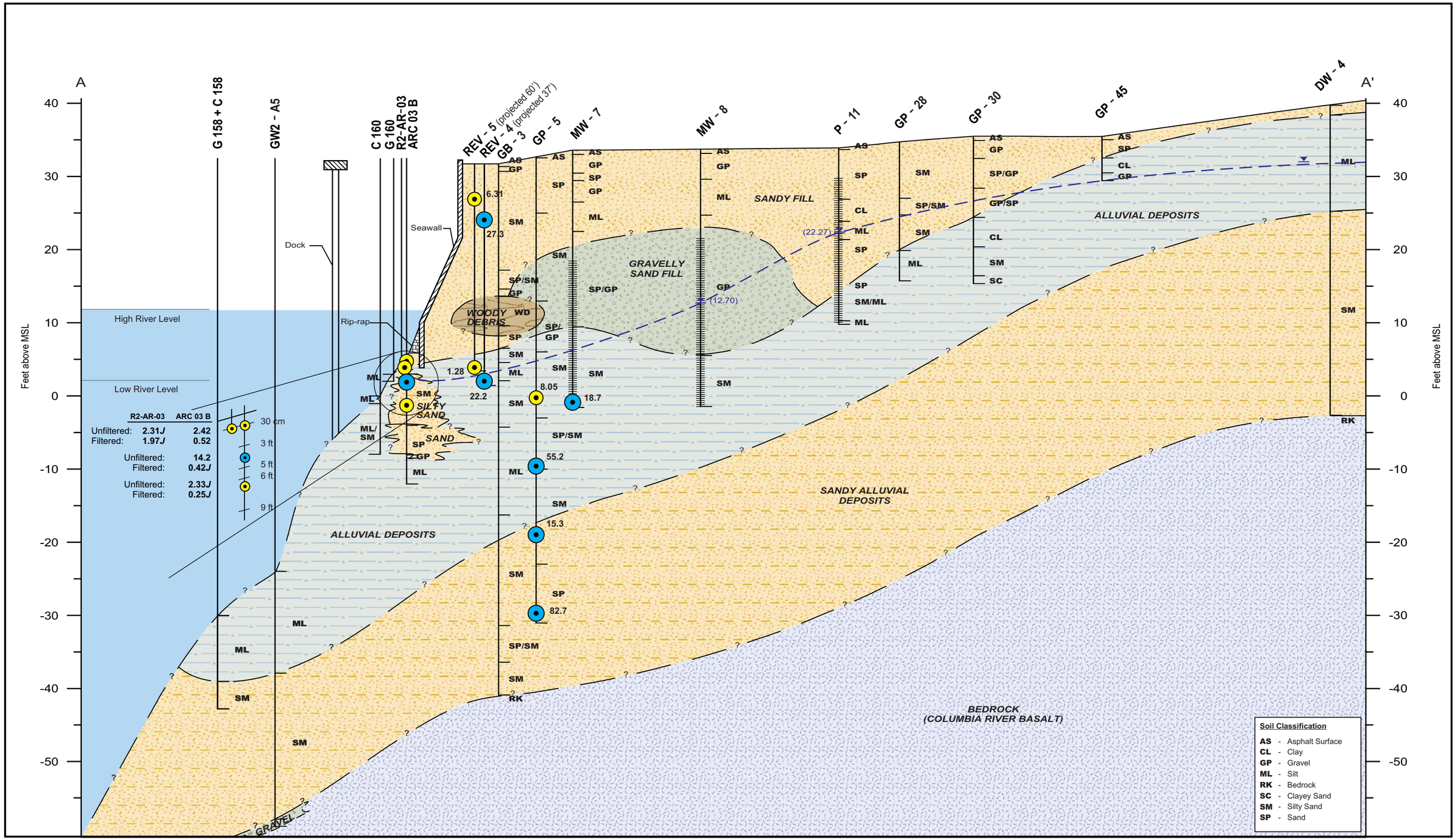
Base features from Basis of Design Report Source Control Measures, URS 2004.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Locations should be considered approximate.

0 10 20 Feet
Vertical scale
0 40 80 Feet
Horizontal scale

Sample Concentration Range:
ND
DL - 10 µg/L
10 - 100 µg/L
> 100 µg/L

Approximate groundwater elevation
ND - Not Detected
DL - Detection Limit
J - Estimated
- Monitoring Well Screen

Figure C3.2-3a
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Stratigraphic Cross Section A-A' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water



Base features from Basis of Design Report Source Control Measures, URS 2004.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Locations should be considered approximate.

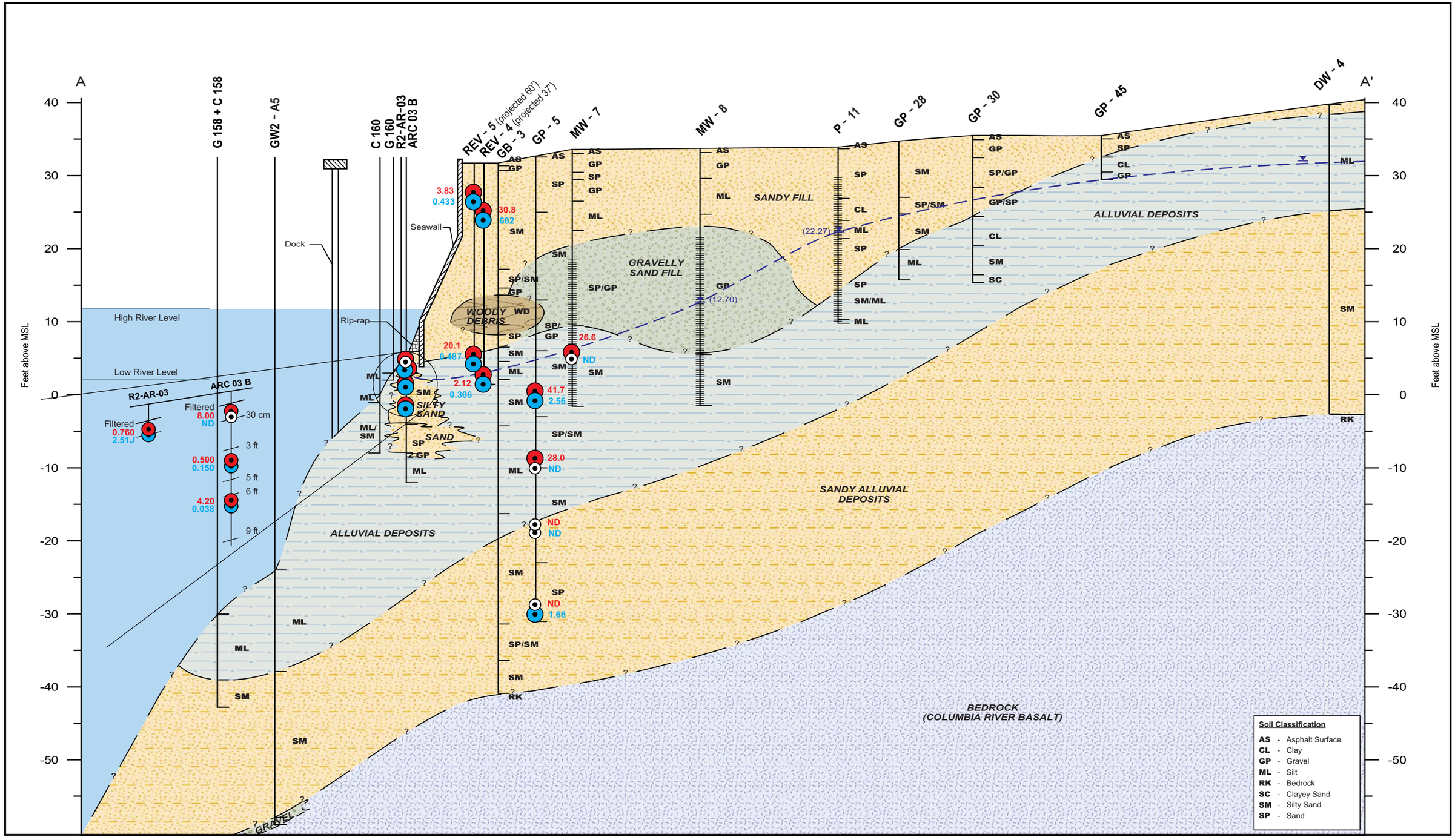
0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

Sample Concentration Range:
DL - 10 µg/L
10 - 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
J - Estimated
- Monitoring Well Screen
Upland groundwater data assumed to be unfiltered.

Figure C3.2-3b
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Stratigraphic Cross Section A-A' and Concentrations of Total PAHs in Nearshore Groundwater and Transition Zone Water



Base features from Basis of Design Report Source Control Measures, URS 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

Sample Concentration Range:

As ND Pb ND

As > DL (µg/L)

Pb > DL (µg/L)

Approximate groundwater elevation

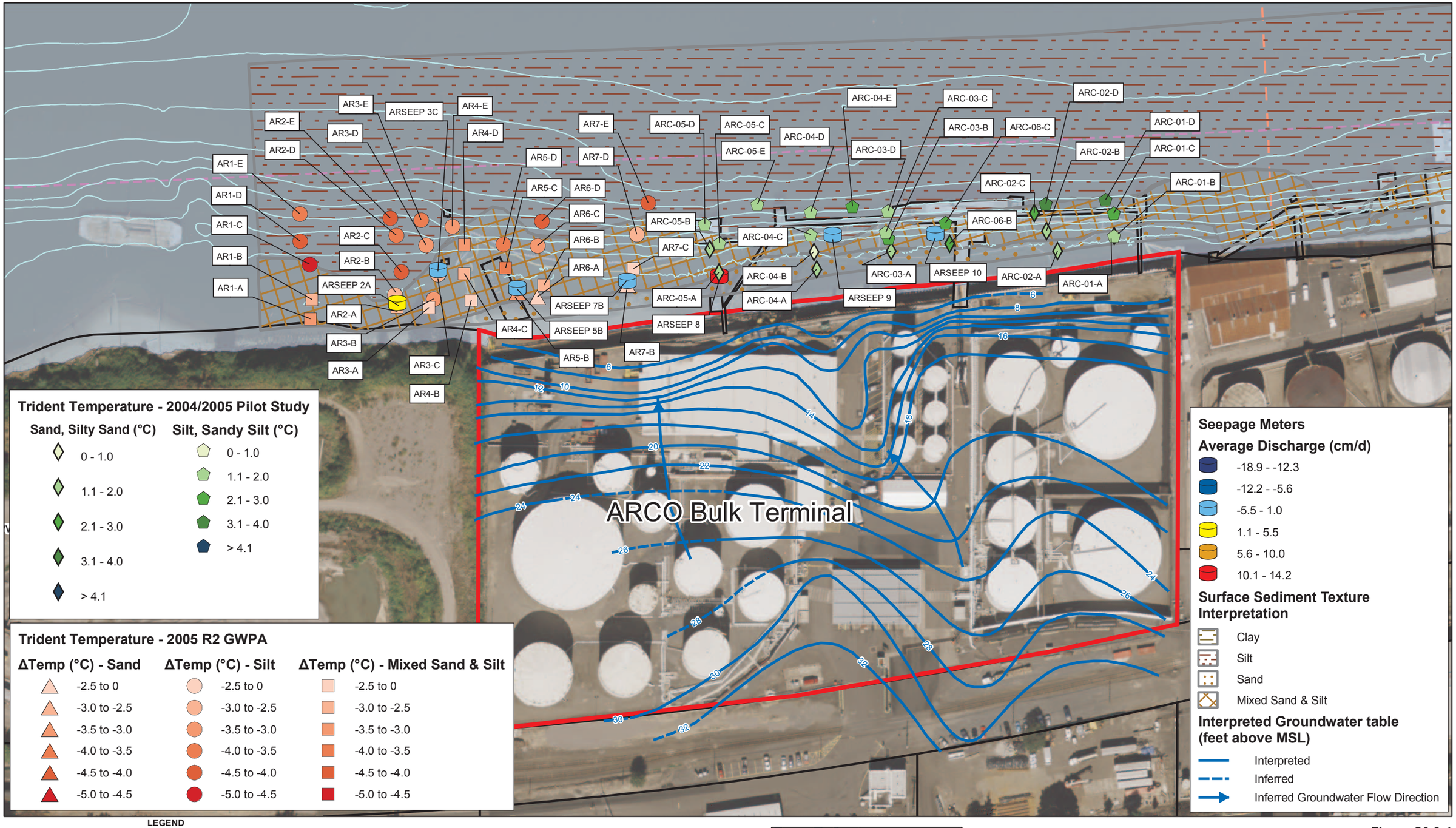
ND - Not Detected

DL - Detection Limit

J - Estimated

- Monitoring Well Screen

Figure C3.2-3c
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Stratigraphic Cross Section A-A' and
Concentrations of Dissolved Arsenic and Dissolved Lead
in Nearshore Groundwater and Transition Zone Water



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
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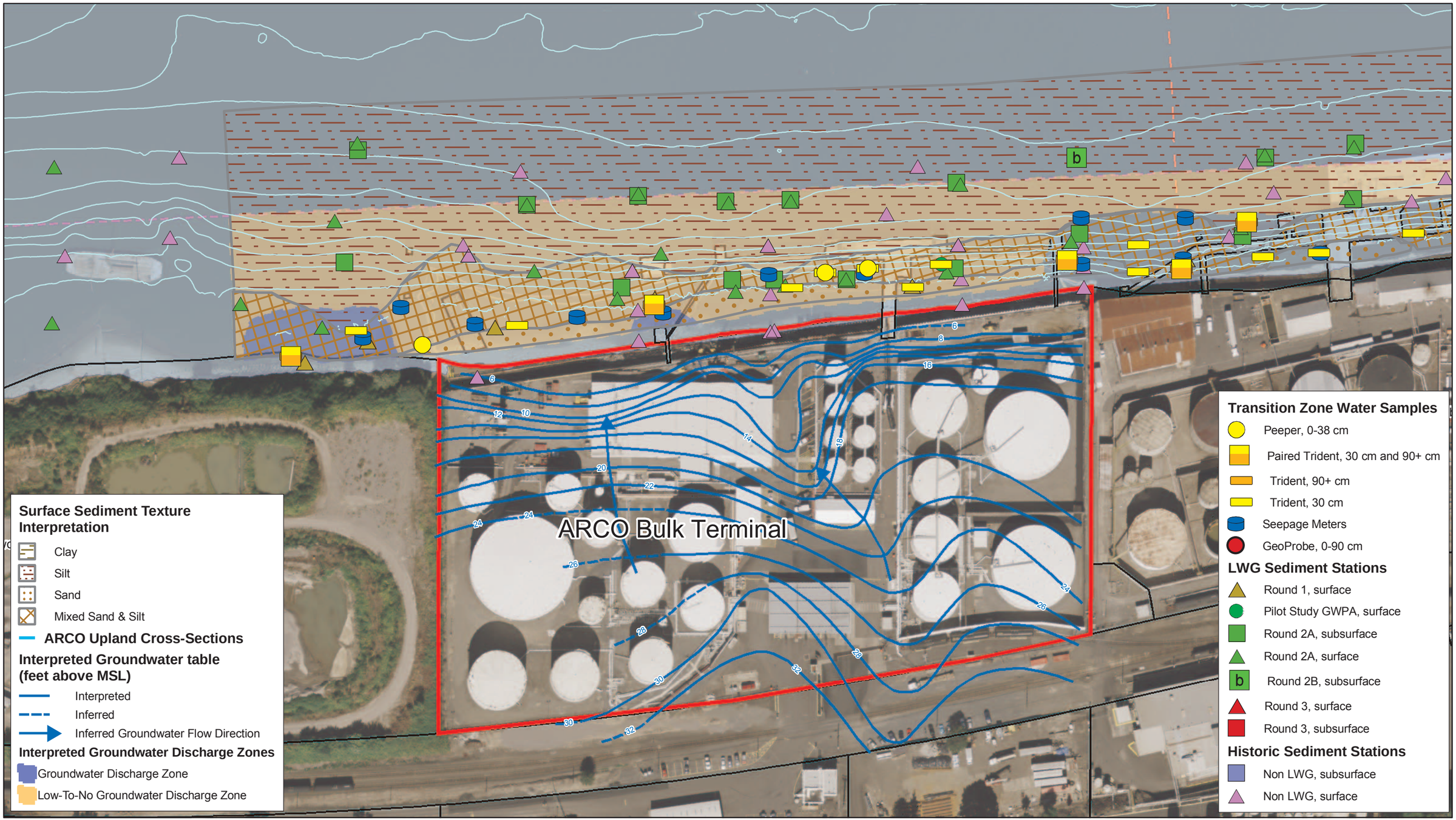
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-4
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Trident Probe and Seepage Meter Results



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Cross-Sections: Locations are approximate and drawn by measuring from Figure 2-2 (SECOR 2004).
Wells & Remediation Systems: Remediation System Outline (ft) is approximate; traced from original figures created by URS (May 27, 2004 & March 2004).
Groundwater Contours: Interpreted Groundwater Table Contours (ft) are approximate; traced from original figures created by URS (May 27, 2004 & March 2004).

Figure C3.2-5
Portland Harbor RI/FS
Remedial Investigation Report
ARCO Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

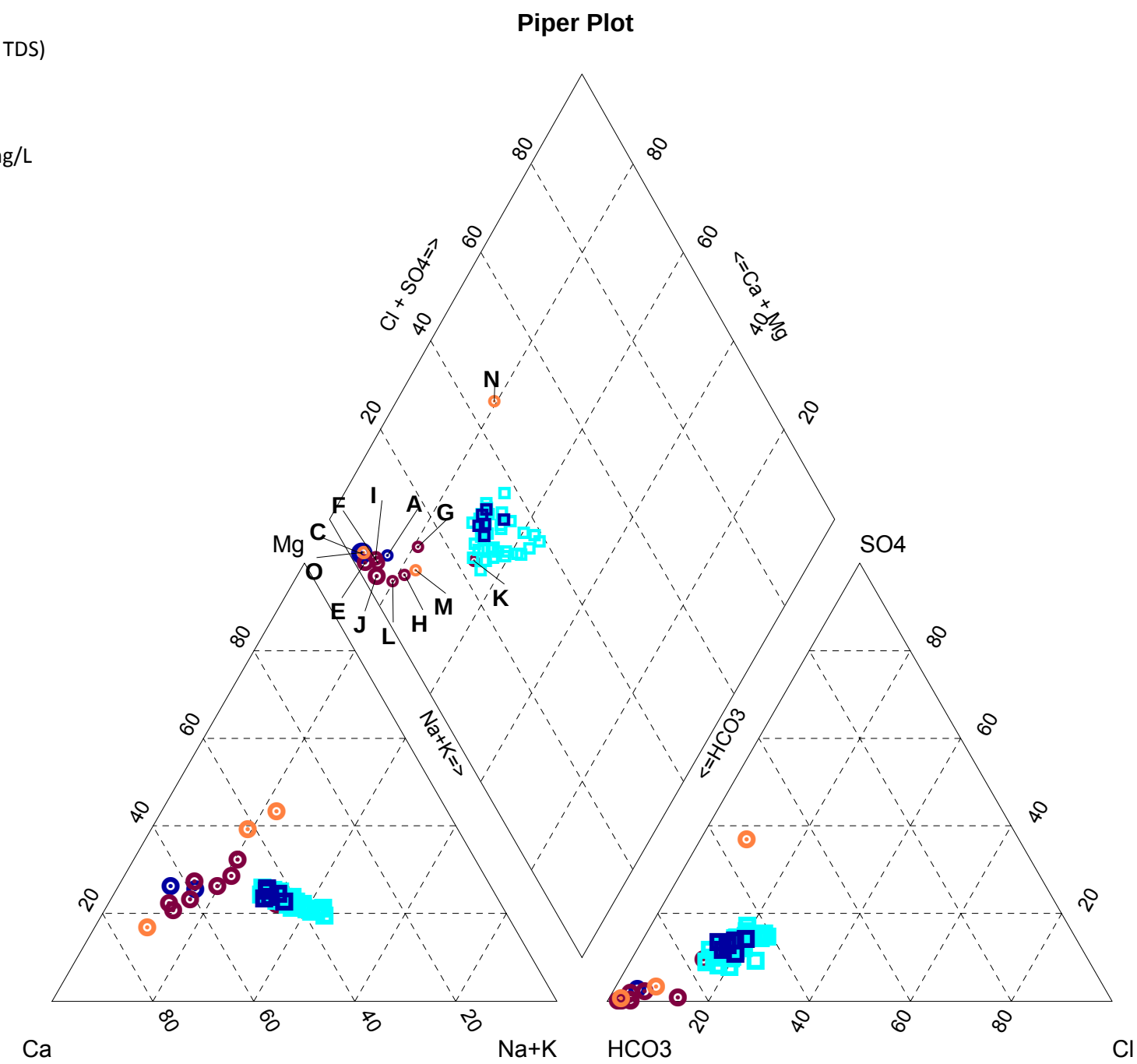
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	AR-01-A, Trident 30 cm	148	4.2	3.4	39.3	10.3	3.6	9.85	6.39	218.65
B[c]	Groundwater Discharge Zone	AR-02-A, Trident 30 cm				40.1	22.4	0.365		6.67	
C	Groundwater Discharge Zone	AR-01-A, Trident 150 cm	446	6.2	0.05	117	29.3	6.71	18	6.36	623.26
D[c]	Low-to-No Groundwater Discharge Zone	AR-04-B, peeper				76.6	25.5	0.297			
E	Low-to-No Groundwater Discharge Zone	R2-AR-01, Trident 30 cm	357	4.2	0.06	83.1	17.1	4.45	14.8	6.4	480.71
F	Low-to-No Groundwater Discharge Zone	R2-AR-02, Trident 30 cm	308	8	0.5	73.5	20.9	4.57	18.5	6.67	433.97
G	Low-to-No Groundwater Discharge Zone	R2-AR-03, Trident 30 cm	60	5.5	0.4	13.2	5.46	1.57	5.71	7.21	91.84
H	Low-to-No Groundwater Discharge Zone	R2-AR-04, Trident 30 cm	164	6.4	3.2	32.4	11.2	3.38	13.7	6.98	234.28
I	Low-to-No Groundwater Discharge Zone	R2-AR-02, Trident 90 cm	304	8.3	0.06	75.8	14.5	3.47	16	6.71	422.13
J	Low-to-No Groundwater Discharge Zone	AR-02-B GeoProbe 3-5' GW	375	6	0.09	85.3	19.6	3.51	23.2	6.56	512.7
K	Low-to-No Groundwater Discharge Zone	AR-03-B GeoProbe 3-5' GW	46	5	4.5	7.76	2.33	0.881	6.15	7.05	72.621
L	Low-to-No Groundwater Discharge Zone	AR-06-B GeoProbe 3-5' GW	201	4.4	2.9	51.4	15.1	2.98	19.6	6.66	297.38
M	Upland Groundwater	MW-02 Upland GW	55.8	2.38	1.32	13.2	10.186[d]	1.22	9.47		93.576
N	Upland Groundwater	MW-05 Upland GW	48	3.85	21.2	17.9	10.186[d]	2.8	7.8		111.736
O	Upland Groundwater	MW-08 Upland GW	293	3.45	1	72.8	10.186[d]	3.5	10		393.936

Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

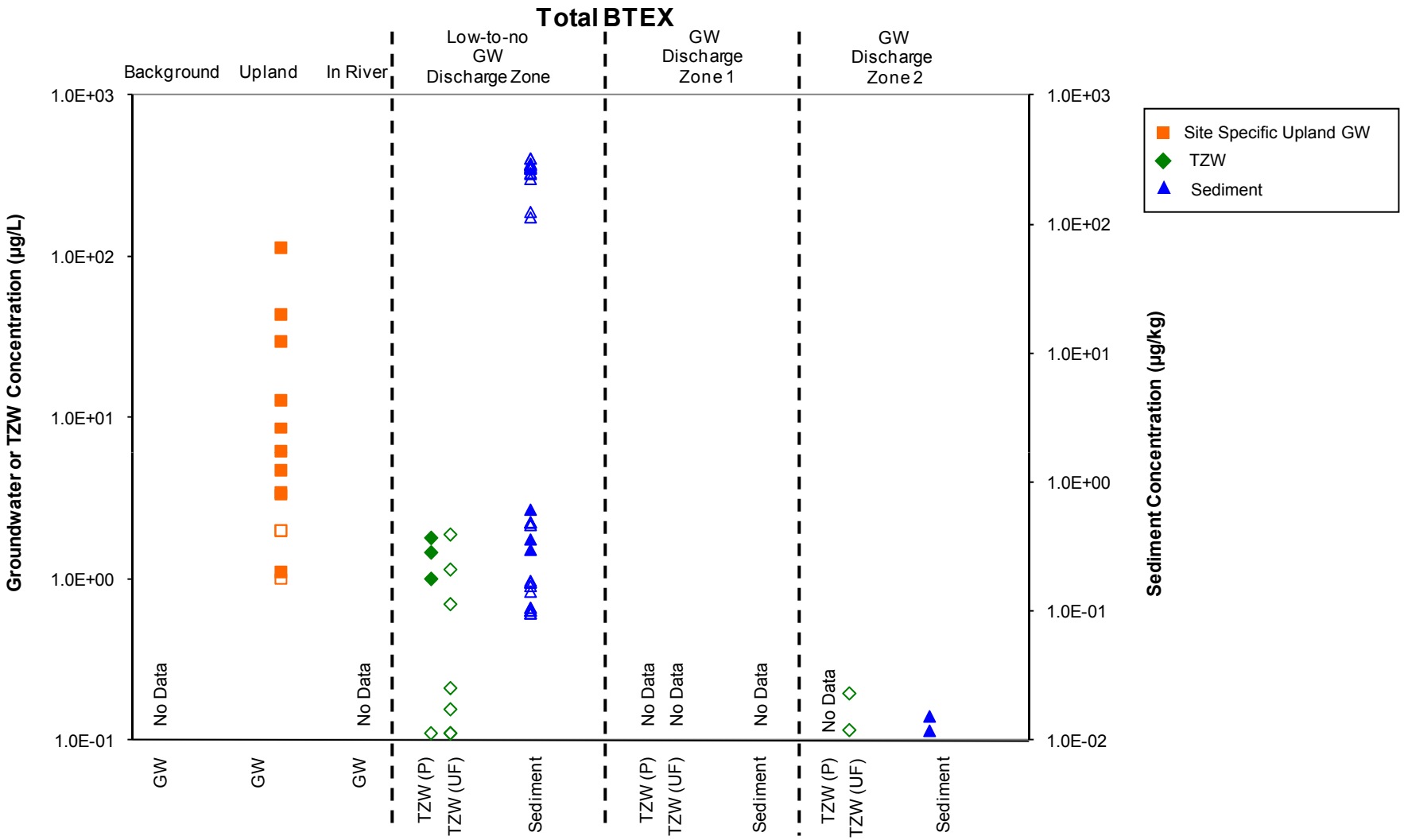
[b] TDS calculated as sum of anions and cations.

[c] Sample not shown on plot, insufficient data.

[d] Estimated value; approximated by nearby location.

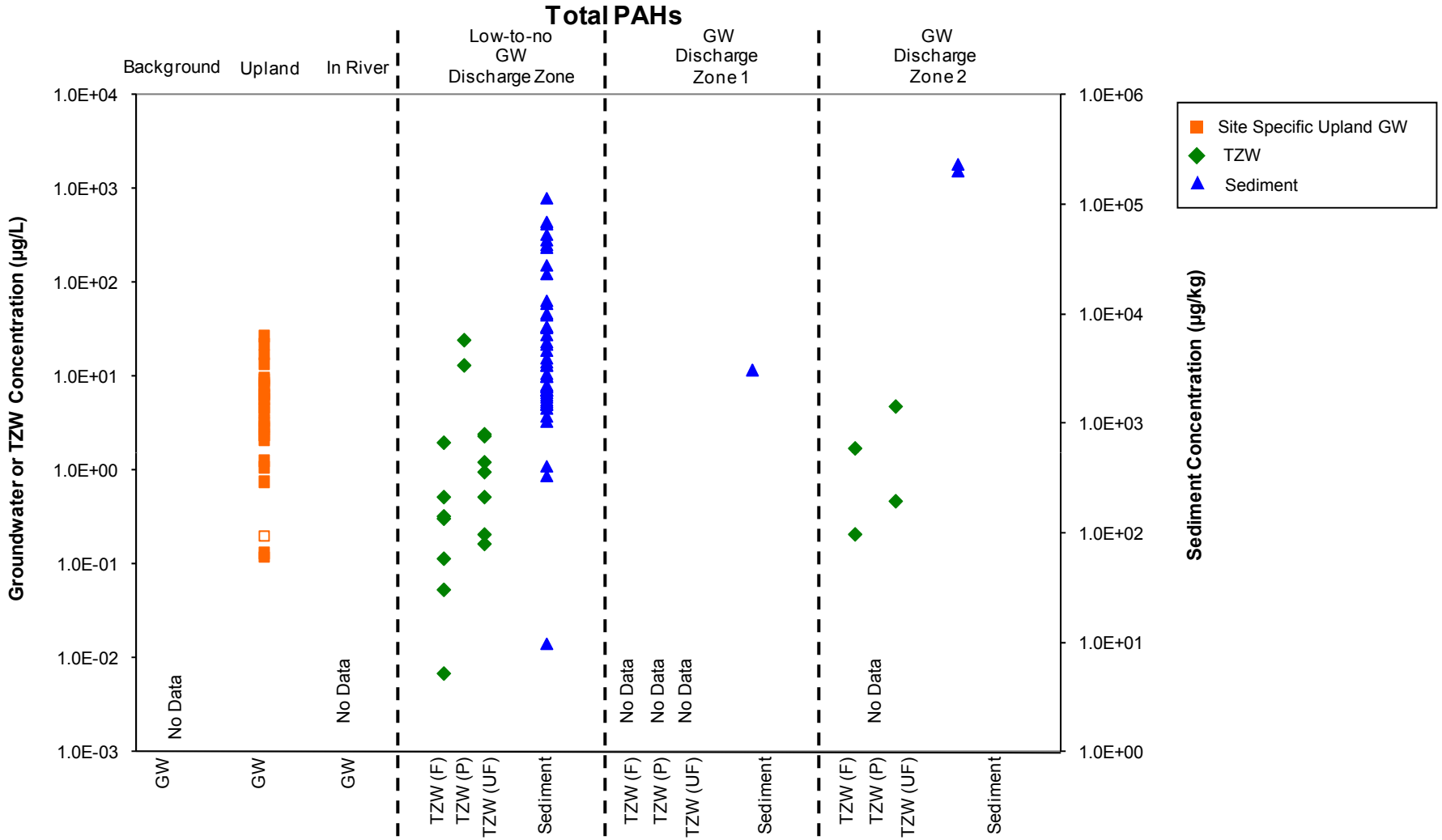
All concentrations as mg/L; pH in s.u.

Figure C3.2-6
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
ARCO



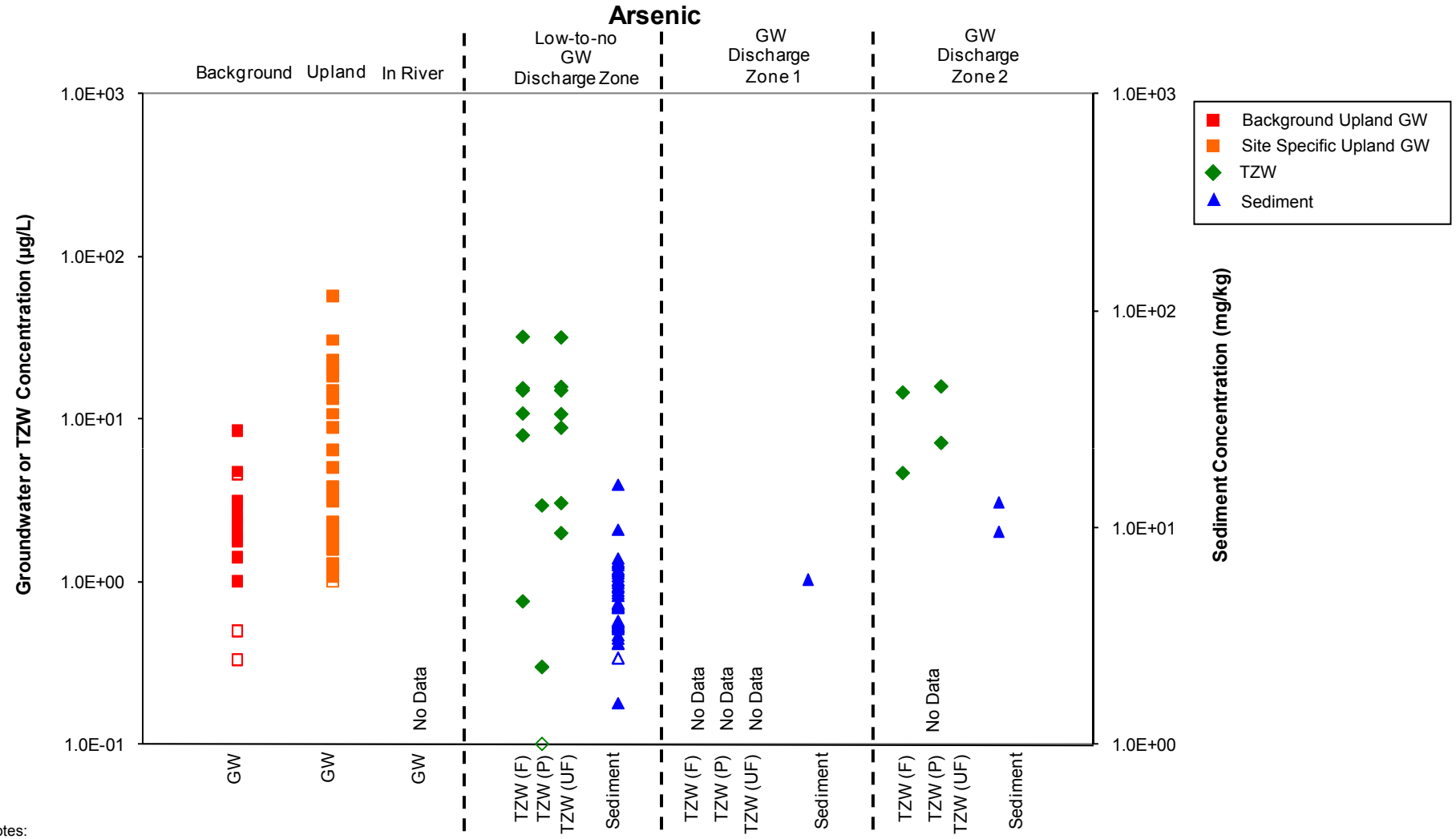
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells:GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.2-7a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total BTEX - ARCO



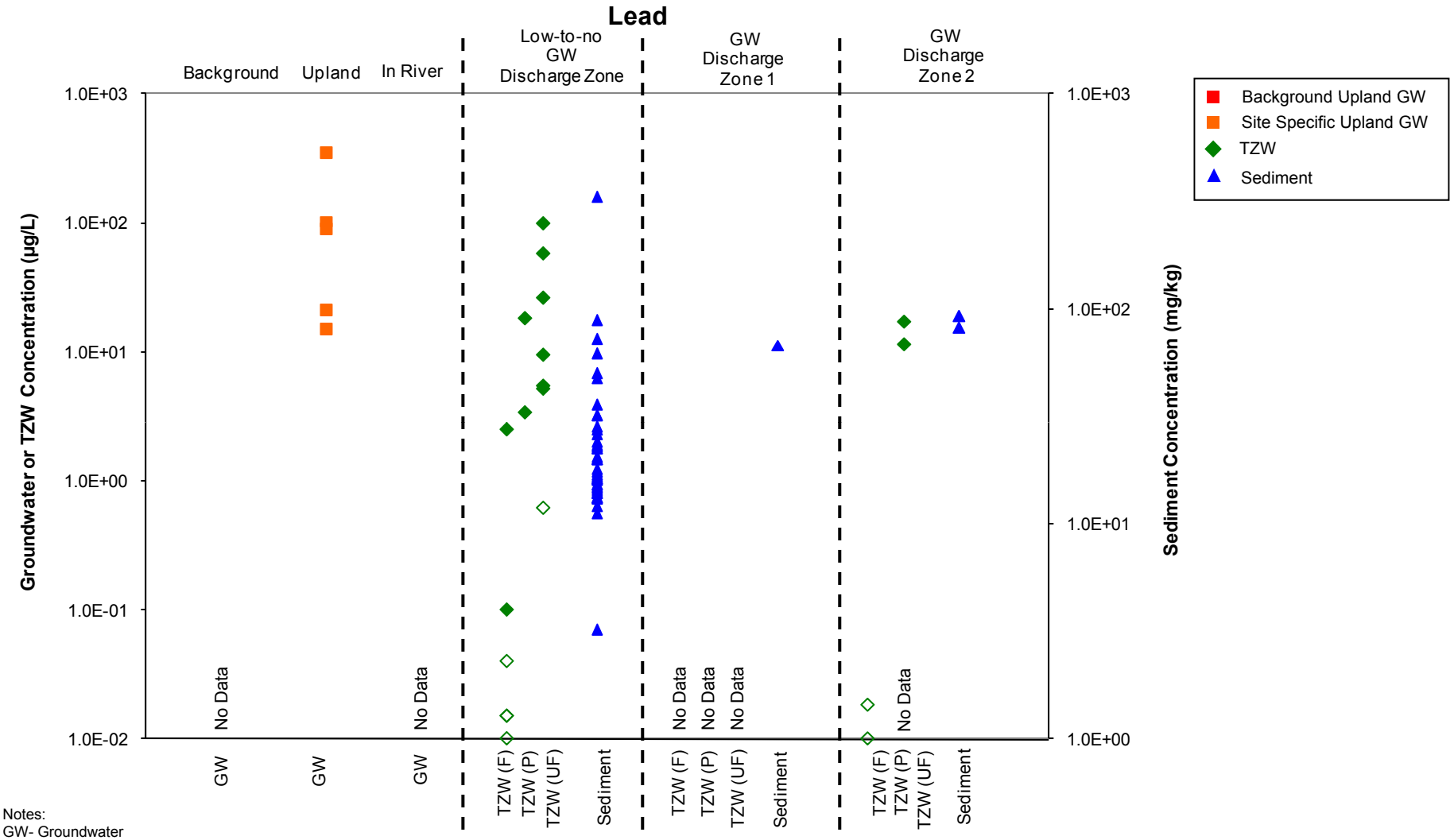
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.2-7b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total PAHs - ARCO



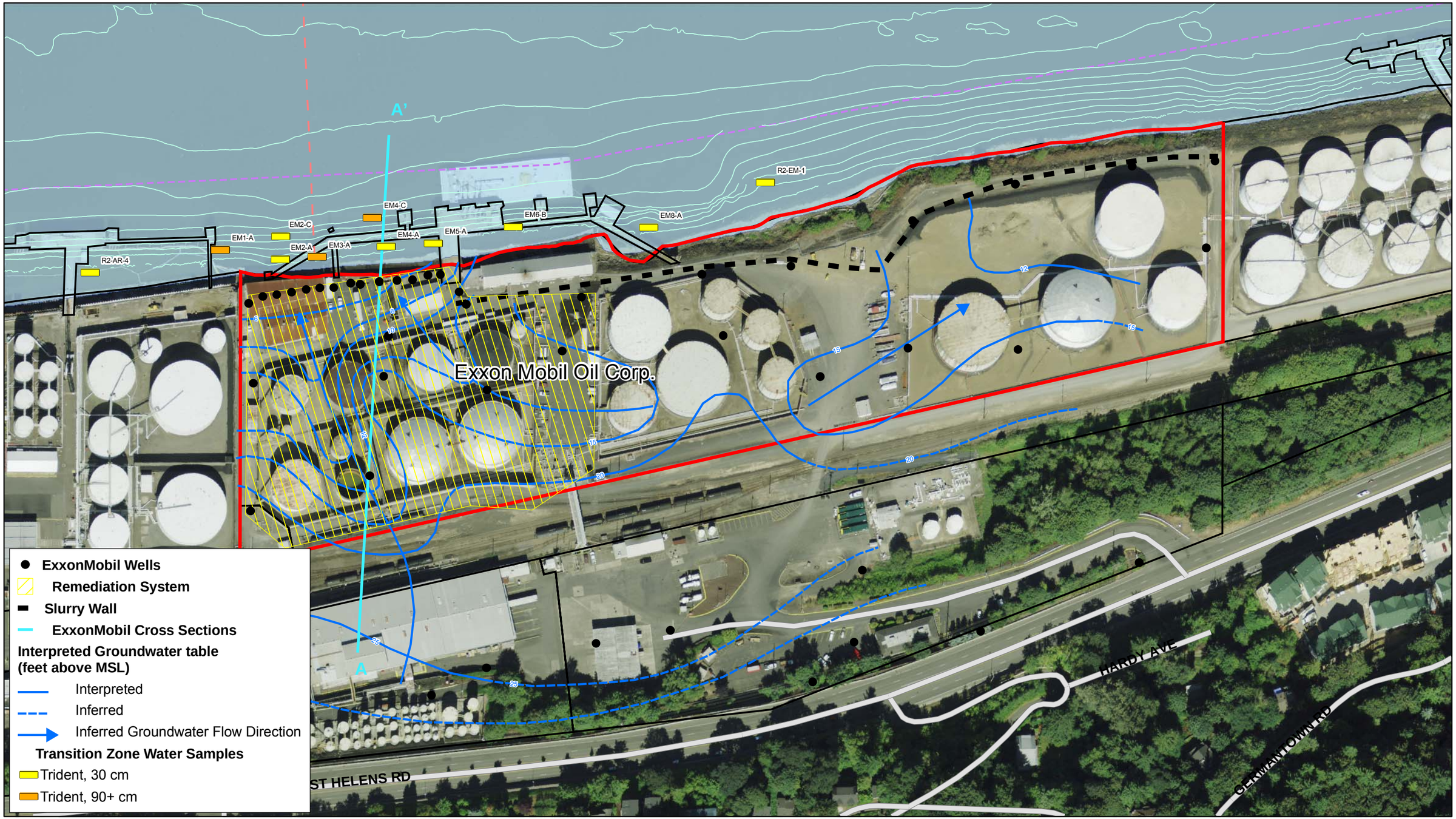
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.2-7c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Arsenic - ARCO



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.2-7d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Lead - ARCO



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LEGEND

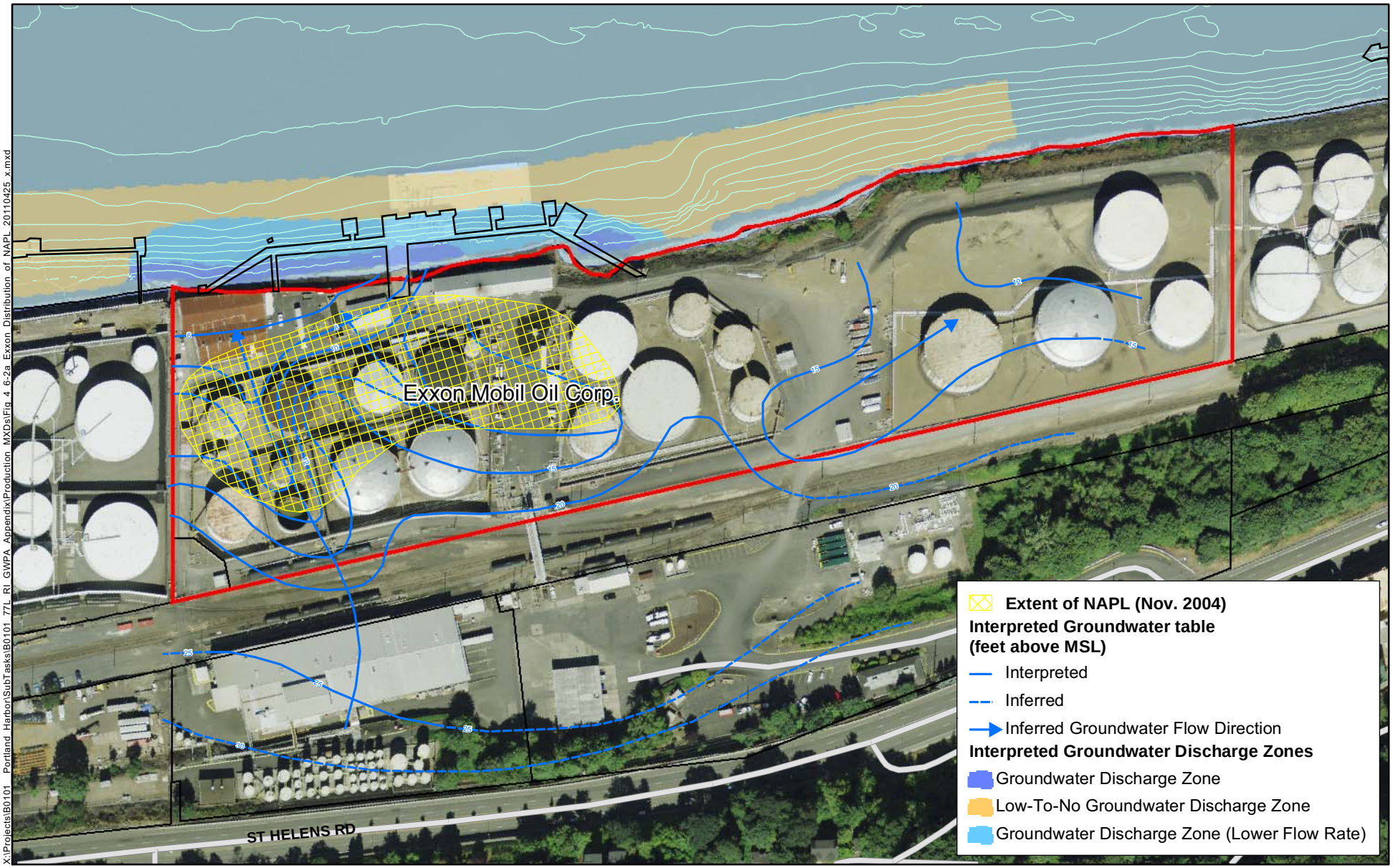
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100 Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-1
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Overview and Cross Section Location



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LEGEND

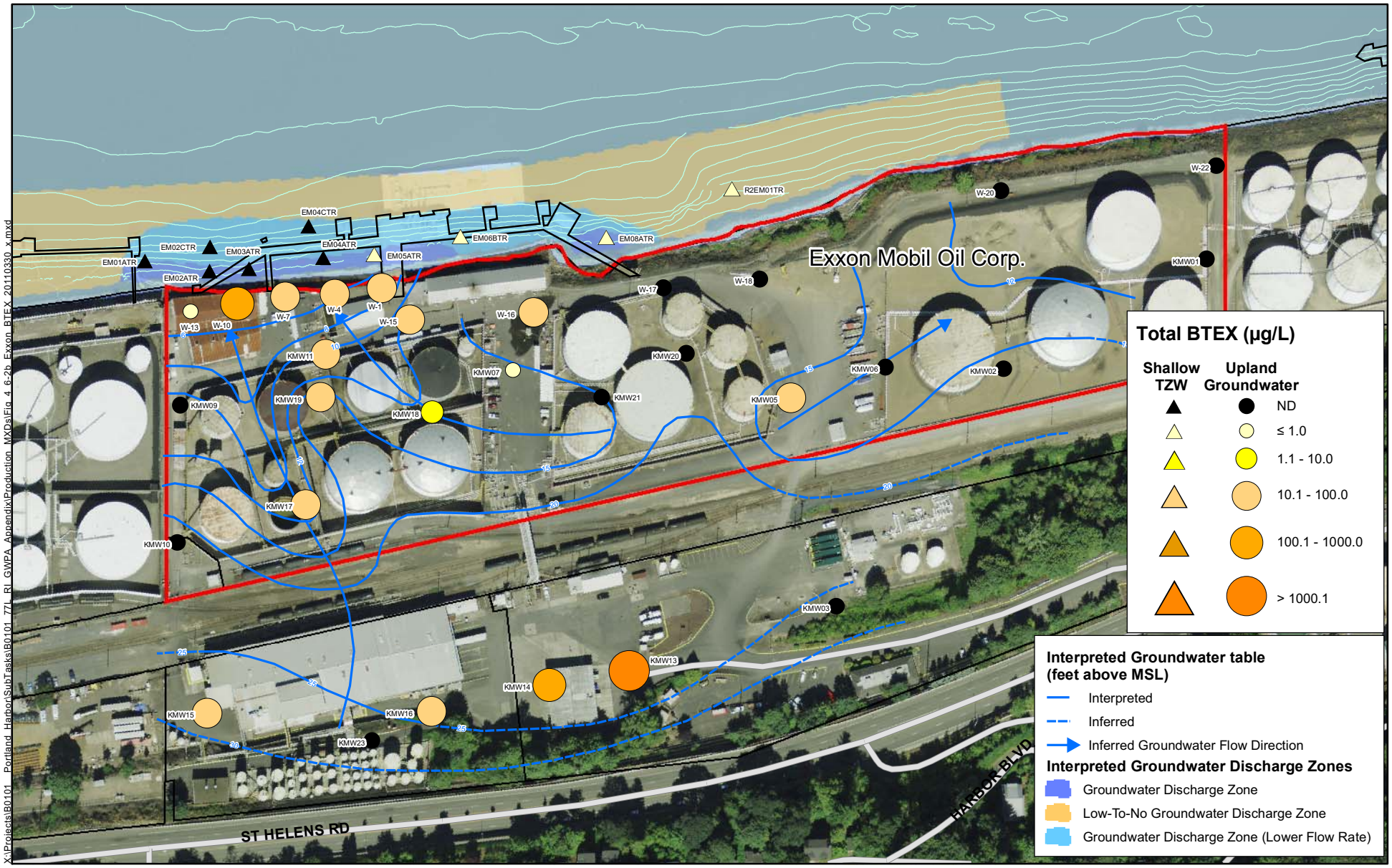
2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-2a
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Distribution of NAPL in Upland Groundwater and TZW



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-2b
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Total BTEX in Upland Groundwater and Shallow TZW

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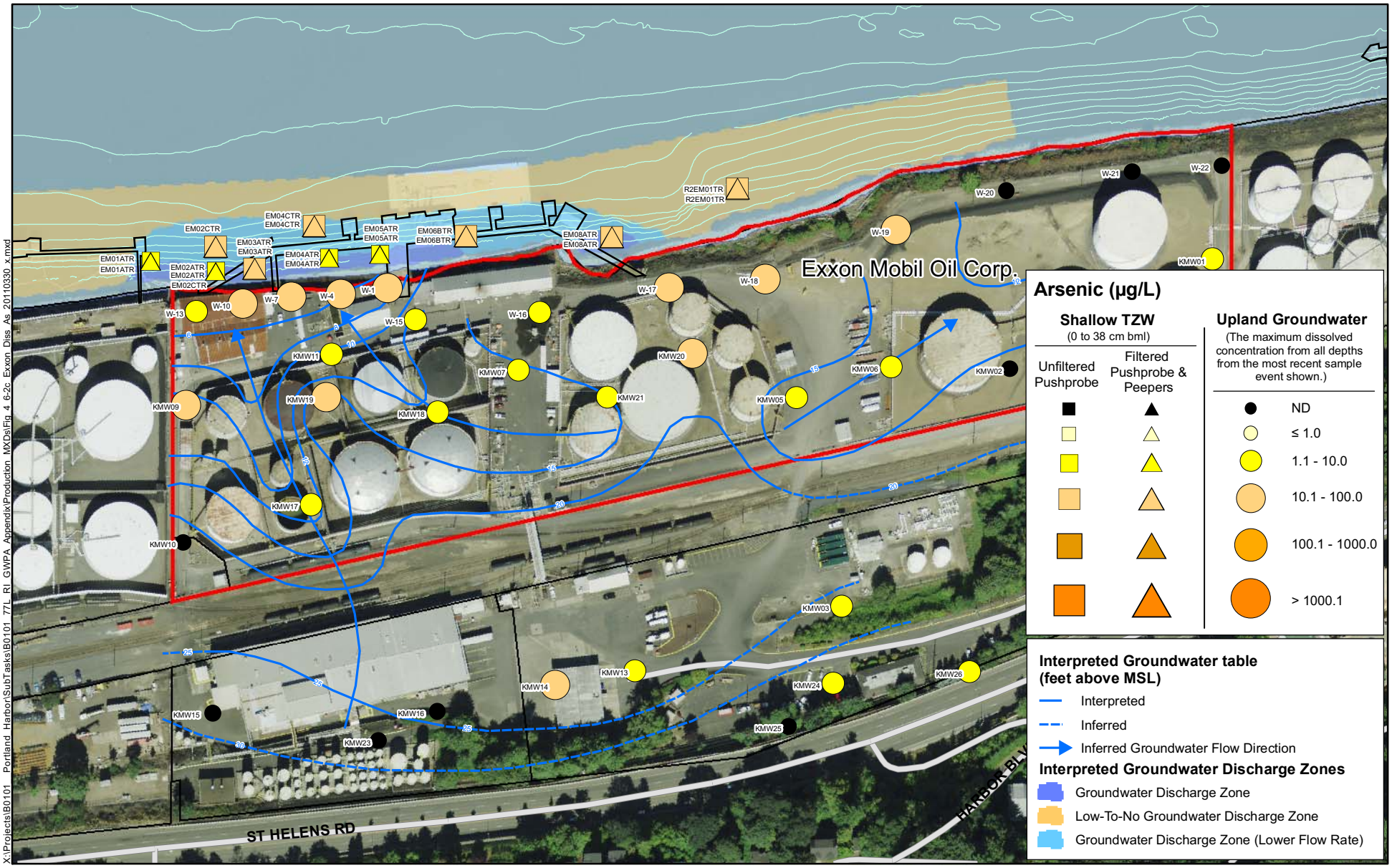

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-2c
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Arsenic in Upland Groundwater and Shallow TZW

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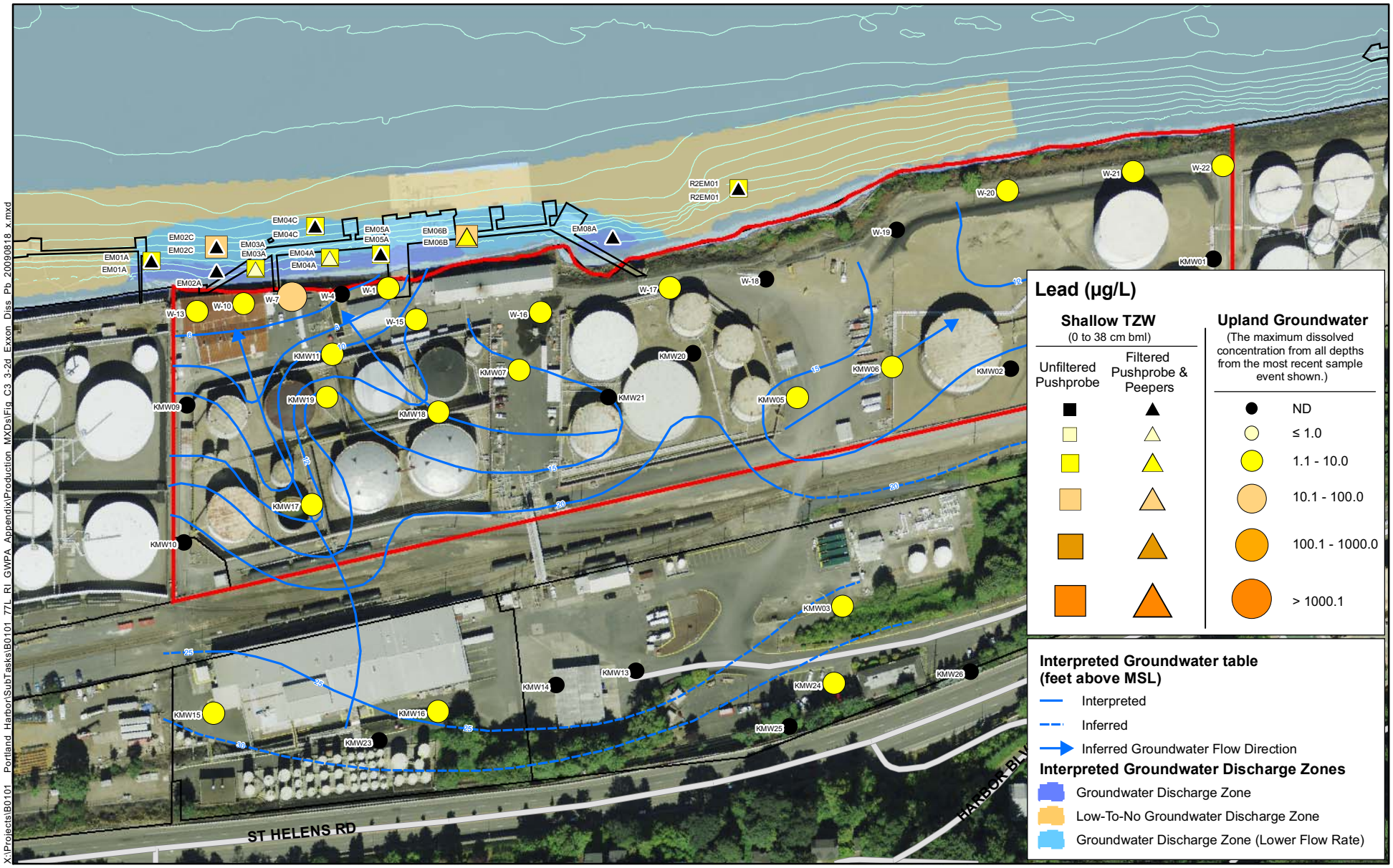

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-2d
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Lead in Upland Groundwater and Shallow TZW

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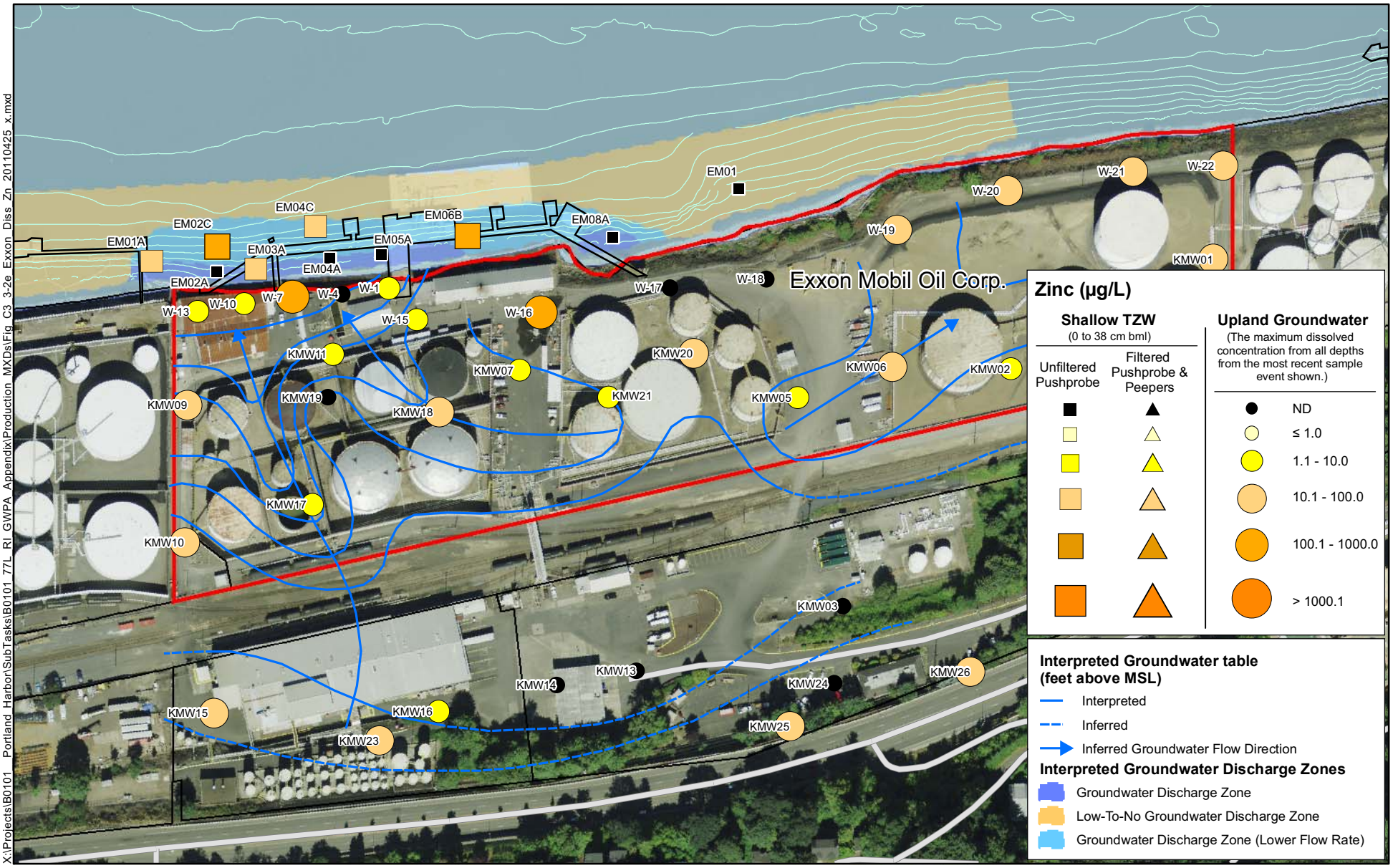

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-2e
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Zinc in Upland Groundwater
and Shallow TZW

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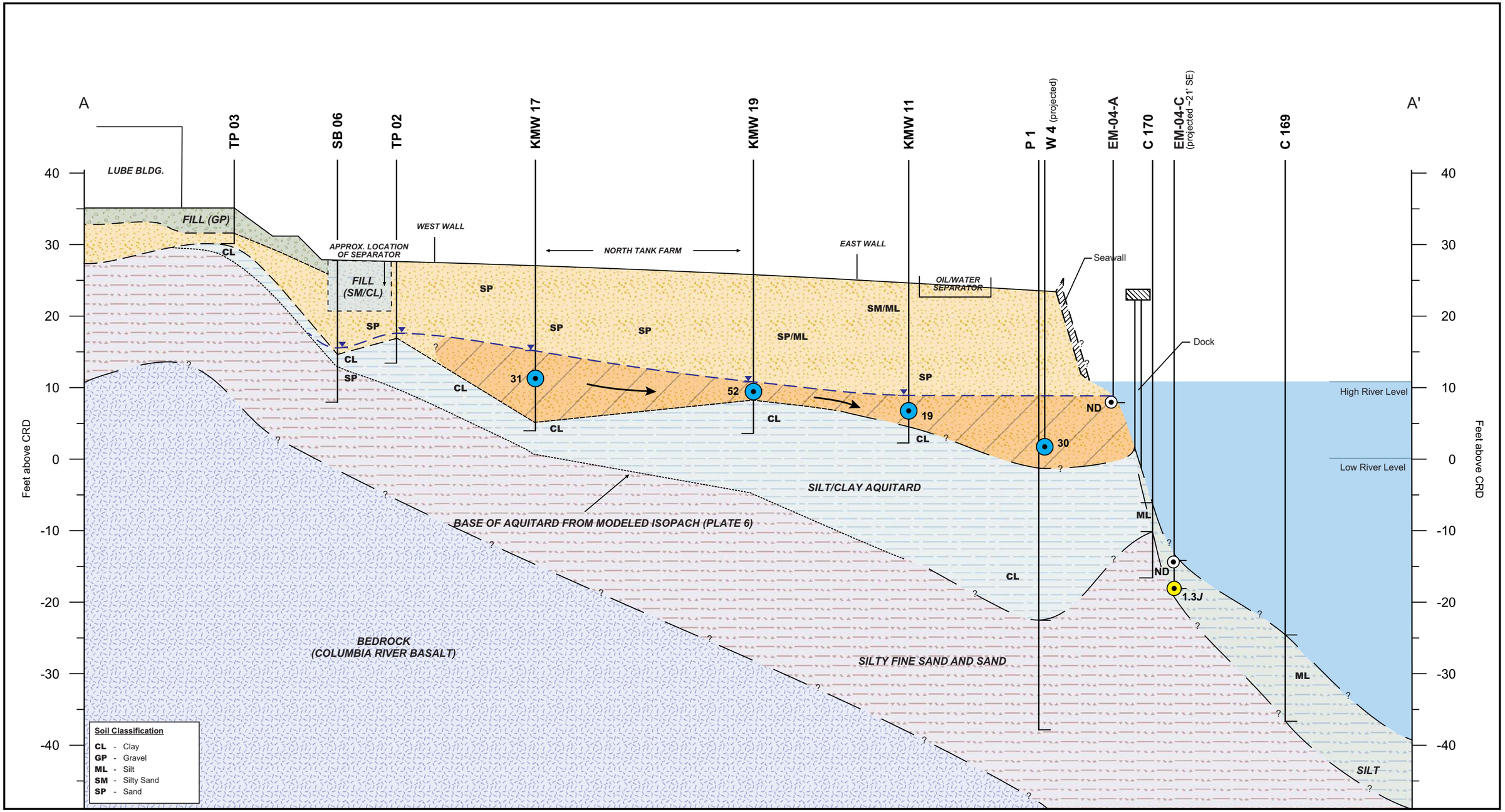


Base features from Groundwater Solutions, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 10 20 Feet
Vertical scale

0 50 100 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Concentration Zone:
- > 10 µg/L

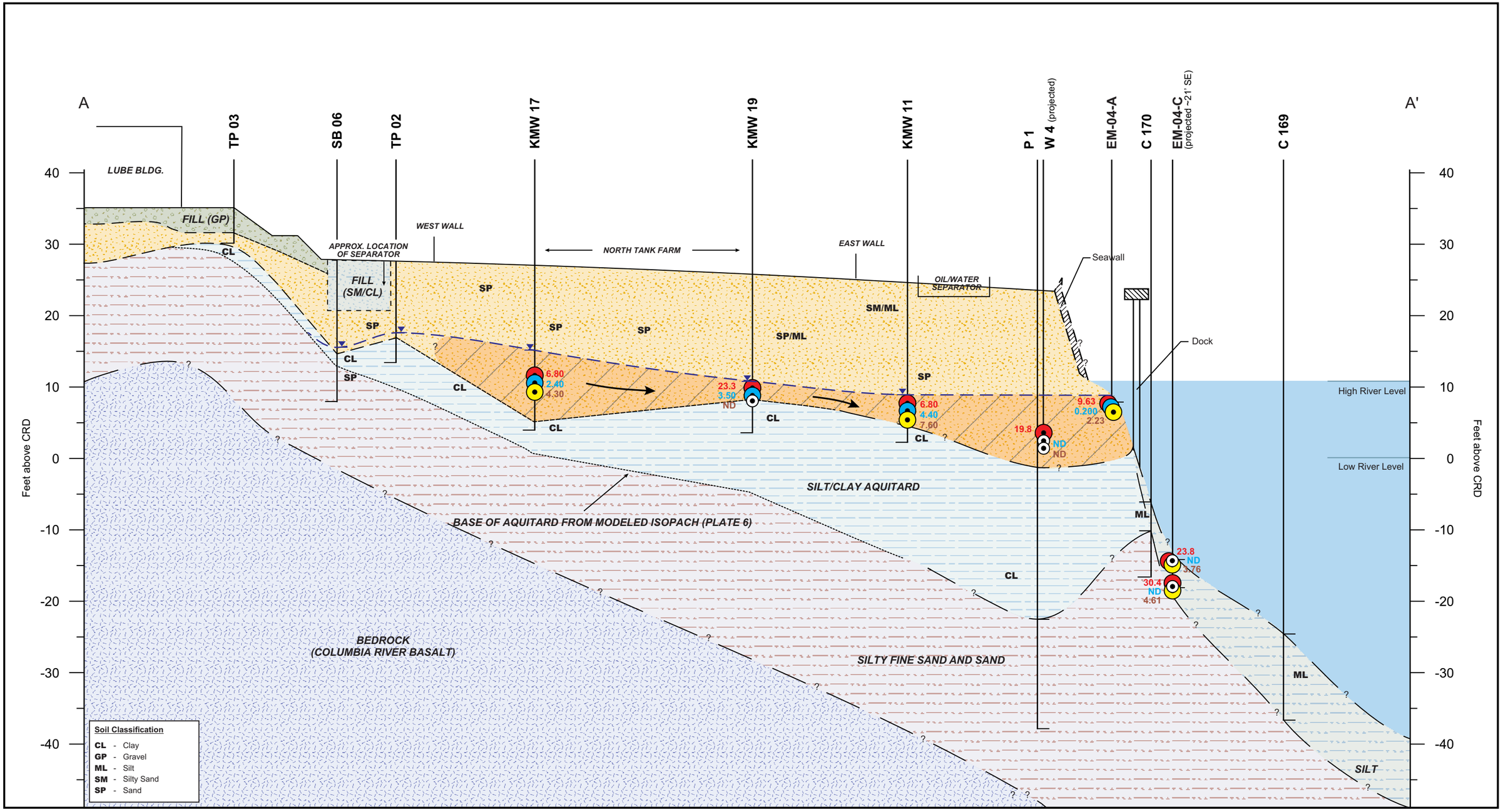
Approximate groundwater elevation

DL - Detection Limit

ND - Not Detected

J - Estimated

Figure C3.3-3a
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Stratigraphic Cross Section A-A' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water



Base features from Groundwater Solutions, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 10 20 Feet
Vertical scale

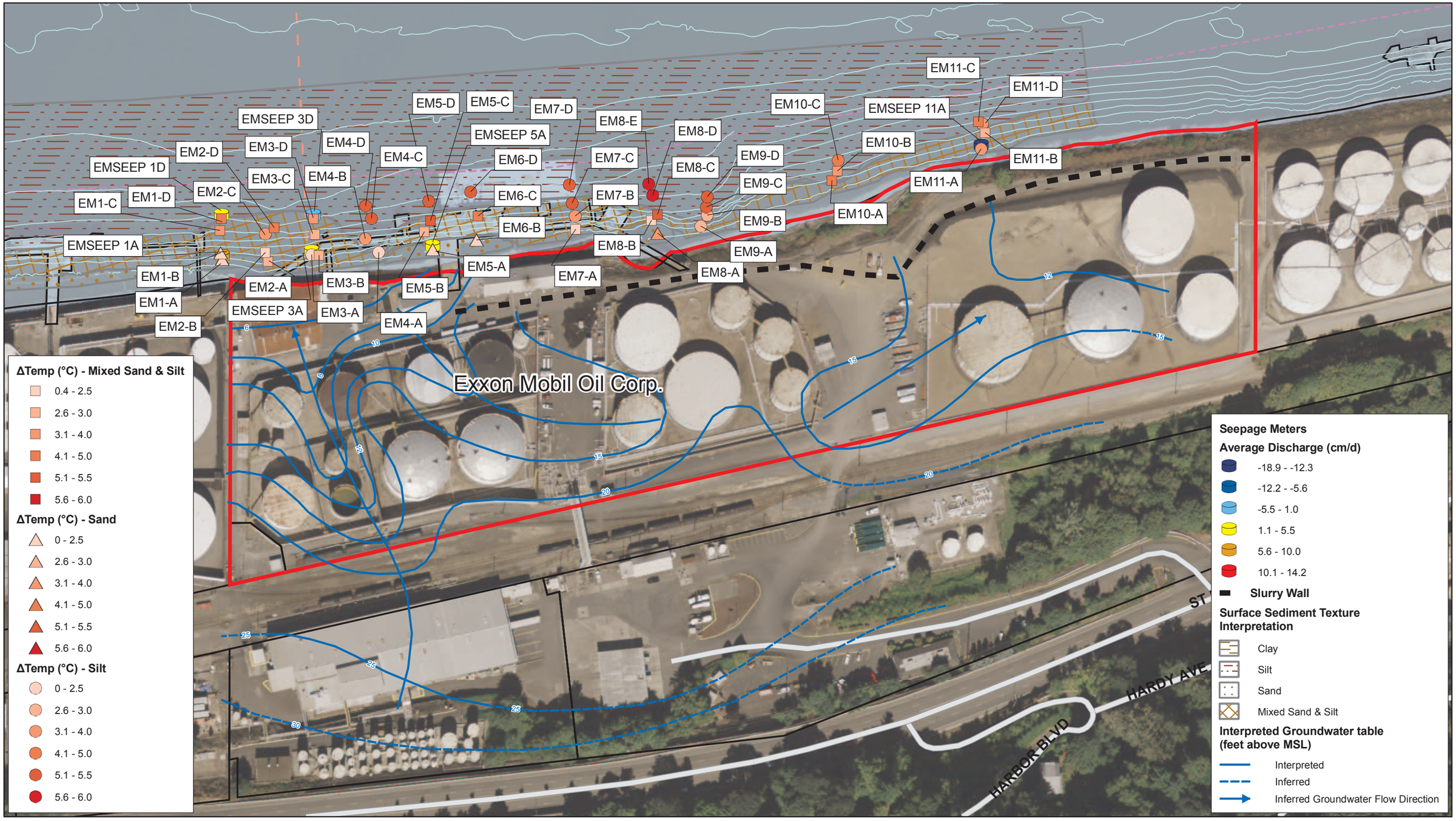
0 50 100 Feet
Horizontal scale

Sample Concentration Range:
As ND Pb ND Zn ND
As > DL (µg/L)
Pb > DL (µg/L)
Zn > DL (µg/L)

Concentration Zone:
> DL

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected

Figure C3.3-3b
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Stratigraphic Cross Section A-A' and
Concentrations of Dissolved Arsenic, Dissolved Lead, and Dissolved Zinc
in Nearshore Groundwater and Transition Zone Water



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LEGEND

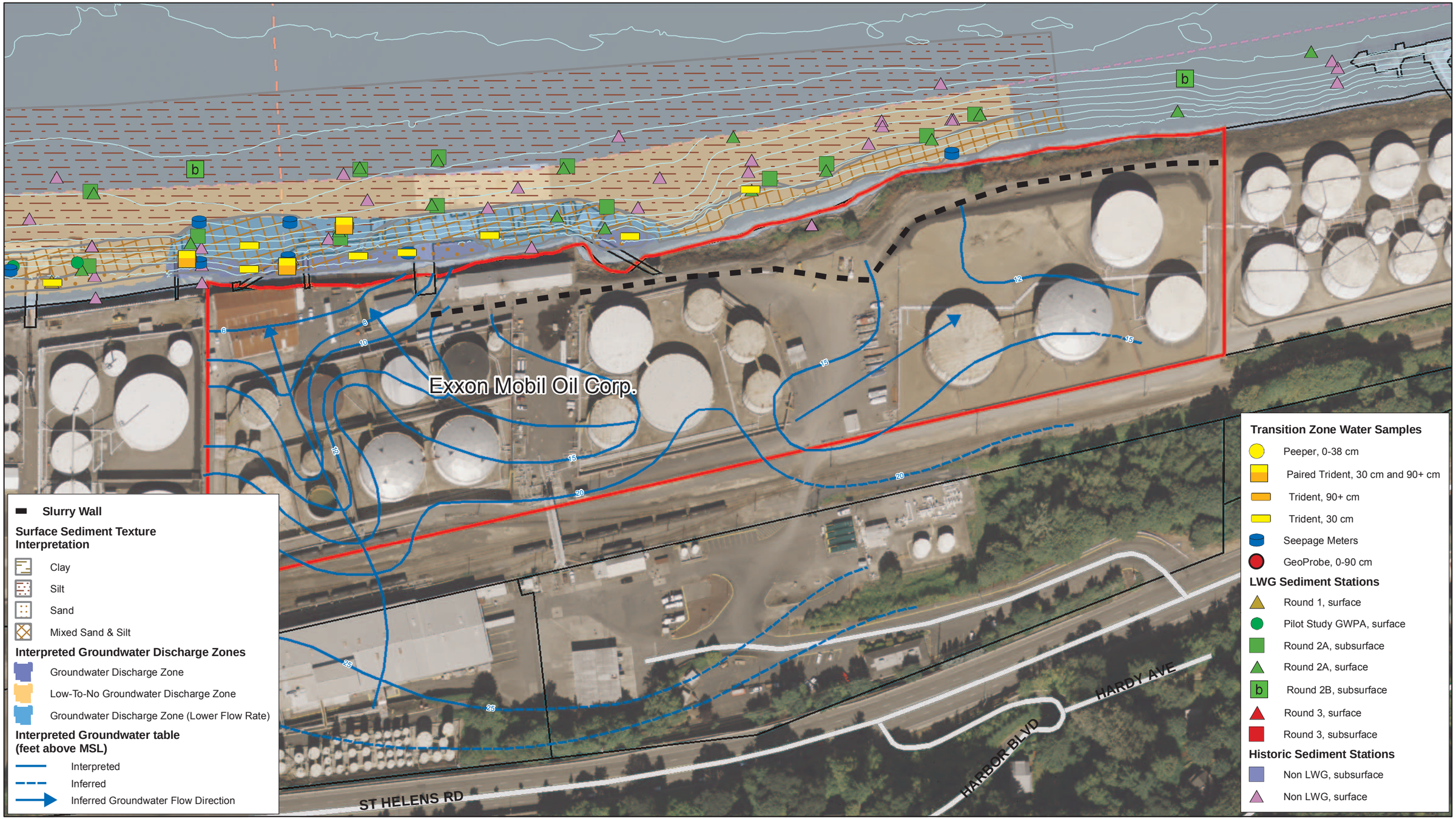
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

Figure C3.3-4
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Trident Probe and Seepage Meter Results



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contour: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).
Wells & Remediation System: locations are approximate and drawn by measuring from Figure 3 (Kleinfelder, Oct. 14, 2002).

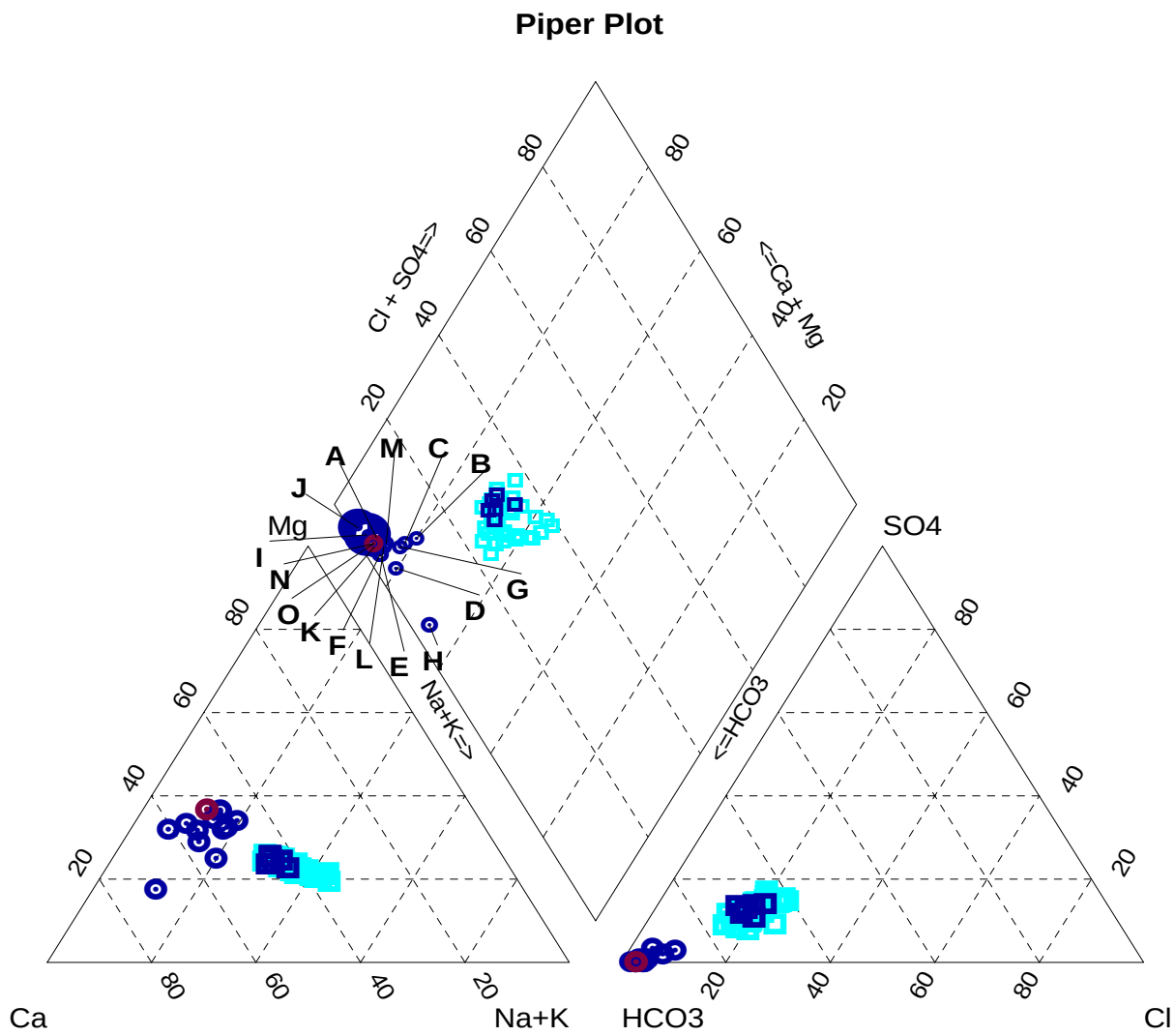
Figure C3.3-5
Portland Harbor RI/FS
Remedial Investigation Report
ExxonMobil Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

- 0 mg/L
- 2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	EM-01-A, Trident 150 cm	179	4.3	0.05	51.2	7.68	2.82	8.37	6.75	253.42
B	Groundwater Discharge Zone	EM-01-A, Trident 30 cm	80	4.6	2	20.2	5.49	2.06	7.11	6.99	121.46
C	Groundwater Discharge Zone	EM-02-A, Trident 30 cm	145	6.3	2.3	29.5	11.7	2.09	11.2	7.34	208.09
D	Groundwater Discharge Zone	EM-02-C, Trident 30 cm	188	4.4	0.3	47.5	20.9	4.68	19.9	6.8	285.68
E	Groundwater Discharge Zone	EM-03-A, Trident 120 cm	277	4.5	0.2	47.7	21.6	2.84	15.2	6.85	369.04
F	Groundwater Discharge Zone	EM-03-A, Trident 120 cm; FR	282	4.3	0.2	48.5	22.2	2.81	15.3	6.87	375.31
G	Groundwater Discharge Zone	EM-03-A, Trident 30 cm	178	4.6	5	40.7	15.7	2.78	14.8	6.99	261.58
H	Groundwater Discharge Zone	EM-04-A, Trident 30 cm	292	5.2	1.6	48.2	15	4.22	38.1	6.86	404.32
I	Groundwater Discharge Zone	EM-04-C, Trident 150 cm	816	11.8	0.05	167	59.6	8.34	28.6	6.68	1091.39
J	Groundwater Discharge Zone	EM-04-C, Trident 30 cm	680	6.4	0.05	152	48.2	6.3	17.1	6.7	910.05
K	Groundwater Discharge Zone	EM-05-A, Trident 30 cm	418	6	0.05	75.1	26.1	6.14	16.3	6.69	547.69
L	Groundwater Discharge Zone	EM-06-B, Trident 30 cm	187	4.7	0.3	39.2	16.1	2.95	11.2	6.85	261.45
M	Groundwater Discharge Zone	EM-08-A, Trident 30 cm	220	6	1.3	50.5	15.6	3.34	13	6.92	309.74
N	Low-to-No Groundwater Discharge Zone	R2-EM-01, Trident 30 cm	331	5.3	0.05	62.4	27.2	4.86	14.3	6.74	445.11
O	Low-to-No Groundwater Discharge Zone	R2-EM-01, Trident 30 cm; FR	330	5.4	0.2	61	26.4	4.77	14	6.77	441.77

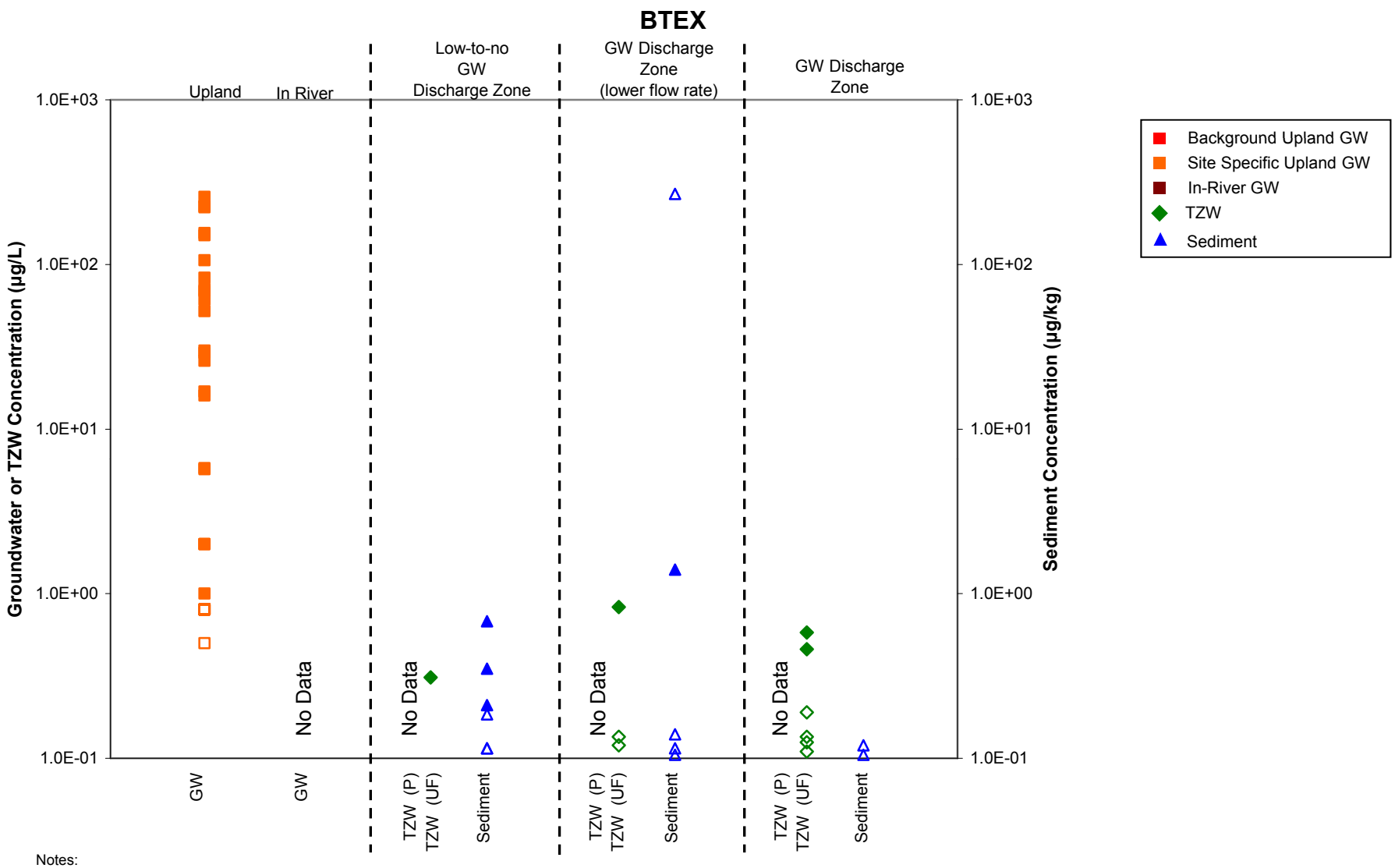
Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

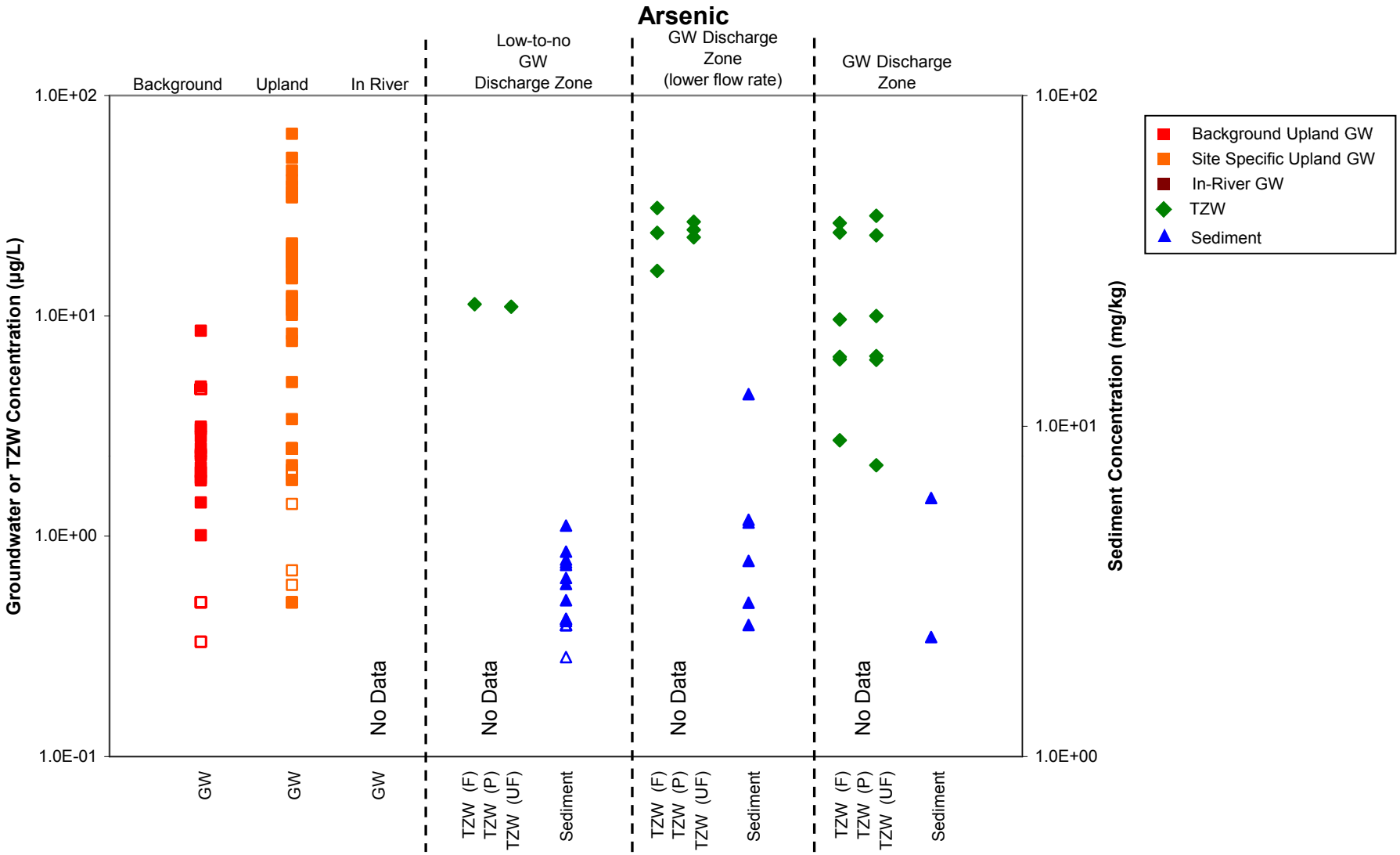
All concentrations as mg/L; pH in s.u.

Figure C3.3-6
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
ExxonMobil



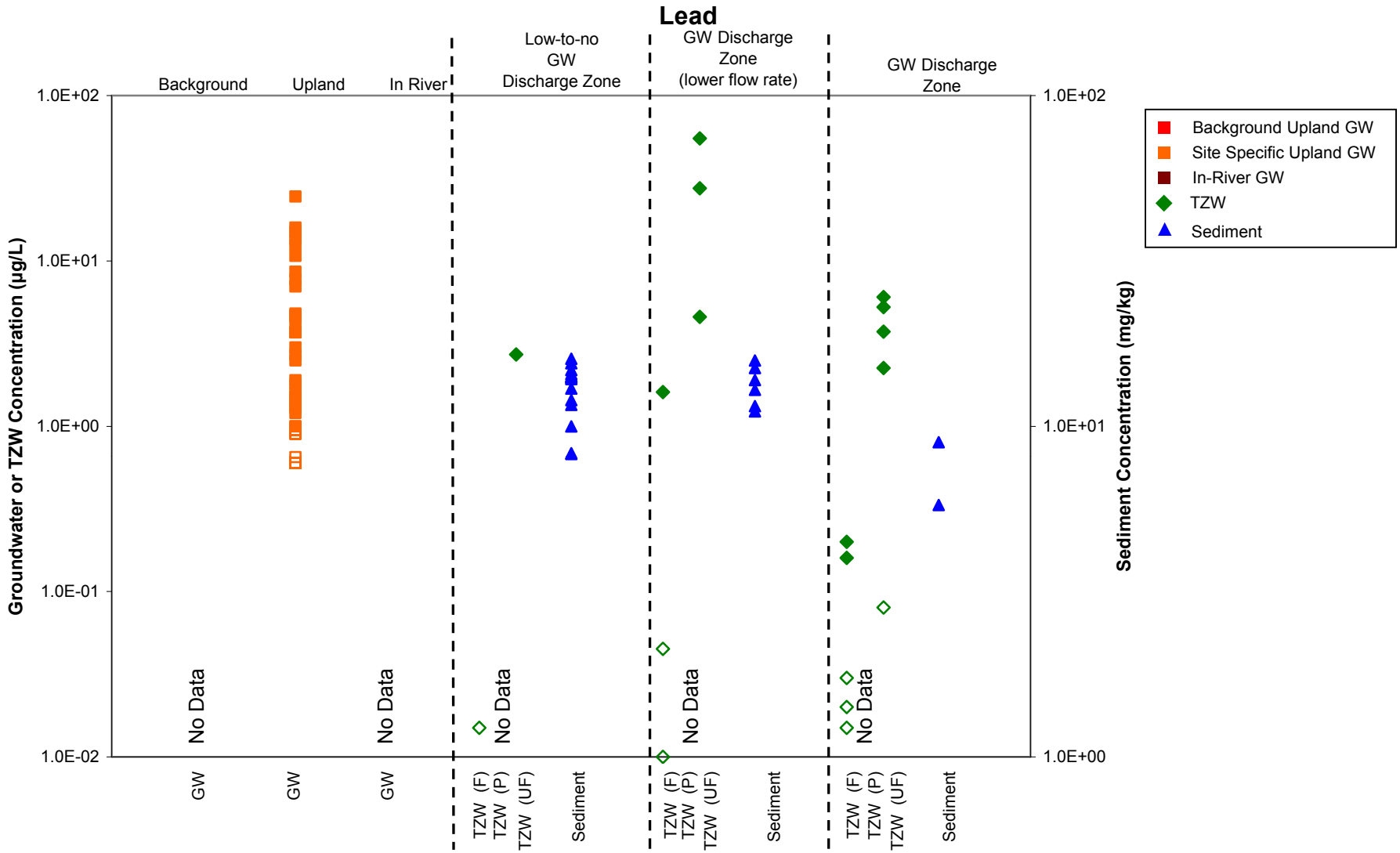
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: W-1, W-4,W-5,W-6, W-7, W-8, W-9, W-10, W-11,W-12,W-13,W-14,W-15,W-16,W-17,W-18,W-19,W-20,W-21,W-22; sampled between 5/3/1991 and 10/3/2003.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.3-7a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
BTEX - ExxonMobil



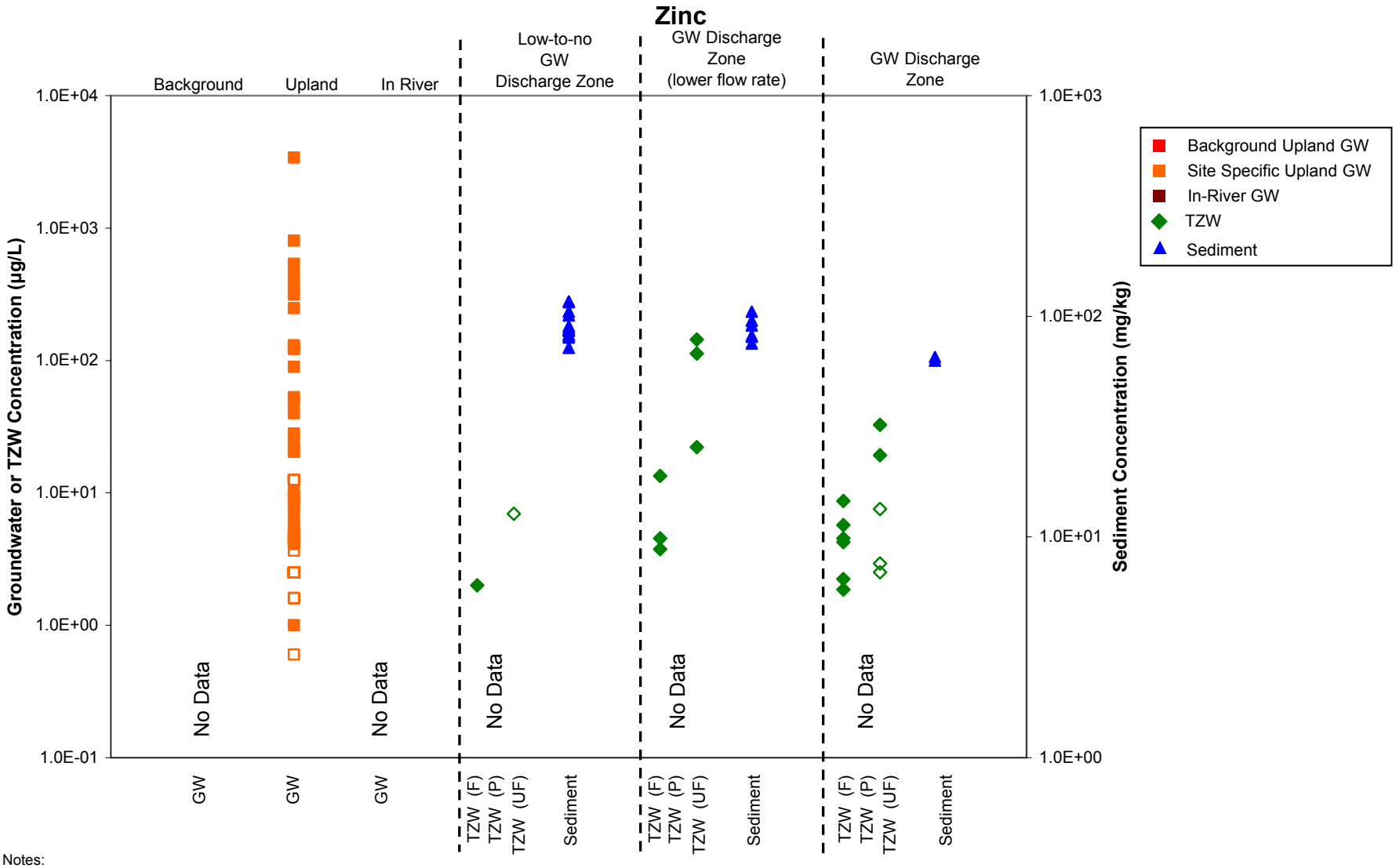
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: W-1, W-4,W-5,W-6, W-7, W-8, W-9, W-10, W-11,W-12,W-13,W-14,W-15,W-16,W-17,W-18,W-19,W-20,W-21,W-22; sampled between 5/3/1991 and 10/3/2003.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.3-7b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Arsenic - ExxonMobil



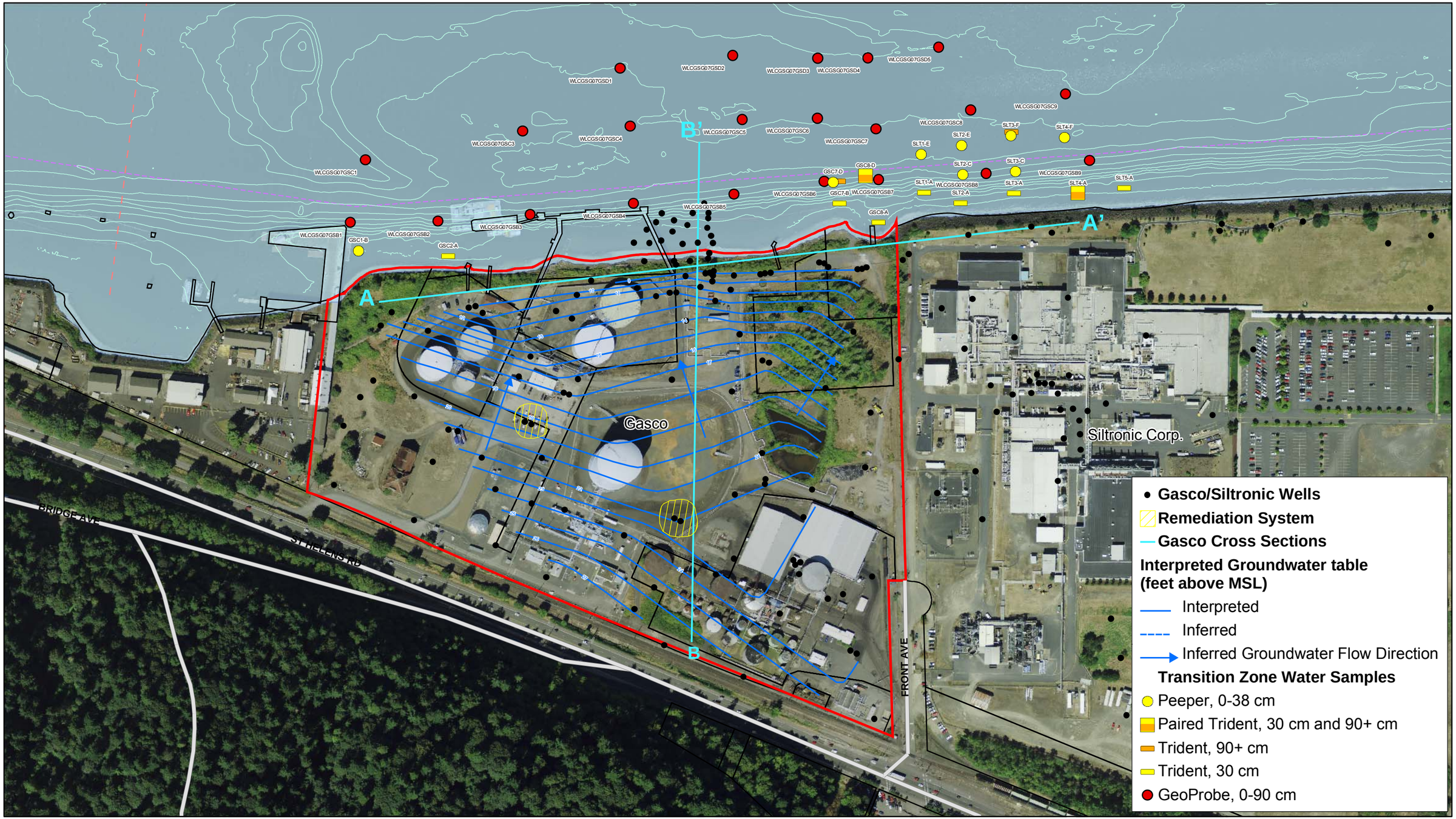
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: W-1, W-4,W-5,W-6, W-7, W-8, W-9, W-10, W-11,W-12,W-13,W-14,W-15,W-16,W-17,W-18,W-19,W-20,W-21,W-22; sampled between 5/3/1991 and 10/3/2003.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.3-7c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Lead - ExxonMobil



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: W-1, W-4,W-5,W-6, W-7, W-8, W-9, W-10, W-11,W-12,W-13,W-14,W-15,W-16,W-17,W-18,W-19,W-20,W-21,W-22; sampled between 5/3/1991 and 10/3/2003.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.3-7d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Zinc - ExxonMobil



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LEGEND

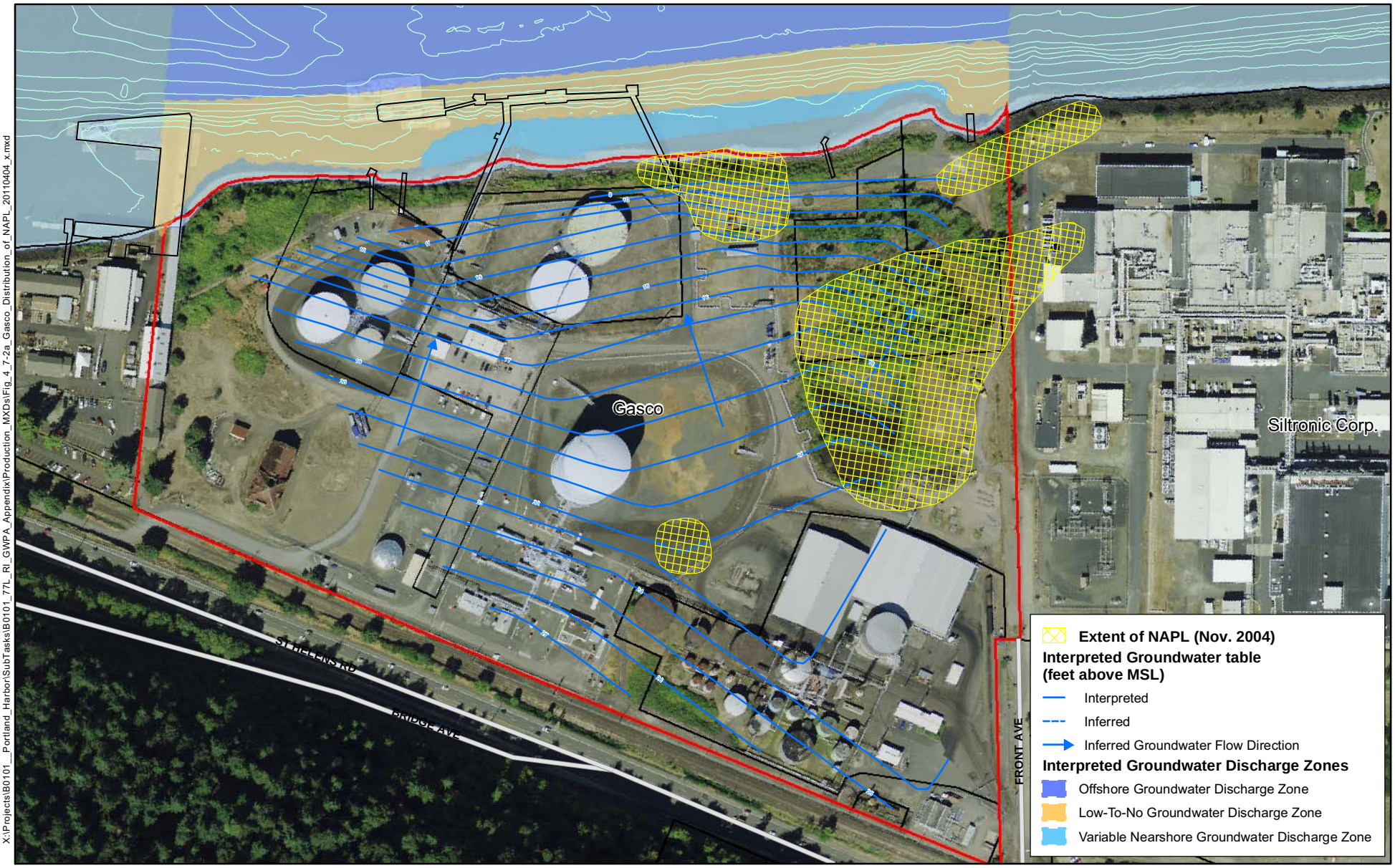
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 125 250
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-1
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Overview and Cross Section Location



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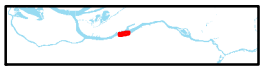
LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

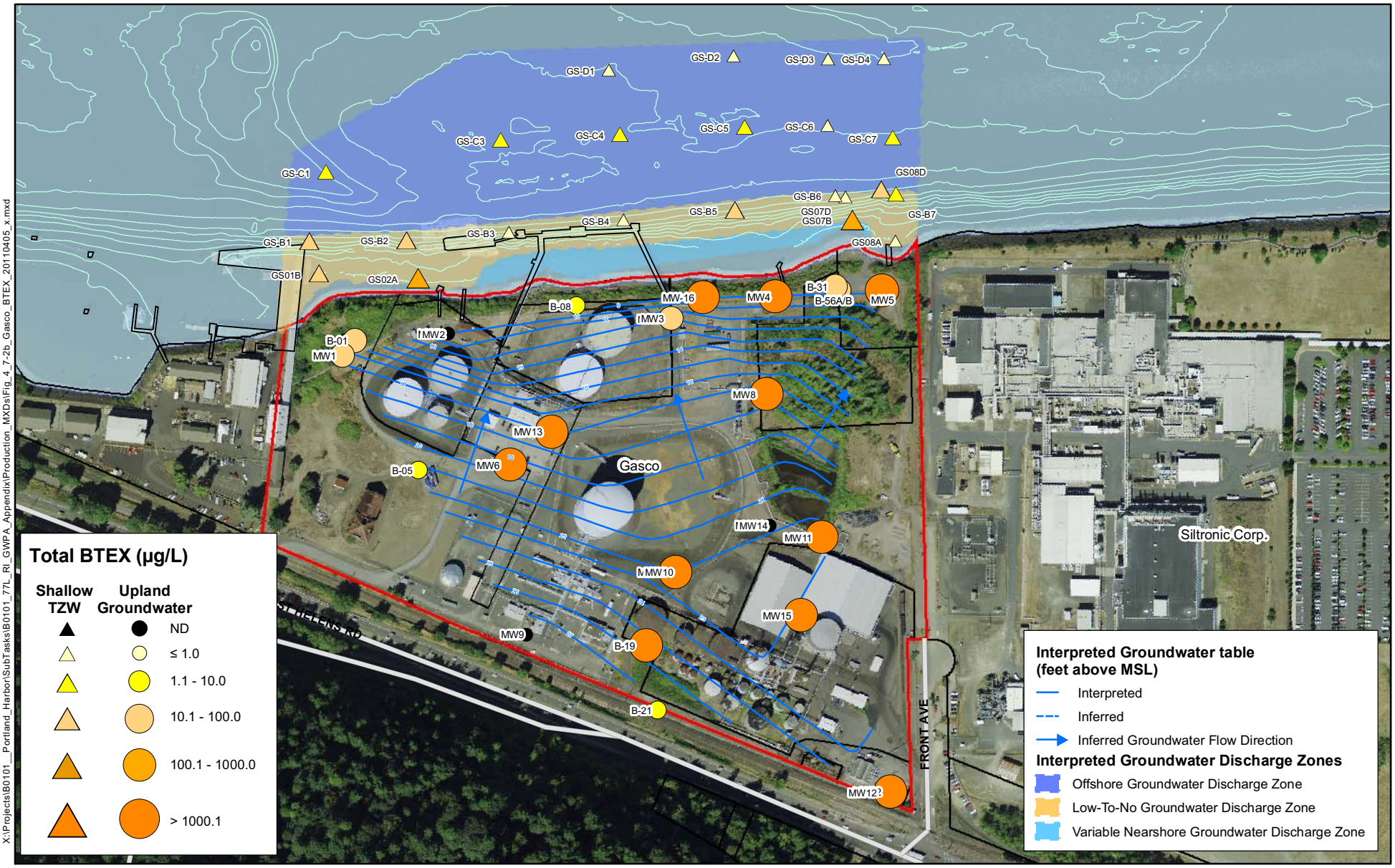
0 50 100
Feet

N



FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-2a
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Distribution of NAPL in Upland Groundwater



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

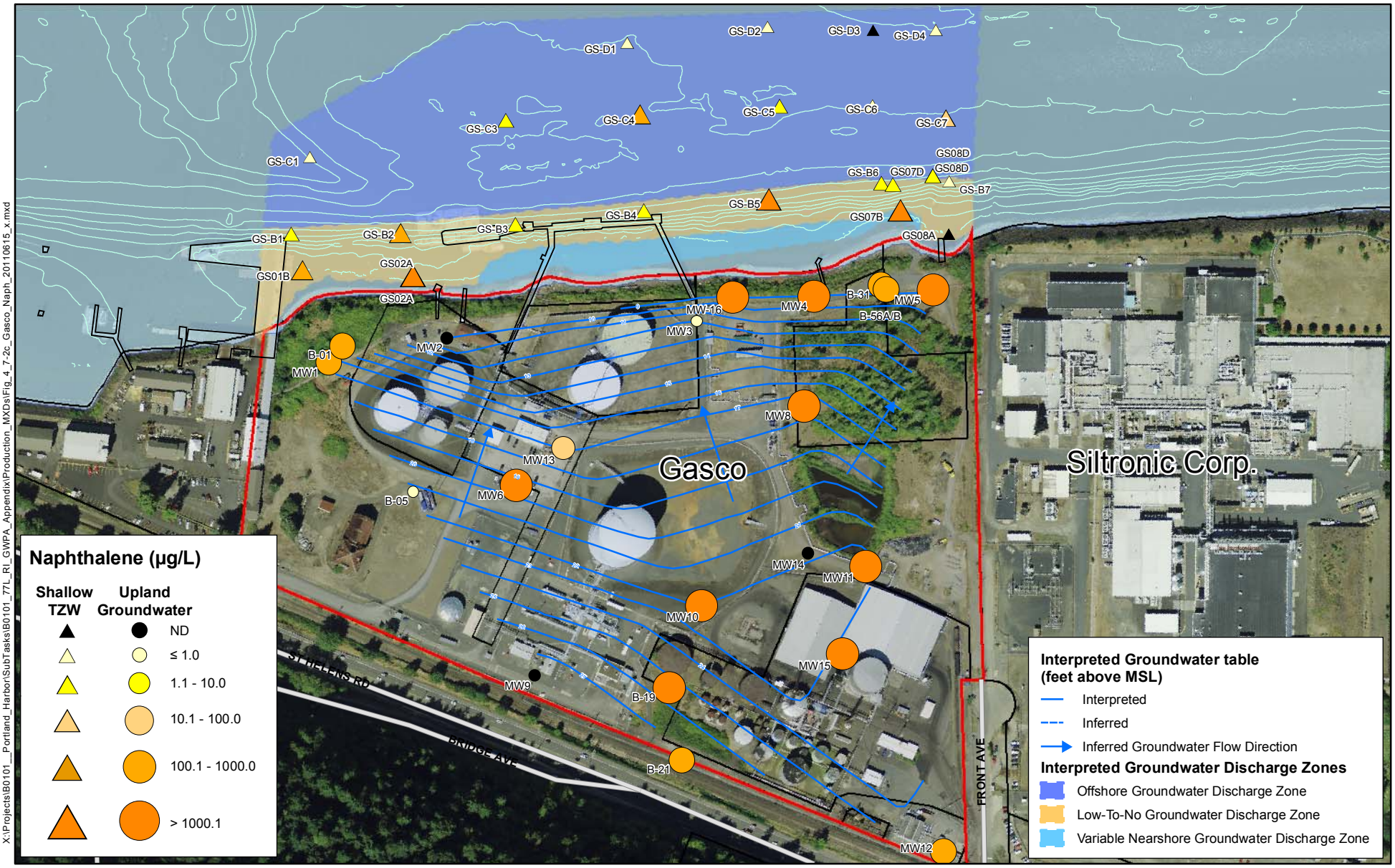
Site Property Boundary

0 100 200

Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-2b
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Total BTEX in Upland Groundwater and Shallow TZW



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

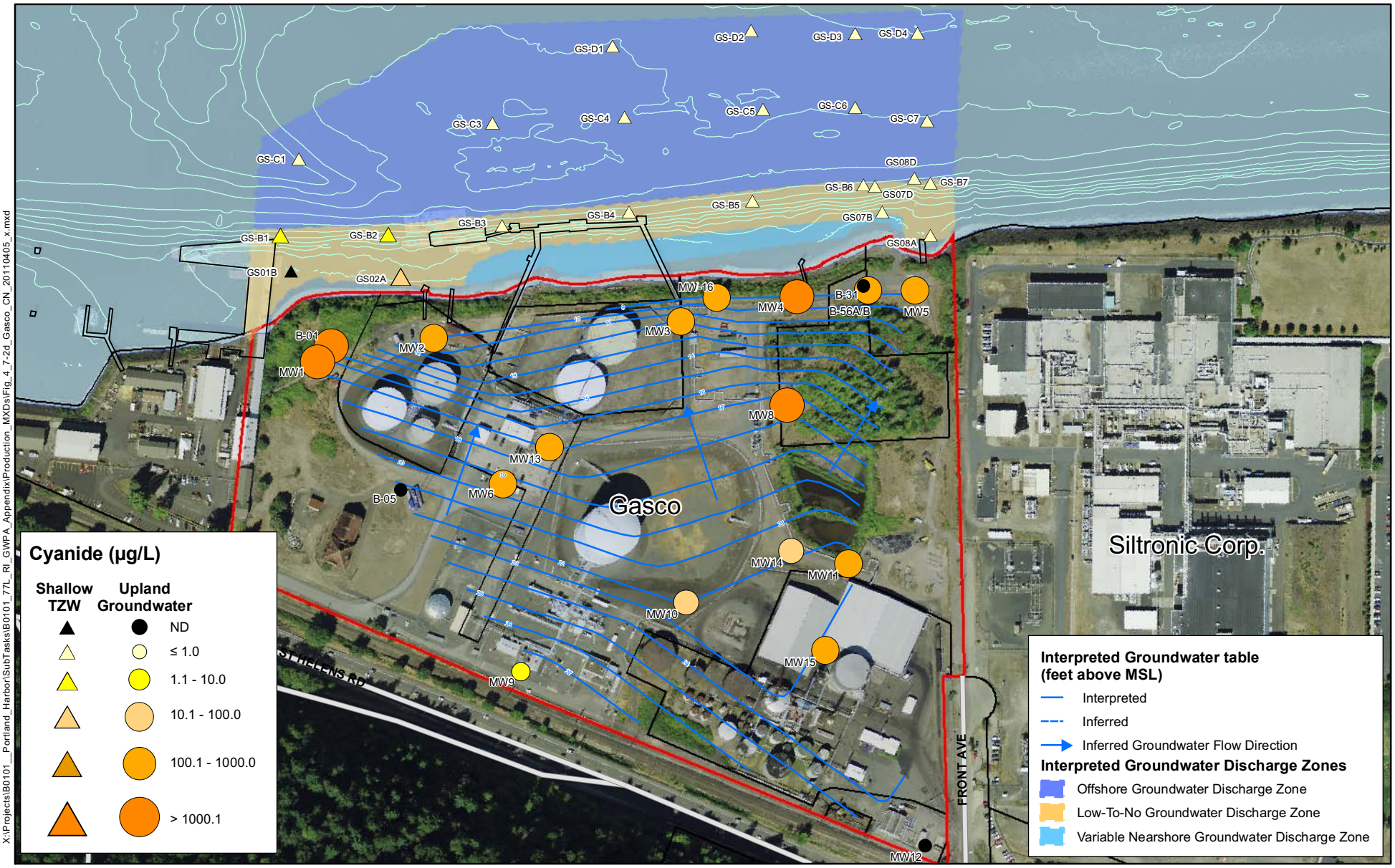
0 50 100

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-2c
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Naphthalene in Upland Groundwater and Shallow TZW



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

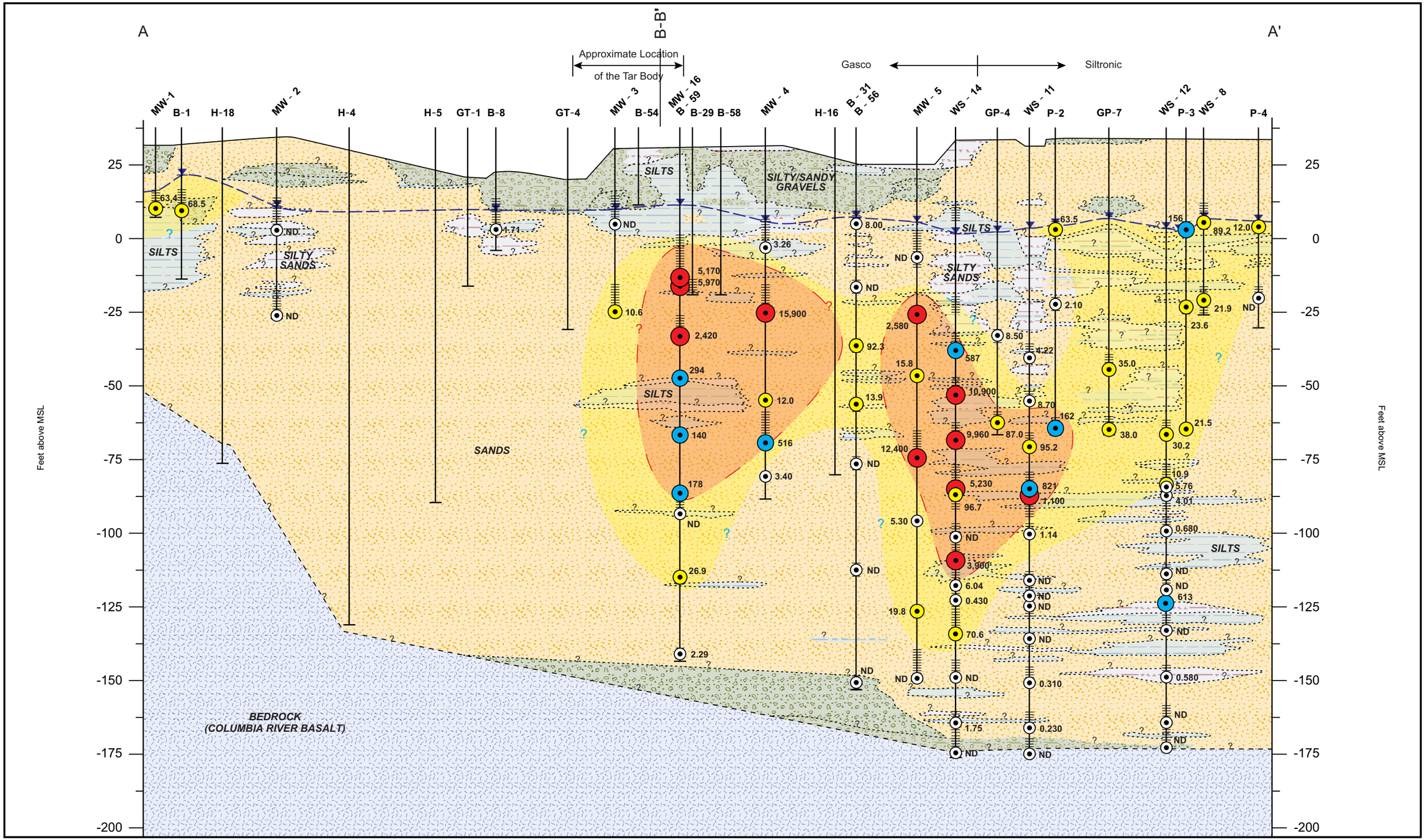
Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-2d
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Total Cyanide in Upland Groundwater and Shallow TZW



Base features from Hahn and Associates, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 25 50 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- DL - 10 µg/L
- 10 - 100 µg/L
- 100 - 1000 µg/L
- > 1000 µg/L

Concentration Zones:
- > 10 µg/L
- > 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
- Monitoring Well Screen

Figure C3.4-3a
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section A-A' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water

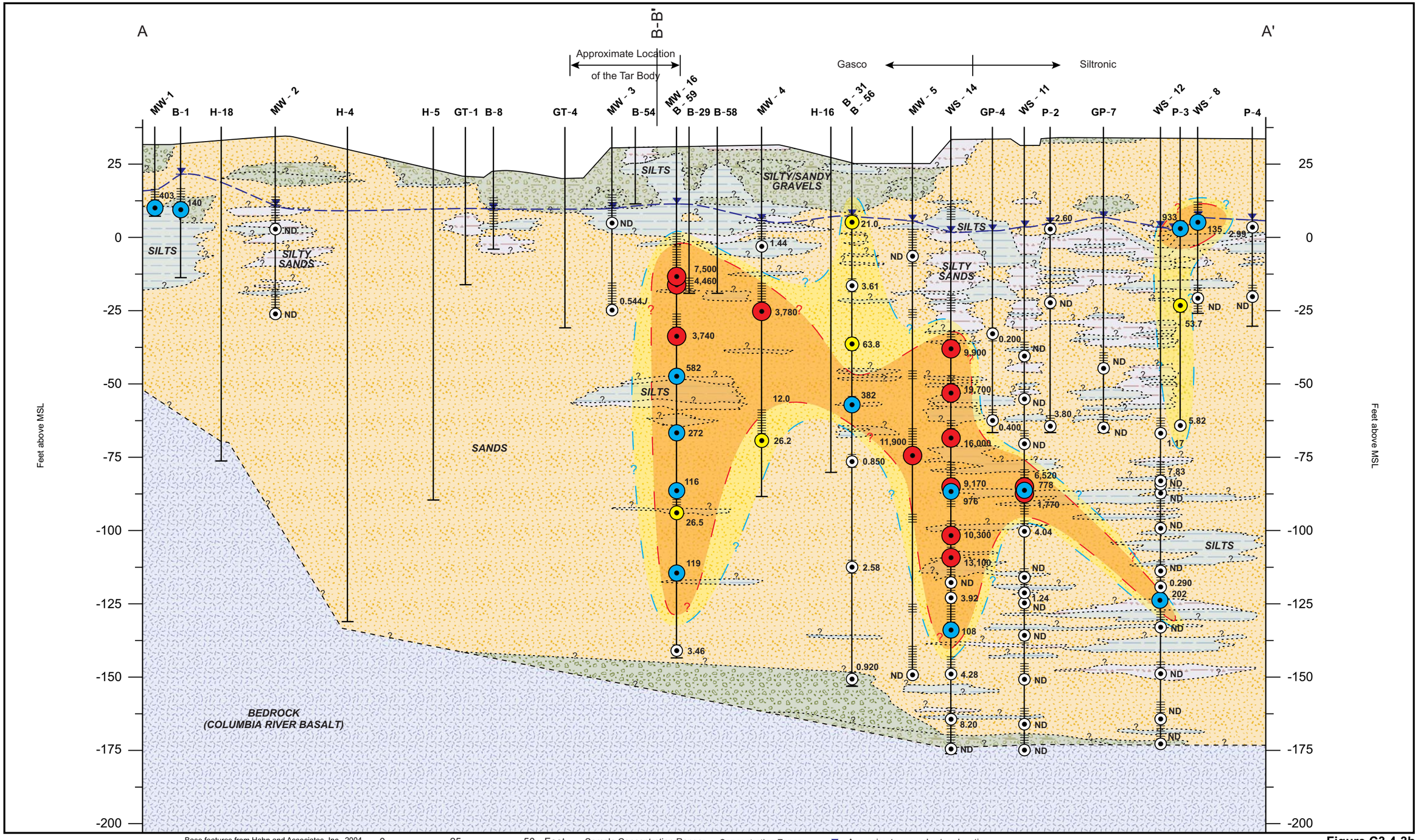
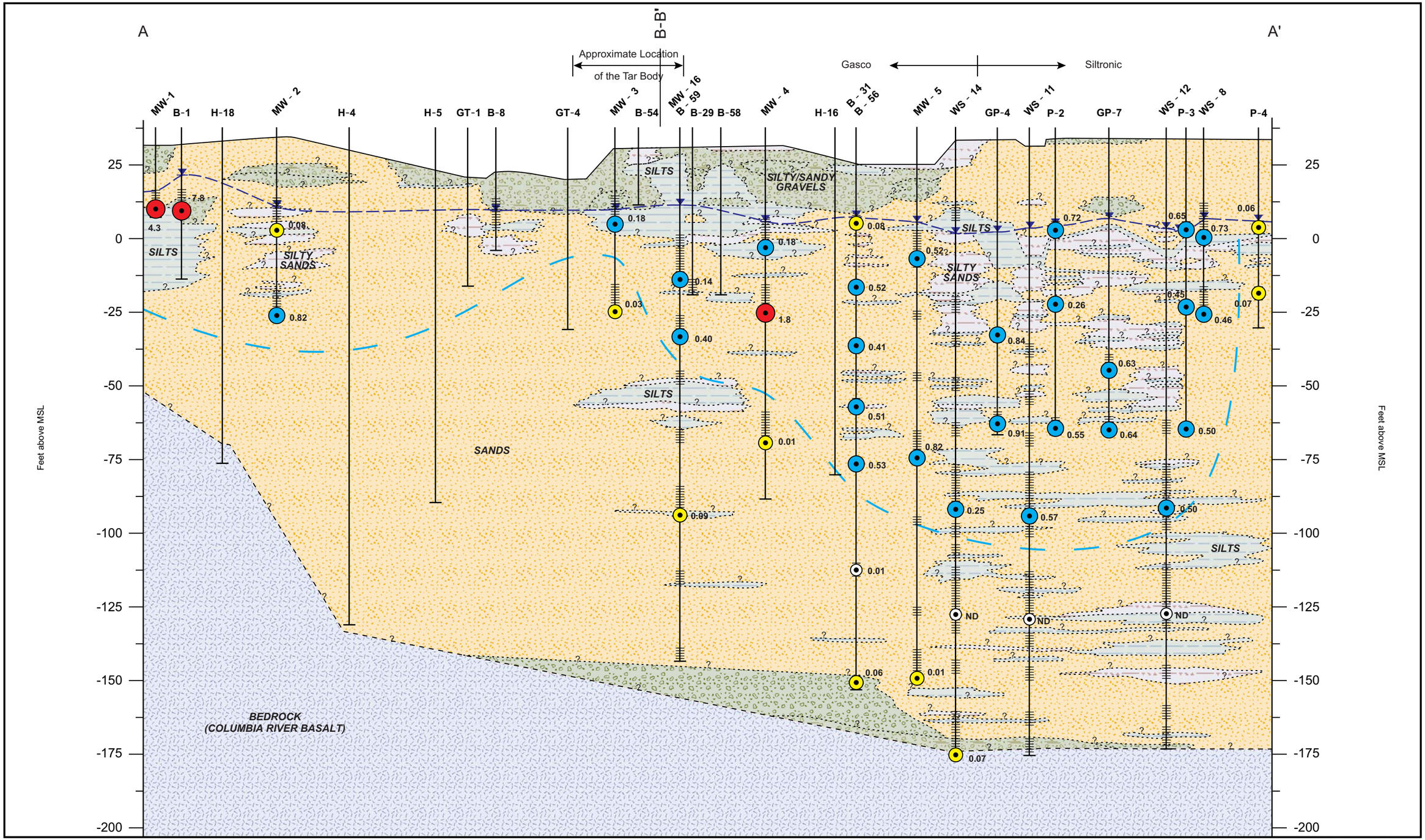


Figure C3.4-3b
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section A-A' and
Concentrations of Naphthalene in Nearshore
Groundwater and Transition Zone Water



Base features from Hahn and Associates, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 25 50 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- DL - 0.01 mg/L
- 0.01 - 0.1 mg/L
- 0.1 - 1 mg/L
- > 1 mg/L

Concentration Zone:
- > 0.1 mg/L

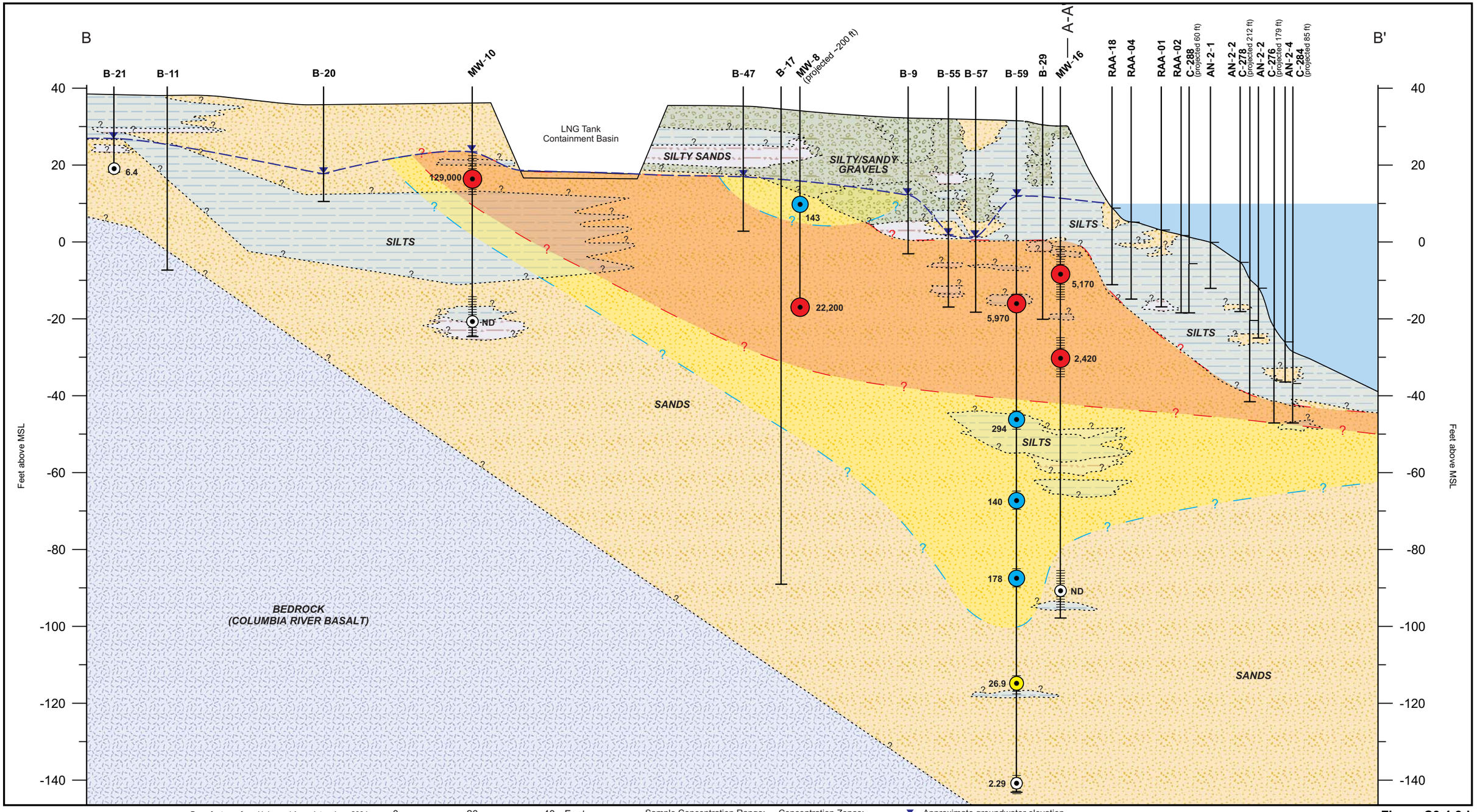
Approximate groundwater elevation

DL - Detection Limit

ND - Not Detected

- Monitoring Well Screen

Figure C3.4-3c
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section A-A' and
Concentrations of Total Cyanide in Nearshore
Groundwater and Transition Zone Water



Base features from Hahn and Associates, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 20 40 Feet
Vertical scale

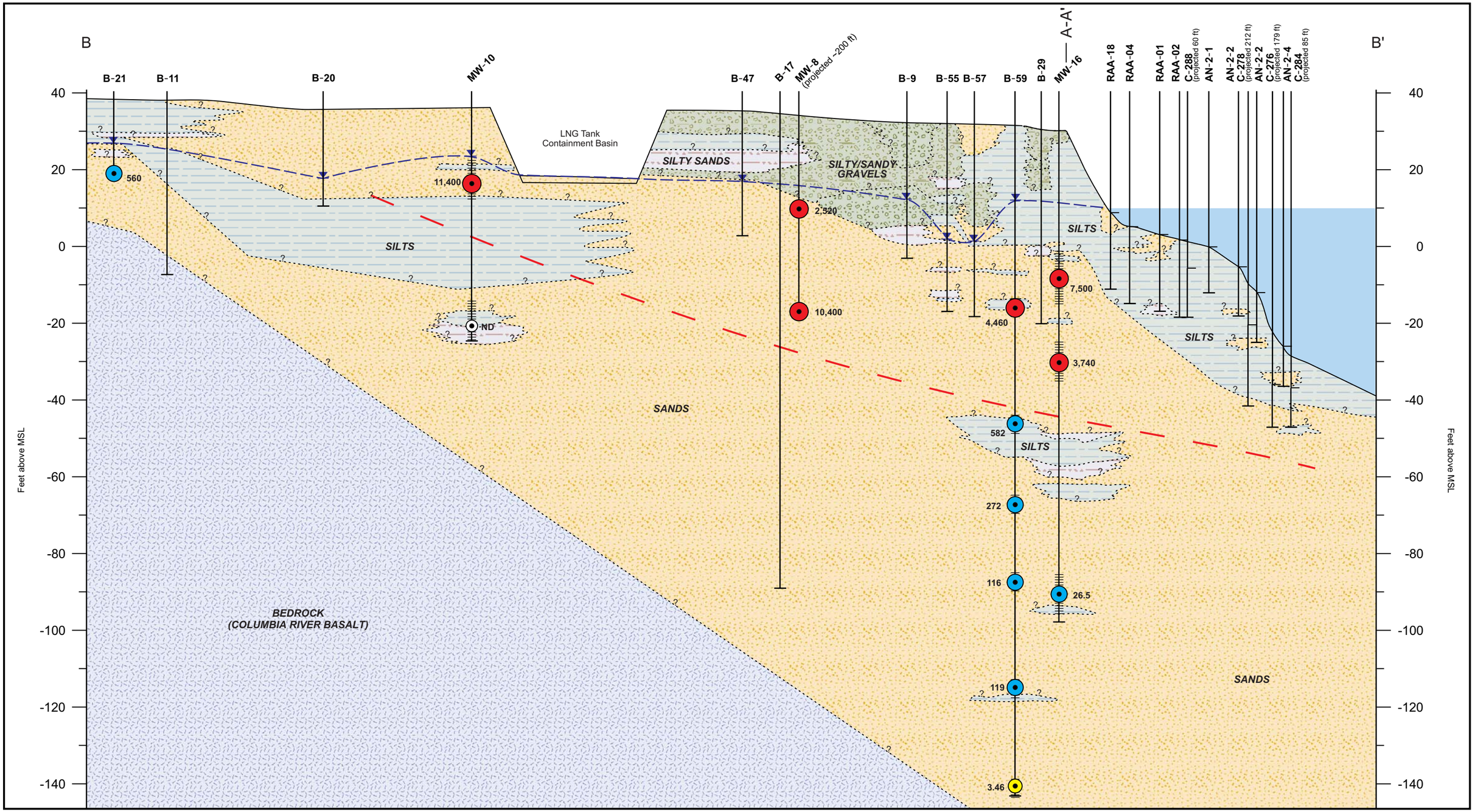
0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- DL - 10 µg/L
- 10 - 100 µg/L
- 100 - 1000 µg/L
- > 1000 µg/L

Concentration Zones:
- > 100 µg/L
- > 1000 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
- Monitoring Well Screen

Figure C3.4-3d
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section B-B' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water



Base features from Hahn and Associates, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 20 40 Feet
Vertical scale

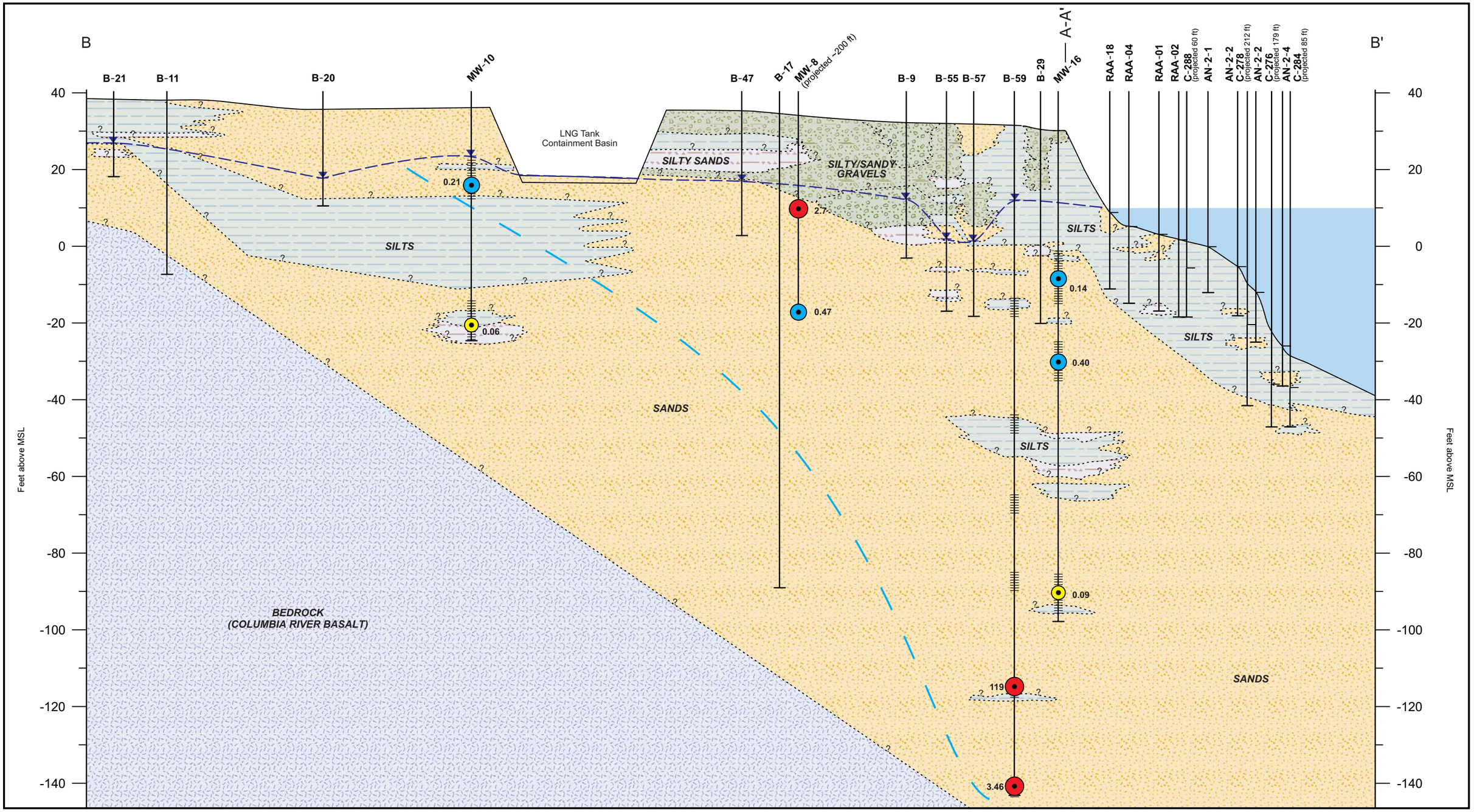
0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 1000 µg/L
- > 1000 µg/L

Concentration Zone:
- > 1000 µg/L

Approximate groundwater elevati--
DL - Detection Limit
ND - Not Detected
- Monitoring Well Screen

Figure C3.4-3e
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section B-B' and Concentrations of Naphthalene in Nearshore Groundwater and Transition Zone Water



Base features from Hahn and Associates, Inc., 2004.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

Locations should be considered approximate.

0 20 40 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- ND
- < 0.1 mg/L
- 0.1 - 1 mg/L
- > 1 mg/L

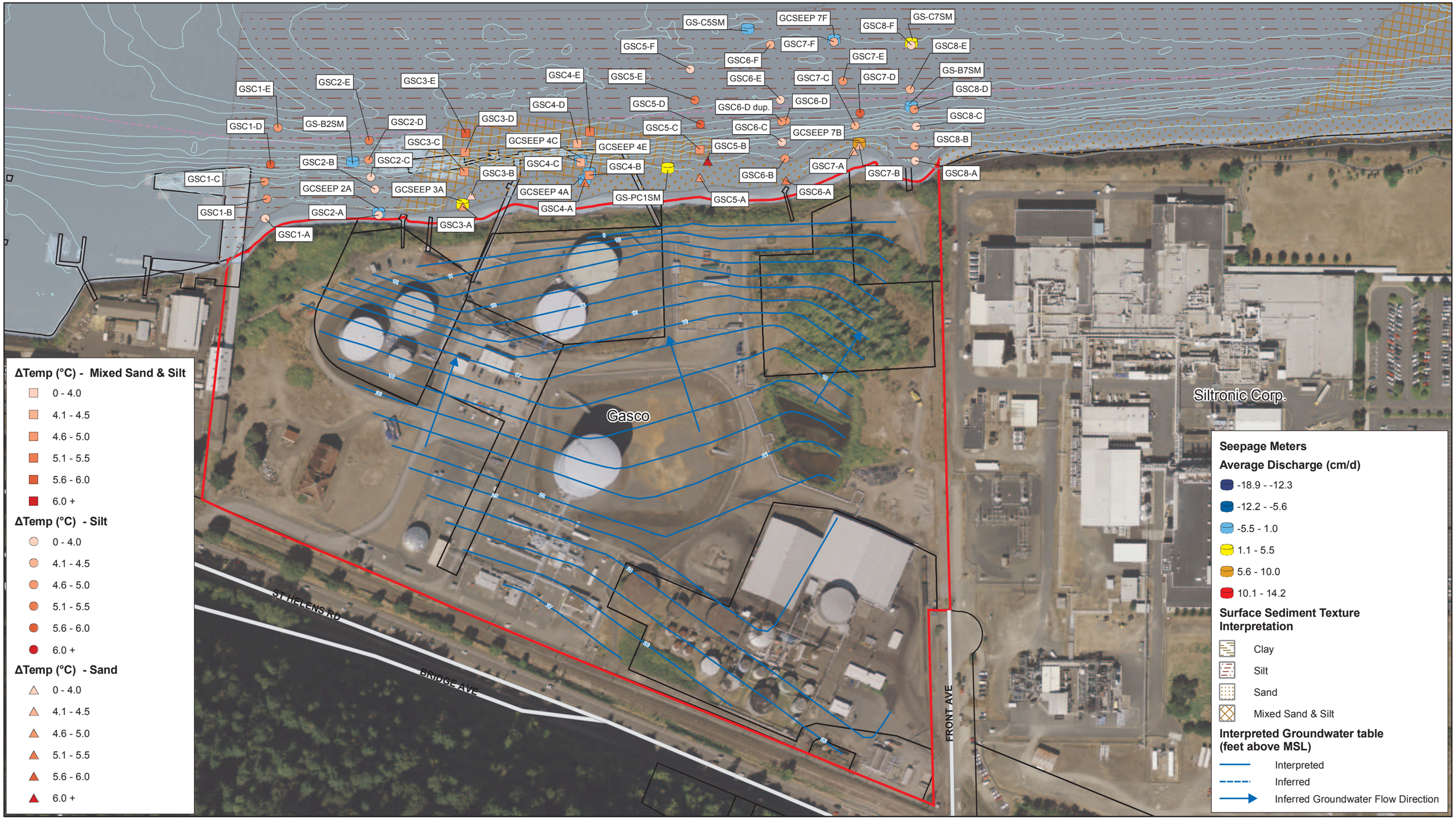
Concentration Zone:
- > 0.1 mg/L

Approximate groundwater elevati

ND - Not Detected

- Monitoring Well Screen

Figure C3.4-3f
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Stratigraphic Cross Section B-B' and Concentrations of Total Cyanide in Nearshore Groundwater and Transition Zone Water



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LEGEND

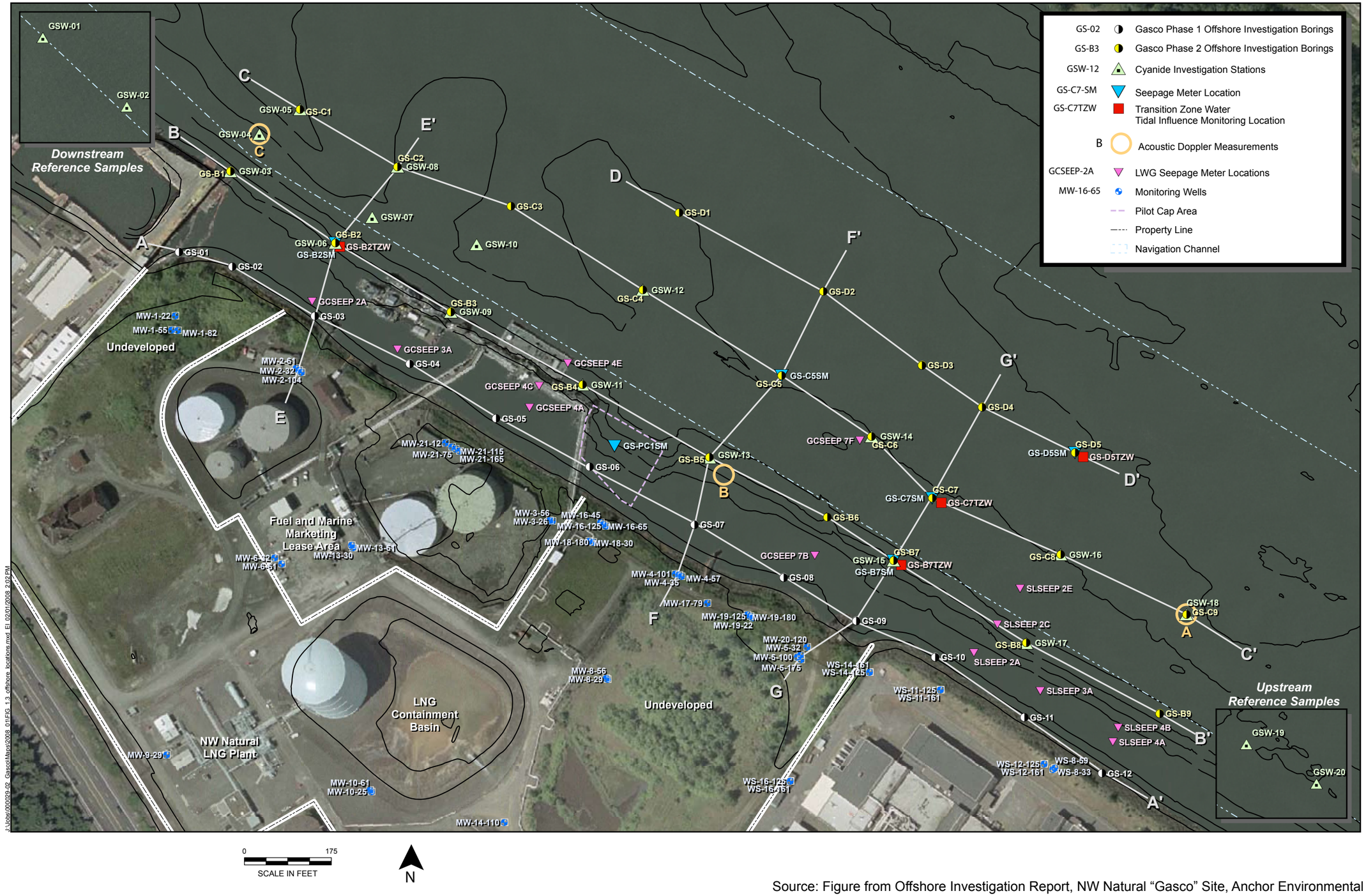
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

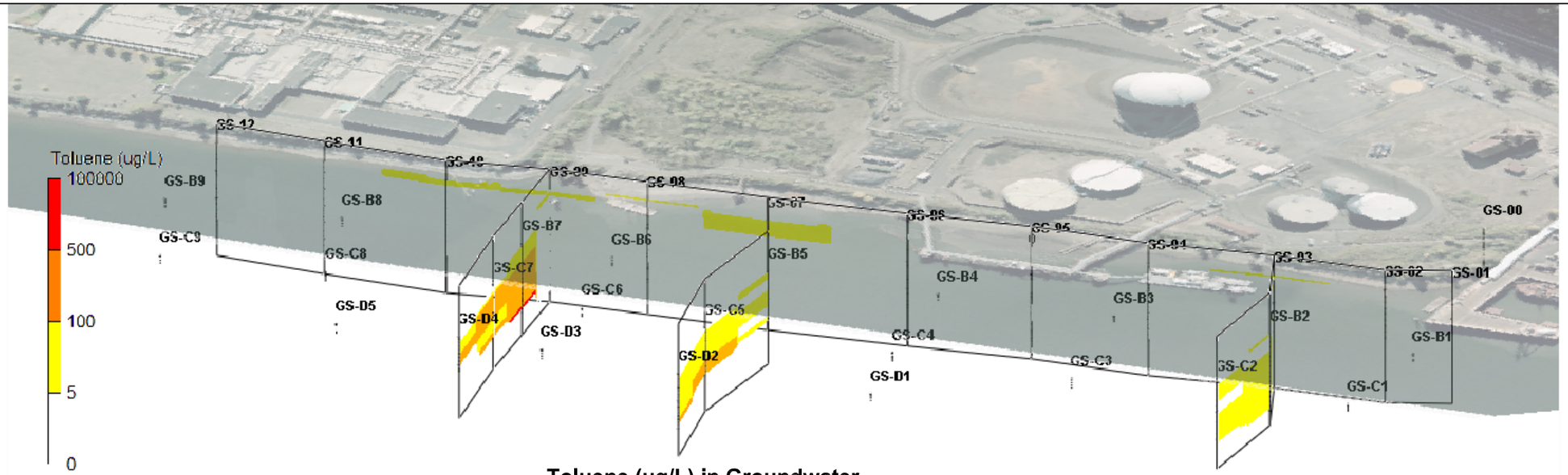
FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours and Remediation Systems: Locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-4
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Trident Probe and Seepage Meter Results

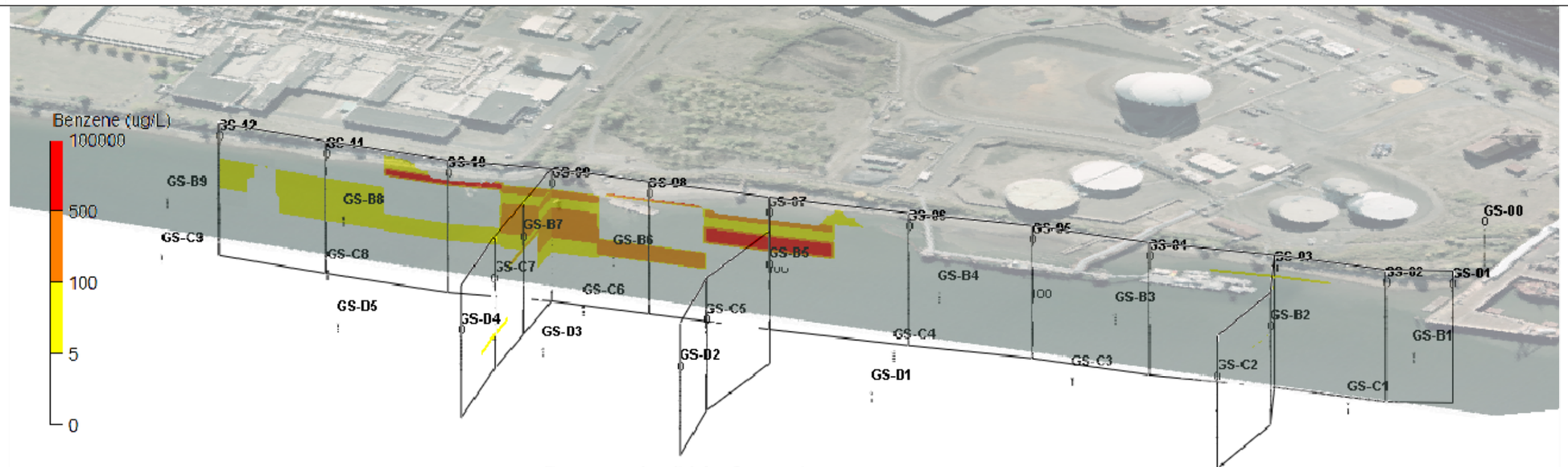


Source: Figure from Offshore Investigation Report, NW Natural "Gasco" Site, Anchor Environmental (2008)

Figure C3.4-5a
Portland Harbor RI/FS
Remedial Investigation Report
Offshore Sampling Locations 2006–2007 NW Natural Investigation



Toluene (ug/L) in Groundwater

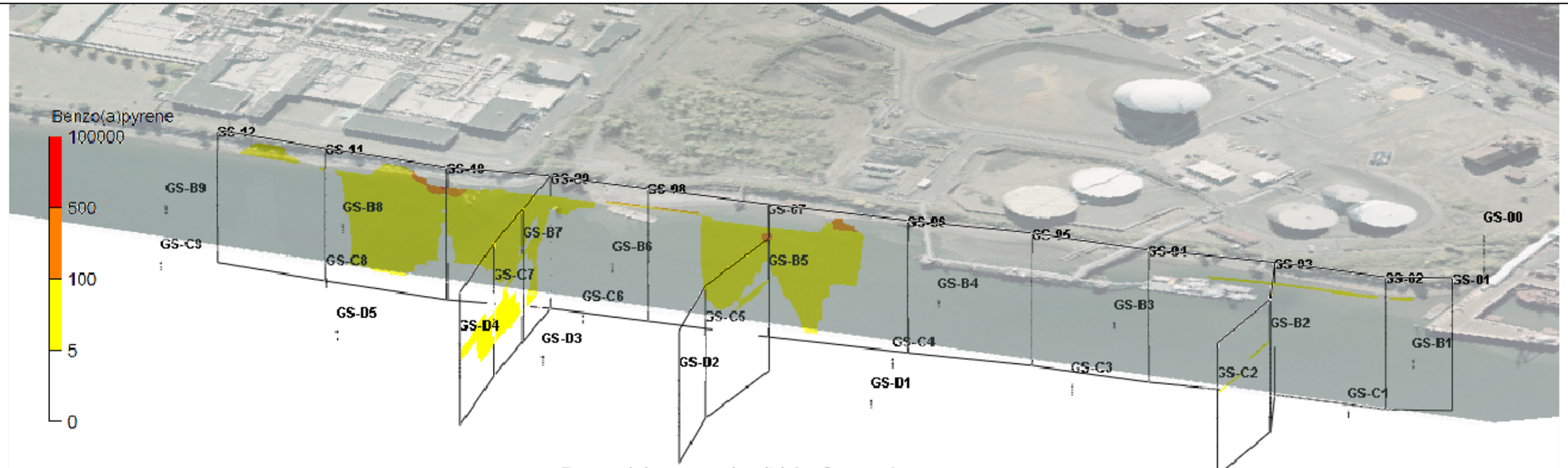


Benzene (ug/L) in Groundwater

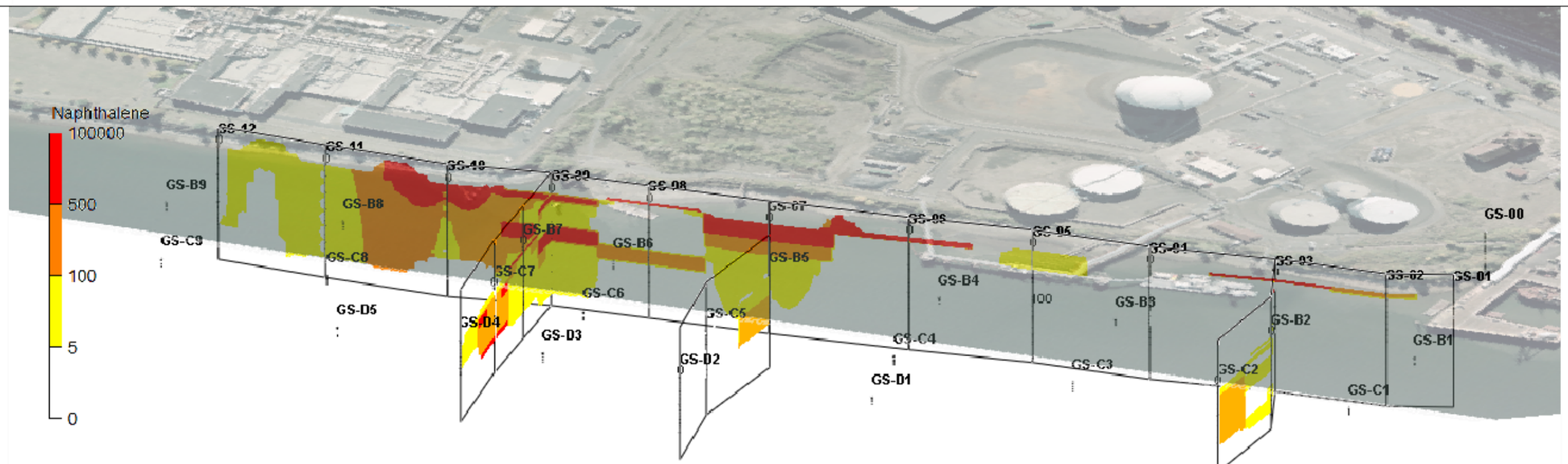
Note: Locations are approximate and are for visualization purposes only.

Source: Figure from Offshore Investigation Report, NW Natural "Gasco" Site, Anchor Environmental (2008)

Figure C3.4-5b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Toluene and Benzene in Nearshore Groundwater
and Transition Zone Water based on the 2006–2007 NW Natural Investigation



Benzo(a)pyrene (ug/L) in Groundwater

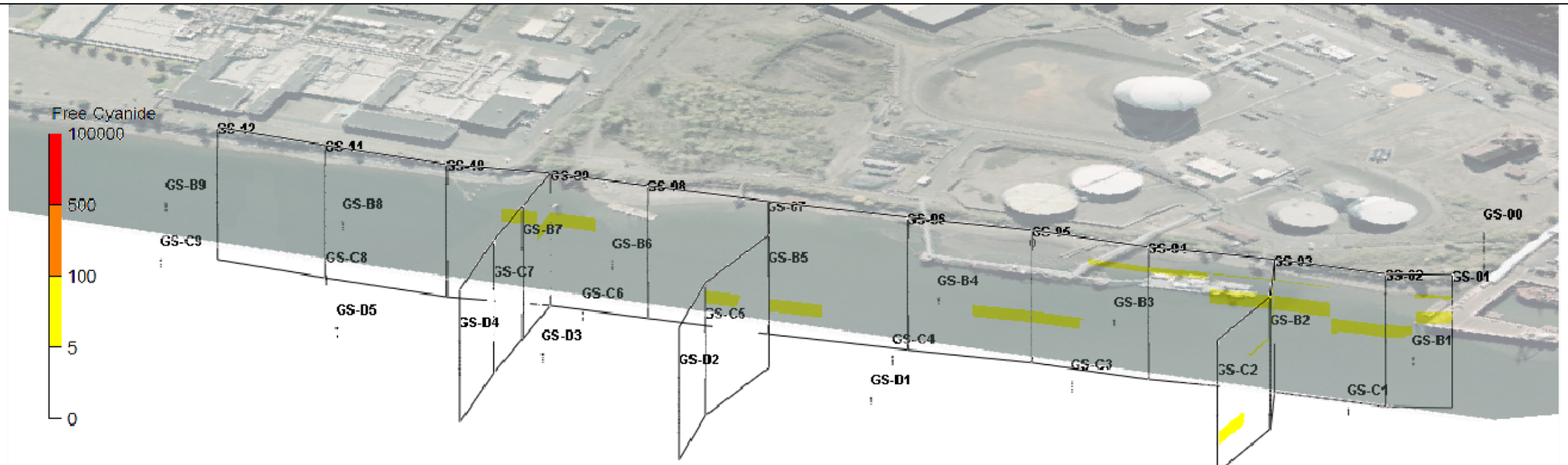


Naphthalene (ug/L) in Groundwater

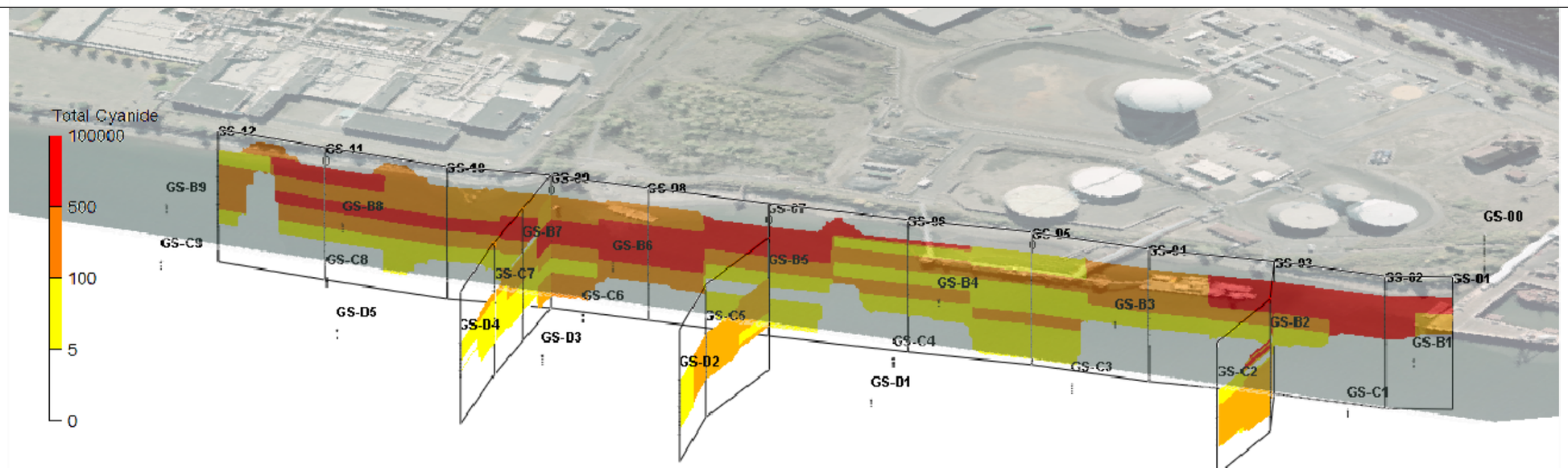
Note: Locations are approximate and are for visualization purposes only.

Source: Figure from Offshore Investigation Report, NW Natural "Gasco" Site, Anchor Environmental (2008)

Figure C3.4-5c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Benzo(a)pyrene and Naphthalene in Nearshore Groundwater
and Transition Zone Water based on the 2006–2007 NW Natural Investigation



Free Cyanide (ug/L) in Groundwater

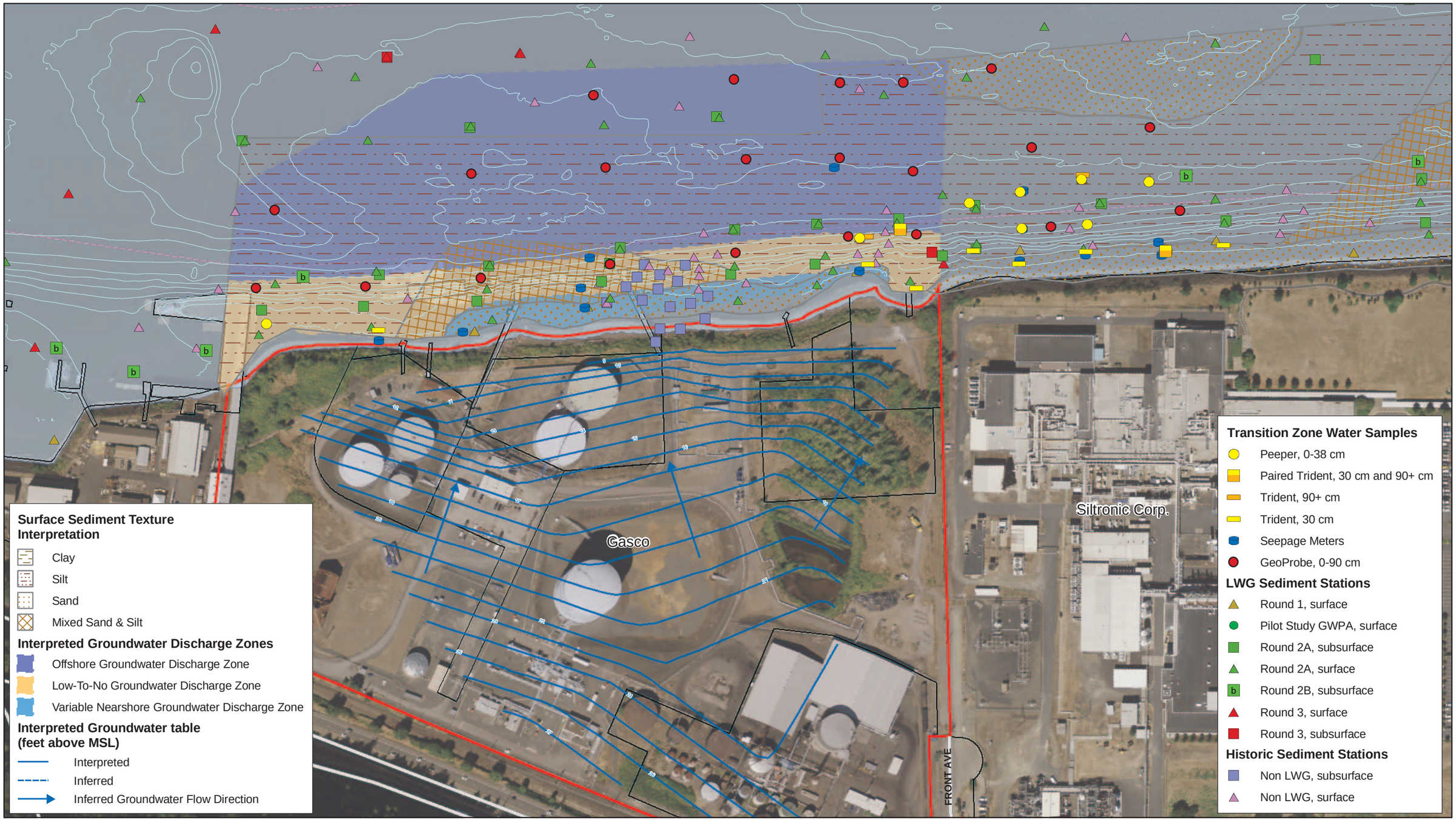


Total Cyanide (ug/L) in Groundwater

Note: Locations are approximate and are for visualization purposes only.

Source: Figure from Offshore Investigation Report, NW Natural "Gasco" Site, Anchor Environmental (2008)

Figure C3.4-5d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Free and Total Cyanide in Nearshore Groundwater
and Transition Zone Water based on the 2006–2007 NW Natural Investigation



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 90 180
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells, Groundwater Contours & Remediation System: locations are approximate and drawn from IHAI (2005). Report on Supplemental Upland Remedial Investigation Activities, 7900 NW St. Helens Road, Portland, Oregon. Hahn and Associates, Inc., March 11, 2005.

Figure C3.4-6
Portland Harbor RI/FS
Remedial Investigation Report
Gasco Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

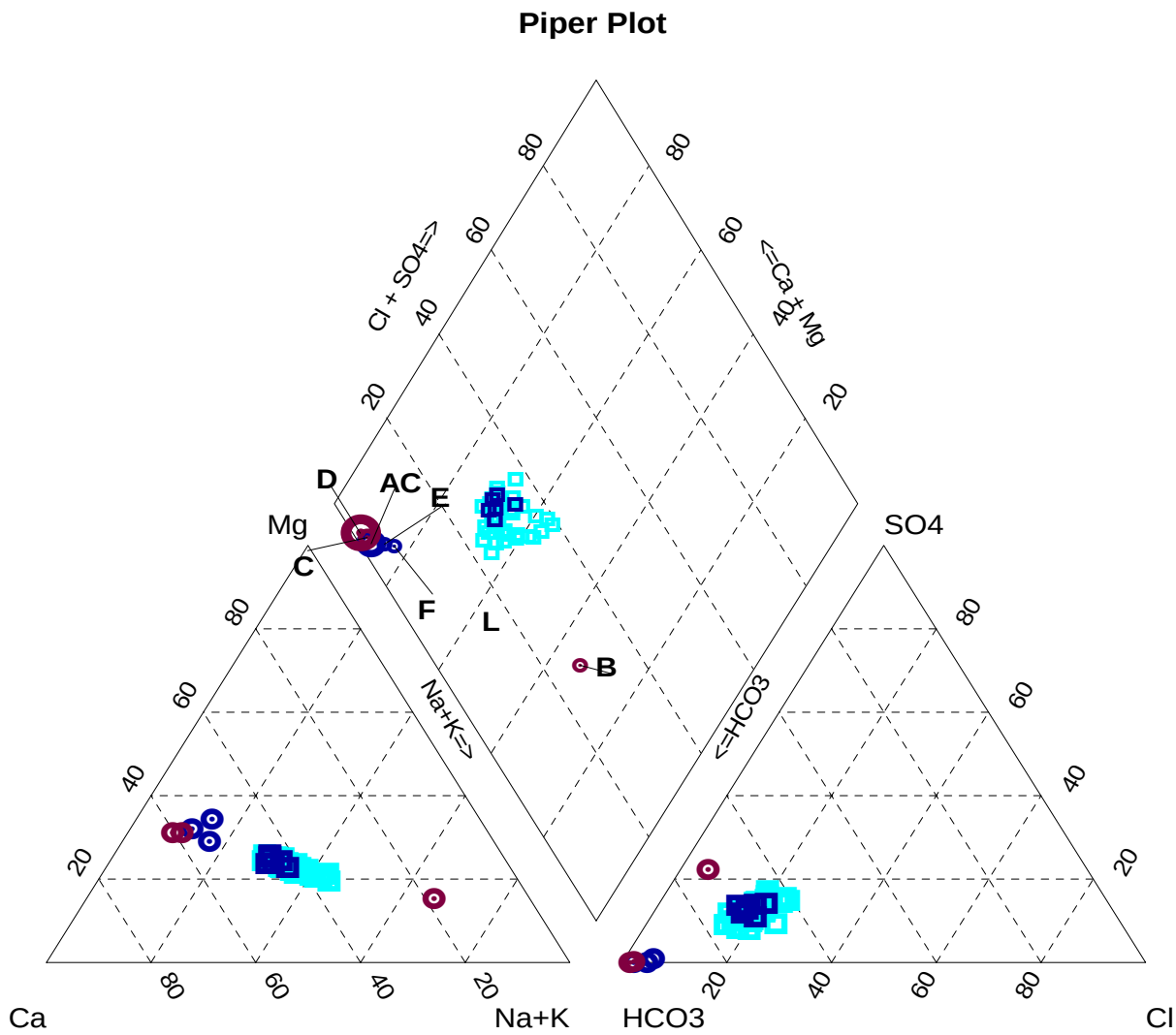
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A[c]	Low-to-No Groundwater Discharge Zone	GS-01-B-PR				88.7	39.2	5.21	23.6		
B	Low-to-No Groundwater Discharge Zone	GS-02-A-TR	66	2.8	15.9	11.5	5.84	1.36	47	5.6	150.4
C	Low-to-No Groundwater Discharge Zone	GS-07-D-PR	337	4.2	0.2	68.8	22.1	2.94	12.2	6.97	447.44
D	Low-to-No Groundwater Discharge Zone	GS-08-A-TR	676	5.55	0	163	50.9	5.44	23.2	6.58	924.09
E	Groundwater Discharge Zone	GS-08-D-TR	223	6.3	0	50.5	20.5	3.7	14.2	6.56	318.2
F	Groundwater Discharge Zone	GS-07-B-TR	168	5.7	1.1	45.4	14.7	3.58	13.8	6.5	252.28
G[c]	Groundwater Discharge Zone	WLCGSG07GSC9				22.7	11.5	4.38	136		
H[c]	Groundwater Discharge Zone	WLCGSG07GSD5				49.7	19.2	4.51	61		
I[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB1				39.8	28.9	5.99	12.7		
J[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB2				85.3	66.9	11.4	19.4		
K[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB3				25.1	16.9	3.32	10.7		
L[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB4				213	223	30.2	28		
M[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB5				87	43.1	6.4	13.7		
N[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB6				58.9	40.5	6.92	14.2		
O[c]	Low-to-No Groundwater Discharge Zone	WLCGSG07GSB7				139	69.5	9.49	23.5		
P[c]	Groundwater Discharge Zone	WLCGSG07GSB8				54.1	42.8	9.59	14.3		
Q[c]	Groundwater Discharge Zone	WLCGSG07GSB9				83.7	71.3	11.4	16.9		
R[c]	Groundwater Discharge Zone	WLCGSG07GSC1				326	171	20.5	38.4		
S[c]	Groundwater Discharge Zone	WLCGSG07GSC3				82.5	12.1	8.21	60.6		
T[c]	Groundwater Discharge Zone	WLCGSG07GSC4				105	20.6	6.29	20.9		
U[c]	Groundwater Discharge Zone	WLCGSG07GSC5				124	47.1	6.17	19.4		
V[c]	Groundwater Discharge Zone	WLCGSG07GSC6				67.9	35.3	5.27	24.8		
W[c]	Groundwater Discharge Zone	WLCGSG07GSC7				81.2	25.6	5.82	26.1		
X[c]	Groundwater Discharge Zone	WLCGSG07GSC8				82	30.7	5.29	17.3		
Y[c]	Groundwater Discharge Zone	WLCGSG07GSD1				122	20	9.48	34.5		
Z[c]	Groundwater Discharge Zone	WLCGSG07GSD2				106	19.9	5.65	60.9		
AA[c]	Groundwater Discharge Zone	WLCGSG07GSD3				86.4	23.4	8.36	136		
AB[c]	Groundwater Discharge Zone	WLCGSG07GSD4				69	20.1	7.09	140		
AC	Groundwater Discharge Zone	GS-08-D-TR	537	6.8	0	111	38.1	7.26	22.6	6.58	722.76

Notes:

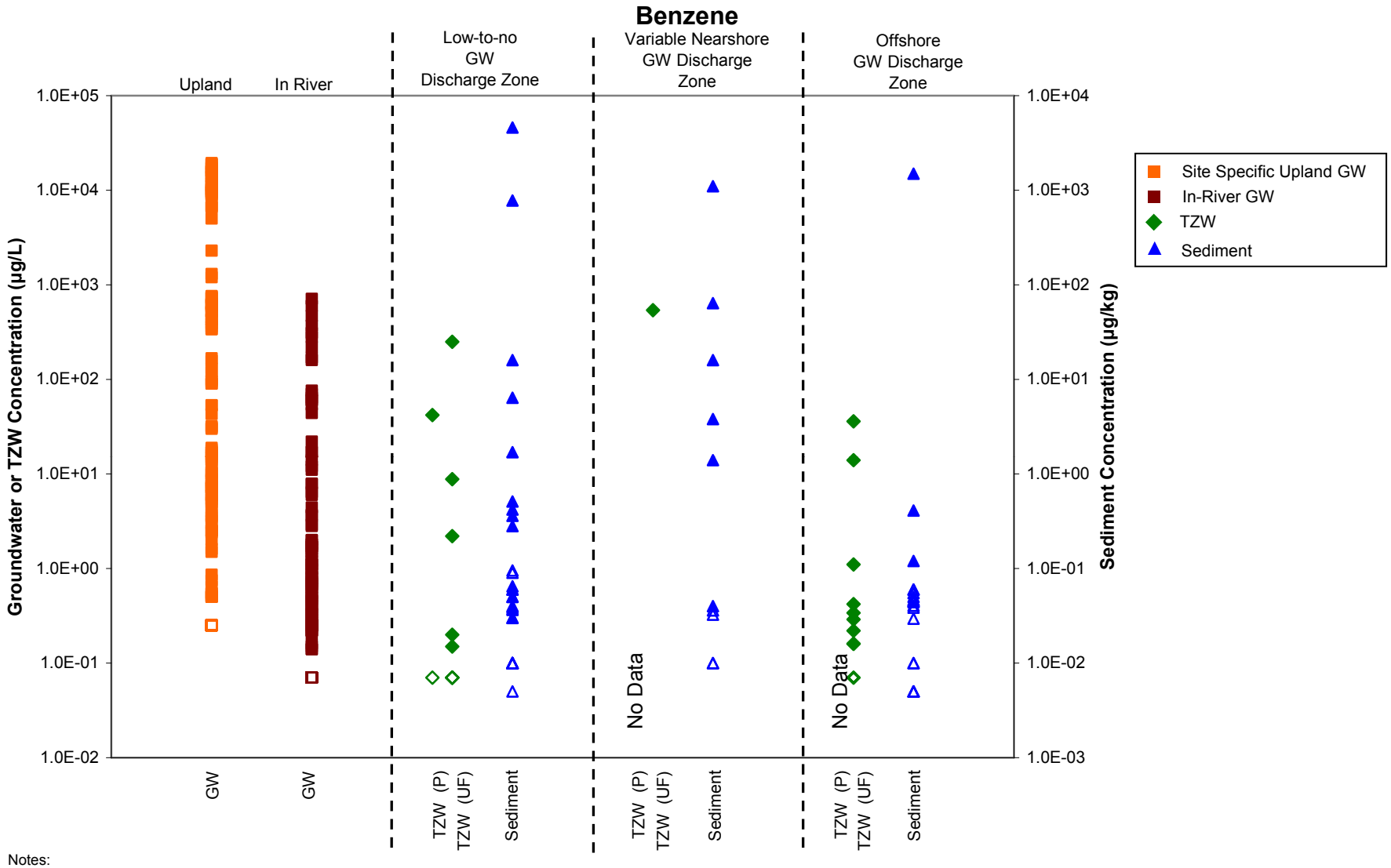
[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

[c] Sample not shown on plot, insufficient data.

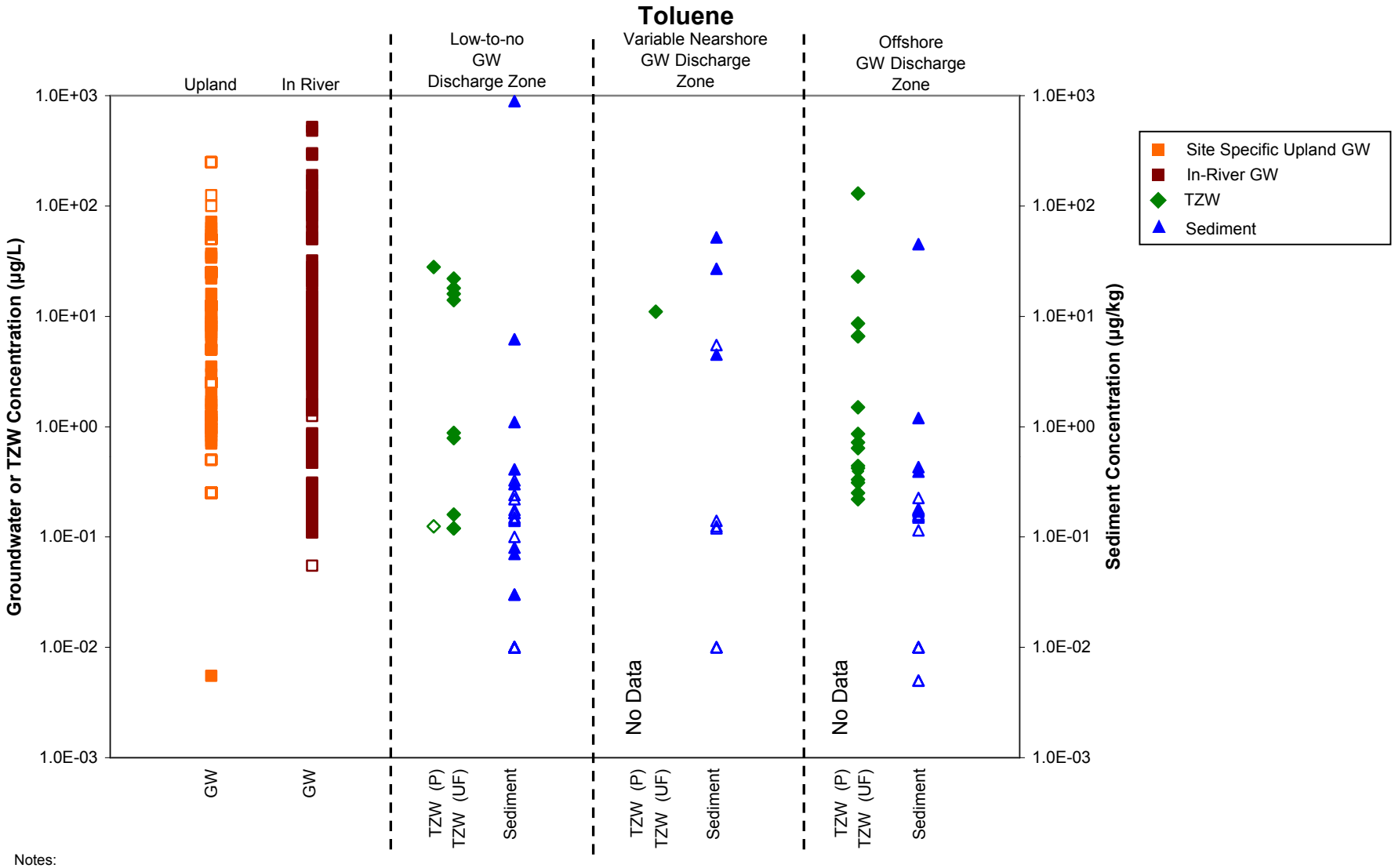
All concentrations as mg/L; pH in s.u.

Figure C3.4-7
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Gasco



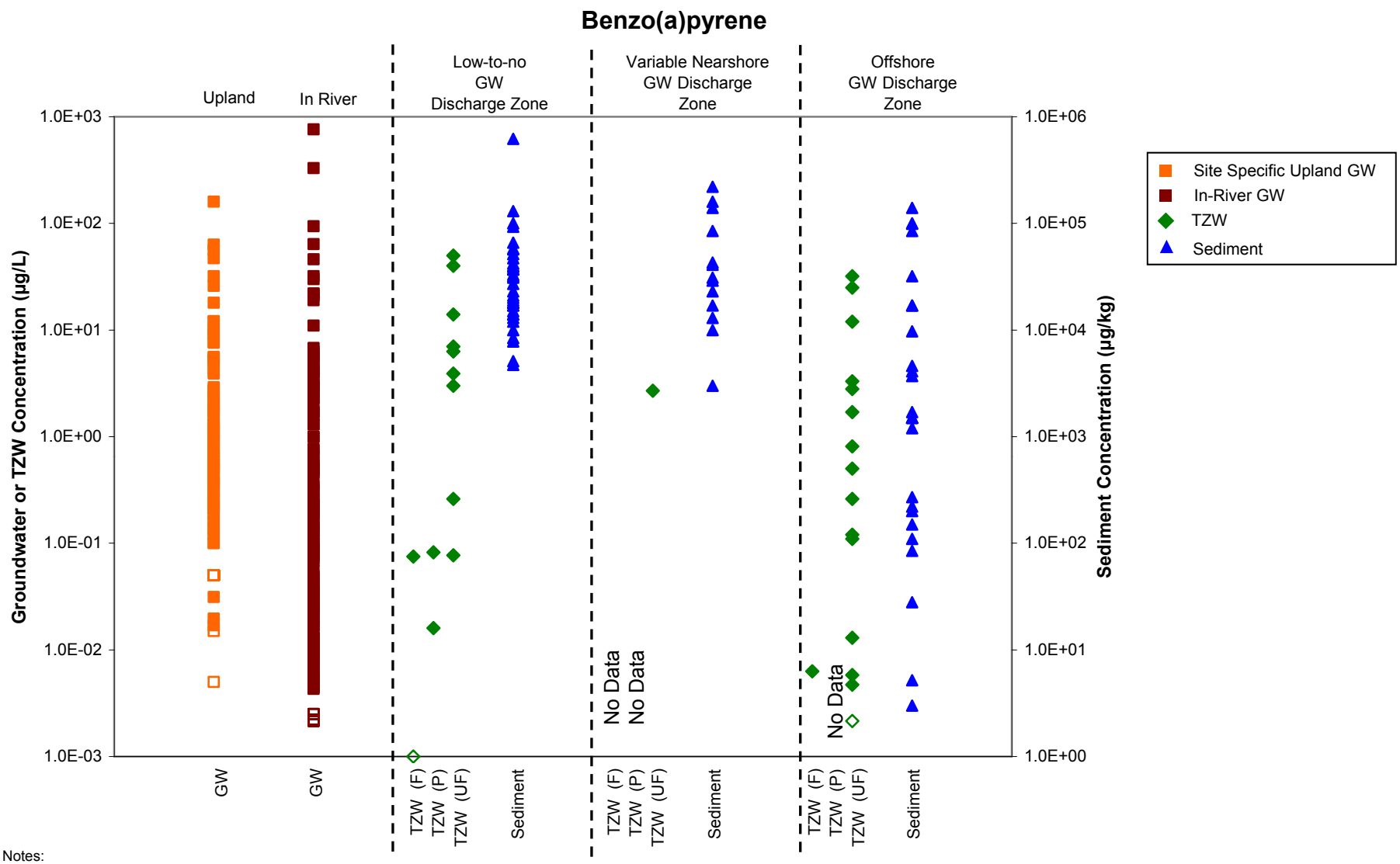
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Benzene - Gasco



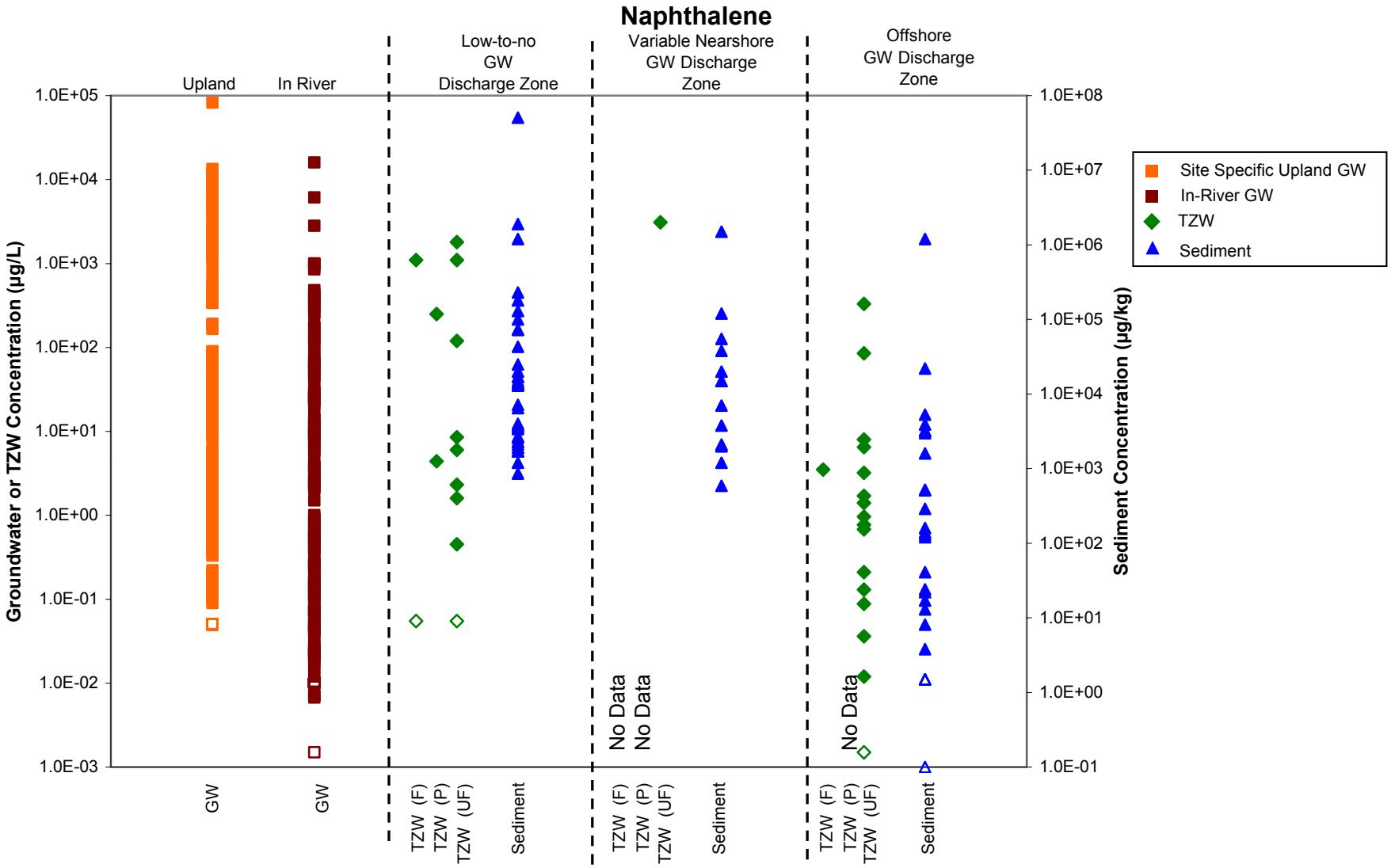
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Toluene - Gasco



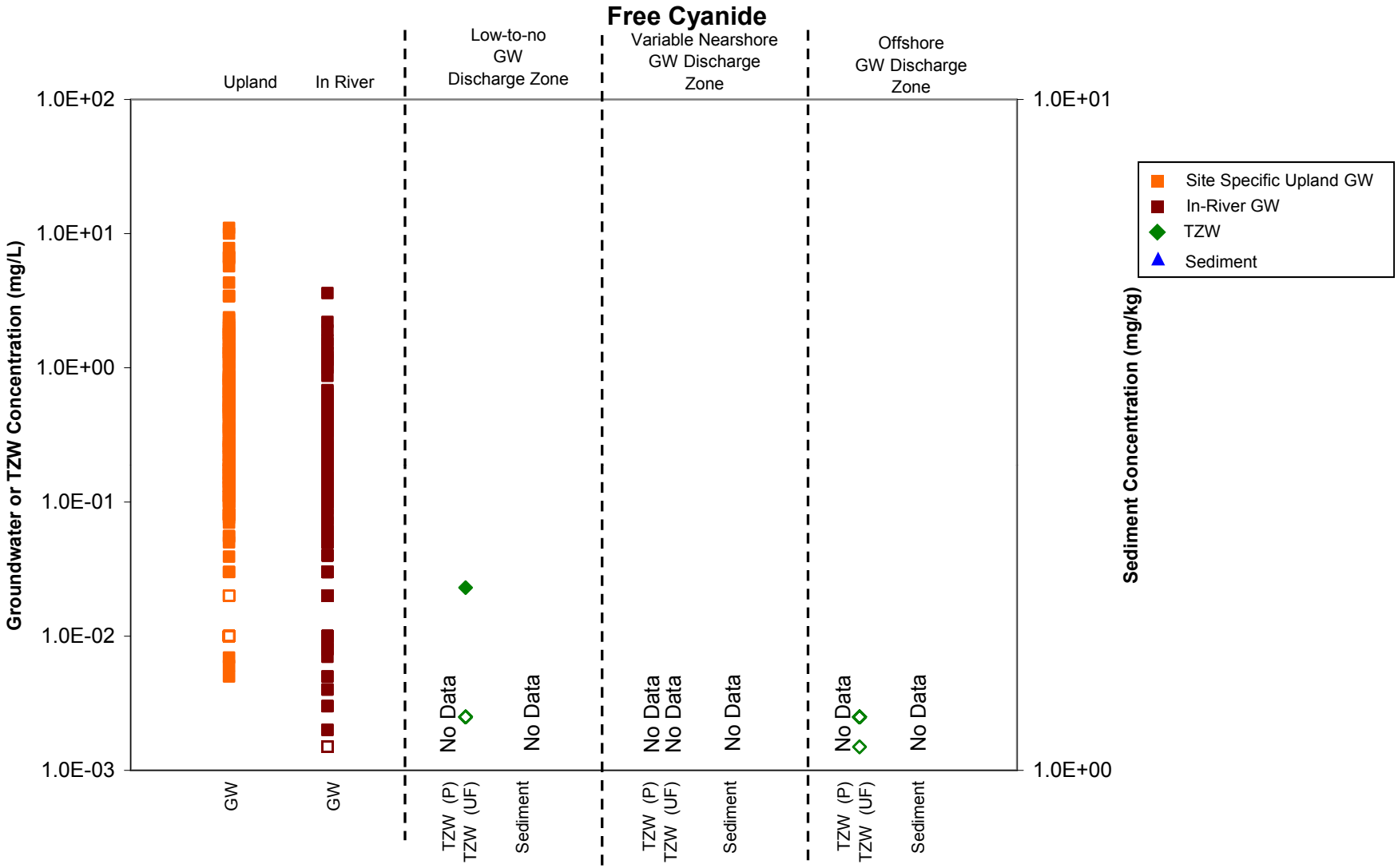
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Benzo(a)pyrene - Gasco



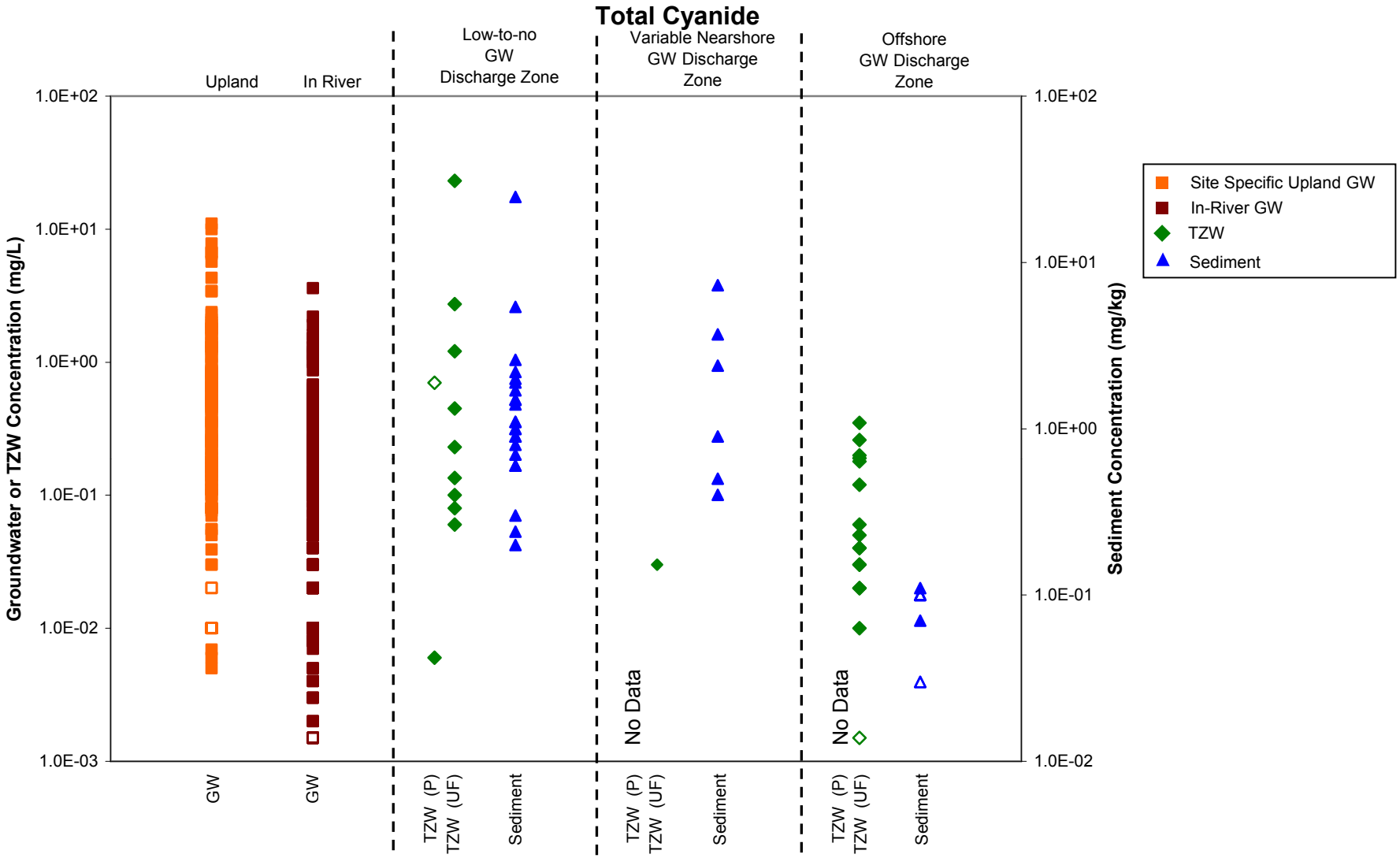
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Naphthalene - Gasco



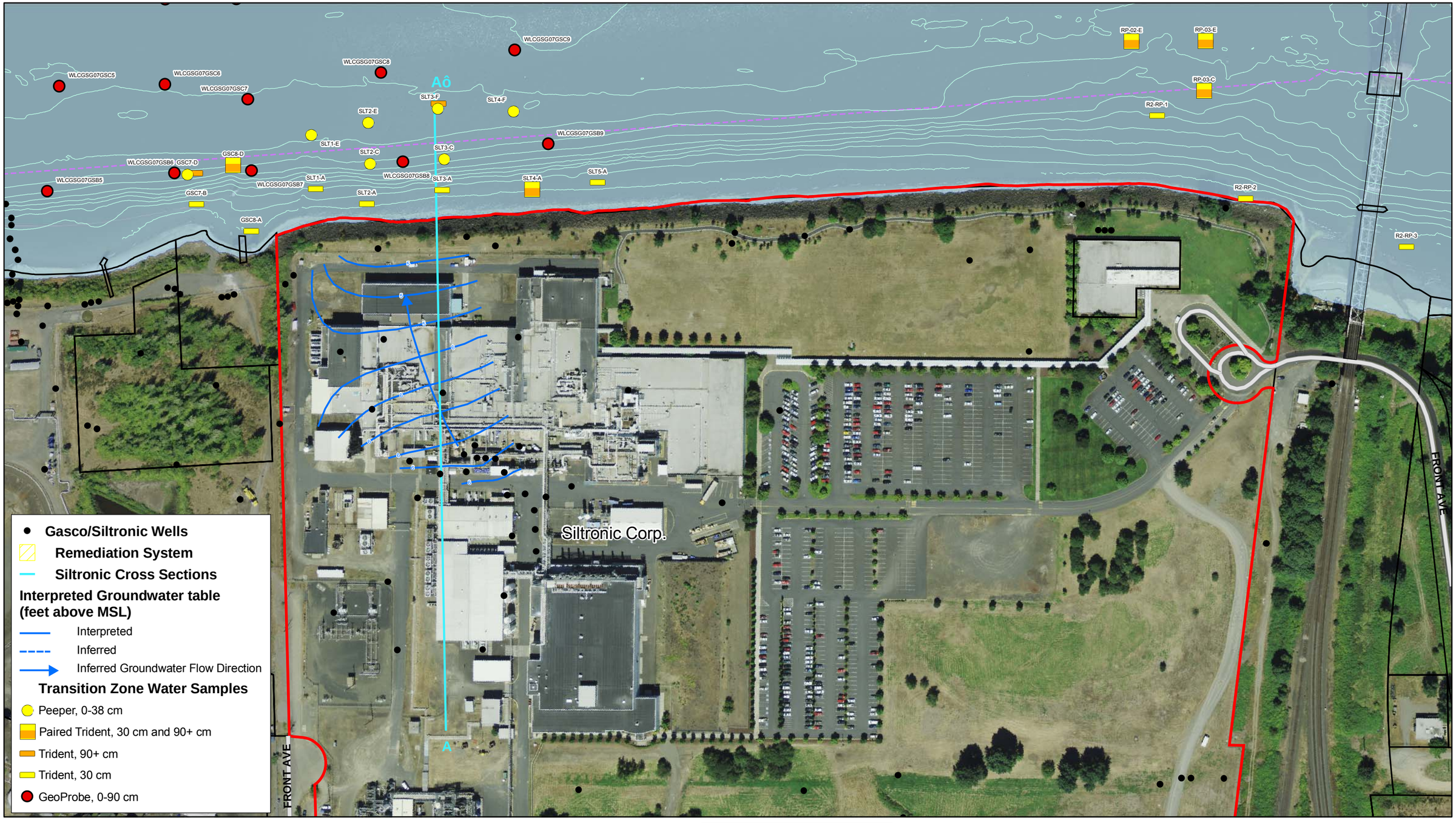
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8e
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Free Cyanide - Gasco



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.4-8f
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total Cyanide - Gasco



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

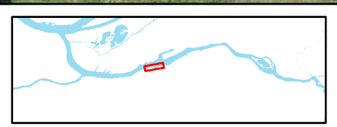
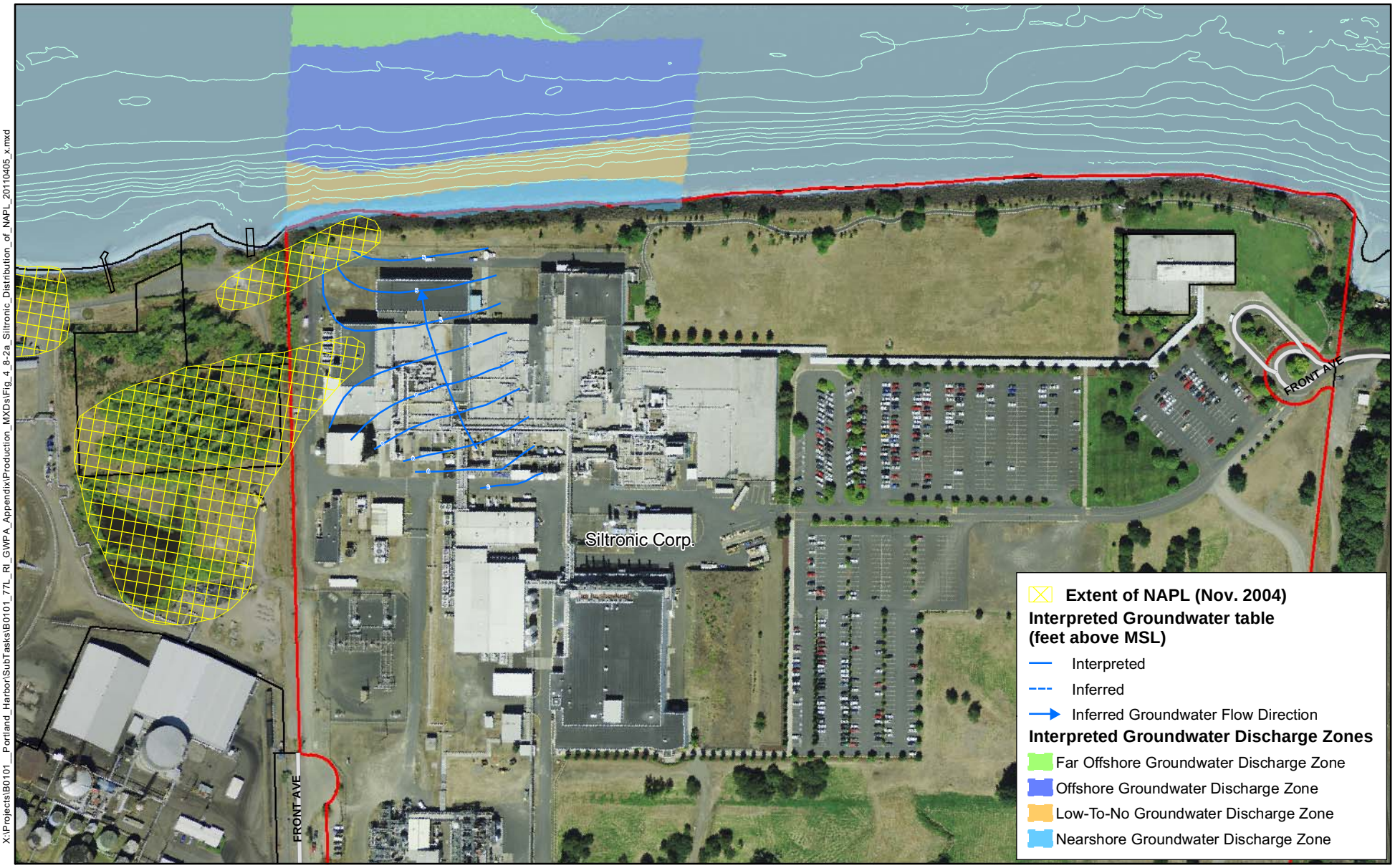


Figure C3.5-1
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Overview and Cross Section Location



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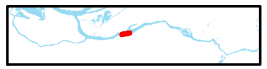
LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

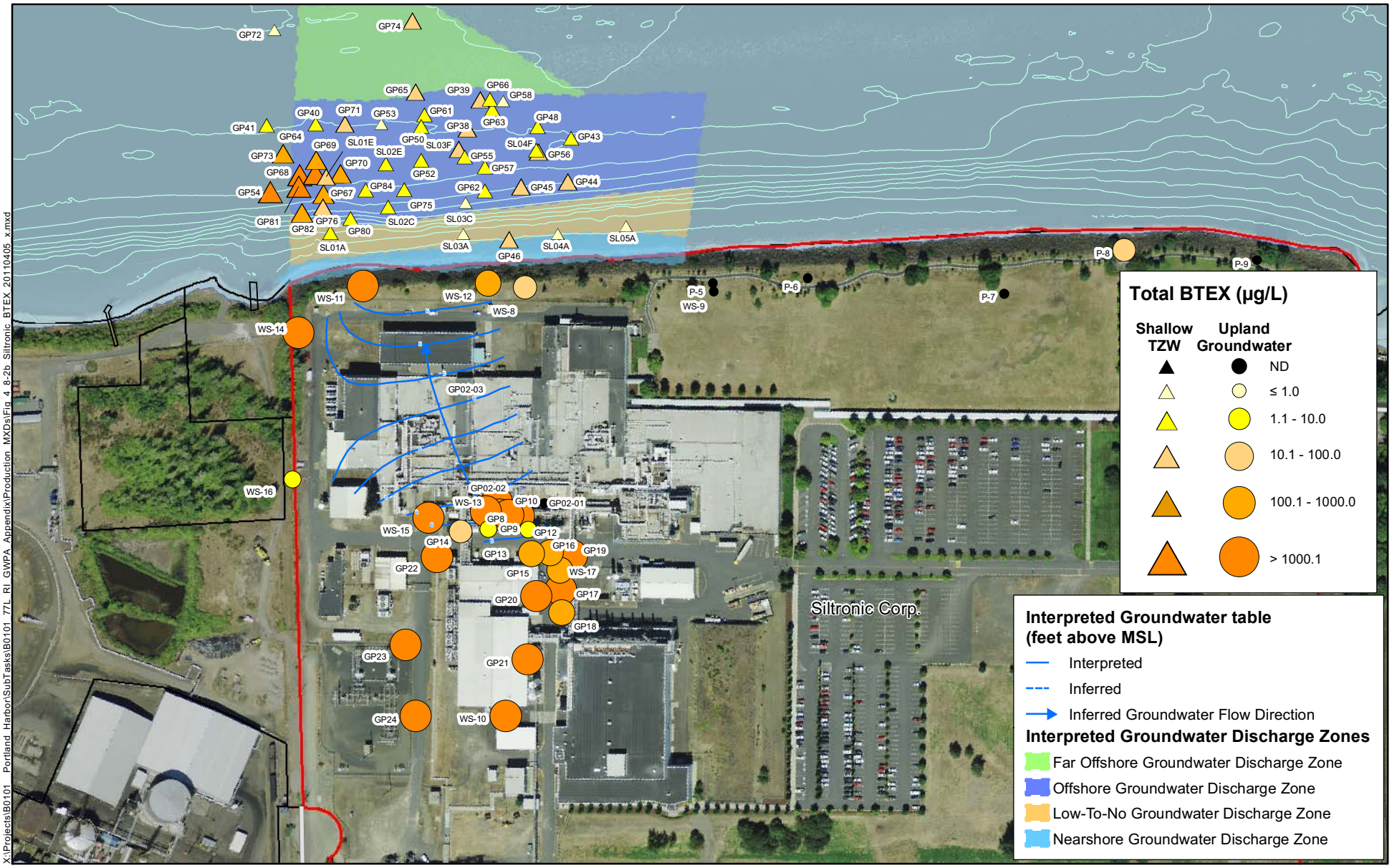
0 100 200
Feet

N



FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-2a
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Distribution of NAPL in Upland Groundwater



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 100 200

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-2b
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Total BTEX in Upland Groundwater and Shallow TZW

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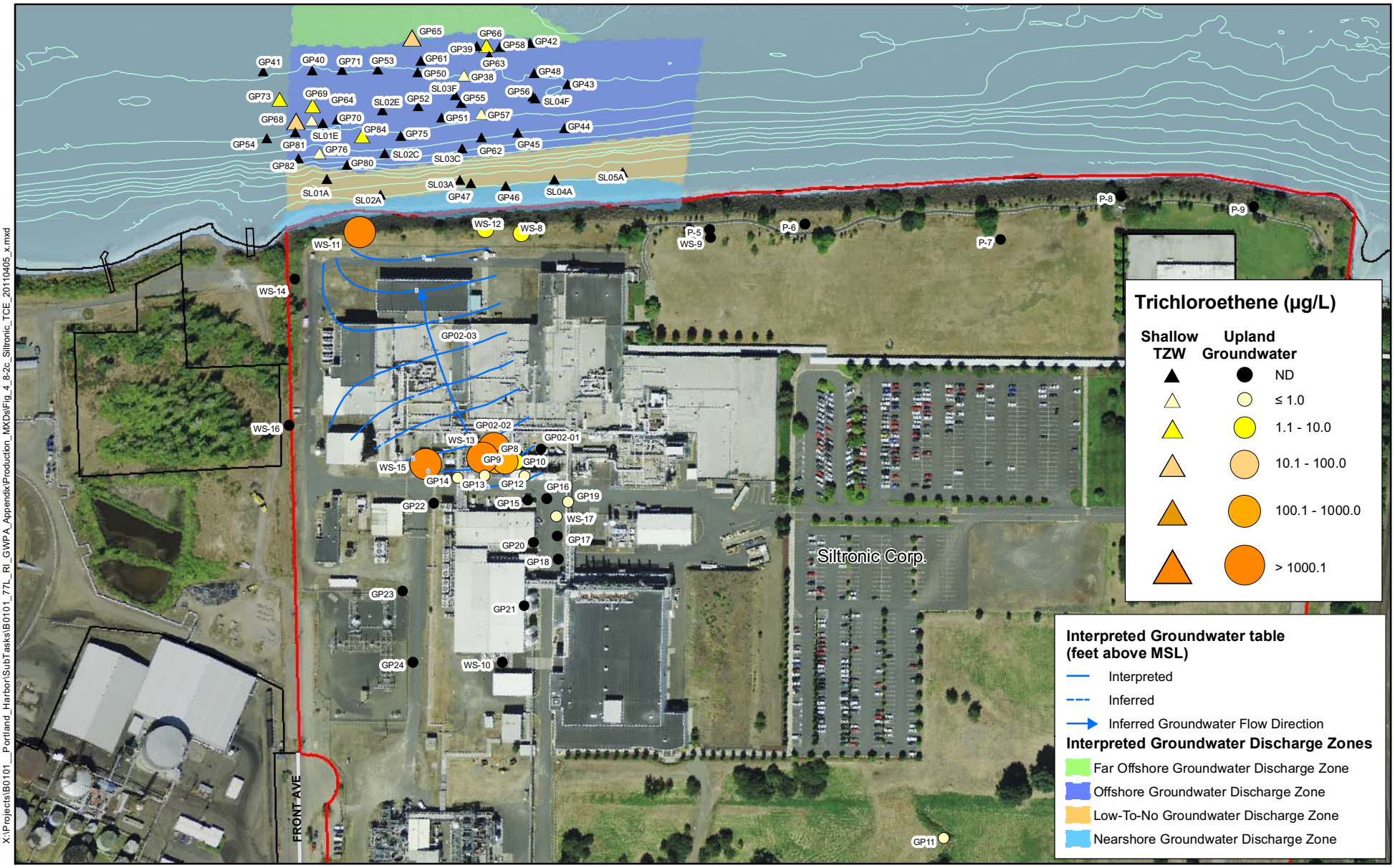


LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

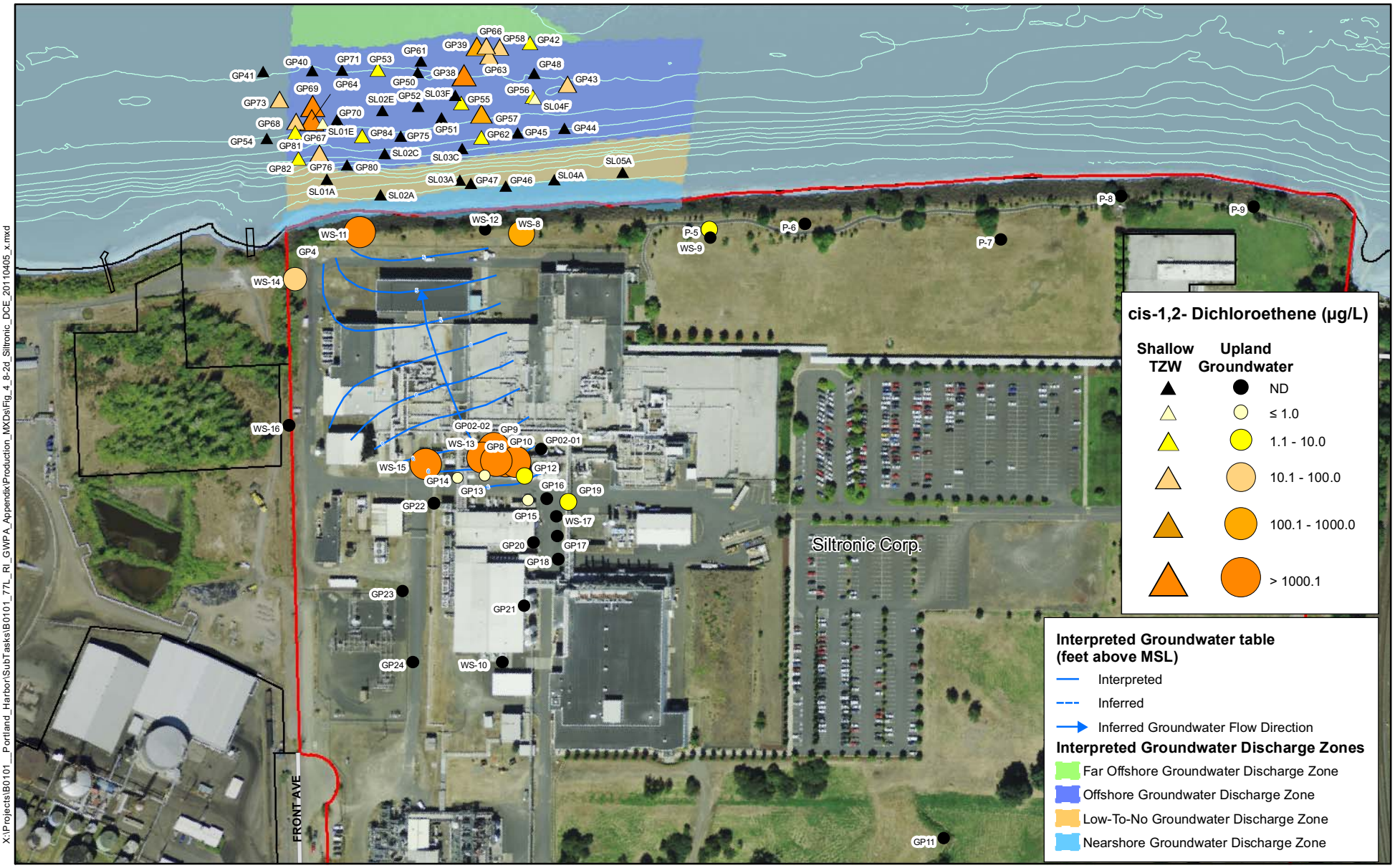
Site Property Boundary

0 100 200 Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-2c
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Trichloroethene in Upland Groundwater and Shallow TZW

X:\Projects\B0101__Portland_Harbor\SubTasks\B0101_77L_RI_GWPA_Appendix\Production_MXDs\Fig_4_8-2c_Siltronic_TCE_20110405_x.mxd



X:\Projects\B0101__Portland_Harbor\SubTasks\B0101_77L_RI_GWPA_Appendix\Production_MXDs\Fig_4_8-2d_Siltronic_DCE_20110405_x.mxd

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

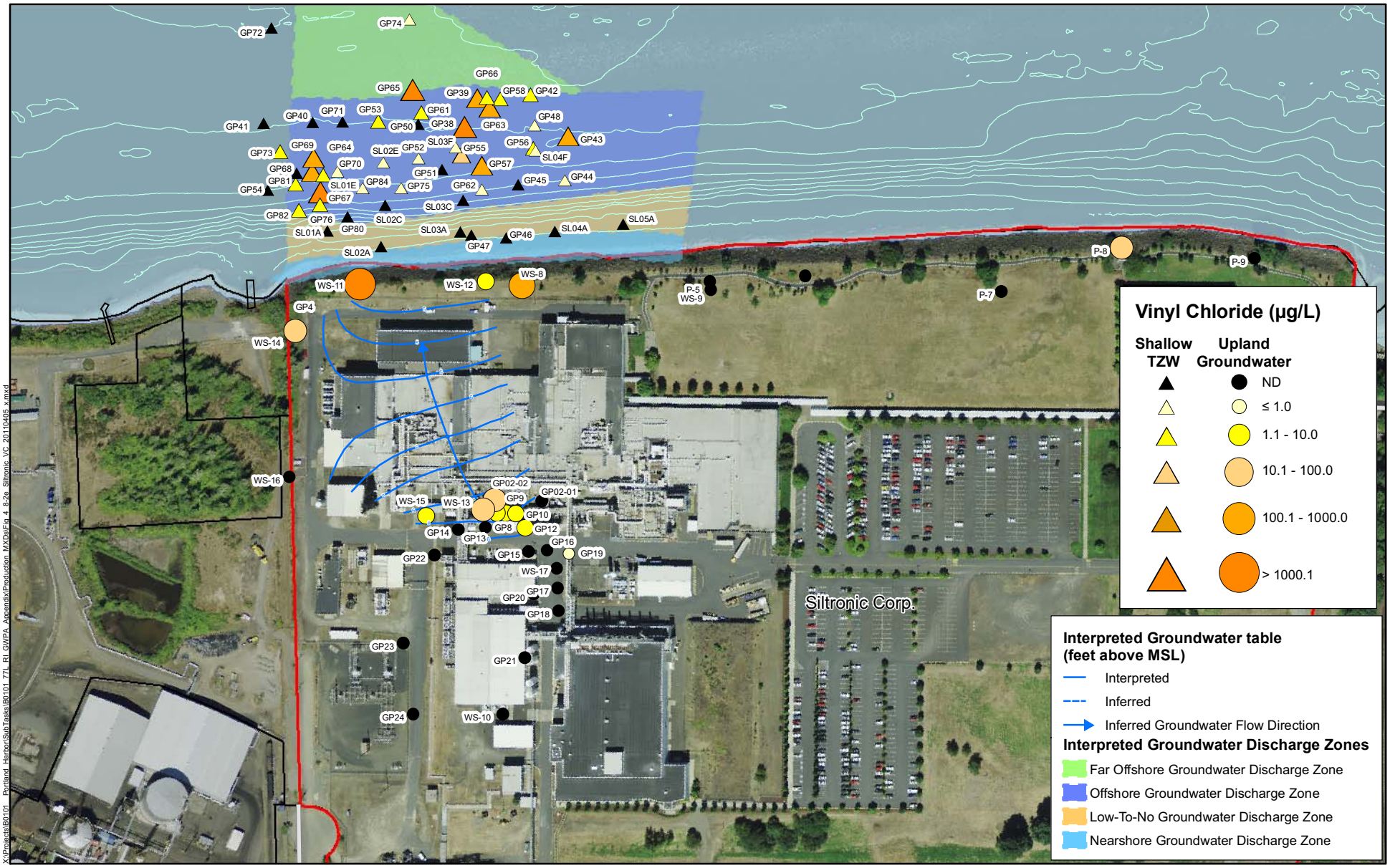
0 100 200

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-2d
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
cis-1,2-Dichloroethene in Upland Groundwater and Shallow TZW



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

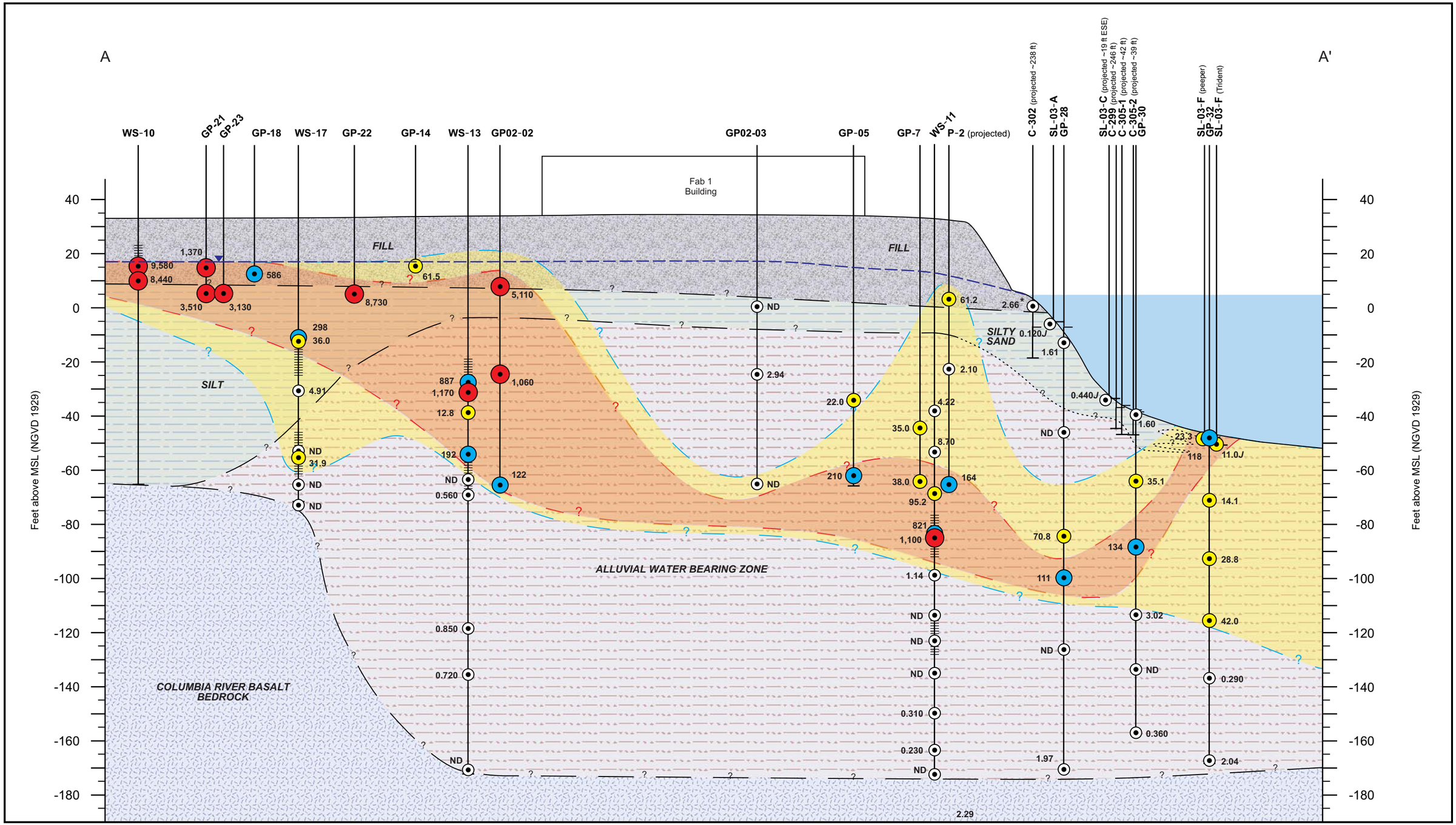
Site Property Boundary

0 100 200 Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-2e
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Vinyl Chloride in Upland Groundwater and Shallow TZW

X:\Projects\B0101 Portland Harbor\SubTasks\B0101 77L RI GWPA Appendix\Production MXDs\Fig 4 8-2e Siltronic VC 20110405 x.mxd



Base features from Maul Foster Alongi, Inc., 2005.
Locations should be considered approximate.

* Measured for TZW screening sample SLT3-A

0 30 60 Feet
Vertical scale

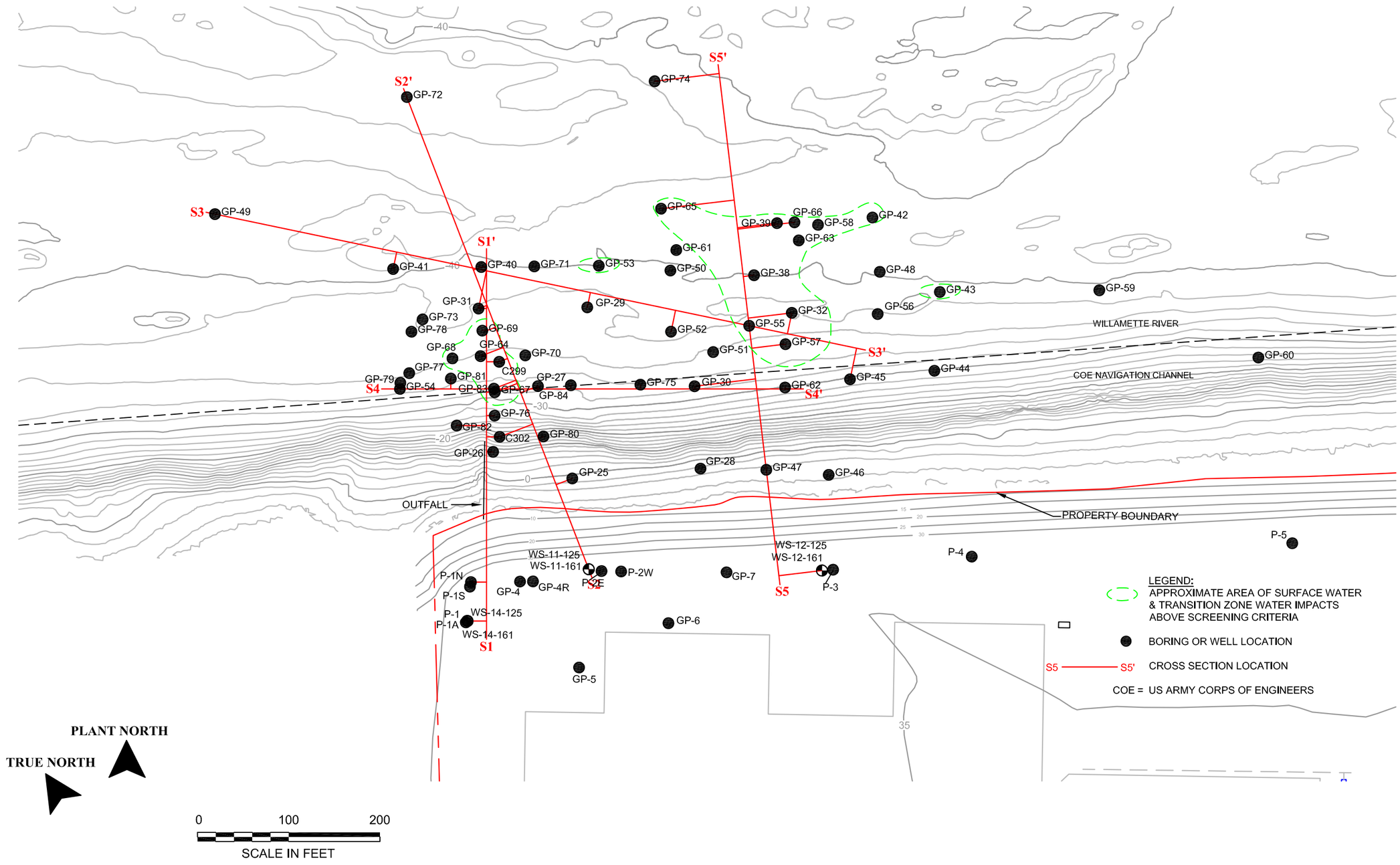
0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- DL - 10 µg/L
- 10 - 100 µg/L
- 100 - 1000 µg/L
- > 1000 µg/L

Concentration Zones:
- 10 - 100 µg/L
- > 100 µg/L

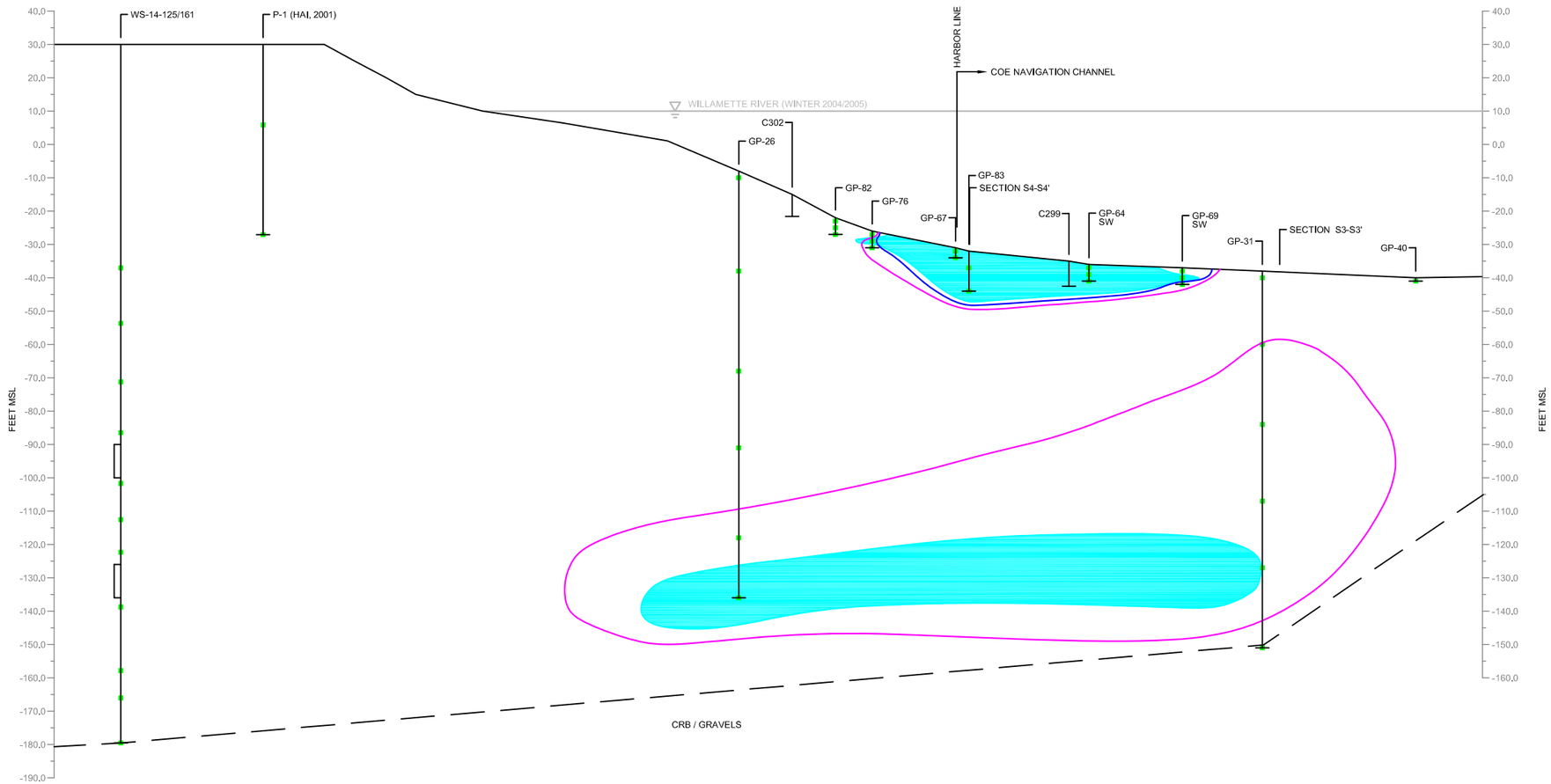
Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
J - Estimated
- Monitoring Well Screen

Figure C3.5-3
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Stratigraphic Cross Section A-A' and
Concentrations of Total BTEX in Nearshore
Groundwater and Transition Zone Water



Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4a
Portland Harbor RI/FS
Remedial Investigation Report
Cross Section Locations in River Groundwater and Transition Zone Water Samples



LEGEND:

TRICHLOROETHENE > 30 ug/L (AWQC)
CIS-1,2-DCE > 590 ug/L (DEQ)
VINYL CHLORIDE > 2.4 ug/L (AWQC)
AWQC = US EPA AMBIENT WATER QUALITY CRITERIA
DEQ = OREGON DEQ LEVEL 2 SCREENING LEVEL VALUE FOR SURFACE WATER (FRESH AQUATIC LIFE)
SW = SURFACE WATER
COE = US ARMY CORP OF ENGINEERS
GROUNDWATER SAMPLE LOCATION

NOTES:

1) C299 & C302 SEDIMENT SAMPLES WERE COLLECTED BY LWG. CIS-1,2-DCE WAS NOT INCLUDED IN LWG's ANALYTE LIST.

2) UPLAND RESULTS FROM 5/05 SAMPLING EVENT.

3) ALL CONCENTRATION BOUNDARIES ARE ESTIMATES BASED ON HYDROGEOLOGIC INTERPRETATION.

4) GROUNDWATER & SURFACE WATER DATA ARE SHOWN ON DRAWINGS IN APPENDIX C.

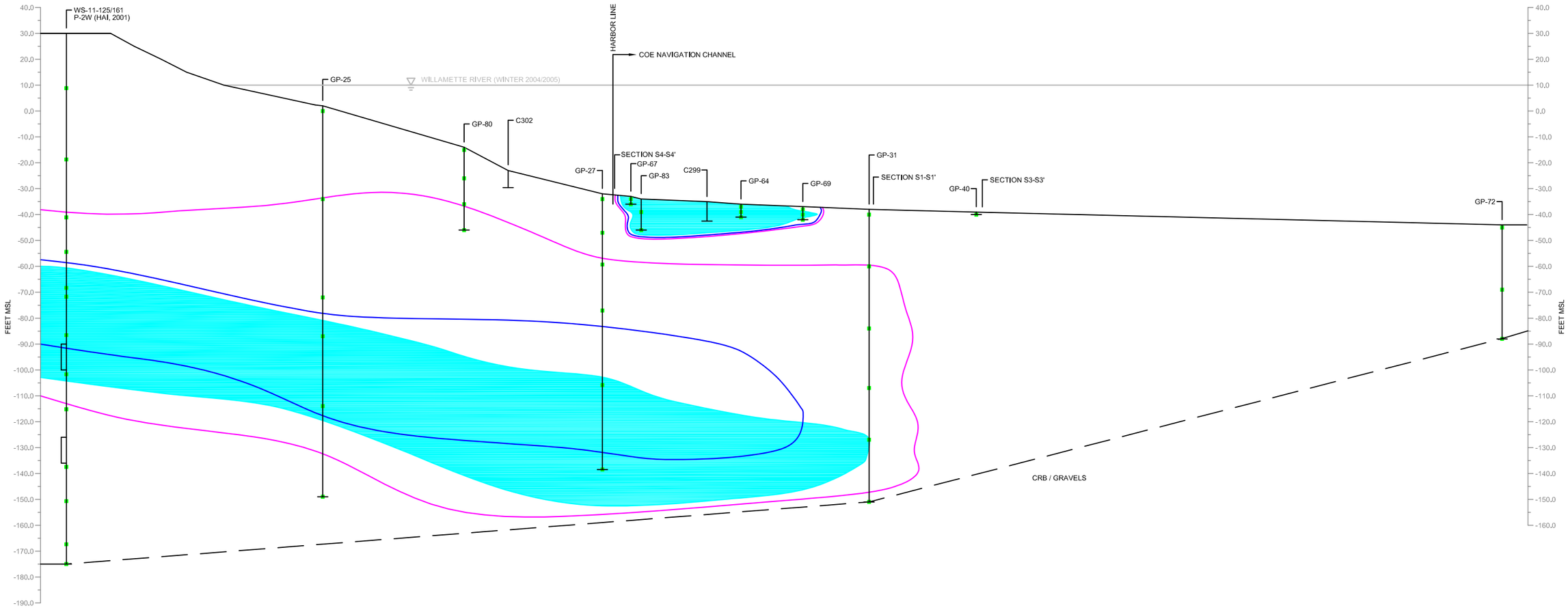
SCALE IN FEET

HORIZONTAL 0 40 80

VERTICAL 0 40 80

Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4b
Portland Harbor RI/FS
Remedial Investigation Report
TCE, DCE, and Vinyl Chloride Concentrations along Section Line S1–S1'



LEGEND:

TRICHLOROETHENE > 30 ug/L (AWQC)
CIS-1,2-DCE > 590 ug/L (DEQ)
VINYL CHLORIDE > 2.4 ug/L (AWQC)

AWQC = US EPA AMBIENT WATER QUALITY CRITERIA
DEQ = OREGON DEQ LEVEL 2 SCREENING LEVEL VALUE FOR SURFACE WATER (FRESH AQUATIC LIFE)
SW = SURFACE WATER
COE = US ARMY CORPS OF ENGINEERS
GROUNDWATER SAMPLE LOCATION

NOTES:

1) C299 & C302 SEDIMENT SAMPLES WERE COLLECTED BY LWG. CIS-1,2-DCE WAS NOT INCLUDED IN LWG's ANALYTE LIST.

2) UPLAND RESULTS FROM 5/05 SAMPLING EVENT.

3) ALL CONCENTRATION BOUNDARIES ARE ESTIMATES BASED ON HYDROGEOLOGIC INTERPRETATION.

4) GROUNDWATER & SURFACE WATER DATA ARE SHOWN ON DRAWINGS IN APPENDIX C.

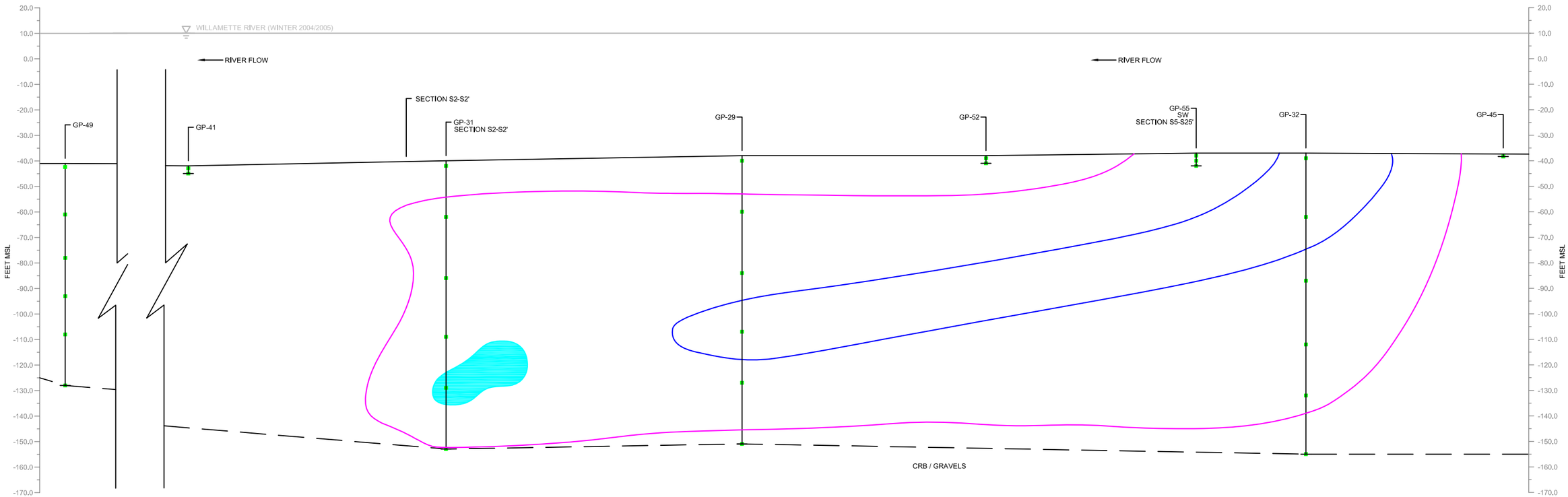
SCALE IN FEET

HORIZONTAL 0 40 80

VERTICAL 0 40 80

Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4c
Portland Harbor RI/FS
Remedial Investigation Report
TCE, DCE, and Vinyl Chloride Concentrations along Section Line S2–S2'



LEGEND:

- TRICHLOROETHENE > 30 ug/L (AWQC)
- CIS-1,2-DCE > 590 ug/L (DEQ)
- VINYL CHLORIDE > 2.4 ug/L (AWQC)

AWQC = US EPA AMBIENT WATER QUALITY CRITERIA
DEQ = OREGON DEQ LEVEL 2 SCREENING LEVEL VALUE FOR SURFACE WATER (FRESH AQUATIC LIFE)
SW = SURFACE WATER
COE = US ARMY CORP OF ENGINEERS
GROUNDWATER SAMPLE LOCATION

NOTES:

1) C299 & C302 SEDIMENT SAMPLES WERE COLLECTED BY LWG. CIS-1,2-DCE WAS NOT INCLUDED IN LWG's ANALYTE LIST.

2) ALL CONCENTRATION BOUNDARIES ARE ESTIMATES BASED ON HYDROGEOLOGIC INTERPRETATION.

3) GROUNDWATER & SURFACE WATER DATA ARE SHOWN ON DRAWINGS IN APPENDIX C.

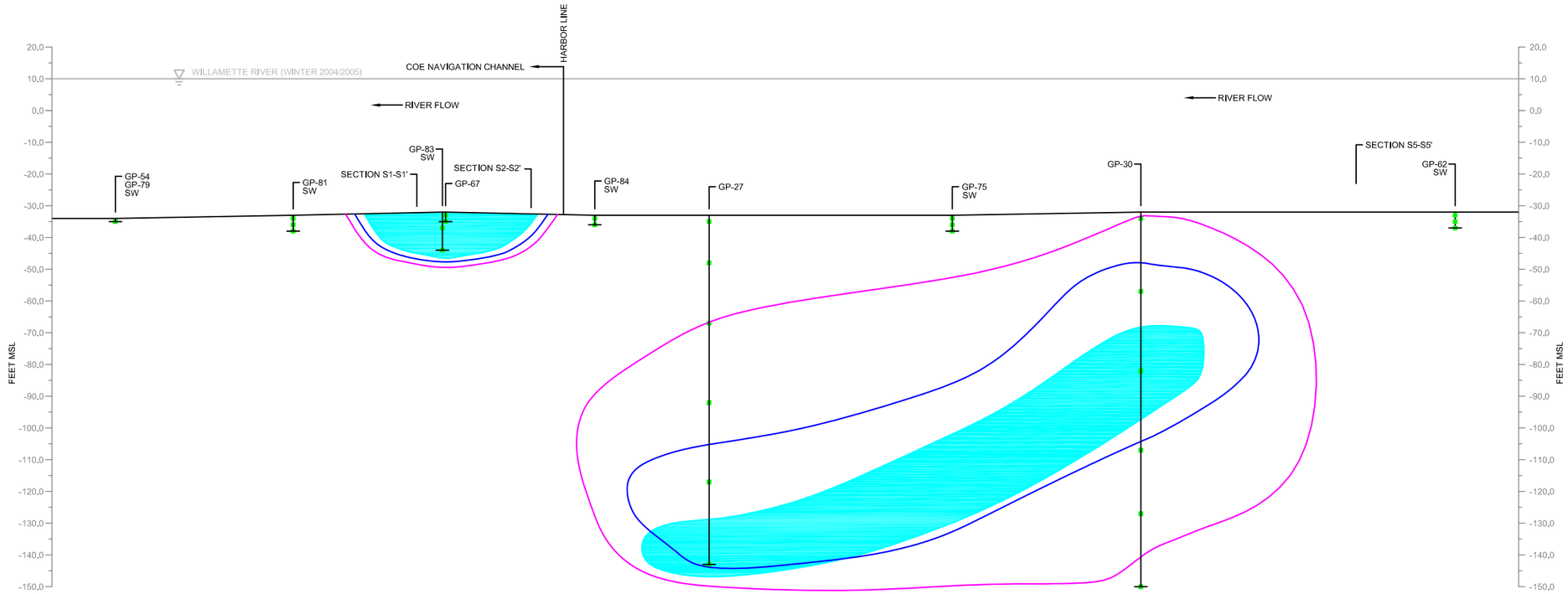
SCALE IN FEET

HORIZONTAL 0 40 80

VERTICAL 0 40 80

Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4d
Portland Harbor RI/FS
Remedial Investigation Report
TCE, DCE, and Vinyl Chloride Concentrations along Section Line S3–S3'



LEGEND:

TRICHLOROETHENE > 30 ug/L (AWQC)
CIS-1,2-DCE > 590 ug/L (DEQ)
VINYL CHLORIDE > 2.4 ug/L (AWQC)
AWQC = US EPA AMBIENT WATER QUALITY CRITERIA
DEQ = OREGON DEQ LEVEL 2 SCREENING LEVEL VALUE FOR SURFACE WATER (FRESH AQUATIC LIFE)
SW = SURFACE WATER
GROUNDWATER SAMPLE LOCATION

NOTES:

1) C299 & C302 SEDIMENT SAMPLES WERE COLLECTED BY LWG. CIS-1,2-DCE WAS NOT INCLUDED IN LWG's ANALYTE LIST.

2) ALL CONCENTRATION BOUNDARIES ARE ESTIMATES BASED ON HYDROGEOLOGIC INTERPRETATION.

3) GROUNDWATER & SURFACE WATER DATA ARE SHOWN ON DRAWINGS IN APPENDIX C.

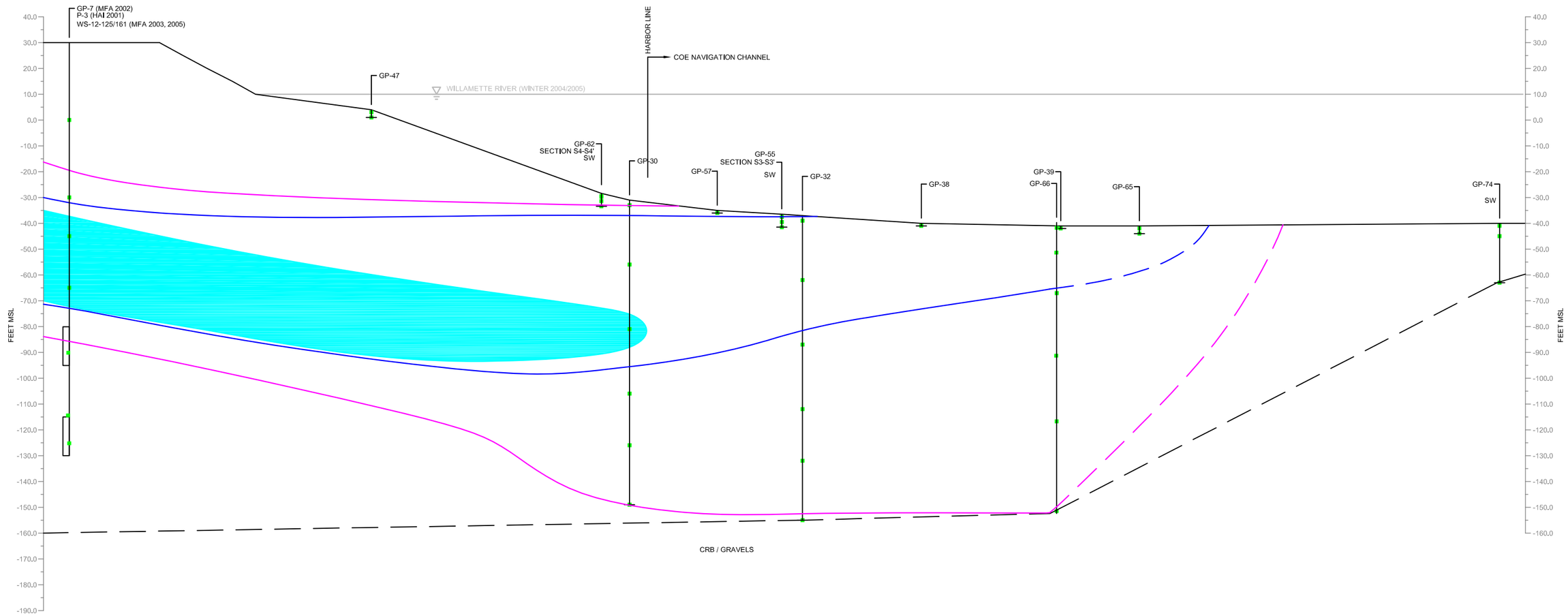
SCALE IN FEET

HORIZONTAL 0 40 80

VERTICAL 0 40 80

Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4e
Portland Harbor RI/FS
Remedial Investigation Report
TCE, DCE, and Vinyl Chloride Concentrations along Section Line S4–S4'



LEGEND:

- TRICHLOROETHENE > 30 ug/L (AWQC)
- CIS-1,2-DCE > 590 ug/L (DEQ)
- VINYL CHLORIDE > 2.4 ug/L (AWQC)

AWQC = US EPA AMBIENT WATER QUALITY CRITERIA
DEQ = OREGON DEQ LEVEL 2 SCREENING LEVEL VALUE FOR SURFACE WATER (FRESH AQUATIC LIFE)
SW = SURFACE WATER
GROUNDWATER SAMPLE LOCATION

NOTES:

1) C299 & C302 SEDIMENT SAMPLES WERE COLLECTED BY LWG. CIS-1,2-DCE WAS NOT INCLUDED IN LWG's ANALYTE LIST.

2) UPLAND RESULTS FROM 5/05 SAMPLING EVENT.

3) ALL CONCENTRATION BOUNDARIES ARE ESTIMATES BASED ON HYDROGEOLOGIC INTERPRETATION.

4) GROUNDWATER & SURFACE WATER DATA ARE SHOWN ON DRAWINGS IN APPENDIX C.

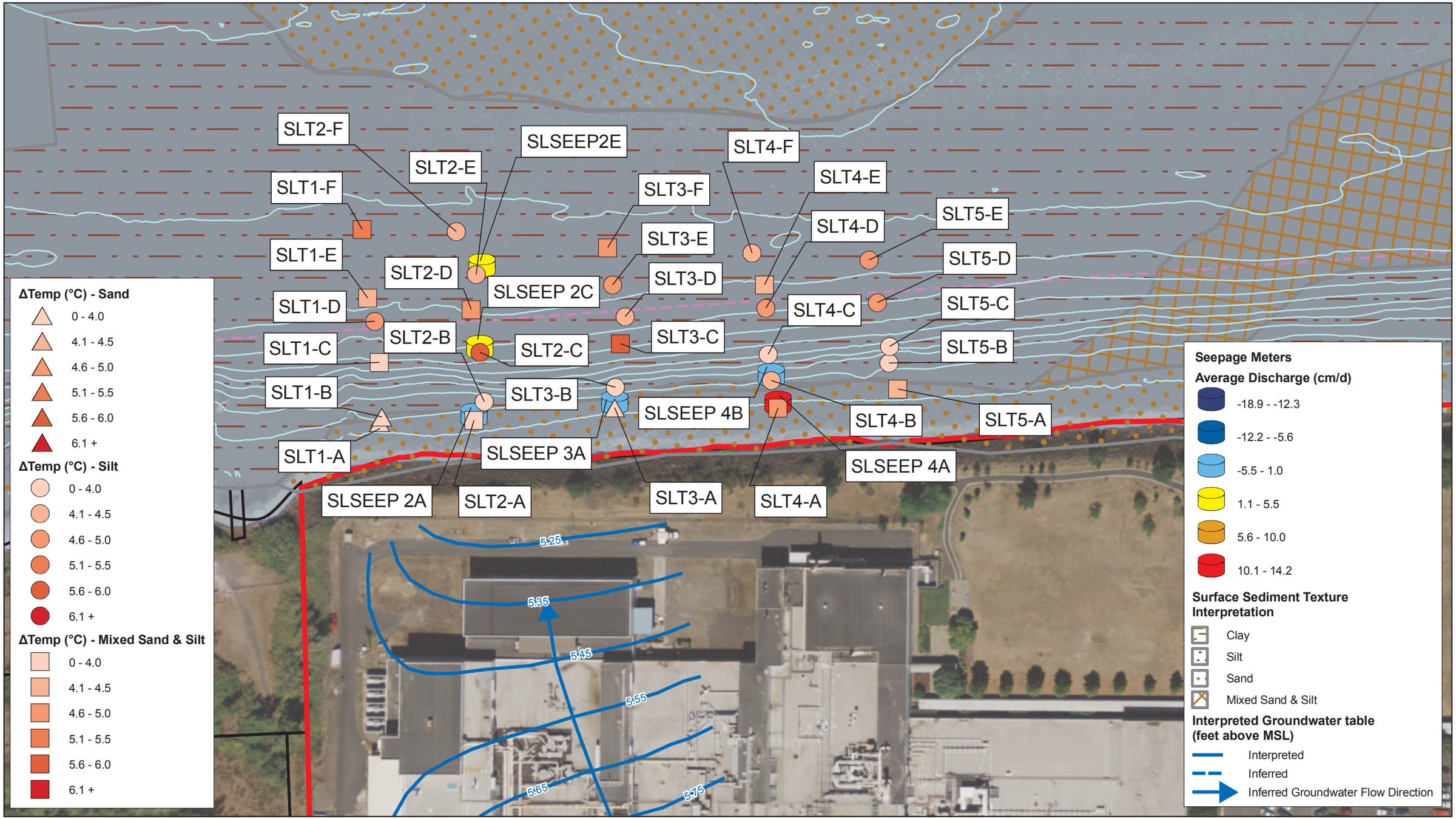
SCALE IN FEET

HORIZONTAL 0 40 80

VERTICAL 0 40 80

Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-4f
Portland Harbor RI/FS
Remedial Investigation Report
TCE, DCE, and Vinyl Chloride Concentrations along Section Line S5–S5'



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LEGEND

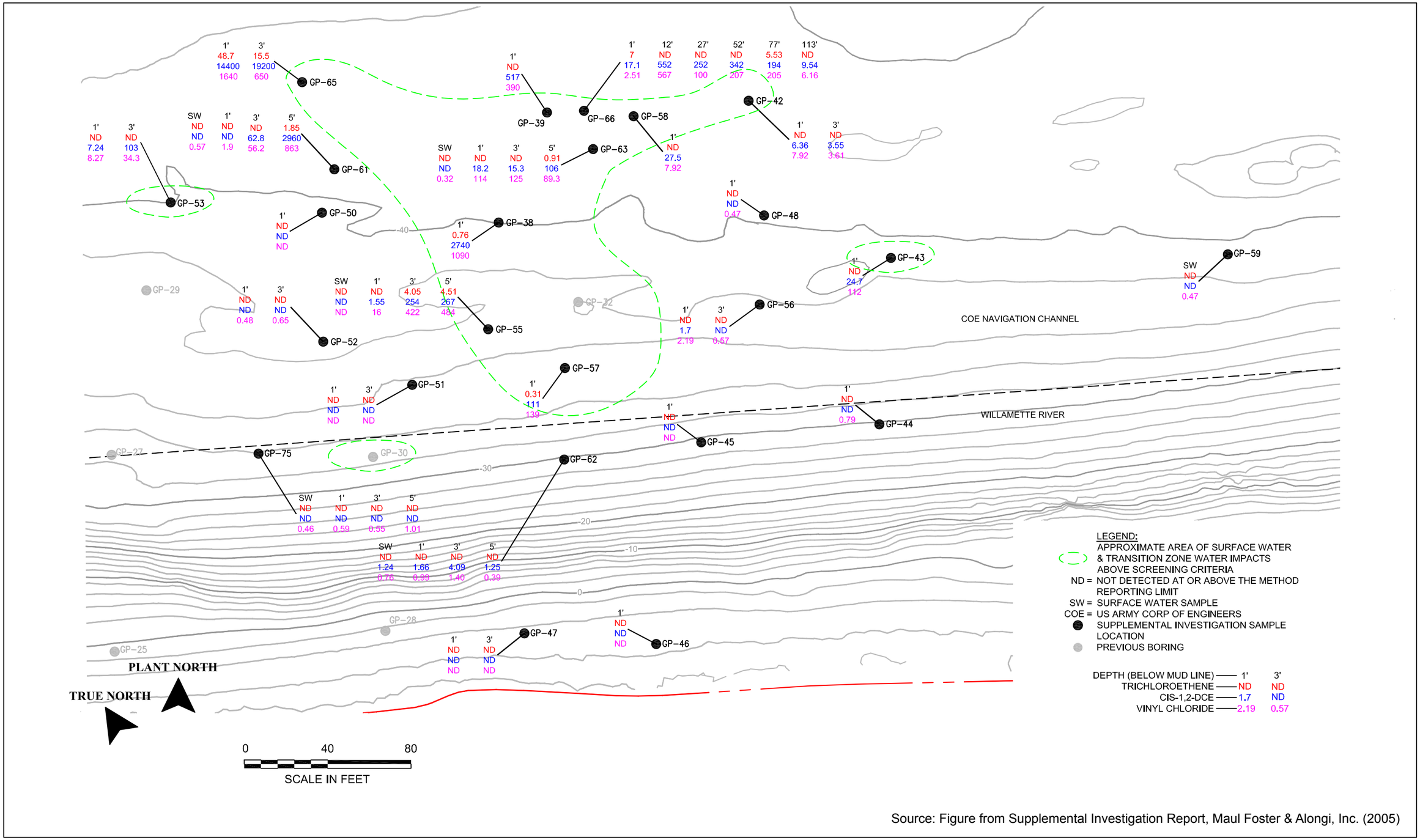
2003 Bathymetric 5 Ft. Contours (NAVD88)
Navigation Channel
Site Property Boundary

0 50 100
Feet

N

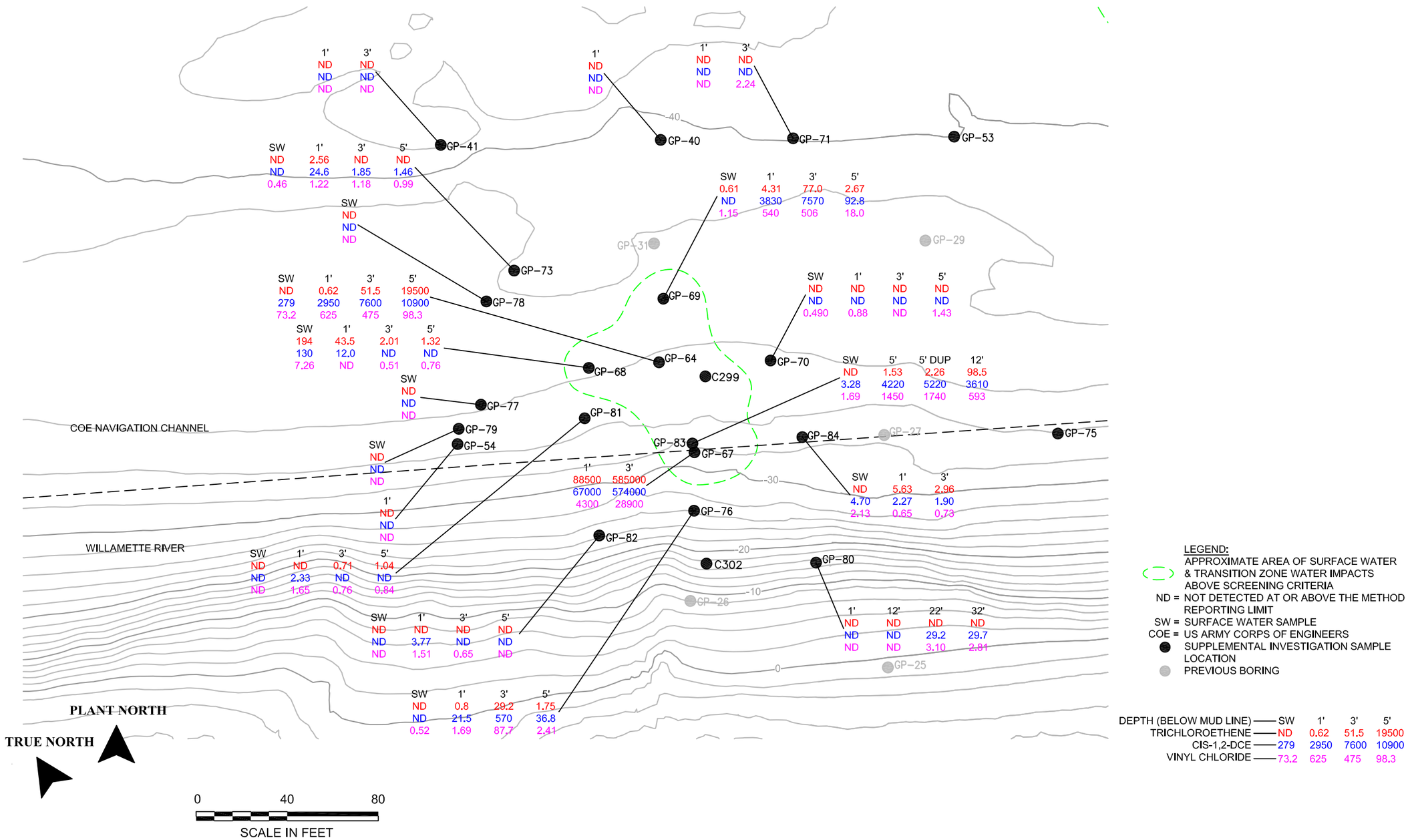
FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004. Remedial Investigation Proposal, Siltronic Corporation Site, 7200 NW Front Avenue, Portland, Oregon 97210, Maul Foster & Alongi, Inc. April 2.

Figure C3.5-5
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Trident Probe and Seepage Meter Results



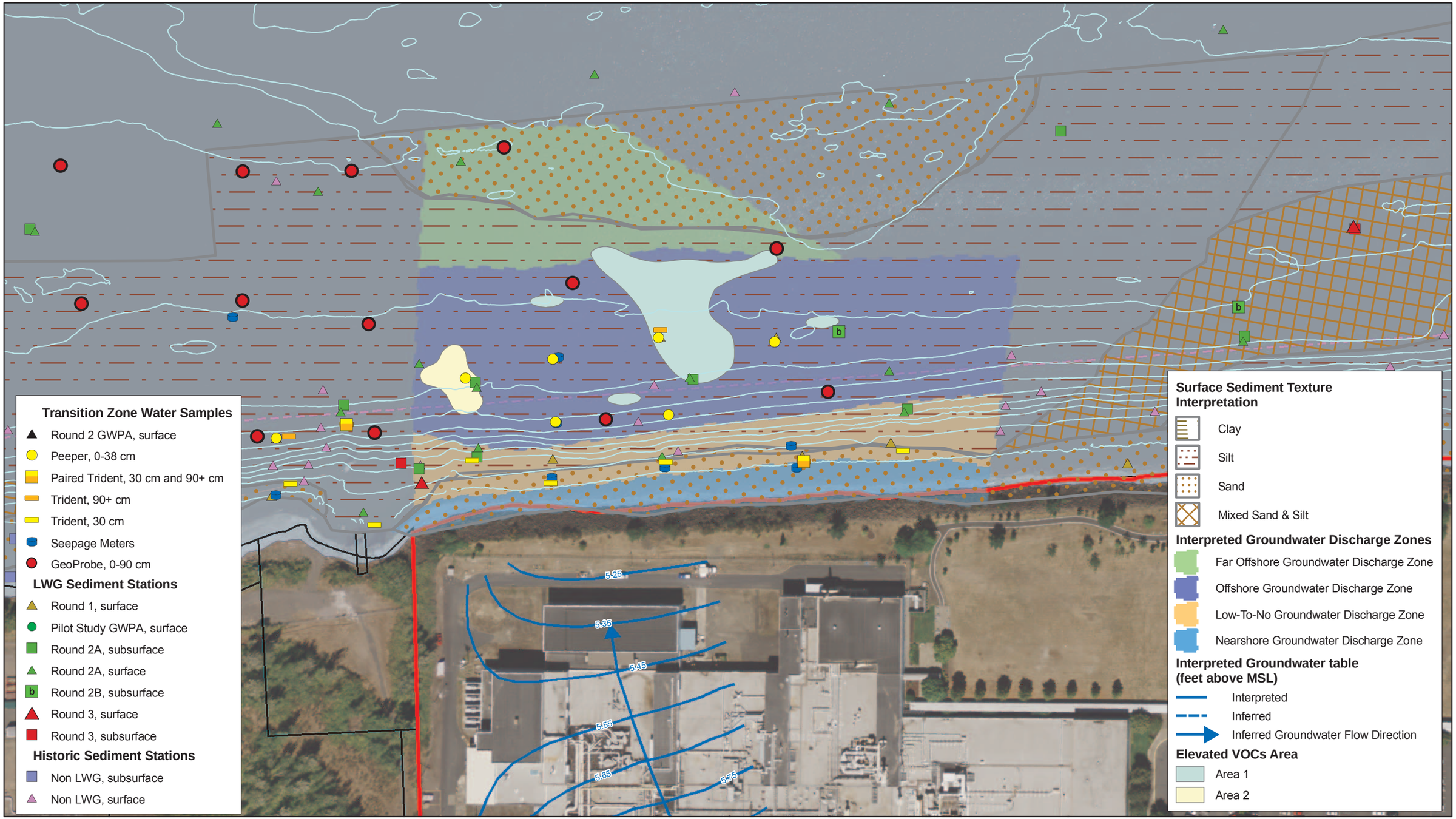
Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi, Inc. (2005)

Figure C3.5-6a
Portland Harbor RI/FS
Remedial Investigation Report
Locations of the Area 1 Groundwater and Transition Zone Water Samples from the 2004 Investigation



Source: Figure from Supplemental Investigation Report, Maul Foster & Alongi Inc. (2005)

Figure C3.5-6b
Portland Harbor RI/FS
Remedial Investigation Report
Locations of the Area 2 Groundwater and Transition Zone Water Samples from the 2004 Investigation



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD88)
Navigation Channel
Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells & Groundwater Contours: Locations are approximate and drawn from MFA, 2004.
Remedial Investigation Proposal, Siltronic Corporation Site,
7200 NW Front Avenue, Portland, Oregon 97210,
Maul Foster & Alongi, Inc. April 2.

Figure C3.5-7
Portland Harbor RI/FS
Remedial Investigation Report
Siltronic Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

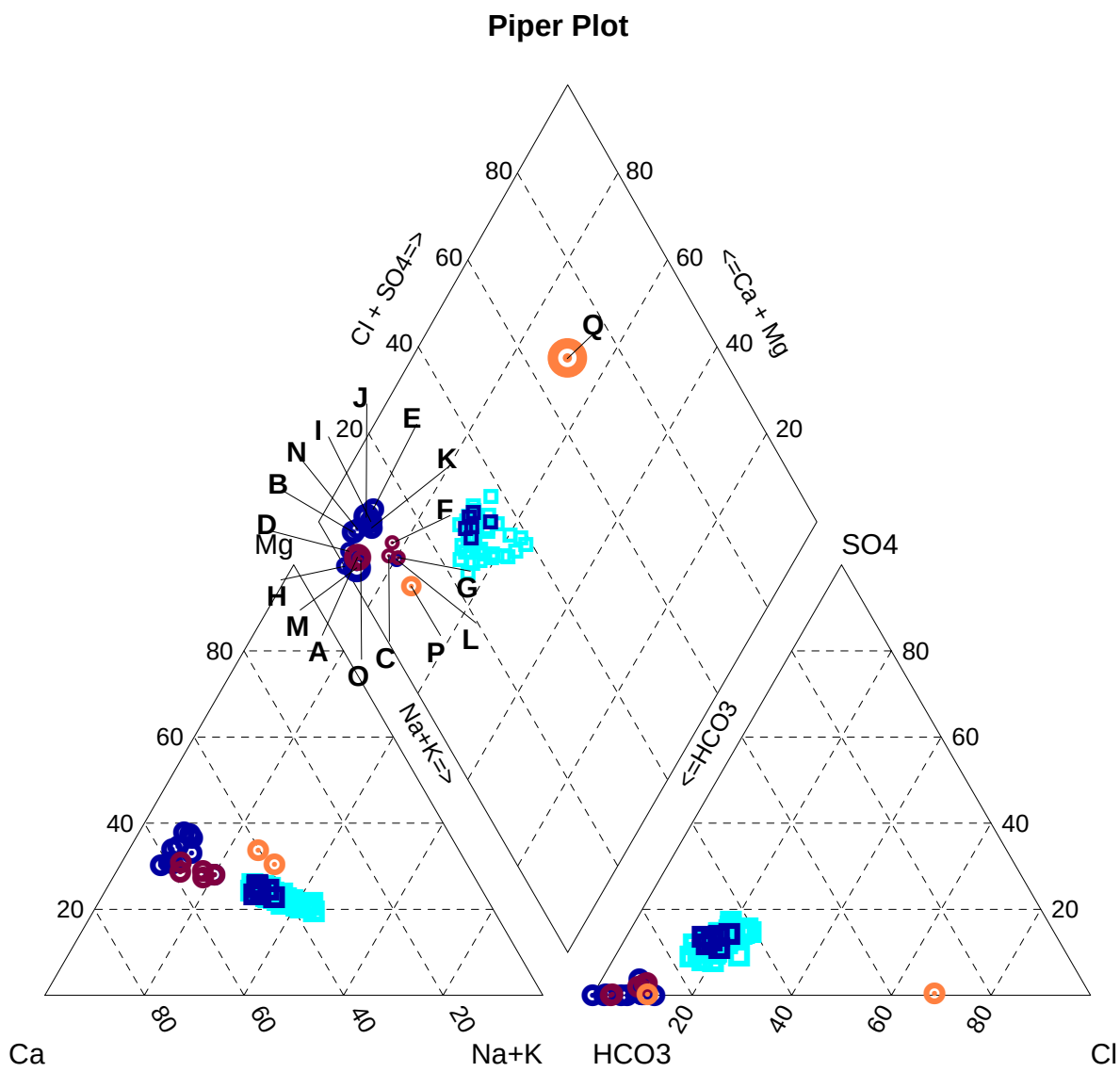
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Low-to-No Groundwater Discharge Zone	SL-01-A, Trident 30 cm	492	10.5	0.05	104	33.9	5.12	21.8	6.47	667.37
B	Groundwater Discharge Zone	SL-01-E, Peeper 0 - 38 cm	426	14.3	0.05	105	31.2	3.26	14	7.75	593.81
C	Low-to-No Groundwater Discharge Zone	SL-02-A, Trident 30 cm	153	8	2.5	36.7	11.2	2.22	12.7	6.67	226.32
D	Groundwater Discharge Zone	SL-02-C, Peeper 0 - 38 cm	330	5	0.2	81.7	25.5	2.96	13.2	7	458.56
E	Groundwater Discharge Zone	SL-02-E, Peeper 0 - 38 cm	350	27.9	0.2	87	32.5	3.85	14.6	6.95	516.05
F	Low-to-No Groundwater Discharge Zone	SL-03-A, Trident 30 cm	109	6.7	2.8	34.4	11.2	2.13	11.4	6.74	177.63
G	Low-to-No Groundwater Discharge Zone	SL-03-A, Trident 30 cm; FR	112	6.7	2.6	24.8	8.09	2.57	9.5	6.77	166.26
H	Groundwater Discharge Zone	SL-03-C, Peeper 0 - 38 cm	317	0.02	0.1	70.1	22.1	3.37	12.2	6.93	424.89
I	Groundwater Discharge Zone	SL-03-F, Peeper 0 - 38 cm	390	25.5	0.4	87.7	38.2	4.03	17.8	6.82	563.63
J	Groundwater Discharge Zone	SL-03-F, Peeper 0 - 38 cm; FR	416	26	0.3	98.4	42.4	3.85	16.9	6.84	603.85
K	Groundwater Discharge Zone	SL-03-F, Trident 120 cm	376	23.1	0.4	79.5	33.7	5.3	16.7	6.88	534.7
L	Groundwater Discharge Zone	SL-04-A, Trident 30 cm	112	5.5	3.6	31.8	10.4	2.44	12.6	6.69	178.34
M	Groundwater Discharge Zone	SL-04-A, Trident 90 cm	536	7.1	0.05	109	40.3	5.28	27	6.58	724.73
N	Groundwater Discharge Zone	SL-04-F, Peeper 0 - 38 cm	352	14.7	0.2	85.1	30.3	2.93	12.9	6.79	498.13
O	Low-to-No Groundwater Discharge Zone	SL-05-A, Trident 30 cm	324	7.5	0.3	76.9	22.8	3.79	17.2	6.69	452.49
P	Upland Groundwater	MW-03-81	330	19.4	0.26	50.6	25.5	4.37	34.9		465.03
Q	Upland Groundwater	MW-03-I	334	350	2.73	122	58.3	3.59	110		980.62

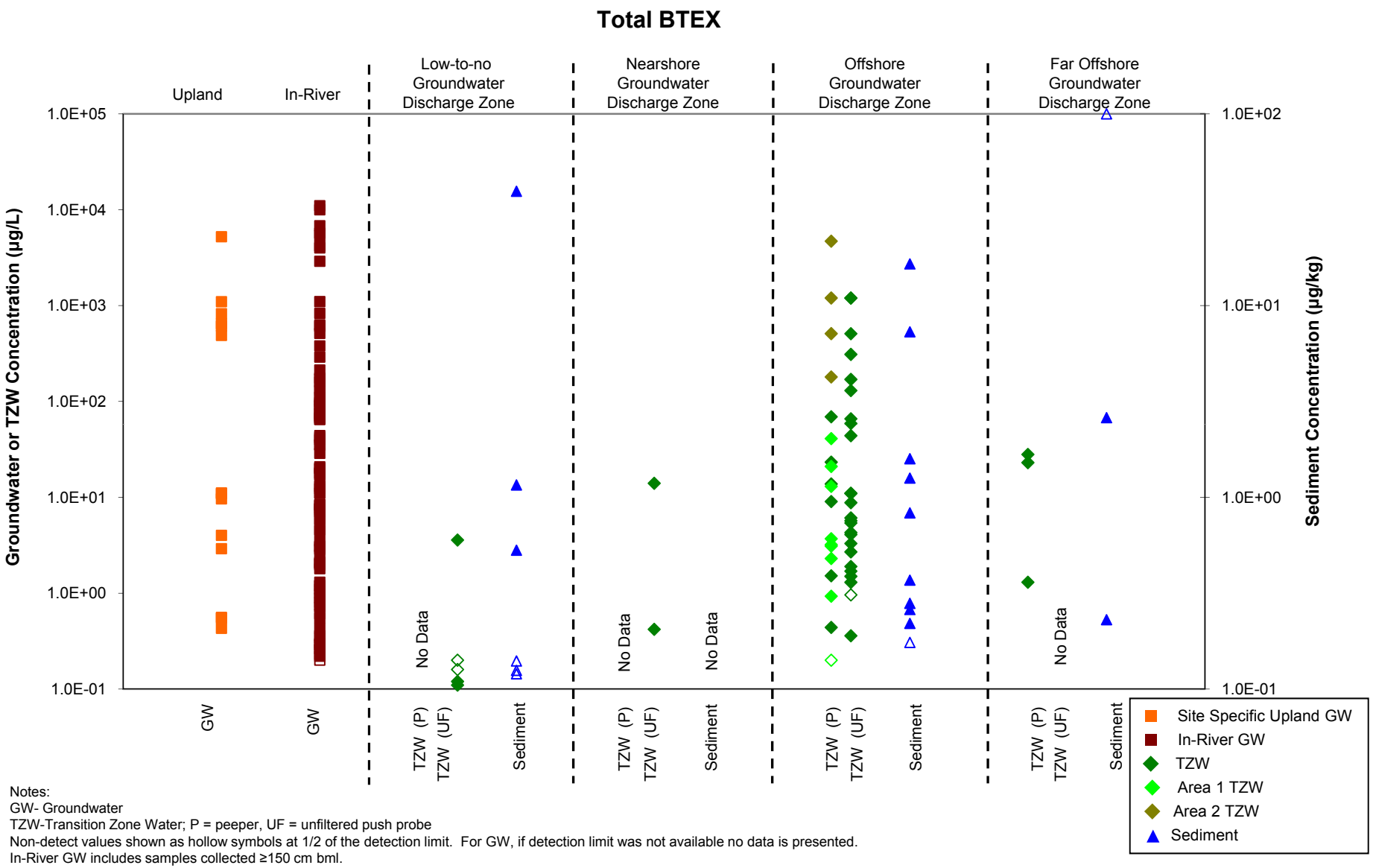
Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

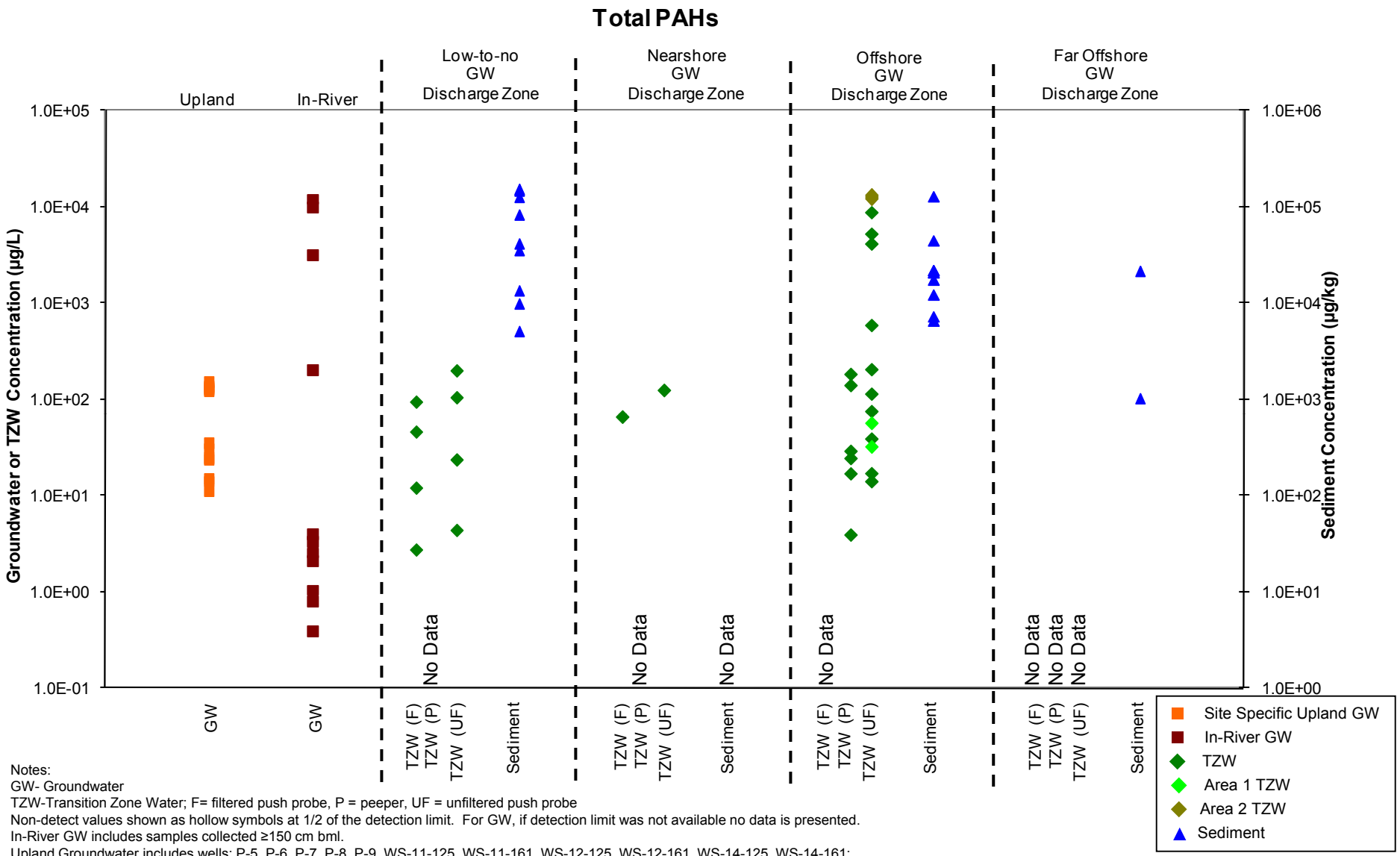
All concentrations as mg/L; pH in s.u.

Figure C3.5-8
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Siltronic



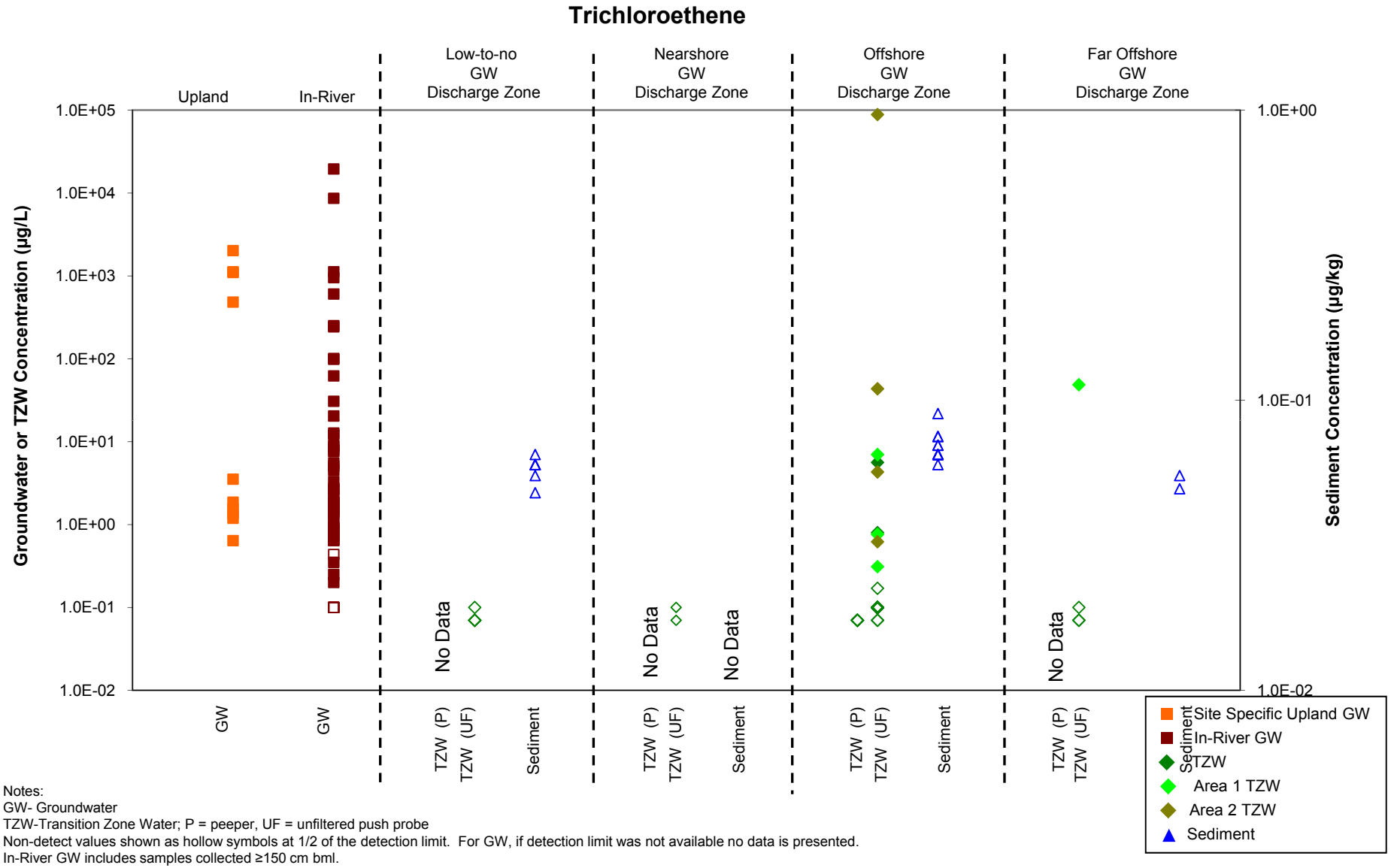
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.5-9a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total BTEX - Siltronic



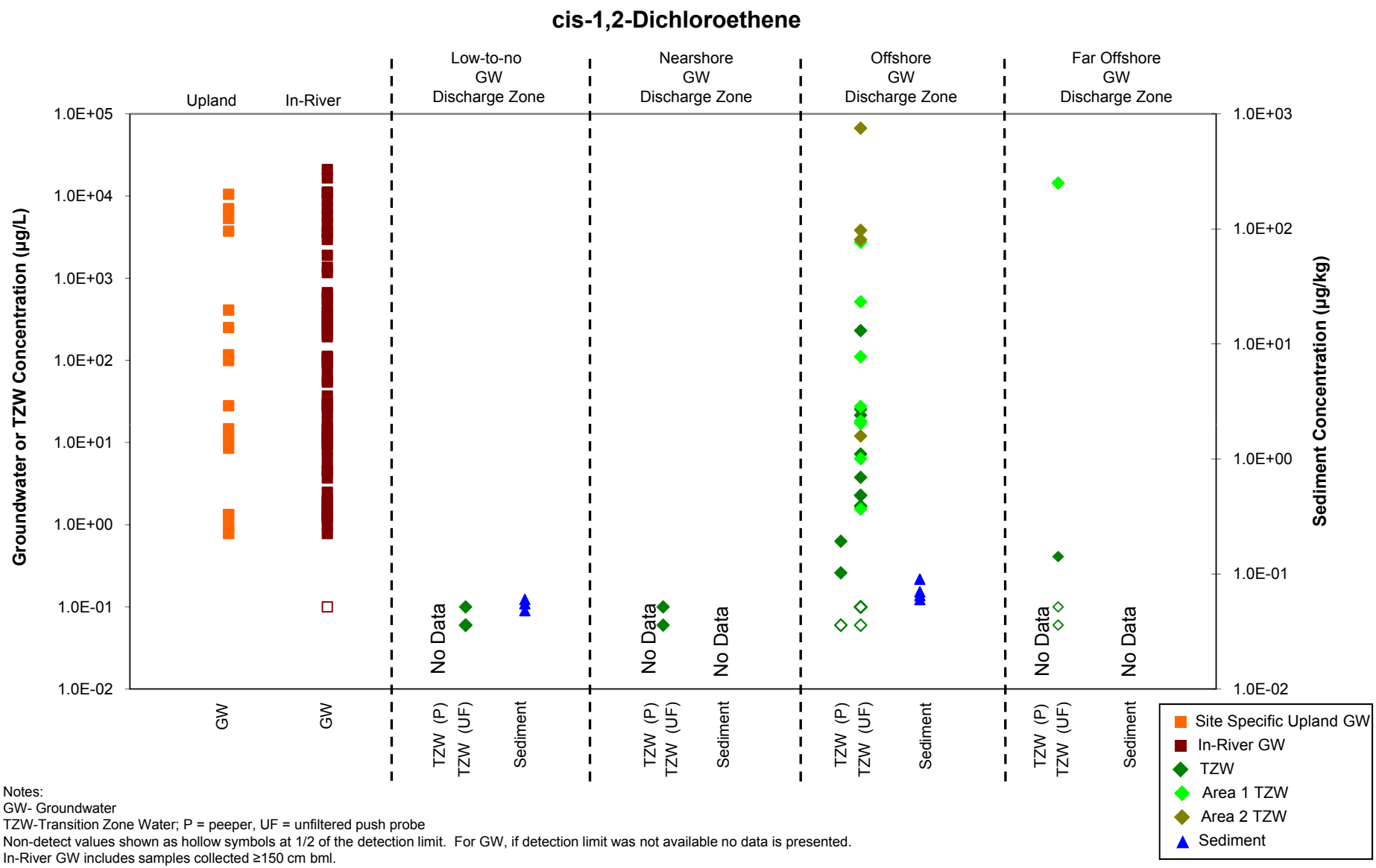
Notes:
GW- Groundwater
TZW-Transition Zone Water; F= filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.5-9b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total PAHs - Siltronic



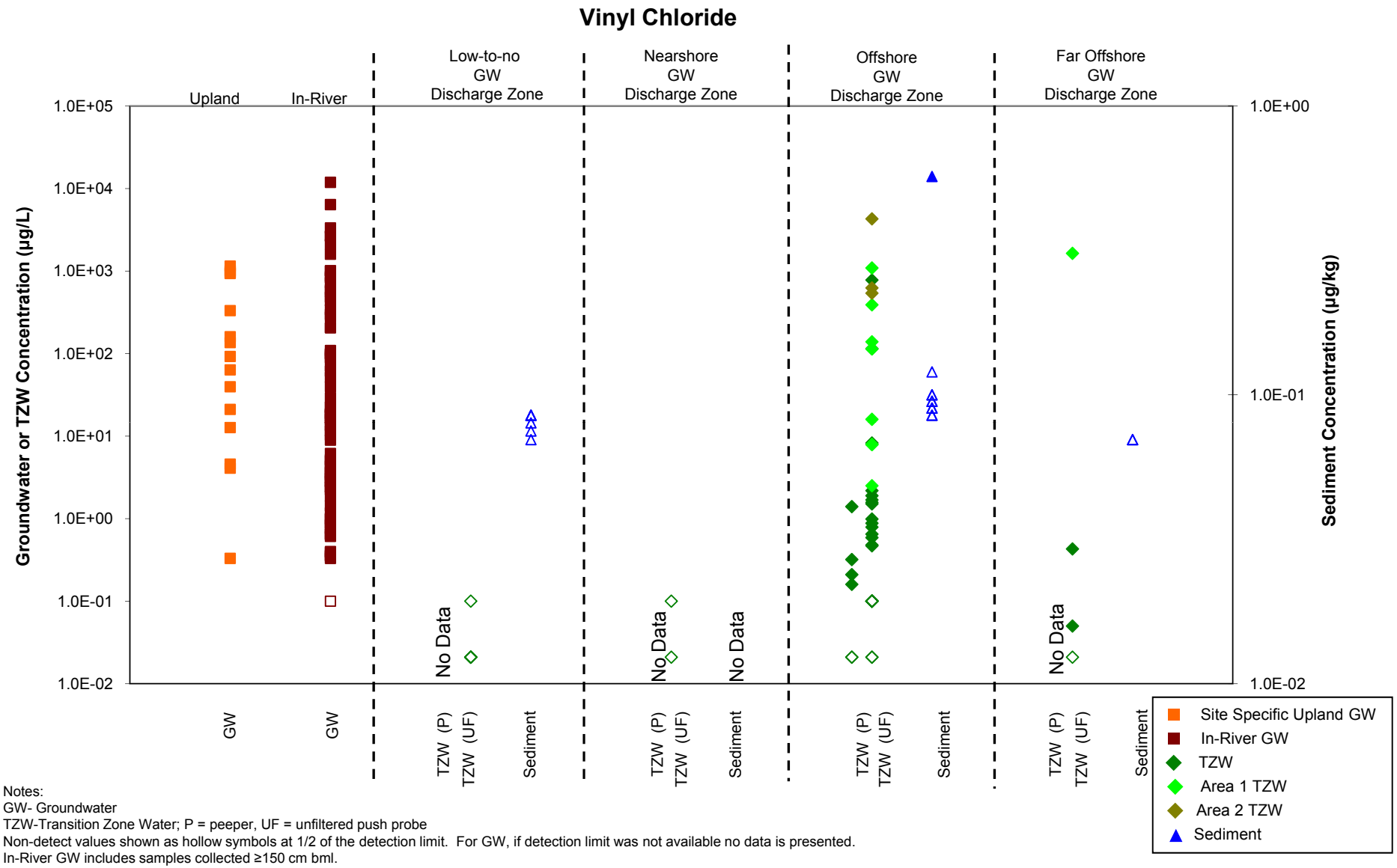
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.5-9c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Trichloroethene - Siltronic



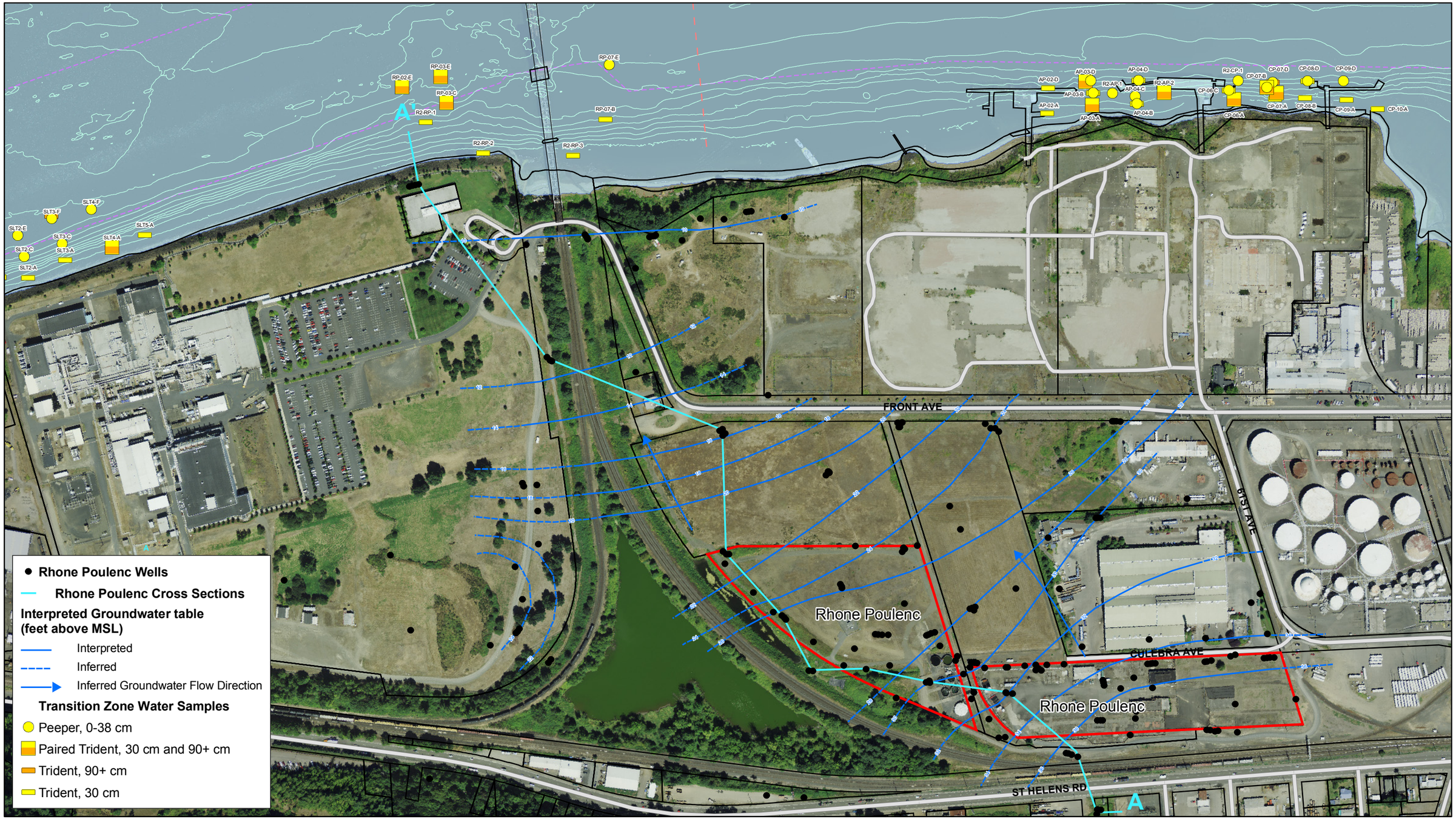
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.5-9d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
cis-1,2-Dichloroethene - Siltronic



Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.5-9e
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Vinyl Chloride - Siltronic



LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: Locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004).
Groundwater Contours: Locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

Figure C3.6-1
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Overview and Cross Section Location

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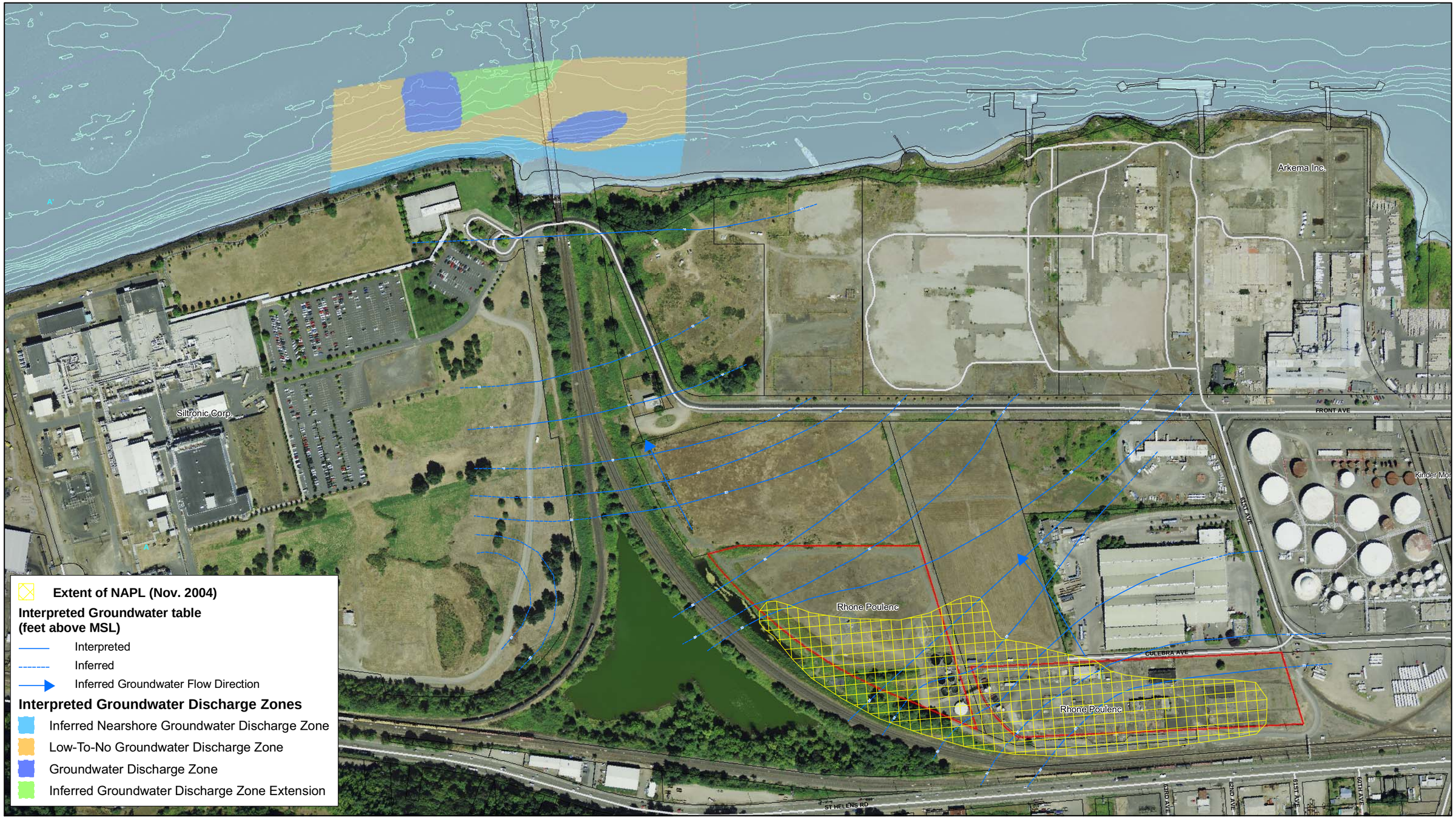

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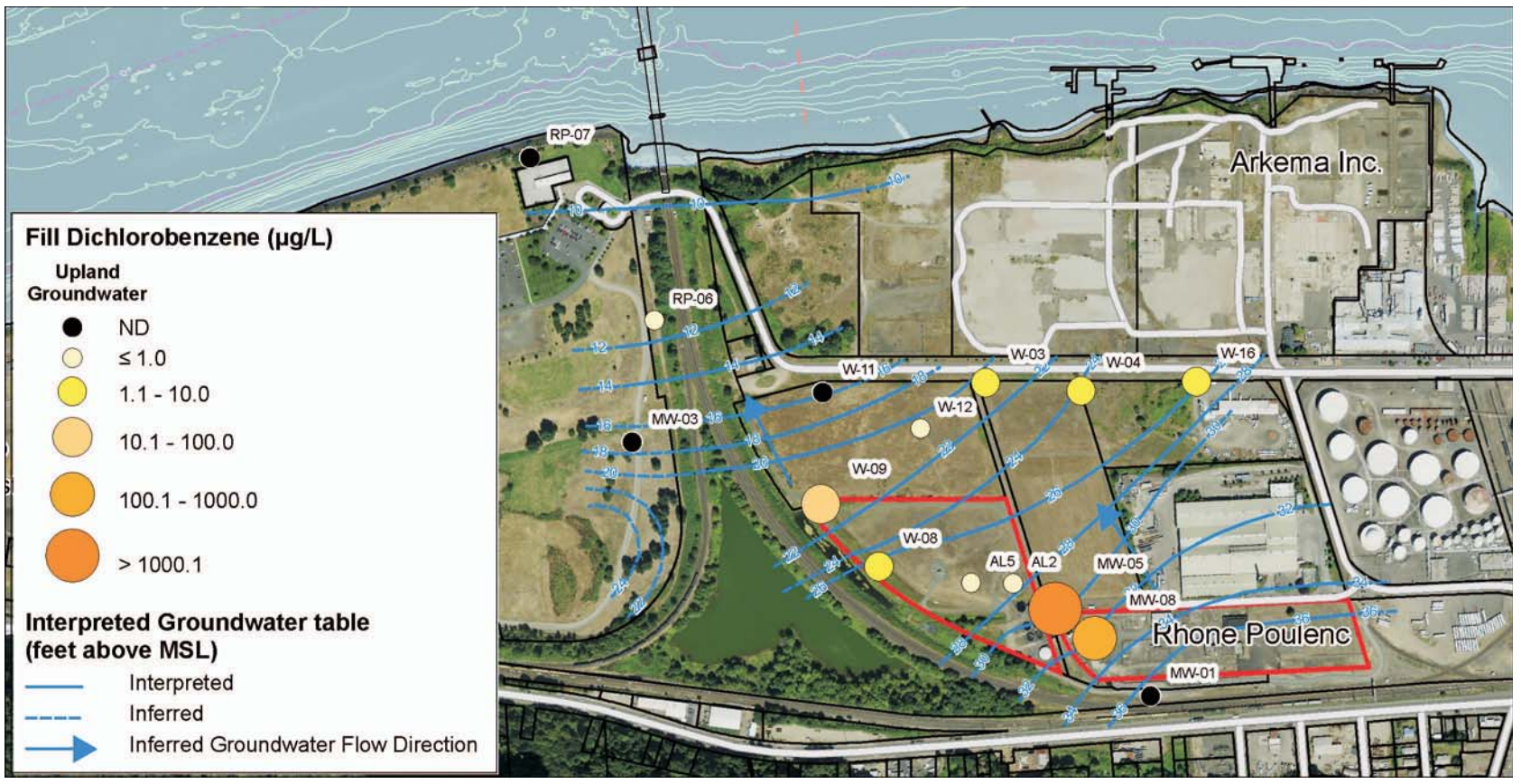
LEGEND

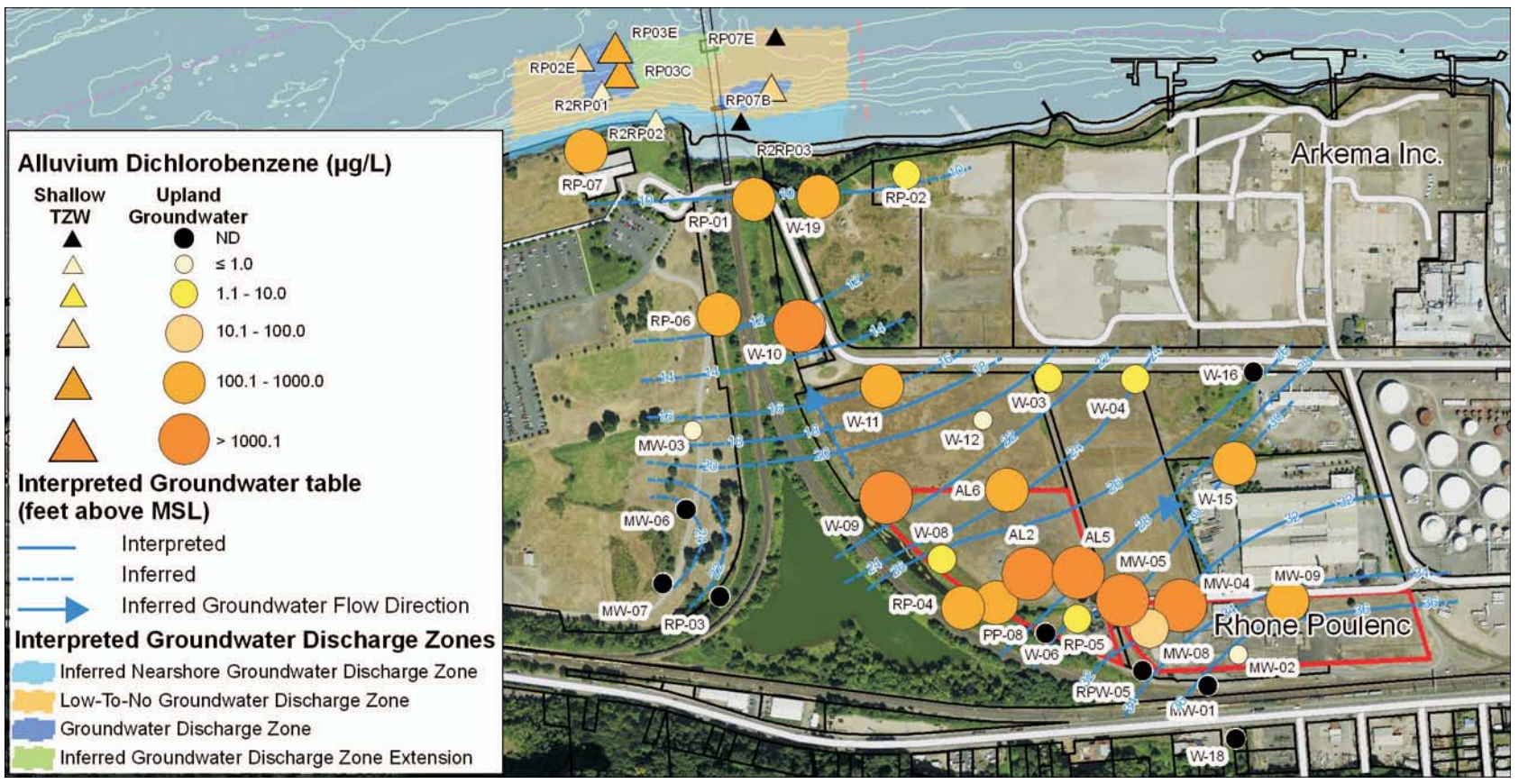
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

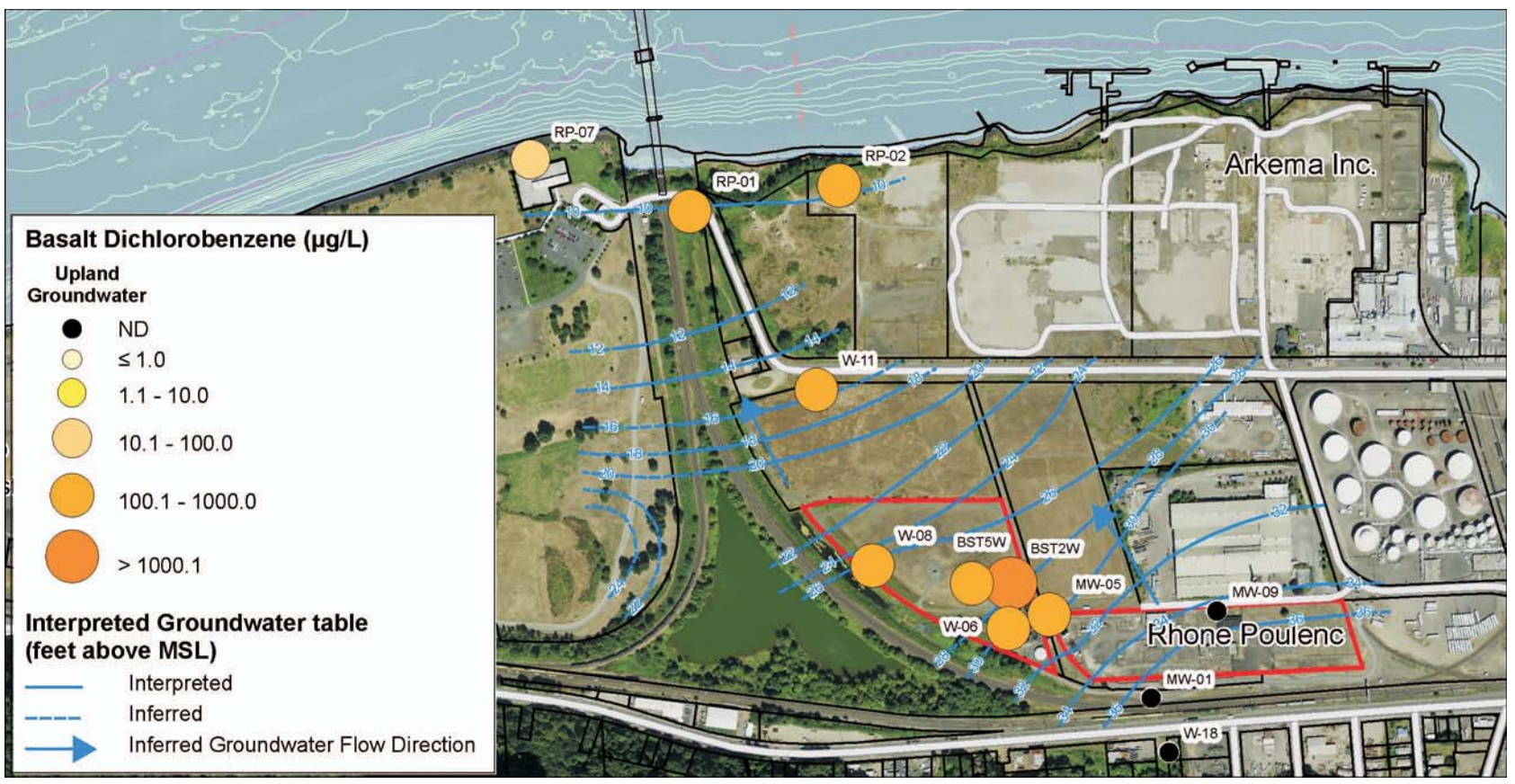
0 100 200
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: Locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004).
Groundwater Contours: Locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

Figure C3.6-2a
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Distribution of NAPL in Upland Groundwater





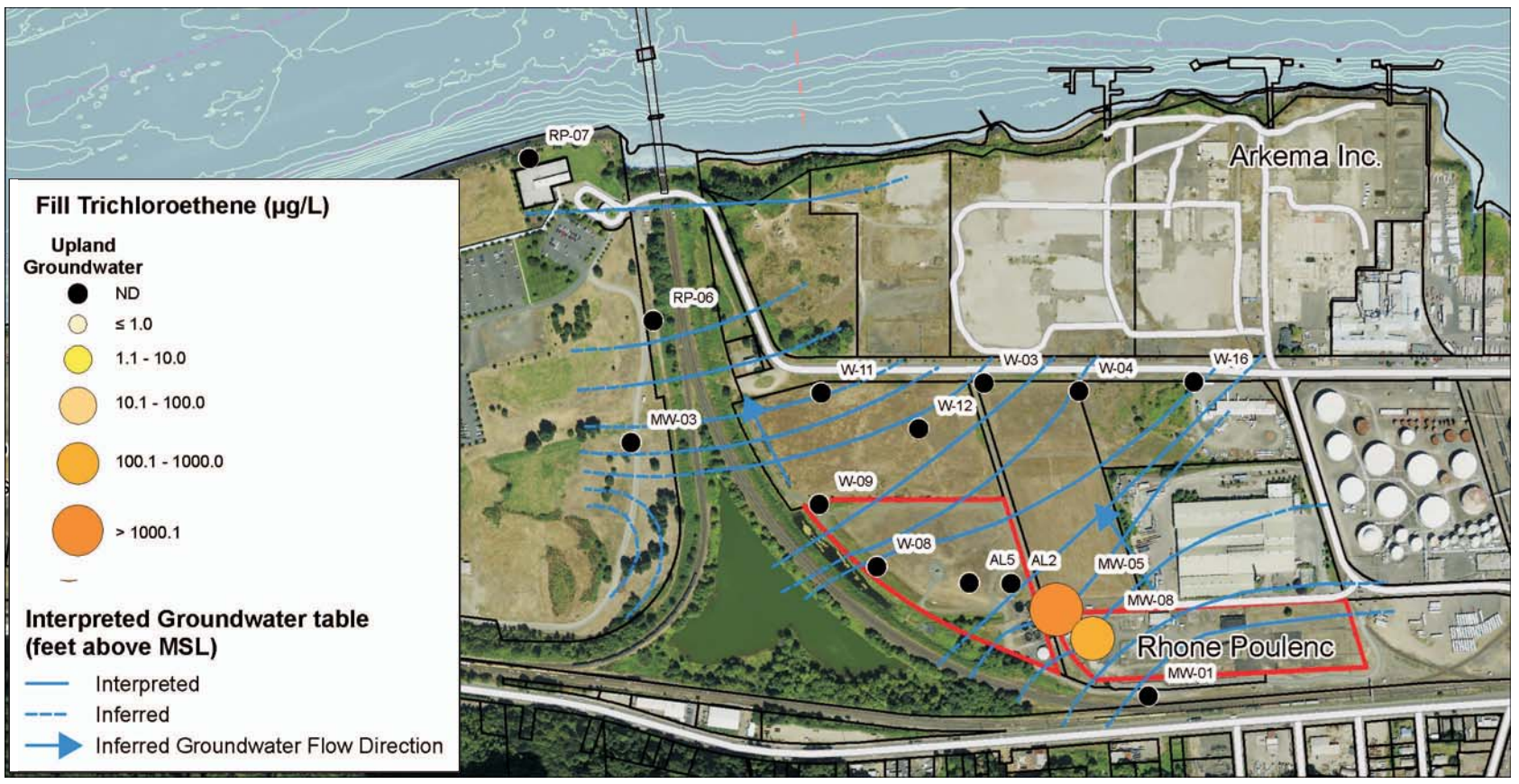


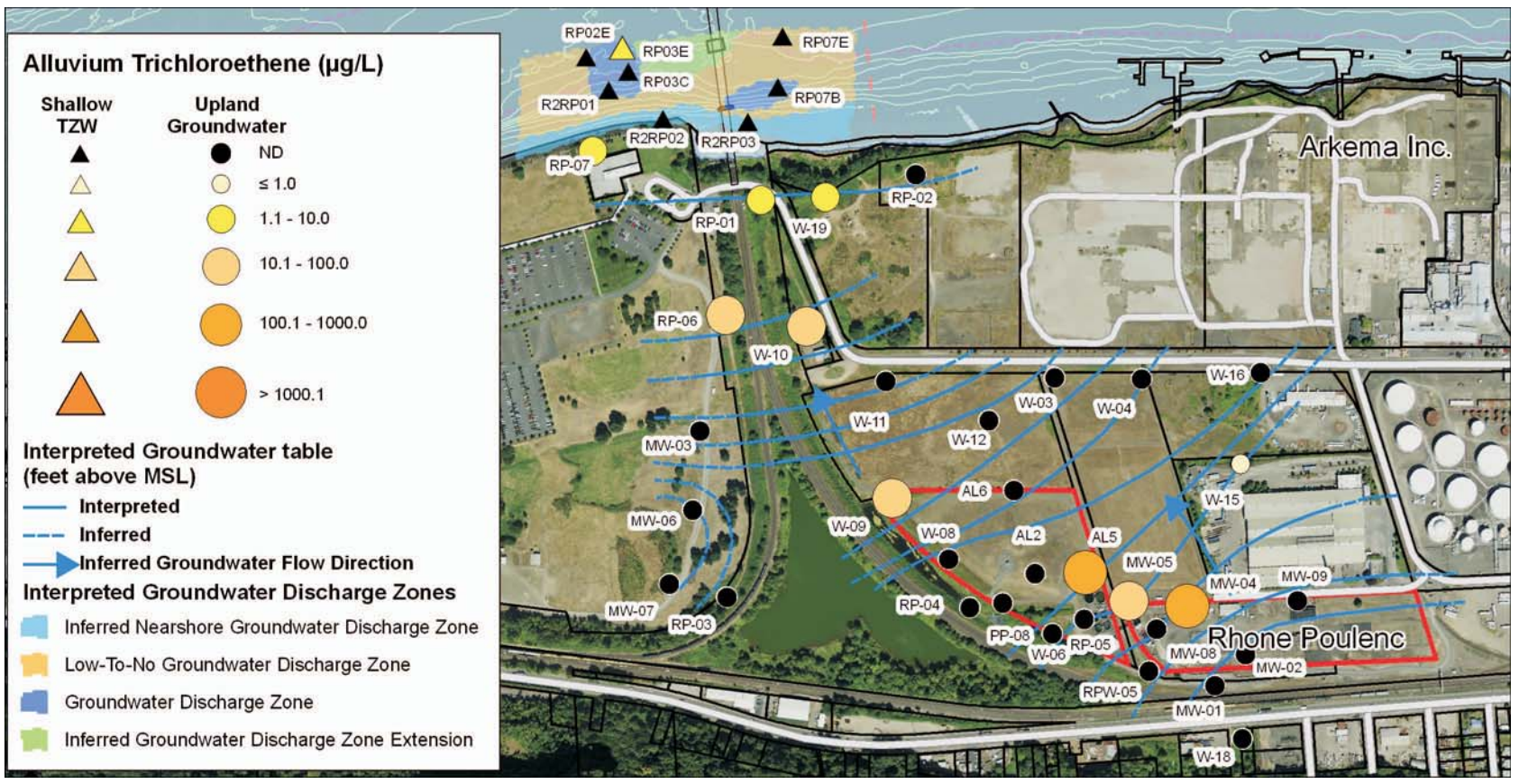
FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004)
Groundwater Contours: locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

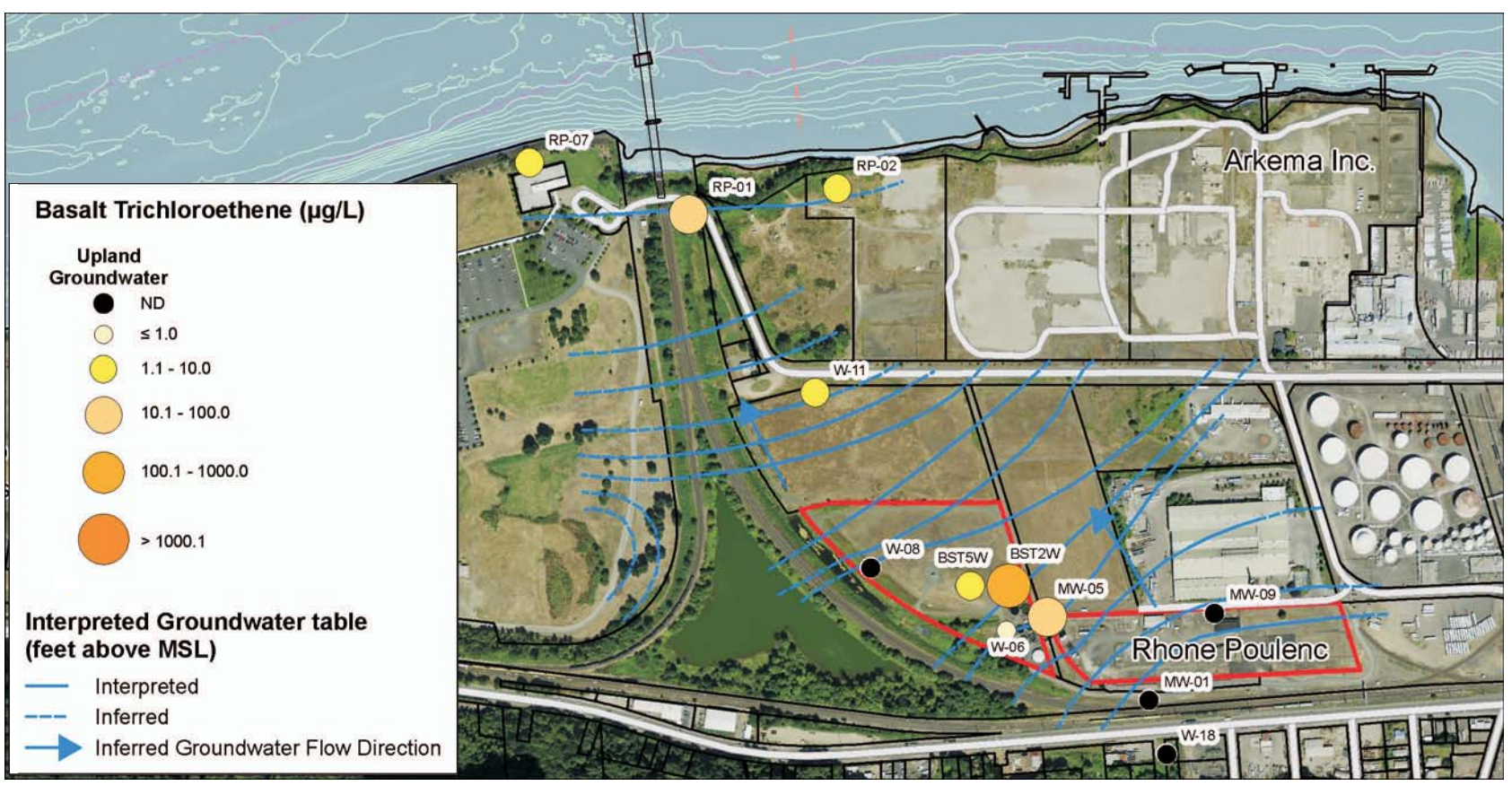
LEGEND
River Miles
2003 Bathymetric 5 Ft. Contours (NAVD88)
Site Property Boundary

0 150 300 Feet

Figure C3.6-2b
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
1,2-Dichlorobenzene in Upland Groundwater and Shallow TZW





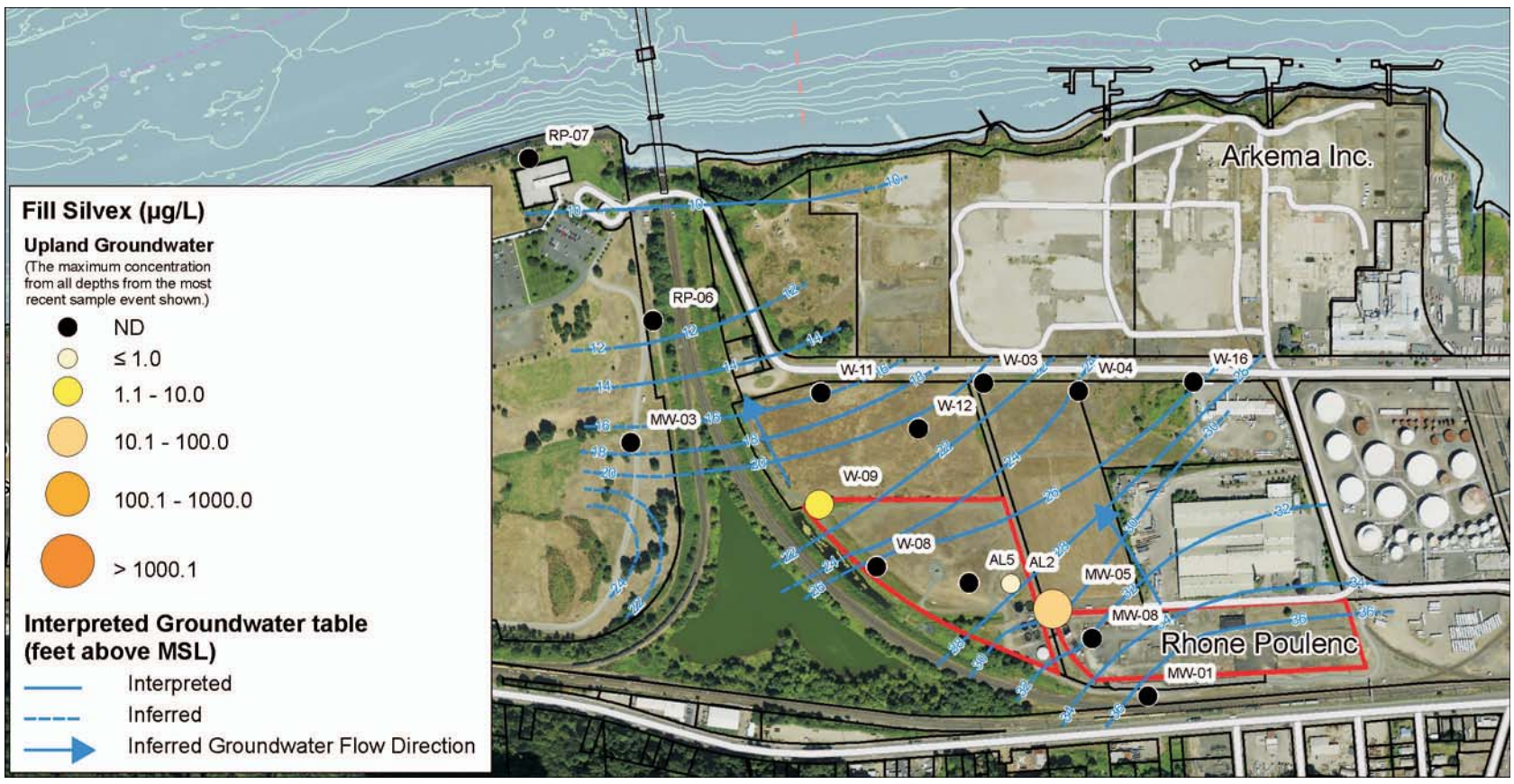


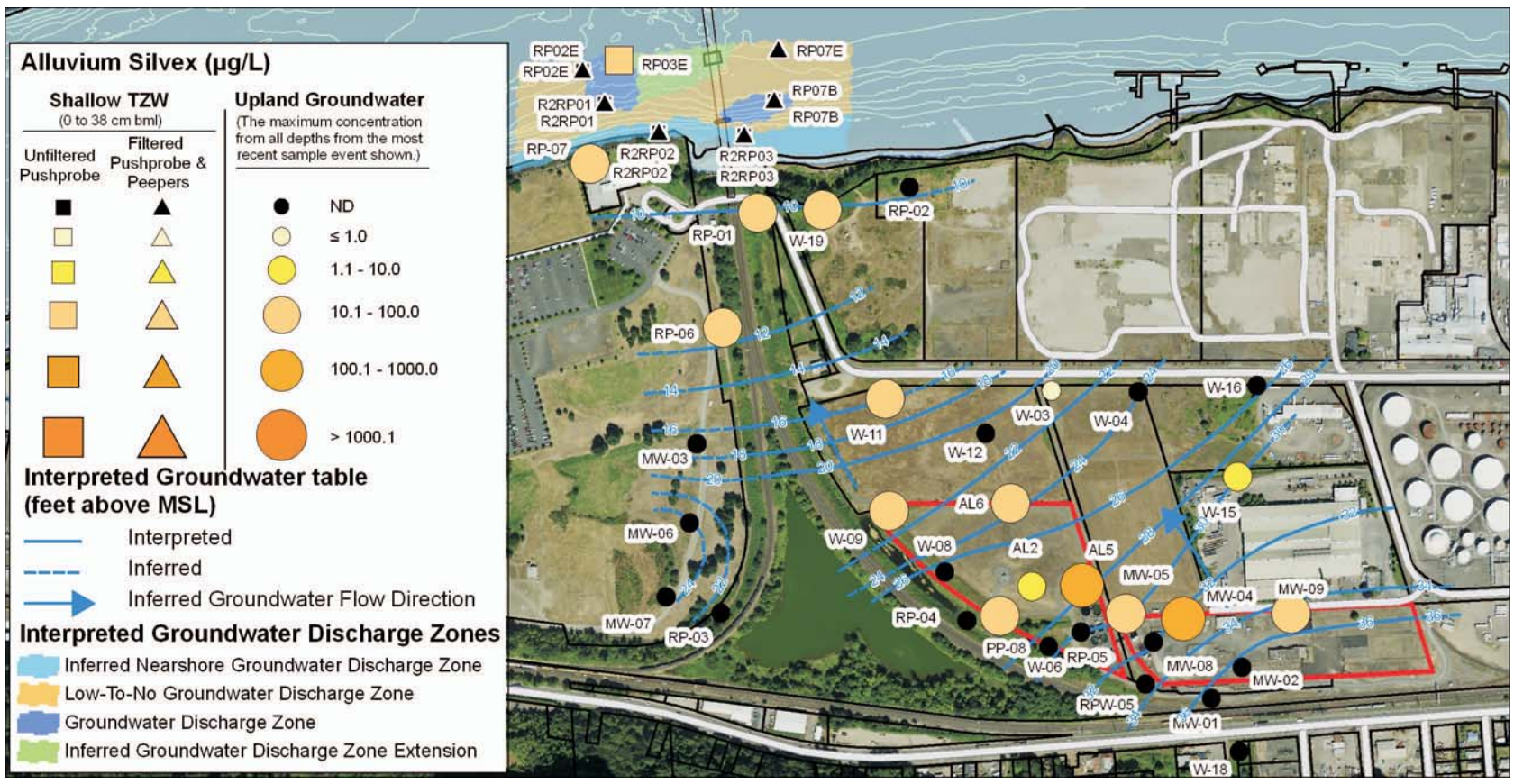
FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004)
Groundwater Contours: locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

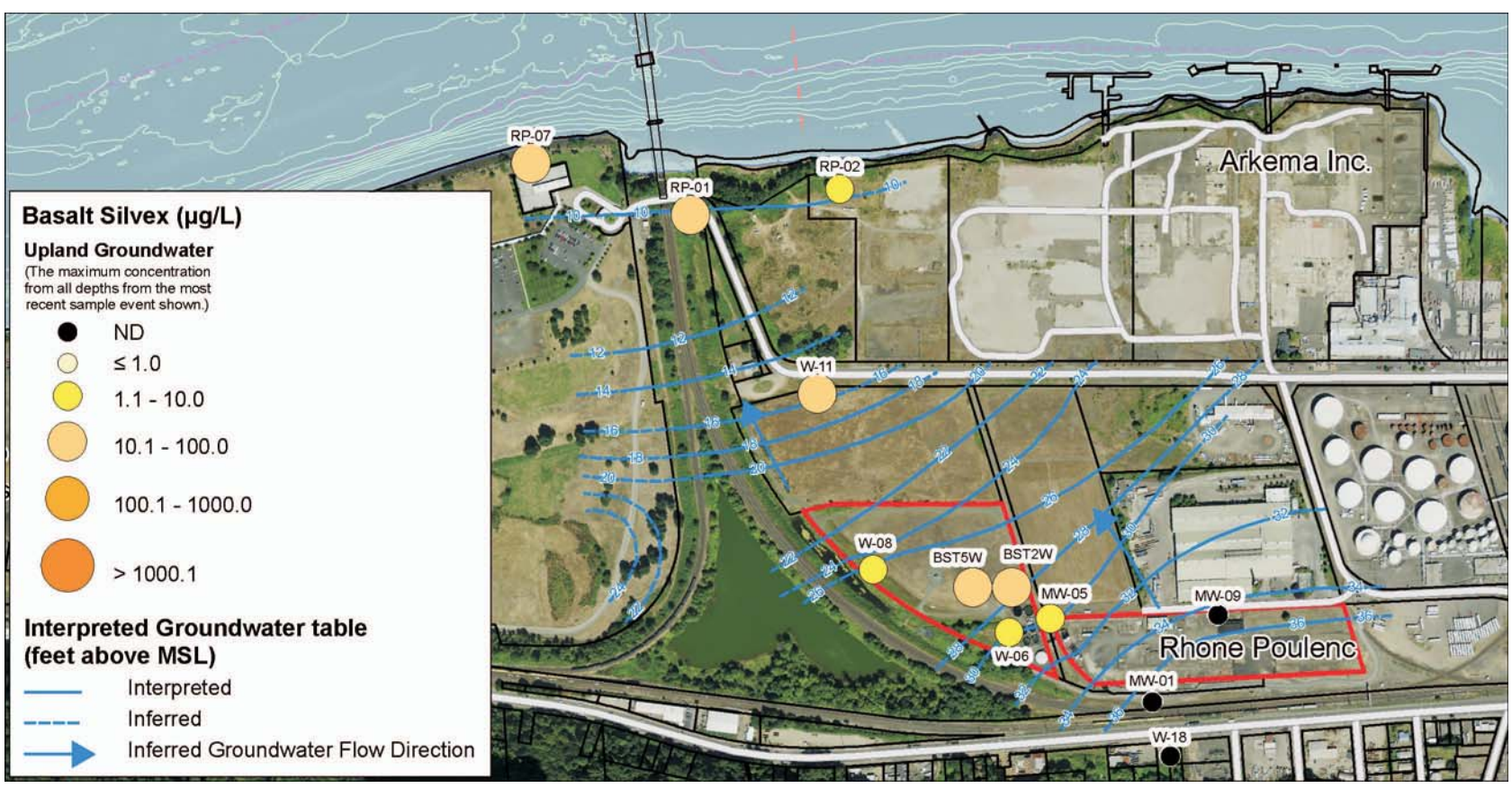
LEGEND
River Miles
2003 Bathymetric 5 Ft. Contours (NAVD88)
Site Property Boundary

0 150 300 Feet

Figure C3.6-2c
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Trichloroethene in Upland Groundwater and Shallow TZW





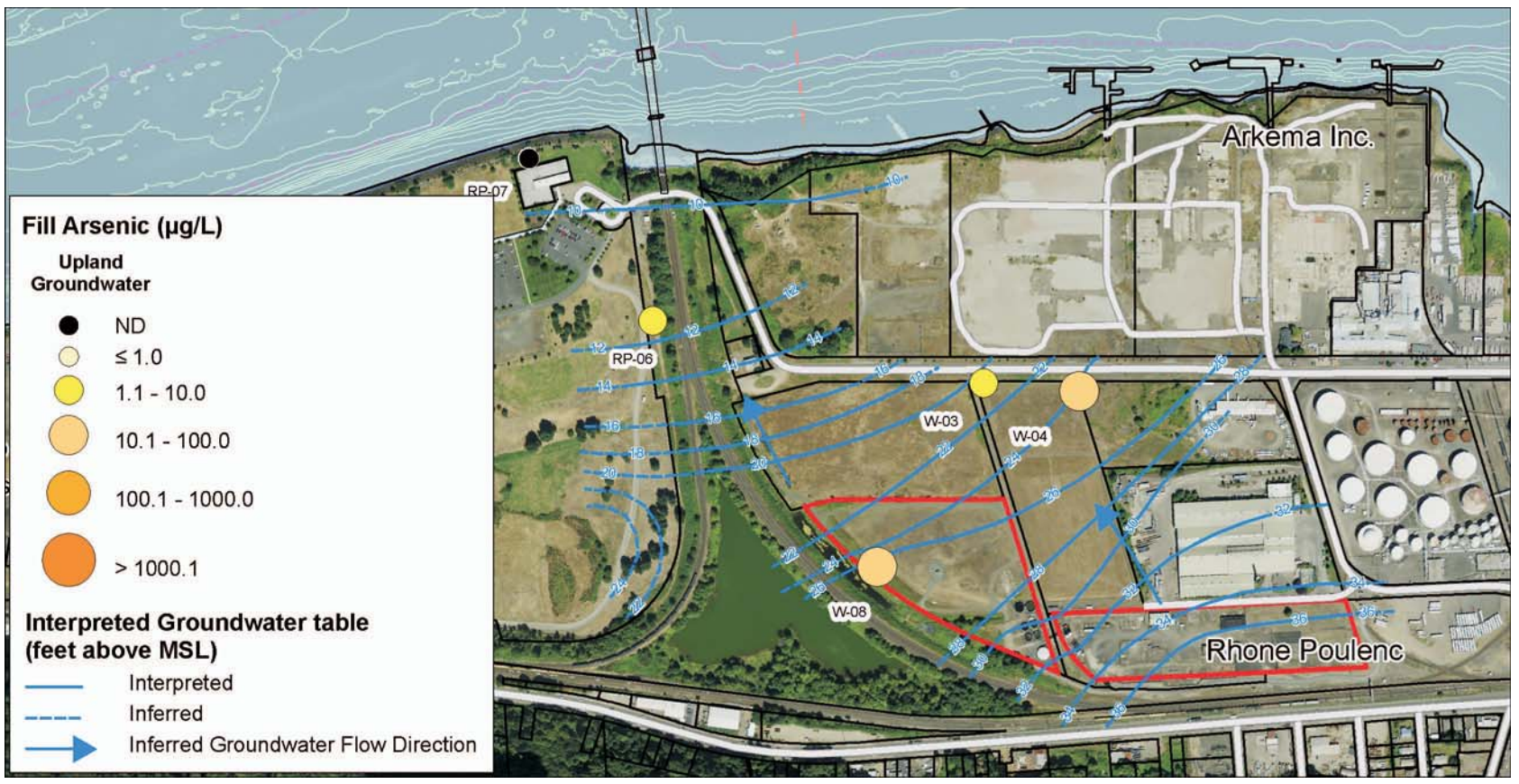


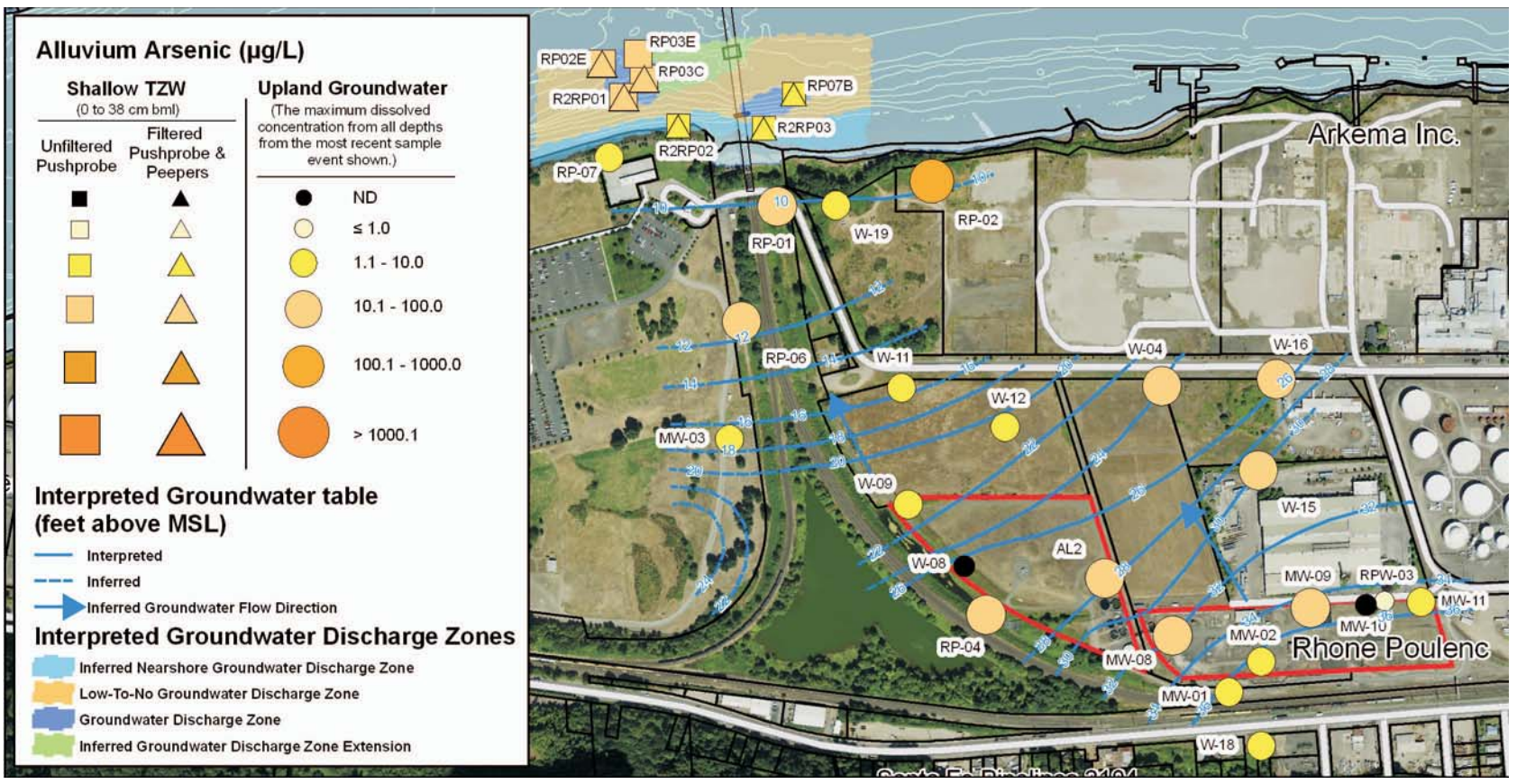
FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004)
Groundwater Contours: locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

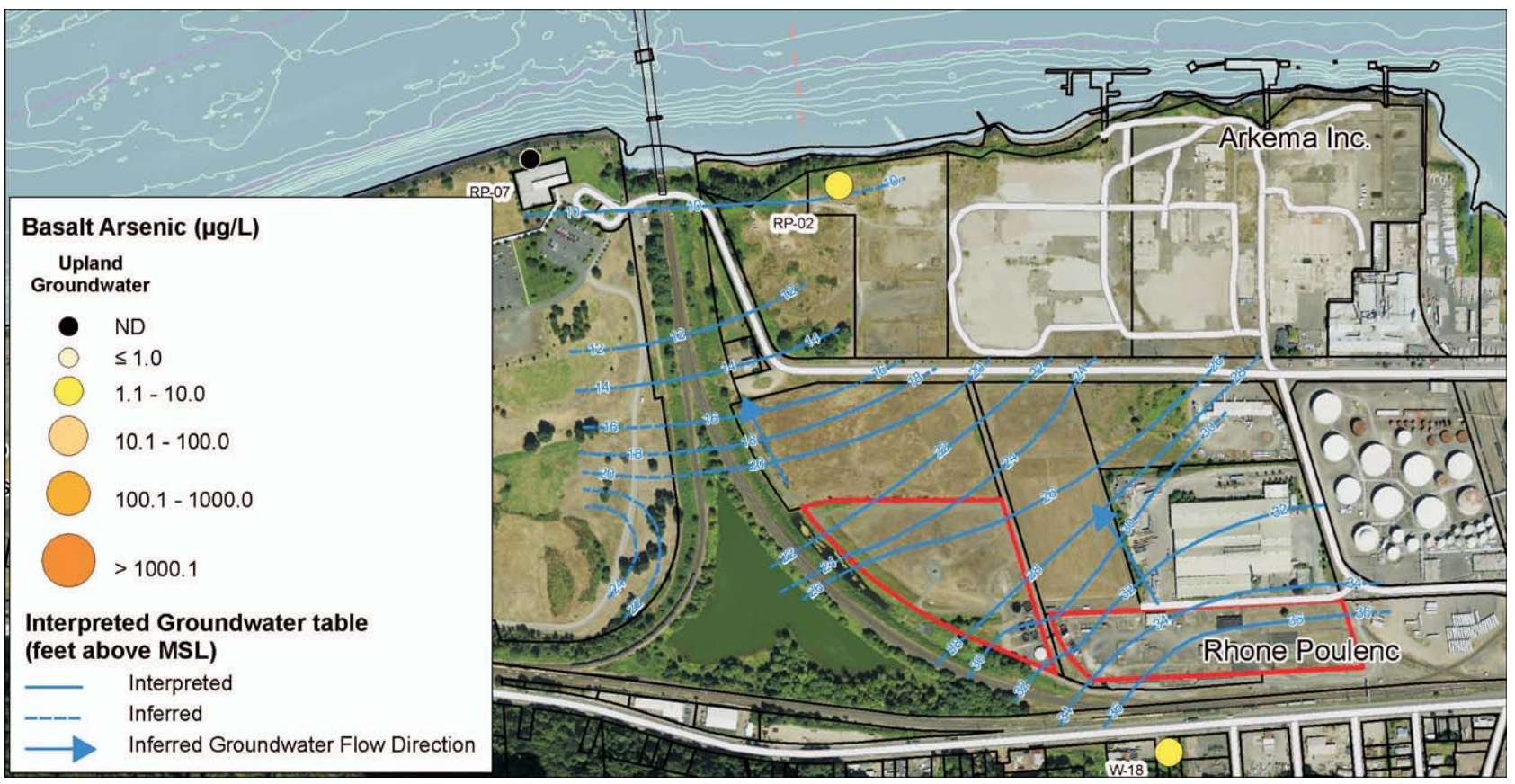
LEGEND
River Miles
2003 Bathymetric 5 Ft. Contours (NAVD88)
Site Property Boundary

0 150 300 Feet

Figure C3.6-2d
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Silvex in Upland Groundwater and Shallow TZW





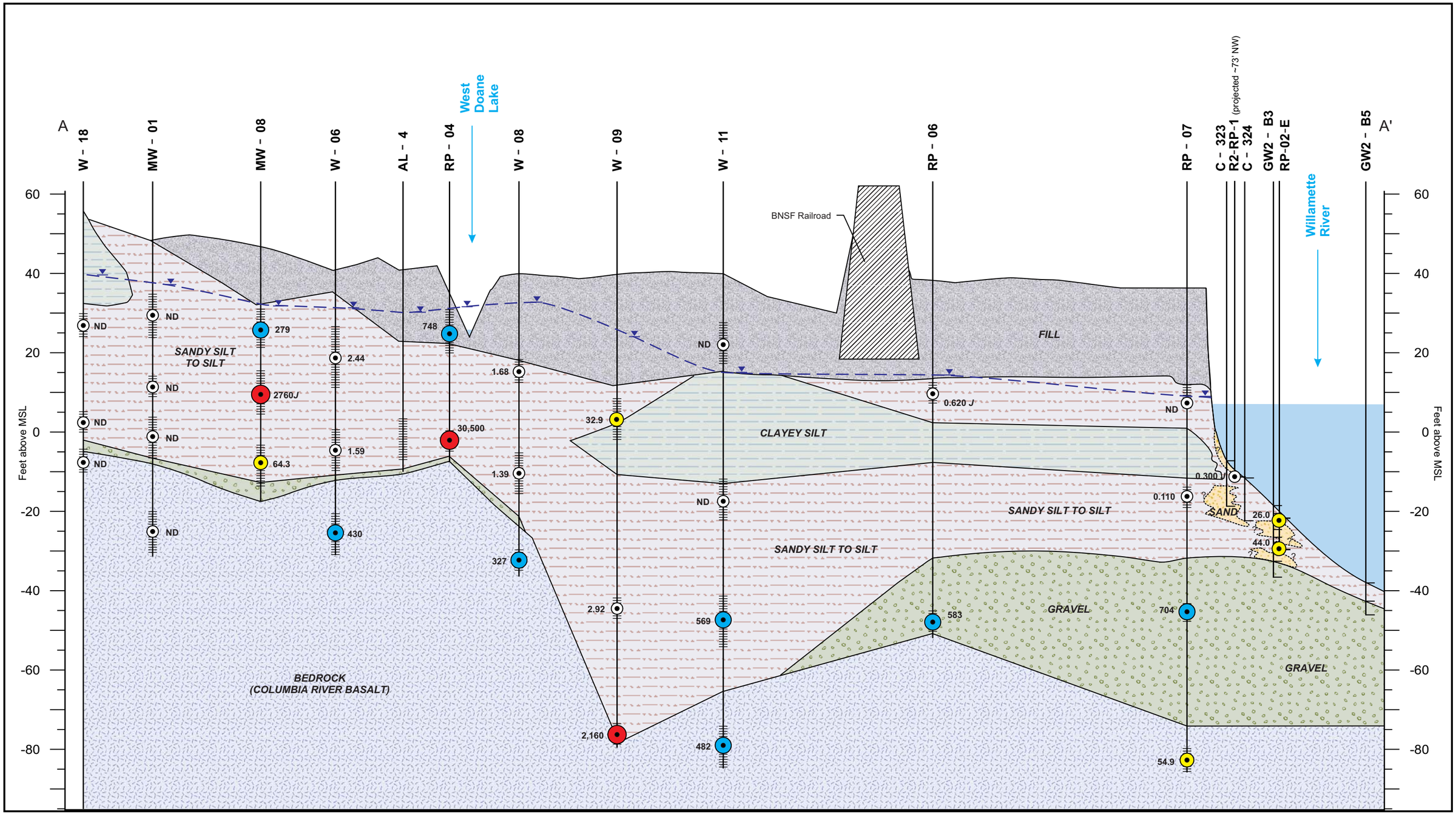


FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004)
Groundwater Contours: locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

LEGEND
River Miles
2003 Bathymetric 5 Ft. Contours (NAVD88)
Site Property Boundary

0 150 300 Feet

Figure C3.6-2e
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Arsenic in Upland Groundwater and Shallow TZW



Base features from AMEC, 2004.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

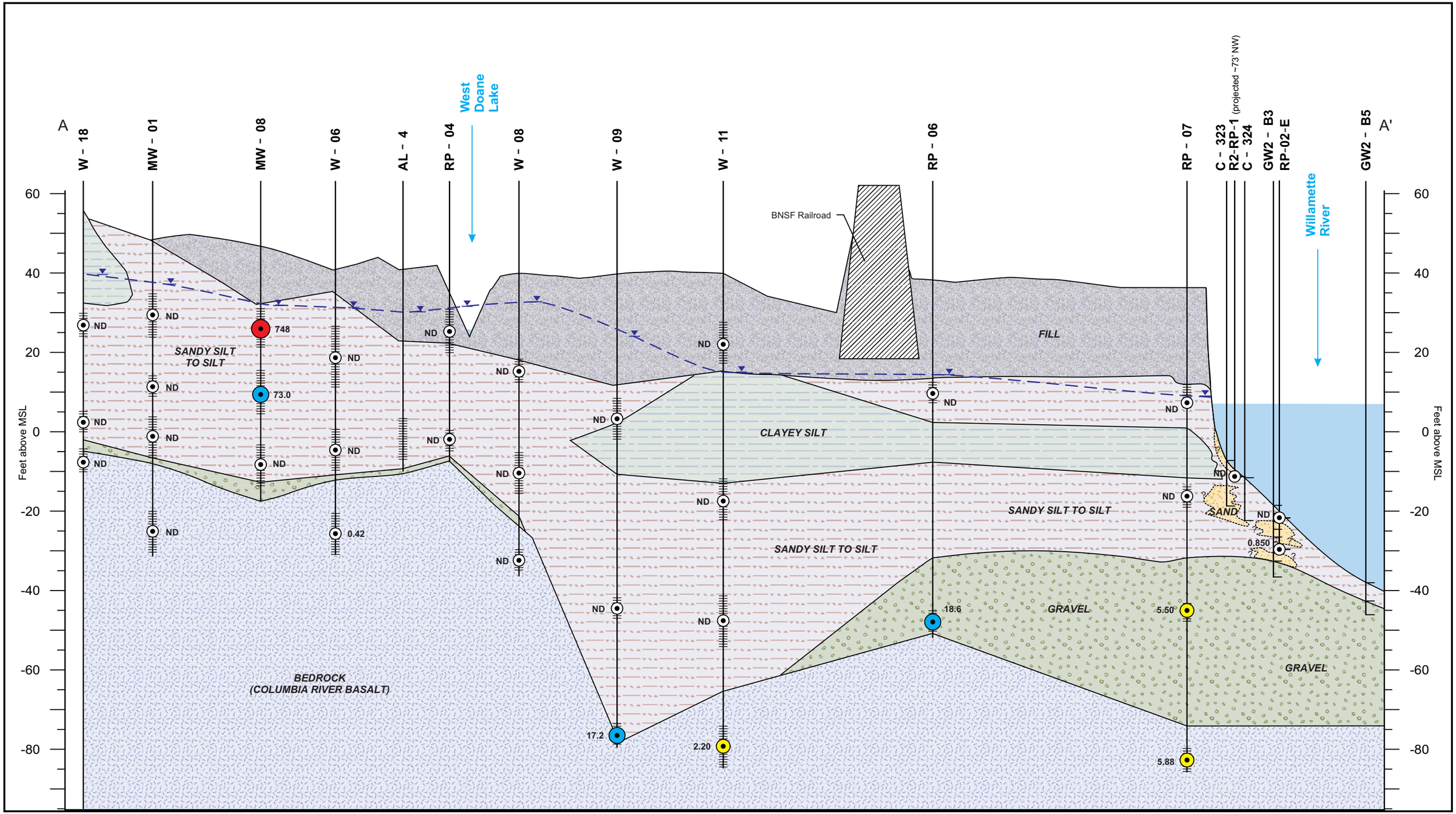
0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- ND - 10 µg/L
- 10 - 100 µg/L
- 100 - 1000 µg/L
- > 1000 µg/L

Approximate groundwater elevation
ND - Not Detected
J - Estimated
- Monitoring Well Screen

Figure C3.6-3a
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Stratigraphic Cross Section A-A' and Concentrations of 1,2-Dichlorobenzene in Nearshore Groundwater and Transition Zone Water



Base features from AMEC, 2004.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

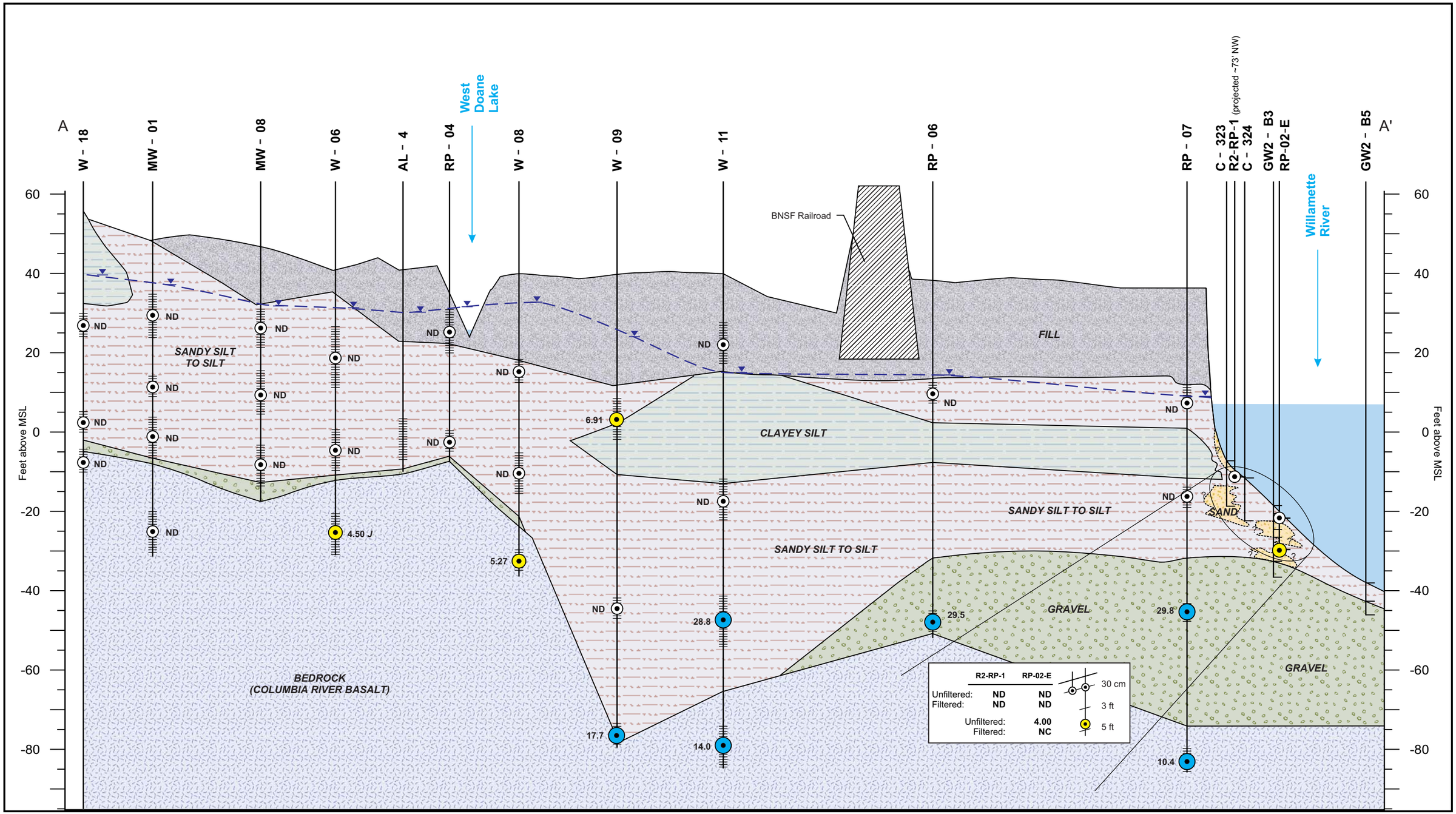
0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- ND - 1 µg/L
- 1 - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
ND - Not Detected
- Monitoring Well Screen

Figure C3.6-3b
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Stratigraphic Cross Section A-A' and Concentrations of Trichloroethene in Nearshore Groundwater and Transition Zone Water



Base features from AMEC, 2004.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

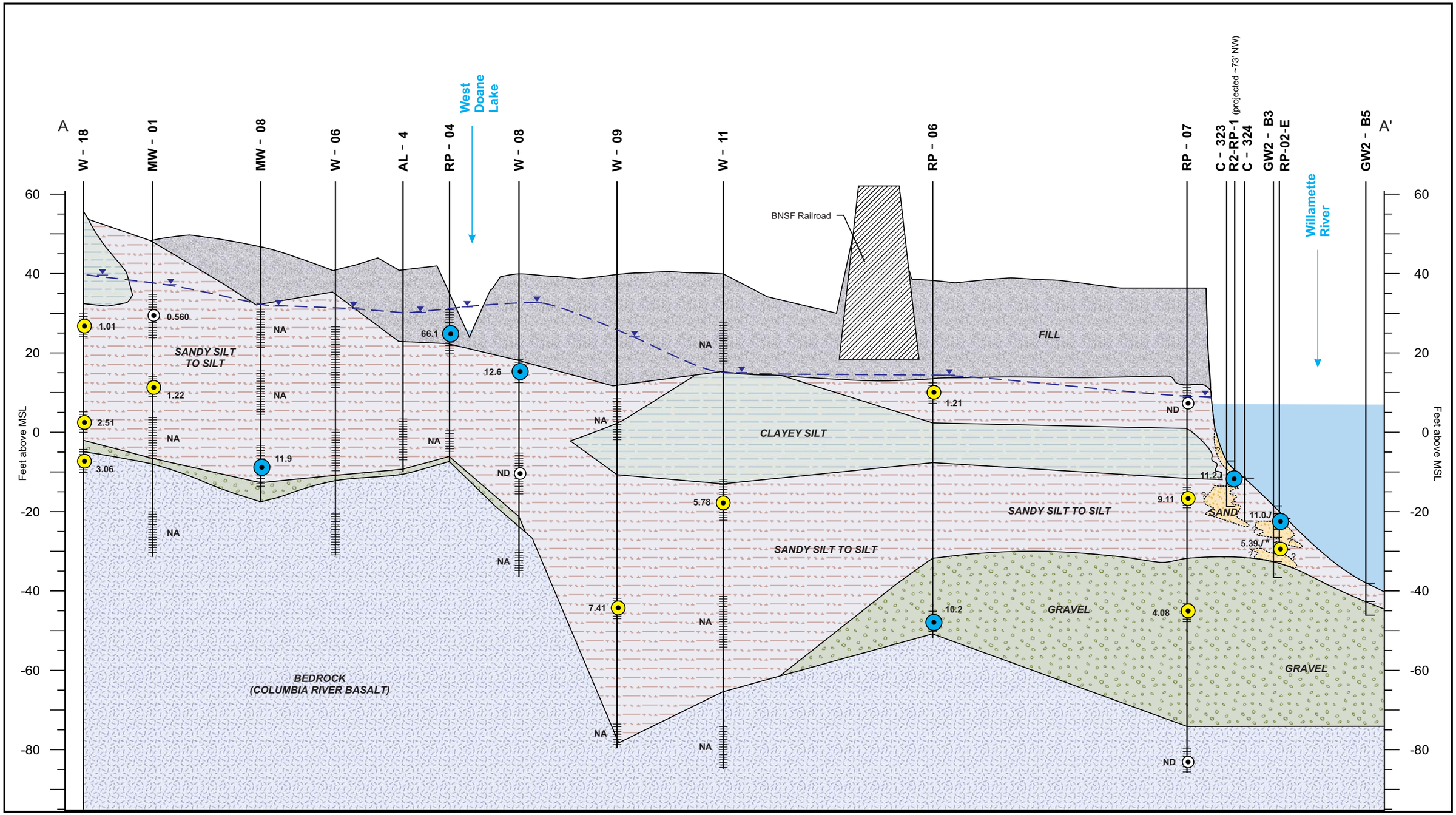
0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
J - Estimated
NC - Not Collected
- Monitoring Well Screen
Upland groundwater data assumed to be unfiltered.

Figure C3.6-3c
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Stratigraphic Cross Section A-A' and Concentrations of Silvex in Nearshore Groundwater and Transition Zone Water



Base features from AMEC, 2004.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

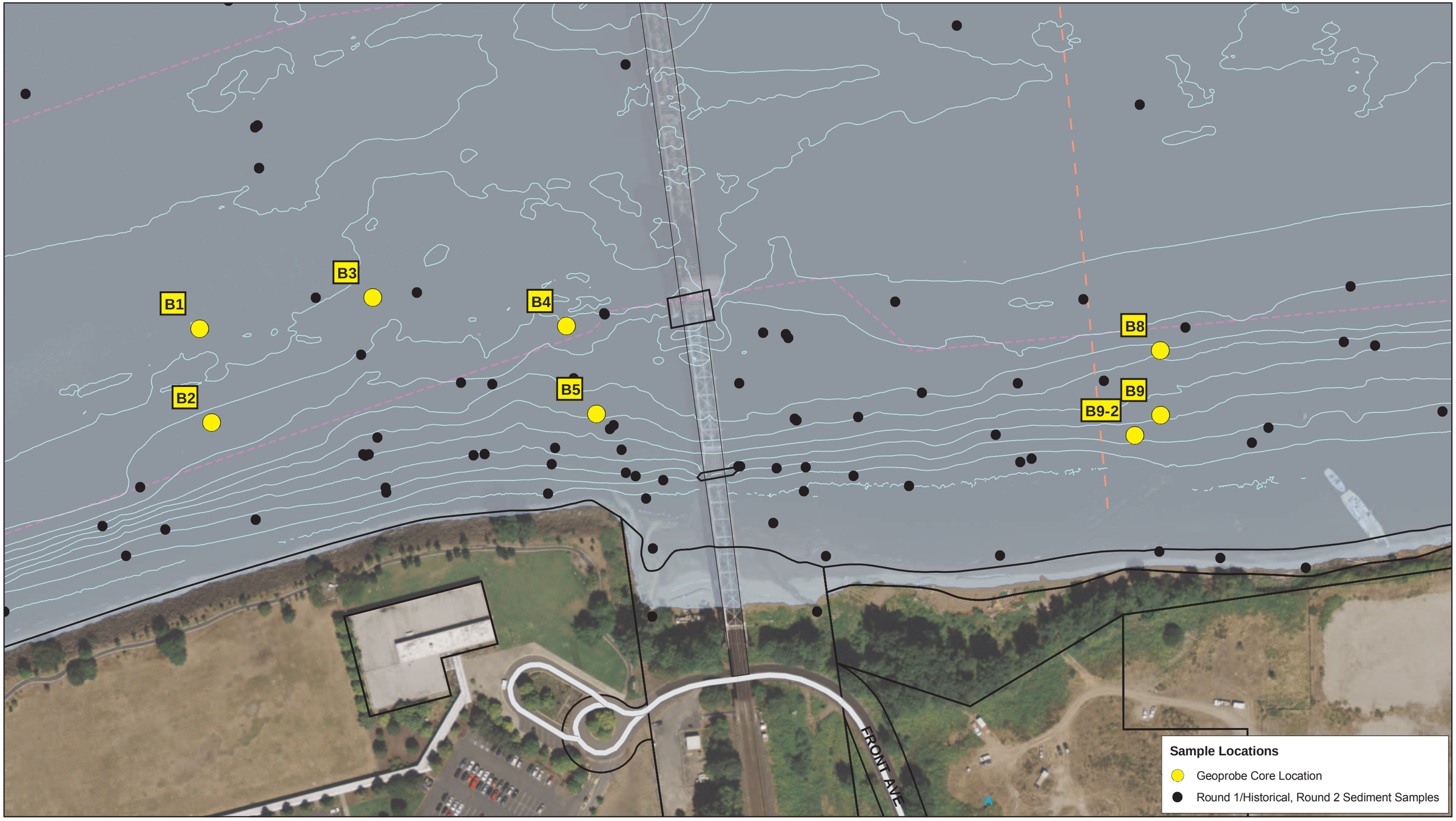
Sample Concentration Range:
- ND - 1 µg/L
- 1 - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation

ND - Not Detected
NA - Not Analyzed
J - Estimated
* - Total (Unfiltered) Data

- Monitoring Well Screen

Figure C3.6-3d
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Stratigraphic Cross Section A-A' and Concentrations of Dissolved Arsenic in Nearshore Groundwater and Transition Zone Water



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LEGEND

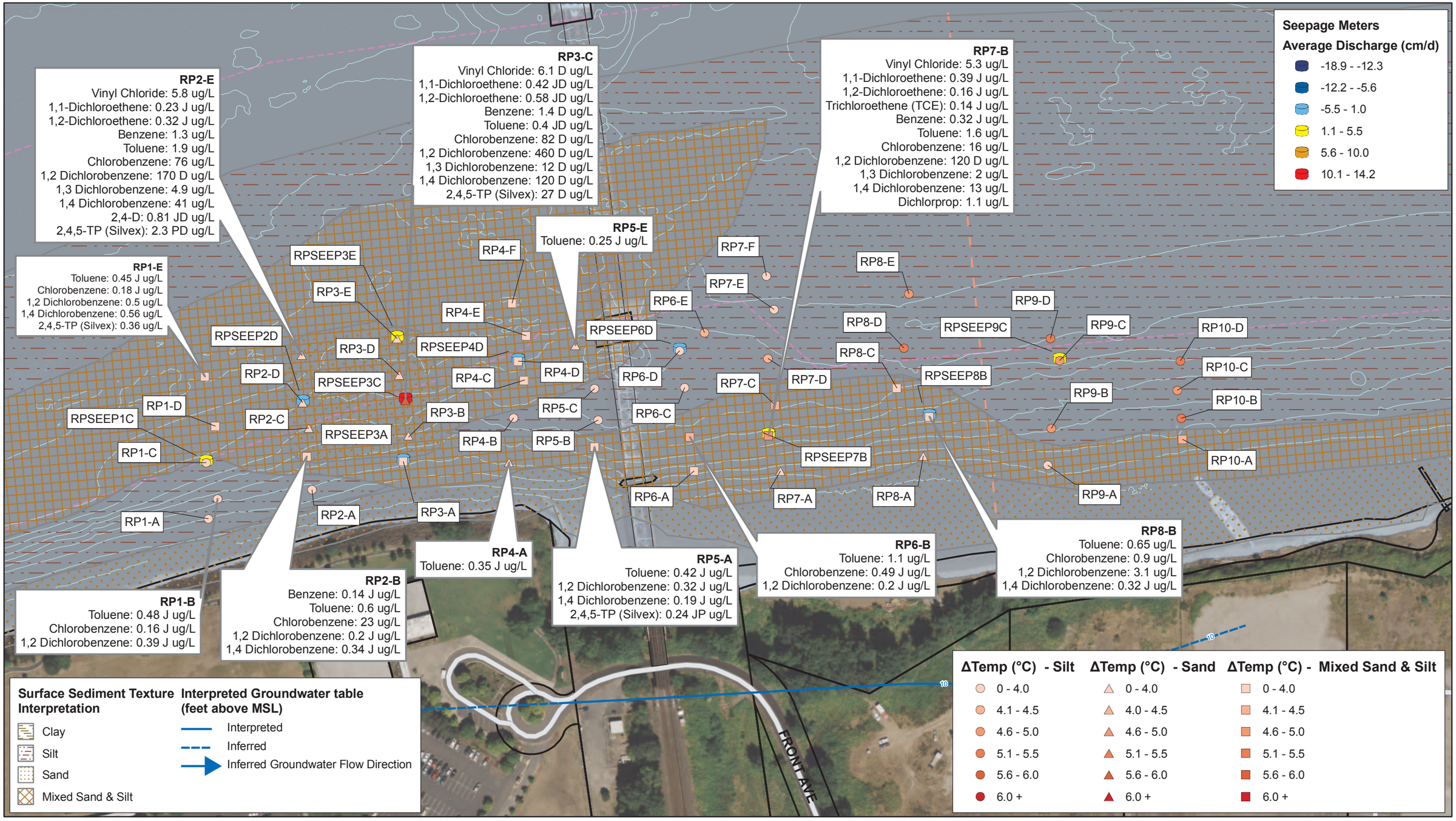
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: Locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004).
Groundwater Contours: Locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

Figure C3.6-4
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Locations of Round 2 GWPA Stratigraphic Cores



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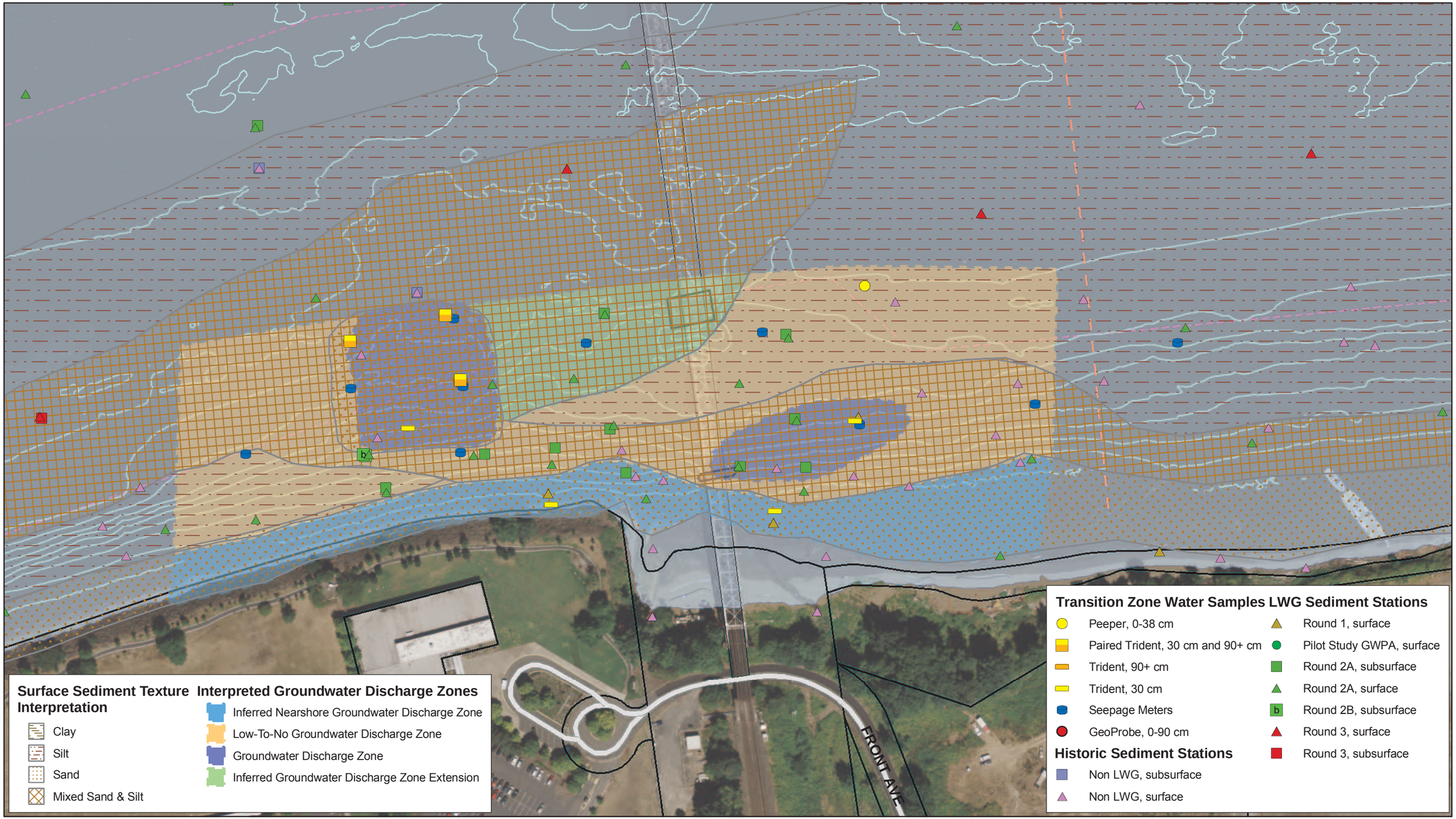
LEGEND

- River Miles
- Navigation Channel
- 2003 Bathymetric 5 Ft. Contours (NAVD88)

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: Locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004).
Groundwater Contours: Locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002), Elevations are relative to the City of Portland Datum.

Figure C3.6-5
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Trident Probe and Seepage Meter Results



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: Locations are approximate and drawn by measuring from Figure 2 (AMEC, July 2004).
Groundwater Contours: Locations are approximate and drawn by measuring from Figure 3-3 (AMEC, August 2002). Elevations are relative to the City of Portland Datum.

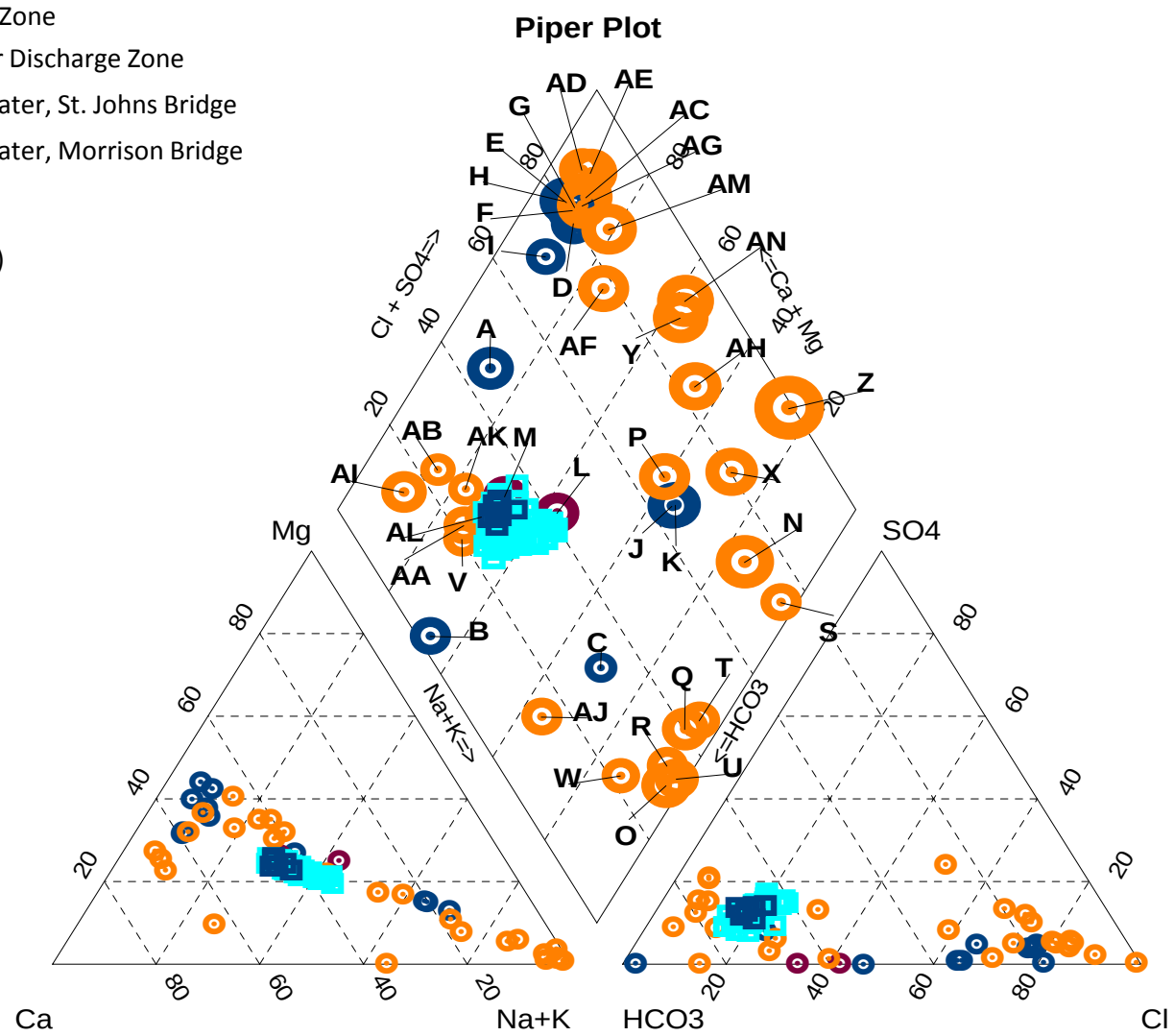
Figure C3.6-6
Portland Harbor RI/FS
Remedial Investigation Report
Rhone Poulenc Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Logarithimic Scale To TDS)

- 10 mg/L
- 1,000,000 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	R2-RP-01, Trident 30 cm	487	234	0.05	167	69.3	8.18	40.7	6.55	1006.23
B	Groundwater Discharge Zone	R2-RP-02, Trident 30 cm	346	5	0.05	54	22.1	4.47	49	6.75	480.62
C	Groundwater Discharge Zone	R2-RP-03, Trident 30 cm	57	11.3	5.2	6.35	2.95	1.77	29	7.28	113.57
D	Groundwater Discharge Zone	RP-02-E, Trident 150 cm	144	307	21.2	123	54.9	6.9	25.9	6.83	682.9
E	Groundwater Discharge Zone	RP-02-E, Trident 30 cm	272	638	2.8	262	119	7.8	35	6.8	1336.6
F	Groundwater Discharge Zone	RP-03-C, Trident 150 cm	390	865	56.7	436	144	12.7	70.3	6.78	1974.7
G	Groundwater Discharge Zone	RP-03-C, Trident 30 cm	376	870	73.5	446	144	13.3	71.8	6.81	1994.6
H	Groundwater Discharge Zone	RP-03-E, Trident 30 cm	358	780	51.8	332	180	13	43.1	6.76	1757.9
I	Groundwater Discharge Zone	RP-03-E, Trident 90 cm	82	103	10.2	93.6	50.1	5.17	18.3	7.02	362.37
J	Groundwater Discharge Zone	RP-07-B, Trident 30 cm	463	476	7.7	93.1	41.5	8.34	326	6.92	1415.64
K	Groundwater Discharge Zone	RP-07-B, Trident 30 cm; FR	468	498	7.7	95.3	43	10.4	343	6.97	1465.4
L	Low-to-No Groundwater Discharge Zone	RP-07-E, Peeper 0 - 38 cm	330	134	0.16	63.4	29.7	1.78	95.4	7.42	654.44
M	Low-to-No Groundwater Discharge Zone	RP-07-E, Peeper 0 - 38 cm; FR	360	103	0.6	79.5	29.5	2.205	63.9	7.25	638.705
N	Upland Groundwater	AL2-32	1480	1780	54.8	147	52.6	11.3	1500		5025.7
O	Upland Groundwater	AL2-46	750	136	22.1	8.41	2.75	2.17	443		1364.43
P	Upland Groundwater	AL6-96	612	517	98.8	141	59.9	12.2	391		1831.9
Q	Upland Groundwater	BST2W-61	560	175	7.86	13.2	4.86	3.32	355		1119.24
R	Upland Groundwater	MW-05-24	247	45.9	14.6	5.88	0.87	0.765	147		462.015
S	Upland Groundwater	MW-05-34	112	104	67.3	2.83	1.59	1.17	187		475.89
T	Upland Groundwater	MW-05-52	230	60.9	35	1.39	3.06	0.488	150		480.838
U	Upland Groundwater	MW-05-70	276	41.7	30.2	1.59	0.751	2.04	159		511.281
V	Upland Groundwater	MW-10-24	154	7.14	15.7	32.4	14.2	1.56	23.5		248.5
W	Upland Groundwater	RP-01-31	153	6.35	19.7	5.76	2.79	2.28	76.7		266.58
X	Upland Groundwater	RP-01-51	525	853	232	140	51.1	13.9	635		2450
Y	Upland Groundwater	RP-01-65	414	1530	144	363	130	18.6	488		3087.6
Z	Upland Groundwater	RP-02-66	252	15500	60	1550	426	73.7	7650		25511.7
AA	Upland Groundwater	RP-04-16	286	23.8	20.9	91.6	8.39	2.89	41.5		475.08
AB	Upland Groundwater	RP-04-41	133	7.39	17.2	29.9	16.4	1.85	10		215.74
AC	Upland Groundwater	RP-06-87	438	1160	109	524	175	13.9	97		2516.9
AD	Upland Groundwater	RP-07-119	150	508	33.5	249	61.9	10.4	20		1032.8
AE	Upland Groundwater	RP-07-84	272	1030	87.1	490	114	15.8	59.5		2068.4
AF	Upland Groundwater	W-09-116	486	761	70.2	235	124	15.1	155		1846.3
AG	Upland Groundwater	W-11-B	328	715	133	411	83.9	11.5	67		1749.4
AH	Upland Groundwater	W-11-D	439	917	210	219	80.2	11.4	468		2344.6
AI	Upland Groundwater	W-11-I	517	42.6	0.37	124	52	6.37	25.1		767.44
AJ	Upland Groundwater	W-11-S	246	7.24	16.5	40	0.0171	12.5	75.8		398.0571
AK	Upland Groundwater	W-18-D	106	4.22	19.7	24.4	12.1	2.61	13		182.03
AL	Upland Groundwater	W-18-I	87	3.6	15.7	19.1	9.42	2.31	14.6		151.73
AM	Upland Groundwater	W-19-D	449	1250	106	448	185	16.8	186		2640.8
AN	Upland Groundwater	W-19-I	373	2040	65.9	479	178	21.2	625		3782.1

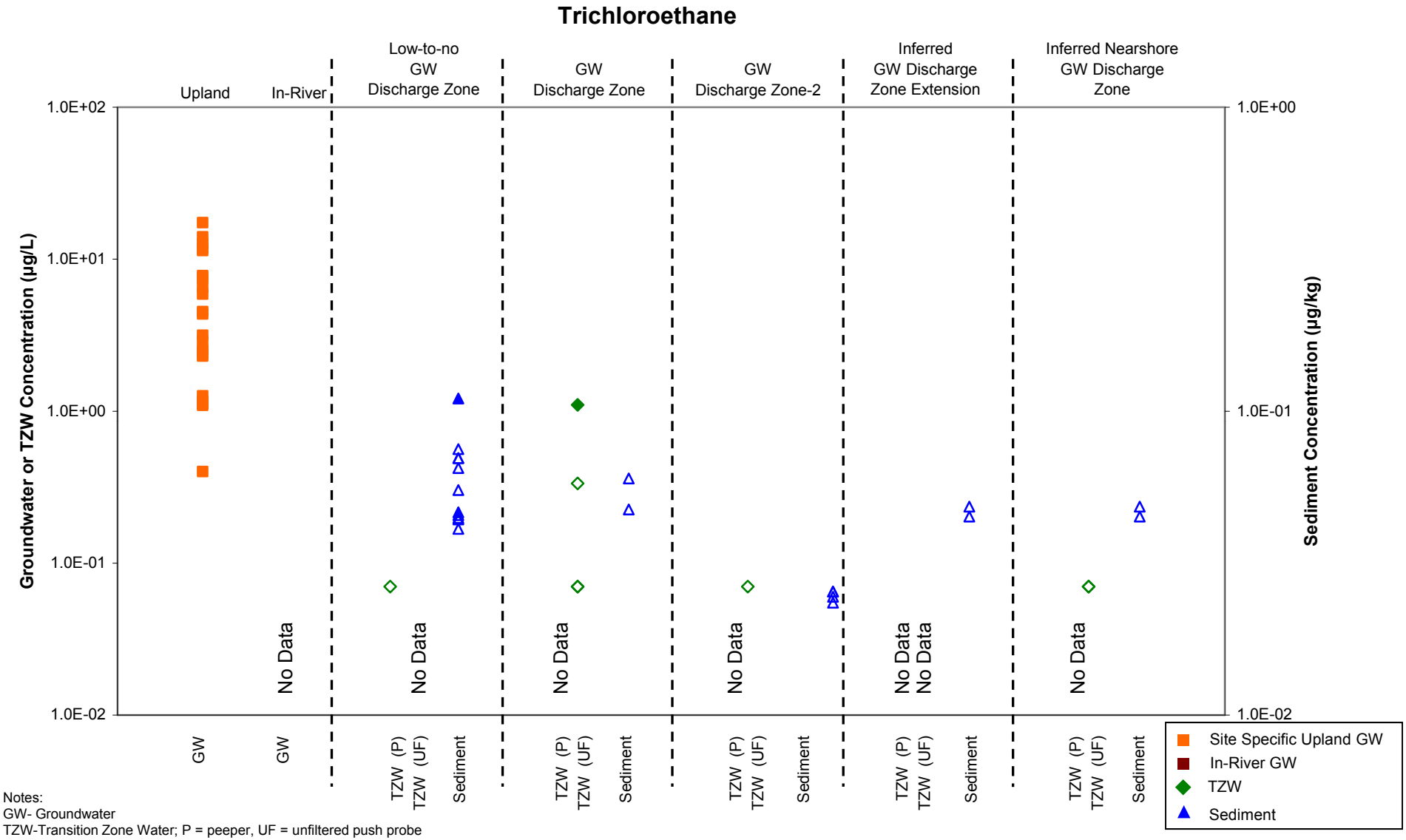
Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

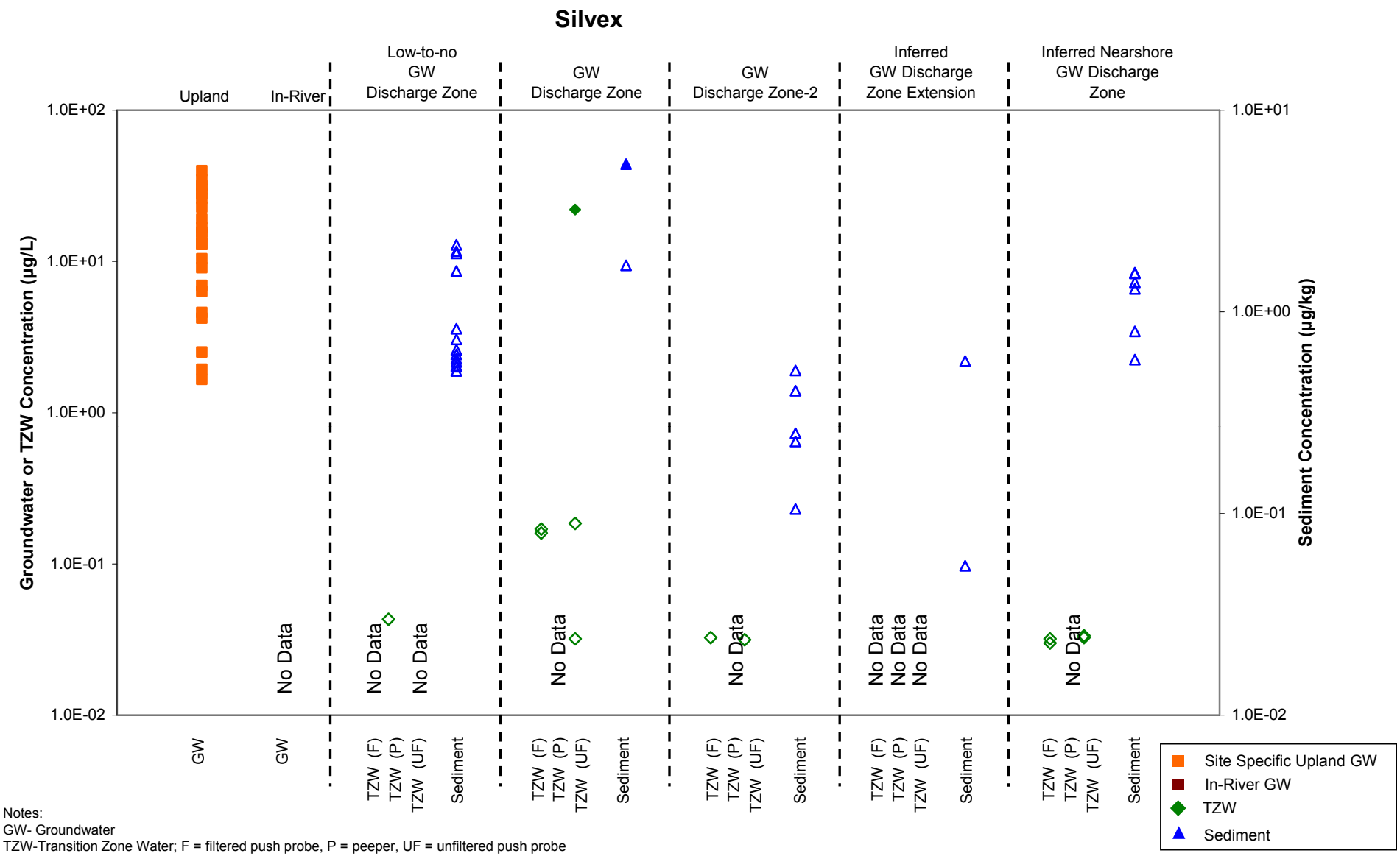
All concentrations as mg/L; pH in s.u.

Figure C3.6-7
Portland Harbor RI/FS
Draft Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Rhone Poulenc



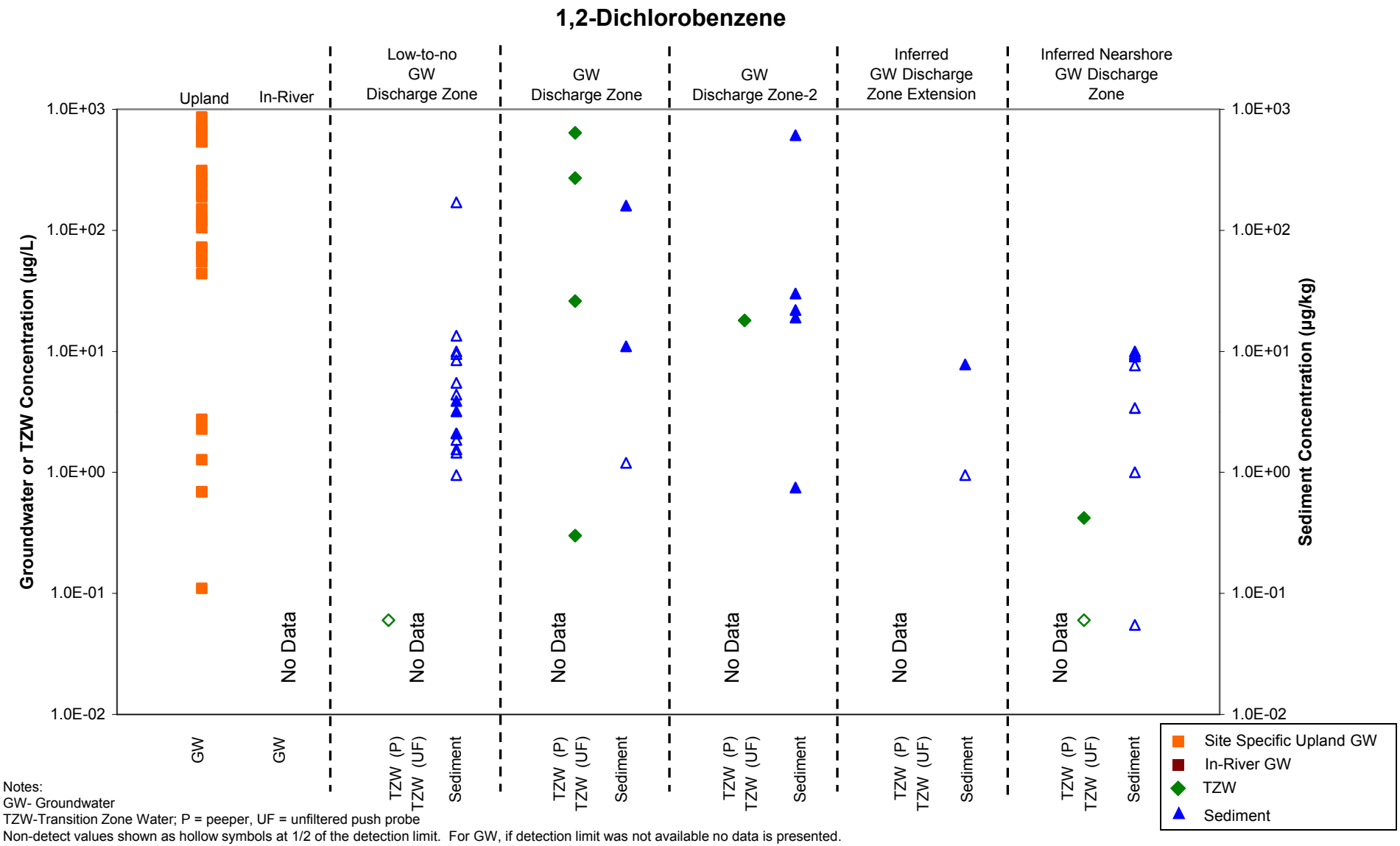
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: RP-02-66, RP-07-119, RP-07-30, RP-01-31, RP-01-51, RP-02-31, RP-02-49, RP-07-55, W-19-I, W-19-S, W-19-D, RP-02-66, RP-01-65, RP-01-119.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.6-8a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Trichloroethene - Rhone Poulenc



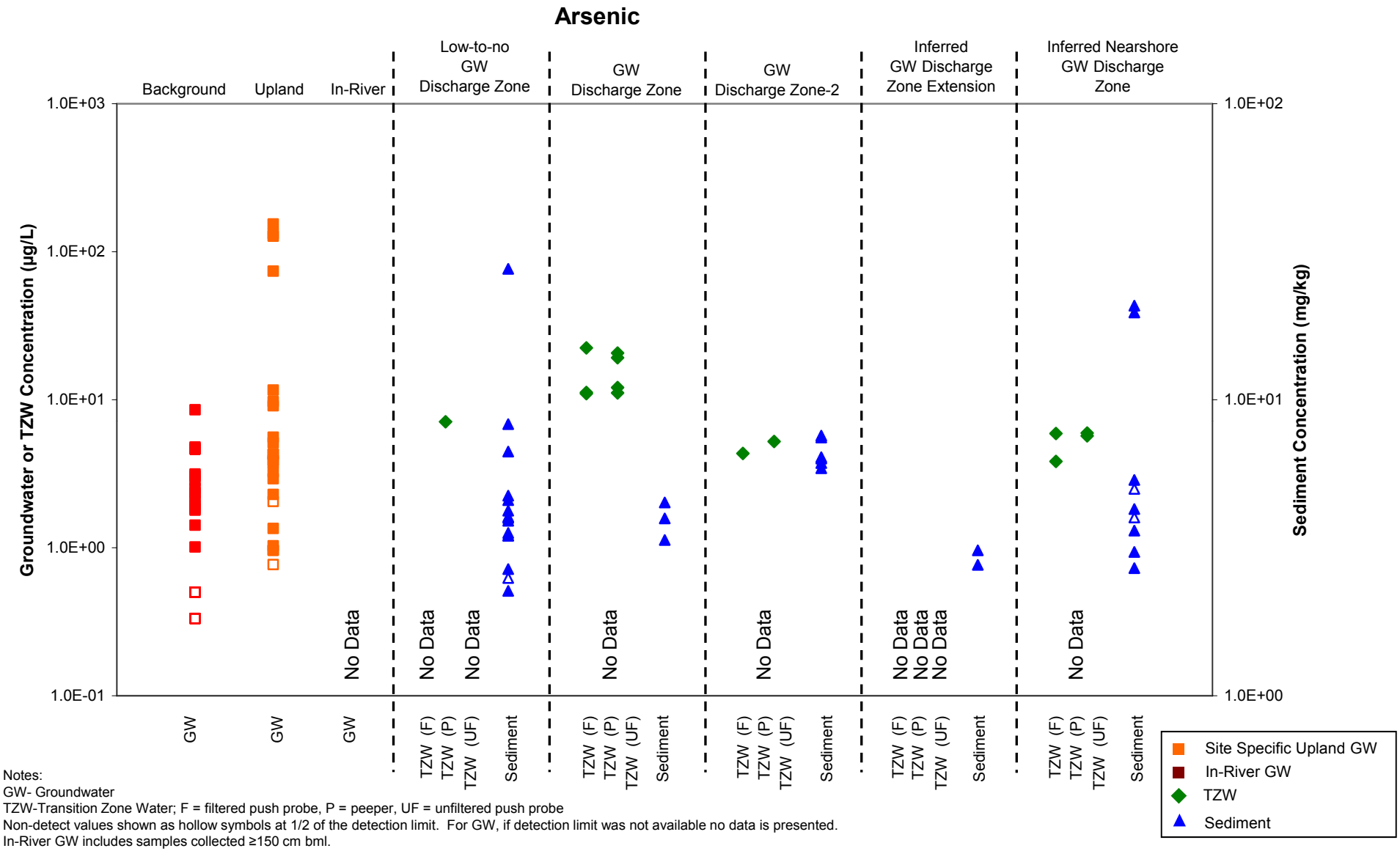
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: RP-02-66, RP-07-119, RP-07-30, RP-01-31, RP-01-51, RP-02-31, RP-02-49, RP-07-55, W-19-I, W-19-S, W-19-D, RP-02-66, RP-01-65, RP-01-119.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.6-8b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Silvex - Rhone Poulenc



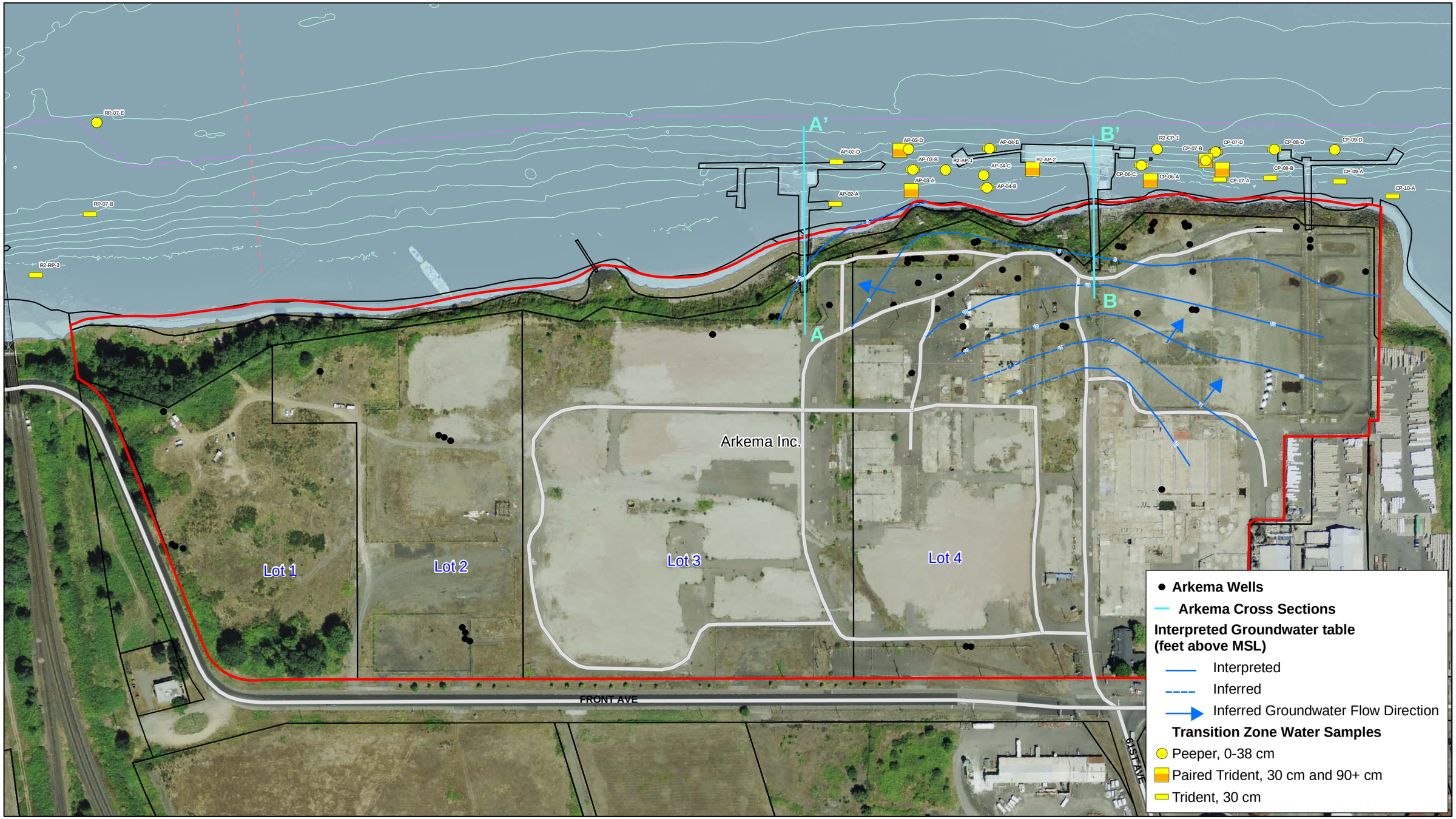
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: RP-02-66, RP-07-119, RP-07-30, RP-01-31, RP-01-51, RP-02-31, RP-02-49, RP-07-55, W-19-I, W-19-S, W-19-D, RP-02-66, RP-01-65, RP-01-119.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.6-8c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
1,2-Dichlorobenzene - Rhone Poulenc



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: RP-02-66, RP-07-119, RP-07-30, RP-01-31, RP-01-51, RP-02-31, RP-02-49, RP-07-55, W-19-I, W-19-S, W-19-D, RP-02-66, RP-01-65, RP-01-119.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.6-8d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Dissolved Arsenic - Rhone Poulenc



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LEGEND

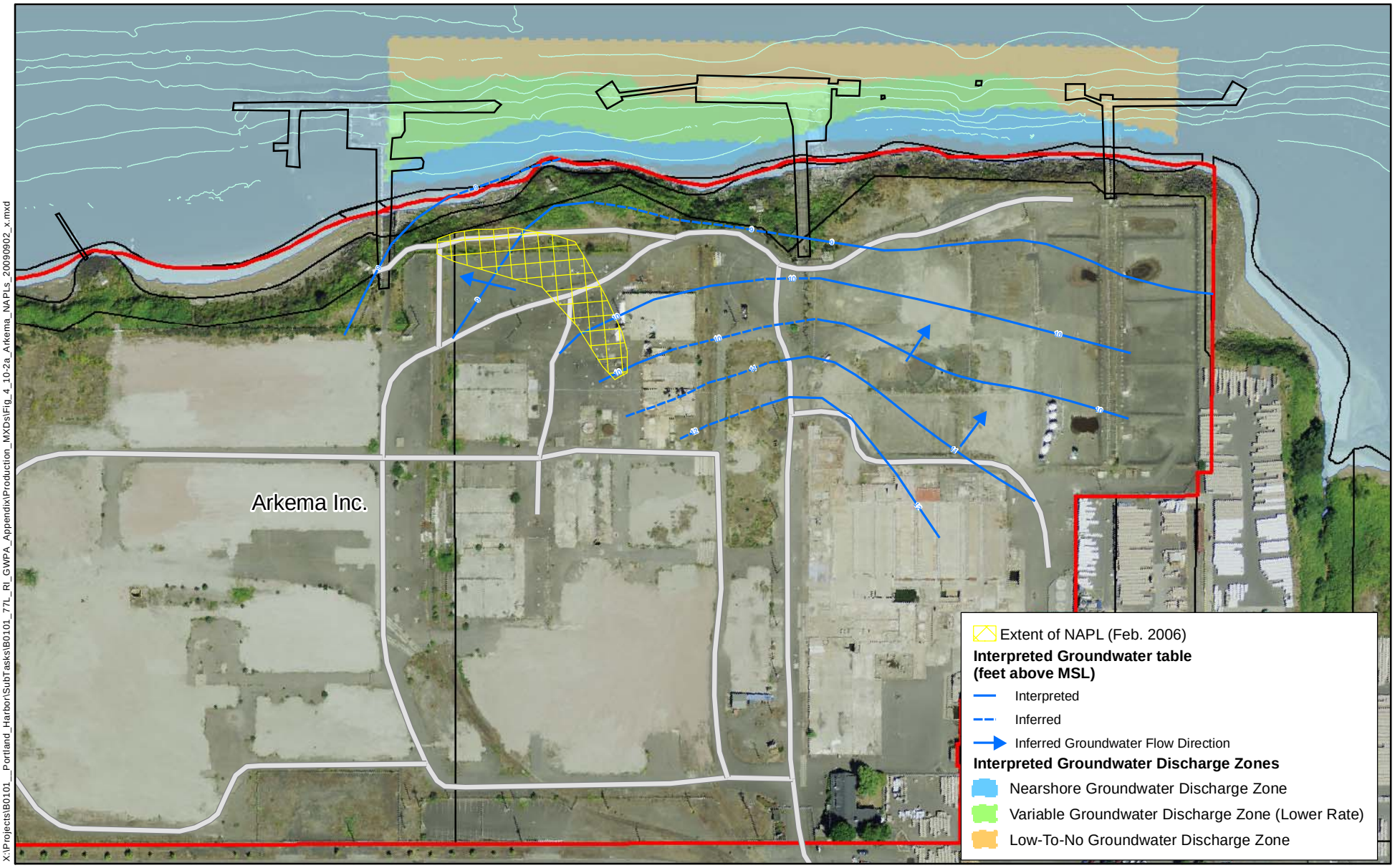
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up
digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours & Wells: locations are approximate and drawn
from ERM. 2004a. Upland Remedial Investigation Report,
Lots 3 &4 and Tract A, ATOFINA Chemicals Facility, Portland, OR.
Prepared for ATOFINA Chemicals, Inc., Portland, OR.
ERM-West, Inc., Bellevue, WA

Figure C3.7-1
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Overview and Cross Section Location



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100 Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from ERM. 2004a. Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. Prepared for ATOFINA Chemicals, Inc., Portland, OR. ERM-West, Inc., Bellvue, WA.

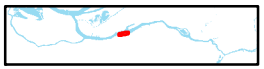
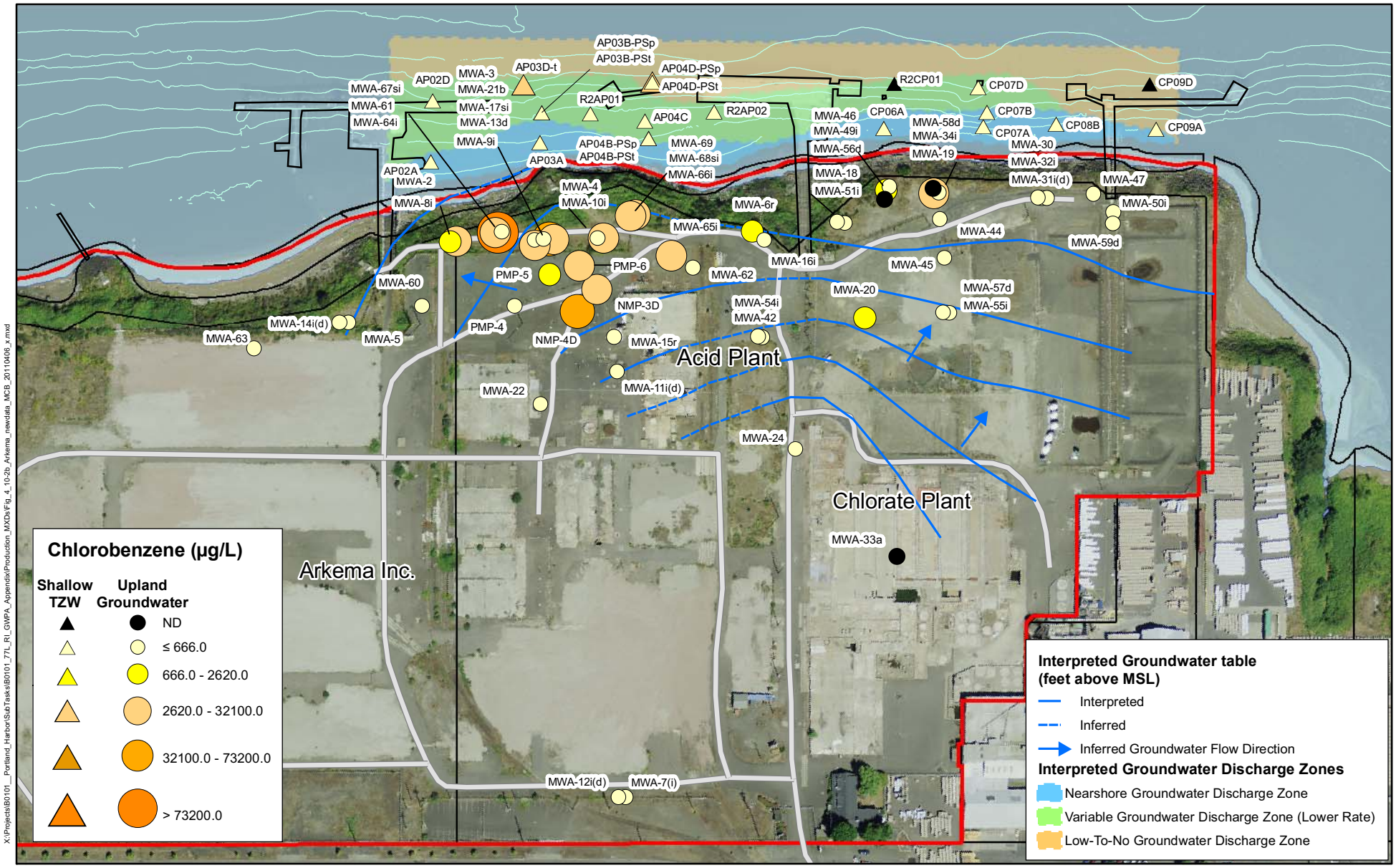


Figure C3.7-2a
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Distribution of NAPL in Upland Groundwater



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LEGEND

River Miles

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

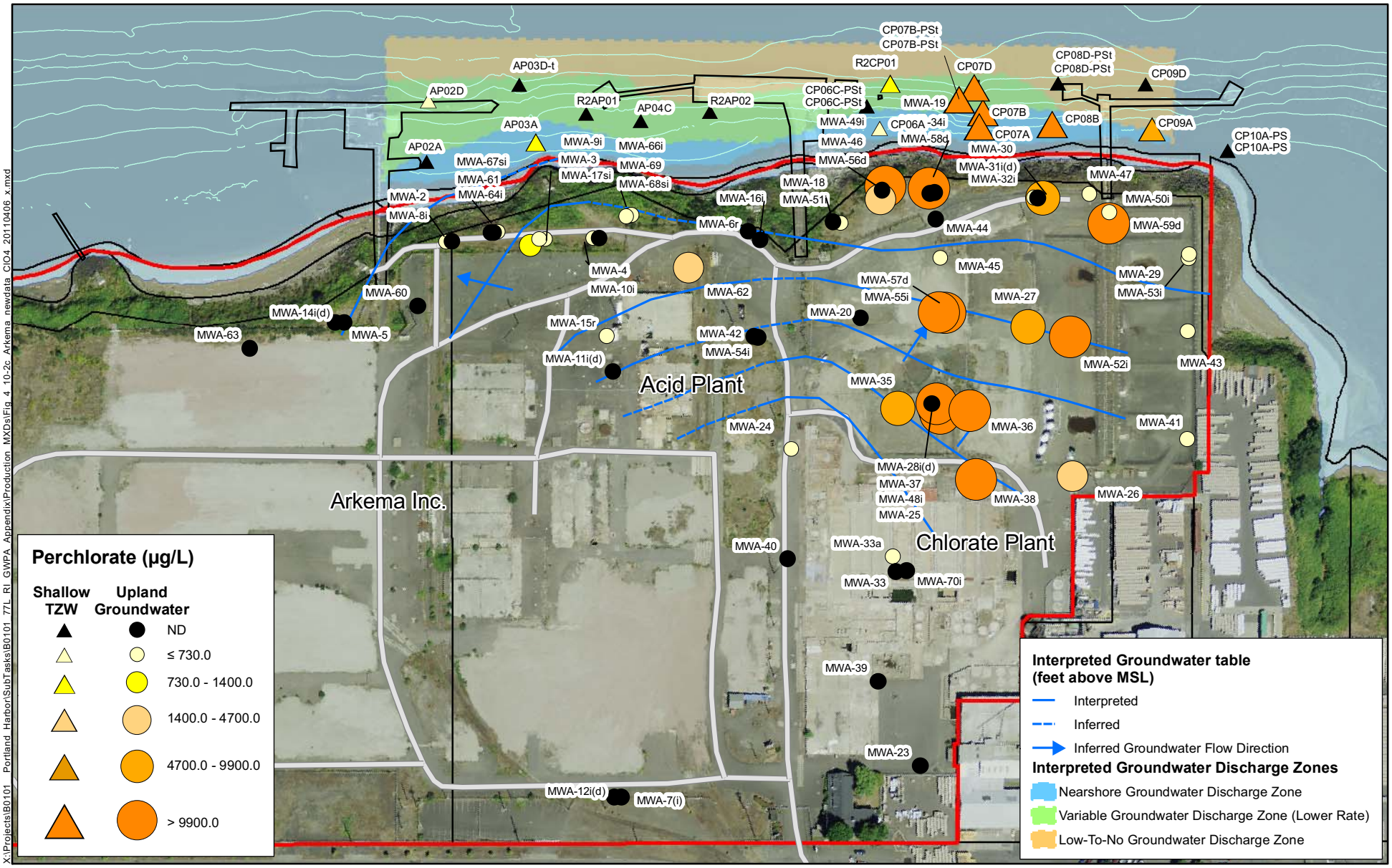
0 50 100

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005.
Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005
Groundwater Wells: locations are approximate and are drawn from ERM 2004a.
Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. and the Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-2b
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Chlorobenzene in Upland Groundwater and Shallow TZW



LEGEND

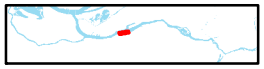
2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100

Feet

N



FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005.
Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005
Groundwater Wells: locations are approximate and are drawn from ERM 2004a.
Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. and the Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-2c
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Perchlorate in Upland Groundwater and Shallow TZW

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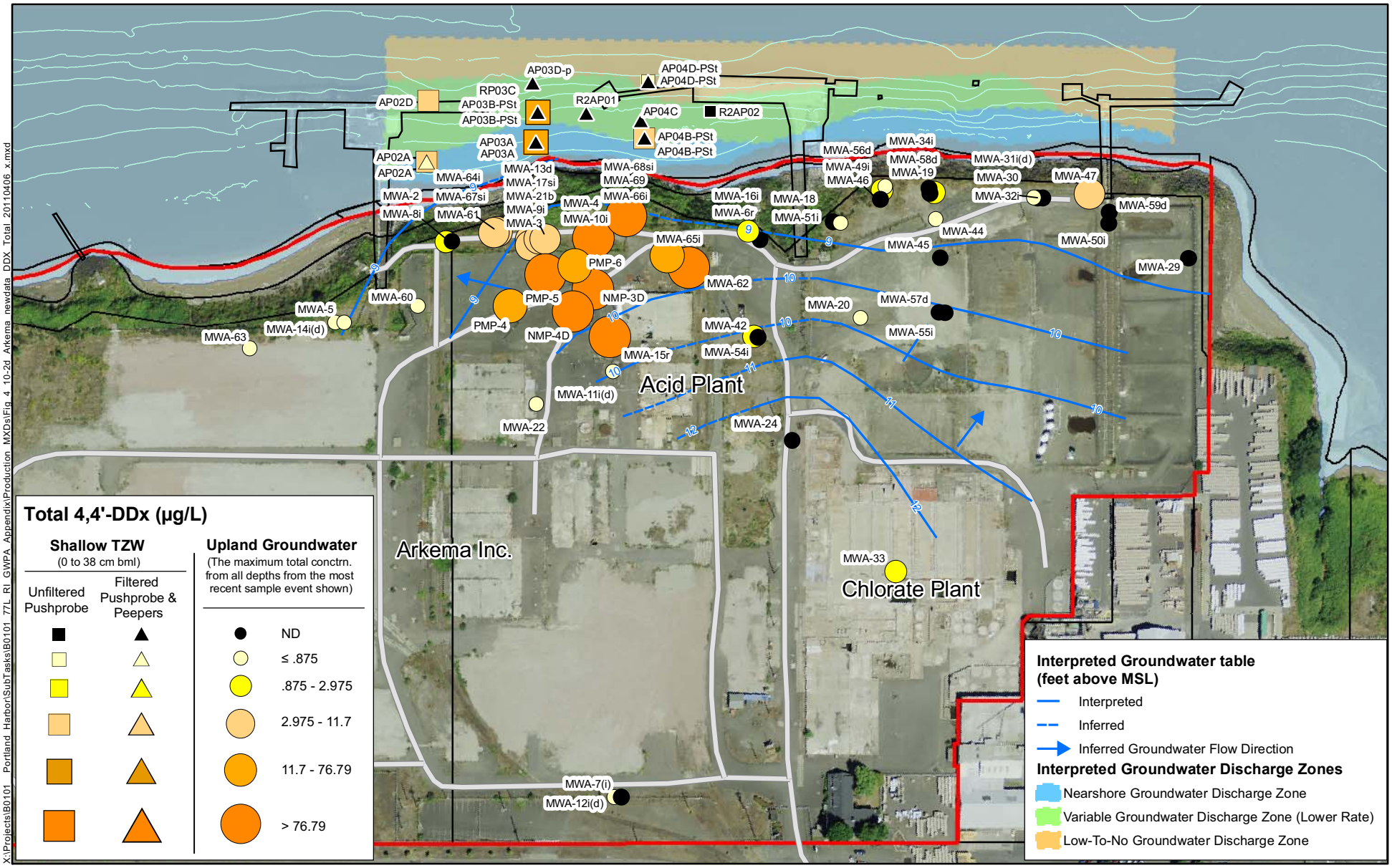

LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005.
Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005
Groundwater Wells: locations are approximate and are drawn from ERM 2004a.
Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. and the Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-2d
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Total of 4,4'-DDx in Upland Groundwater and Shallow TZW

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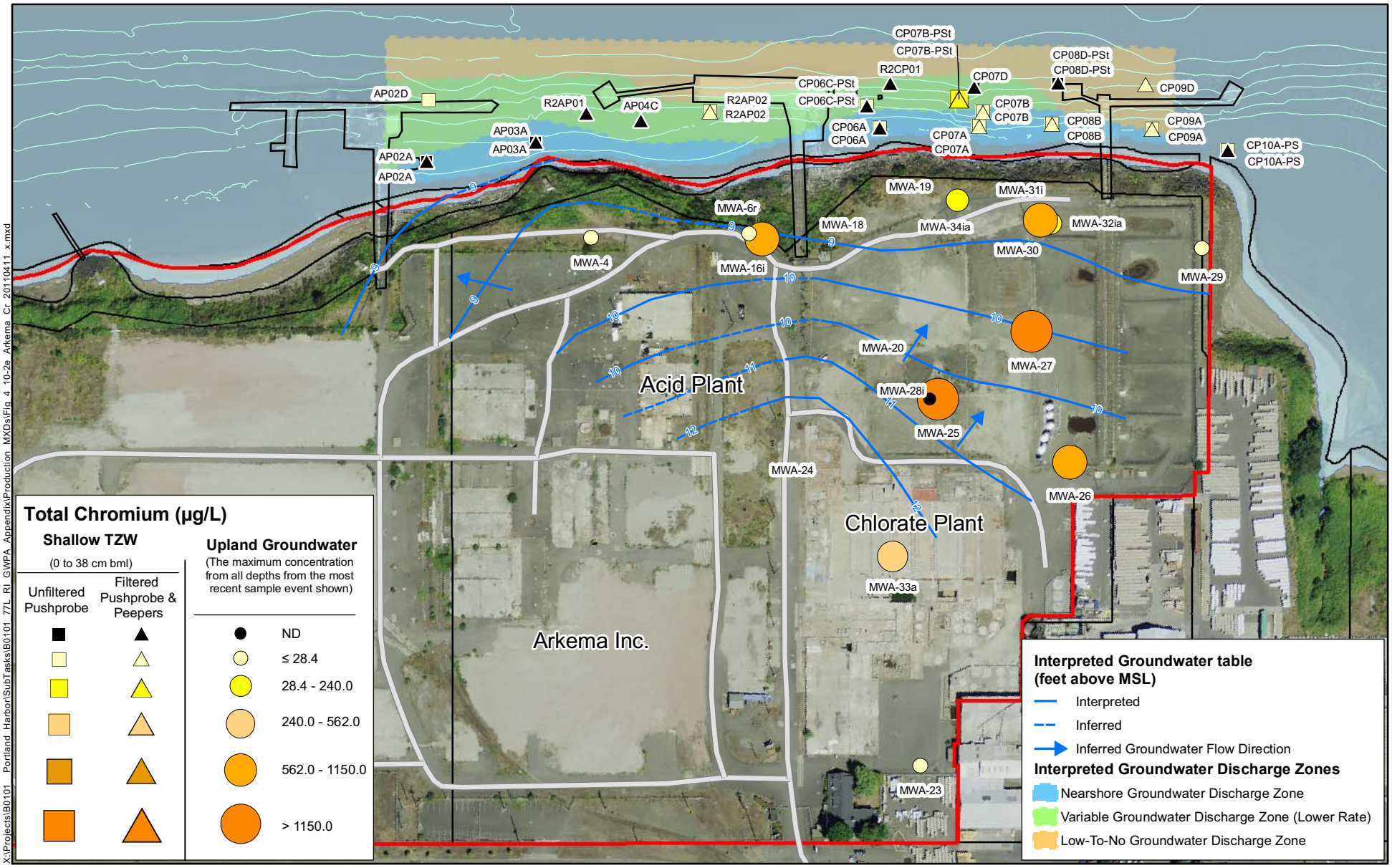

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LEGEND

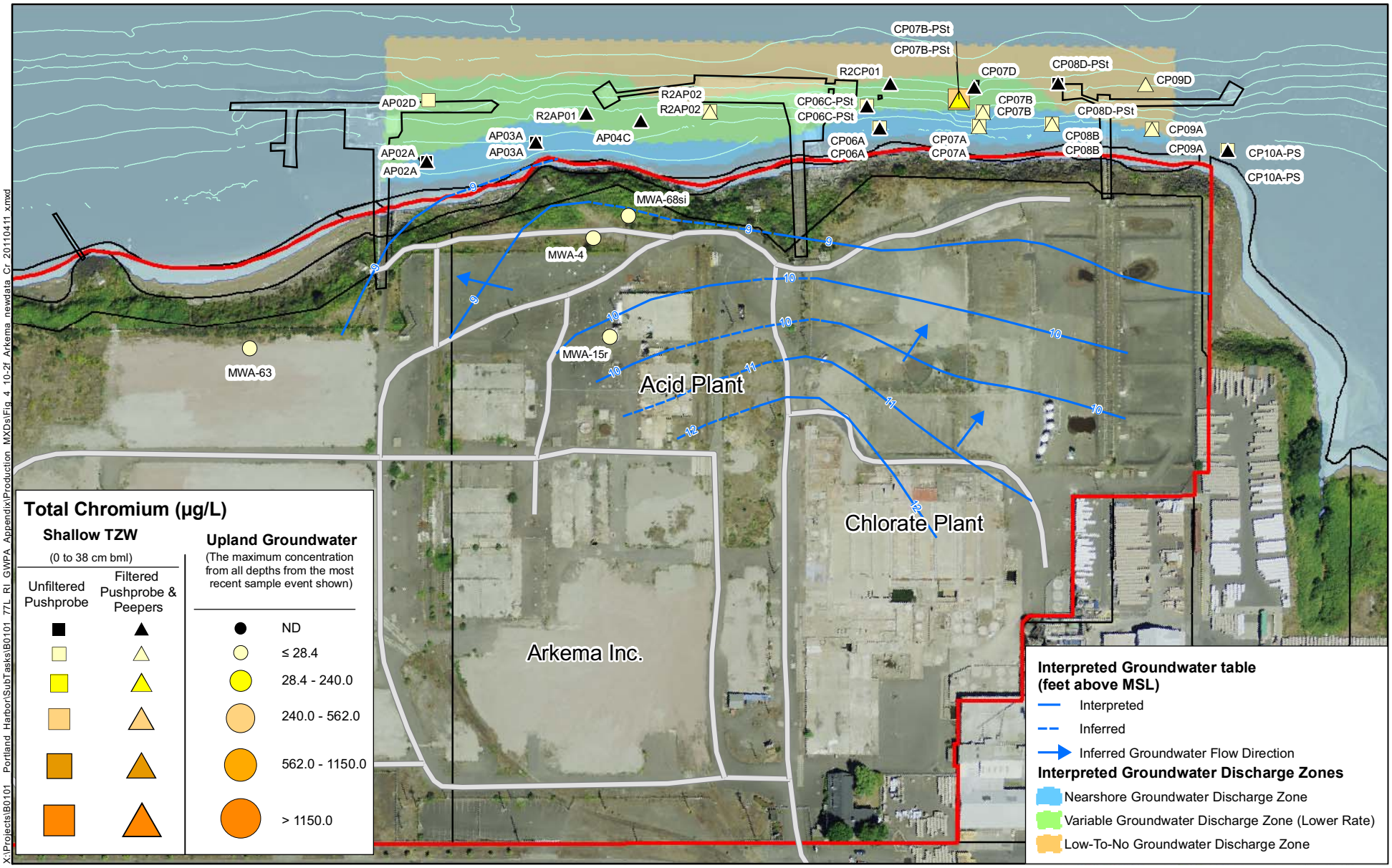
2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005.
Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005
Groundwater Wells: locations are approximate and are drawn from ERM 2004a.
Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. and the Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-2e
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Total Chromium in Upland Groundwater and Shallow TZW (2003 Data)



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LEGEND

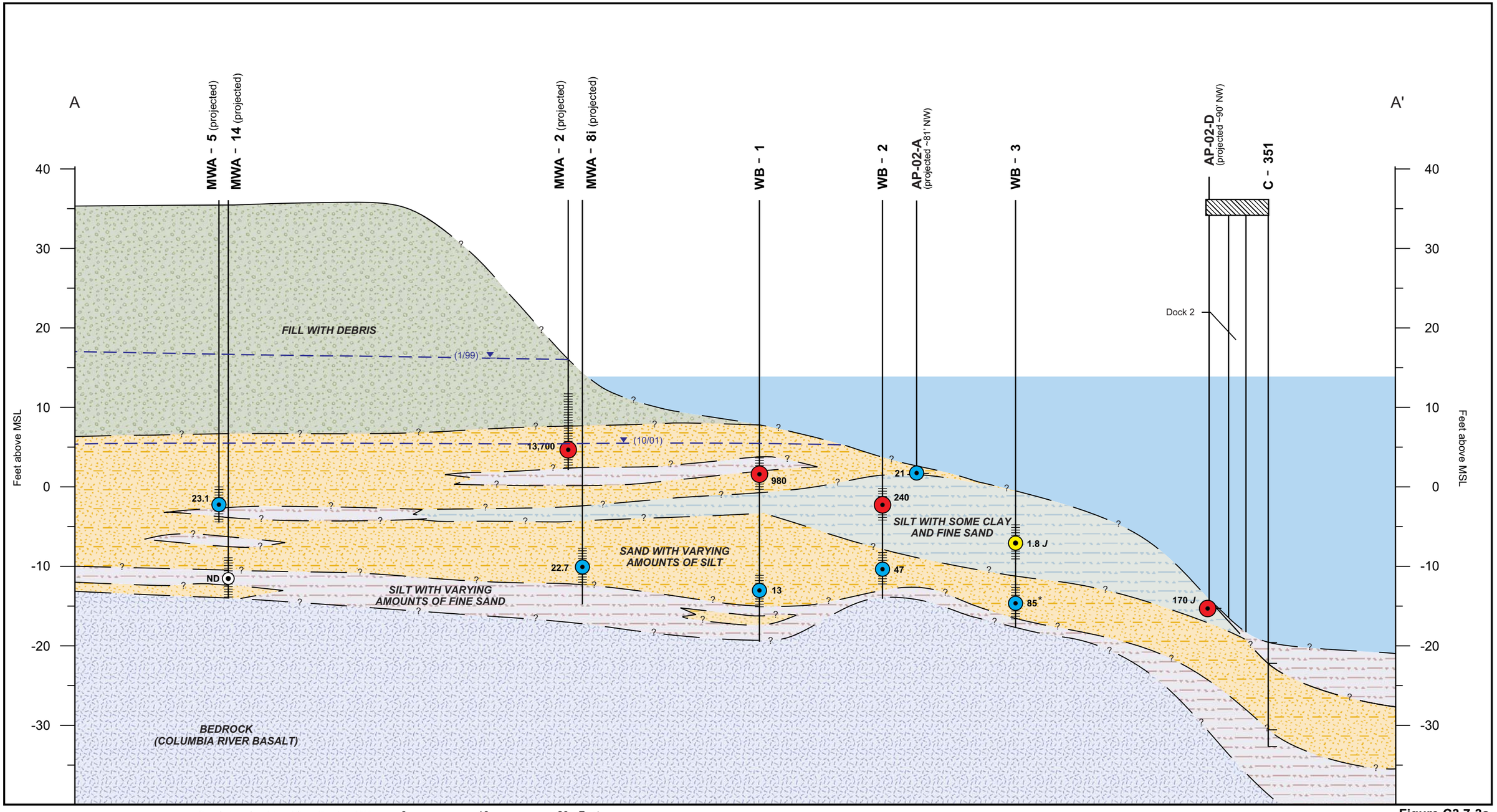
2003 Bathymetric 5 Ft. Contours (NAVD 88)

Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005. Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005
Groundwater Wells: locations are approximate and are drawn from ERM 2004a. Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR. and the Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-2f
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Total Chromium in Upland Groundwater and Shallow TZW (2006-2007 Data)



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Upland groundwater results shown are from the 2003 Arkema RI groundwater sampling event.
Wells MWA-2 and MWA-8i, which are at the top of the bank, appear at the toe of the slope as a result of projection onto the cross section line.

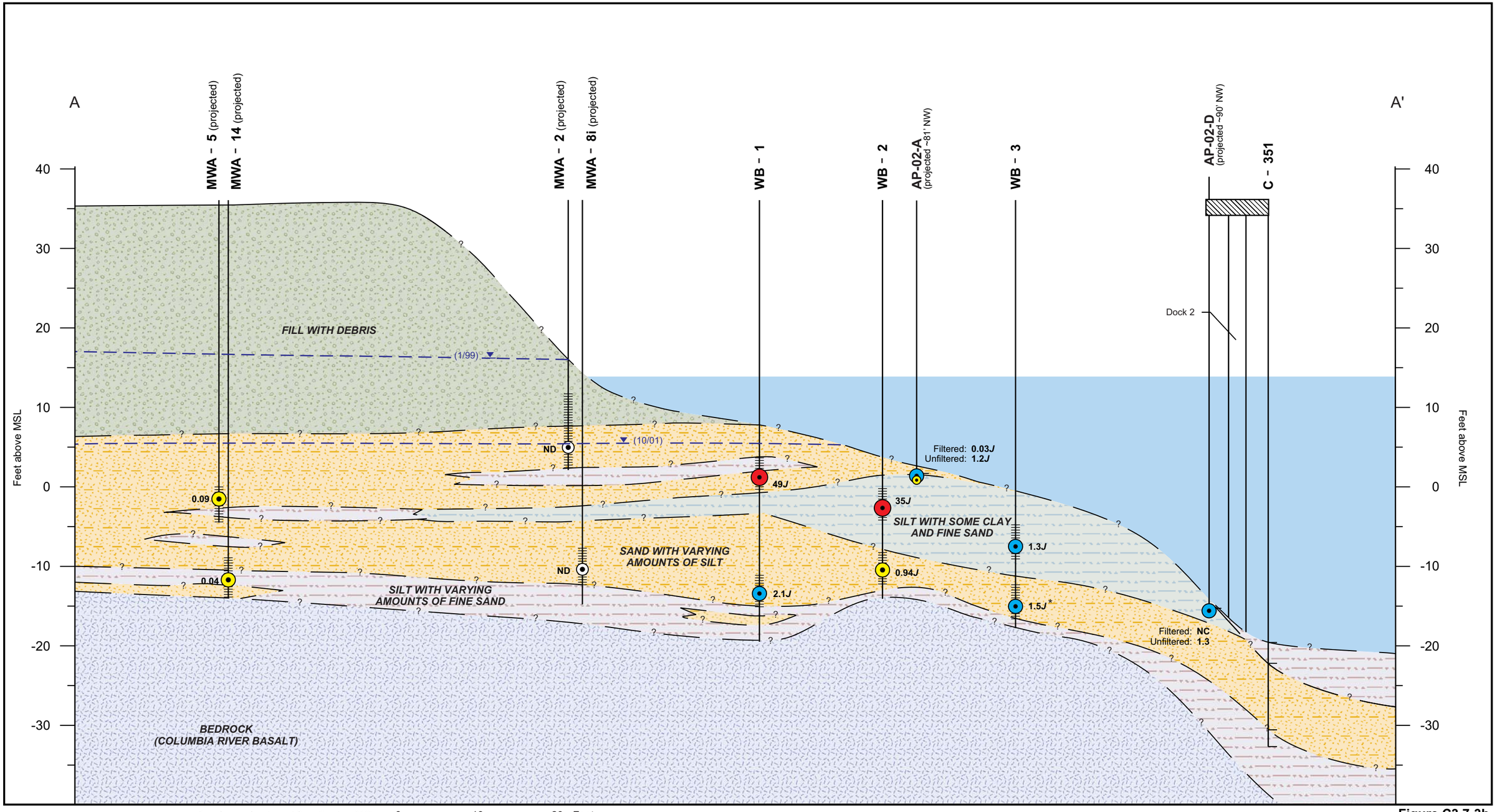
0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

Sample Concentration Range:
- ND
- < 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
ND - Not Detected
J - Estimated
* - Average of sample and sample duplicate
- Monitoring Well Screen

Figure C3.7-3a
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Stratigraphic Cross Section A-A' and Concentrations of Chlorobenzene in Nearshore Groundwater and Transition Zone Water



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Upland groundwater results shown are from the 2003 Arkema RI groundwater sampling event.
Wells MWA-2 and MWA-8i, which are at the top of the bank, appear at the toe of the slope as a result of projection onto the cross section line.

0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

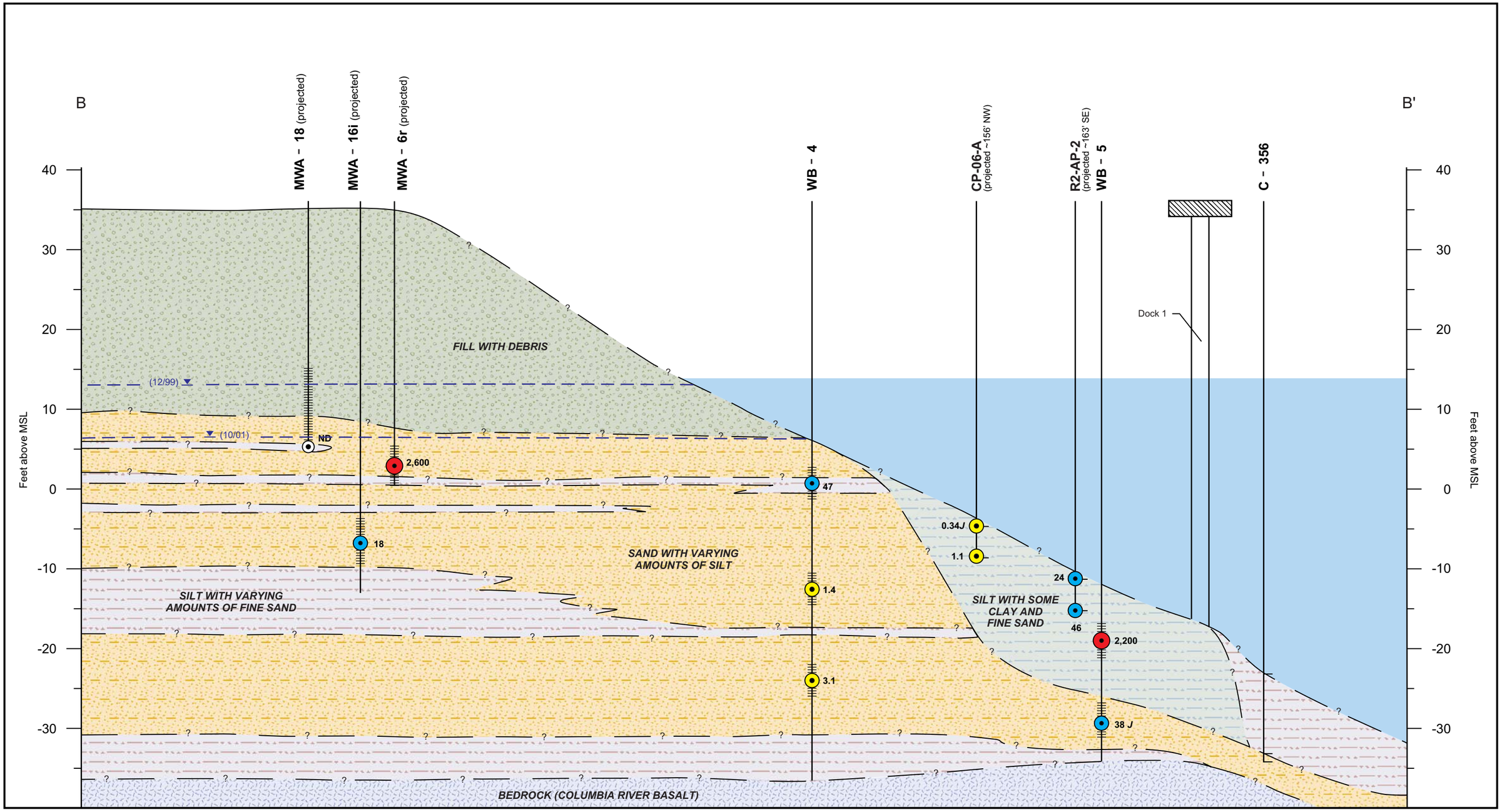
Sample Concentration Range:
- ND
- < 1 µg/L
- 1 - 10 µg/L
- > 10 µg/L

Approximate groundwater elevation

NC - Not Collected
ND - Not Detected
J - Estimated
* - Average of sample and sample duplicate
Upland groundwater data assumed to be unfiltered.

- Monitoring Well Screen

Figure C3.7-3b
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Stratigraphic Cross Section A-A' and Concentrations of Total 4,4'-DDX in Nearshore Groundwater and Transition Zone Water



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Upland groundwater results shown are from the 2003 Arkema RI groundwater sampling event.

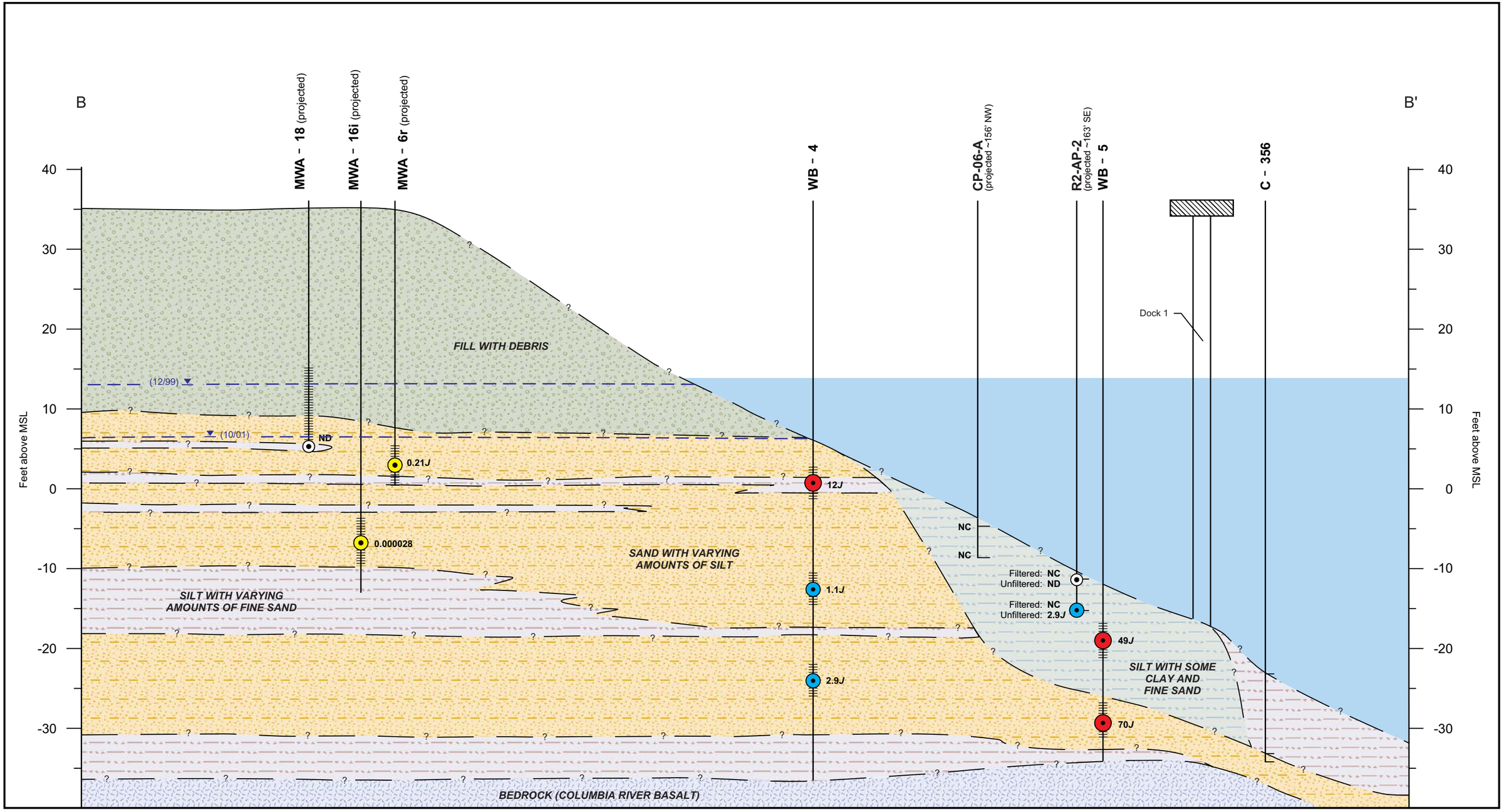
0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

Sample Concentration Range:
- ND
- < 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
ND - Not Detected
J - Estimated
- Monitoring Well Screen

Figure C3.7-3c
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Stratigraphic Cross Section B-B' and Concentrations of Chlorobenzene in Nearshore Groundwater and Transition Zone Water



Base features from Integral Consulting, Inc., 2003.
Locations should be considered approximate.
Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.
Upland groundwater results shown are from the 2003 Arkema RI groundwater sampling event.

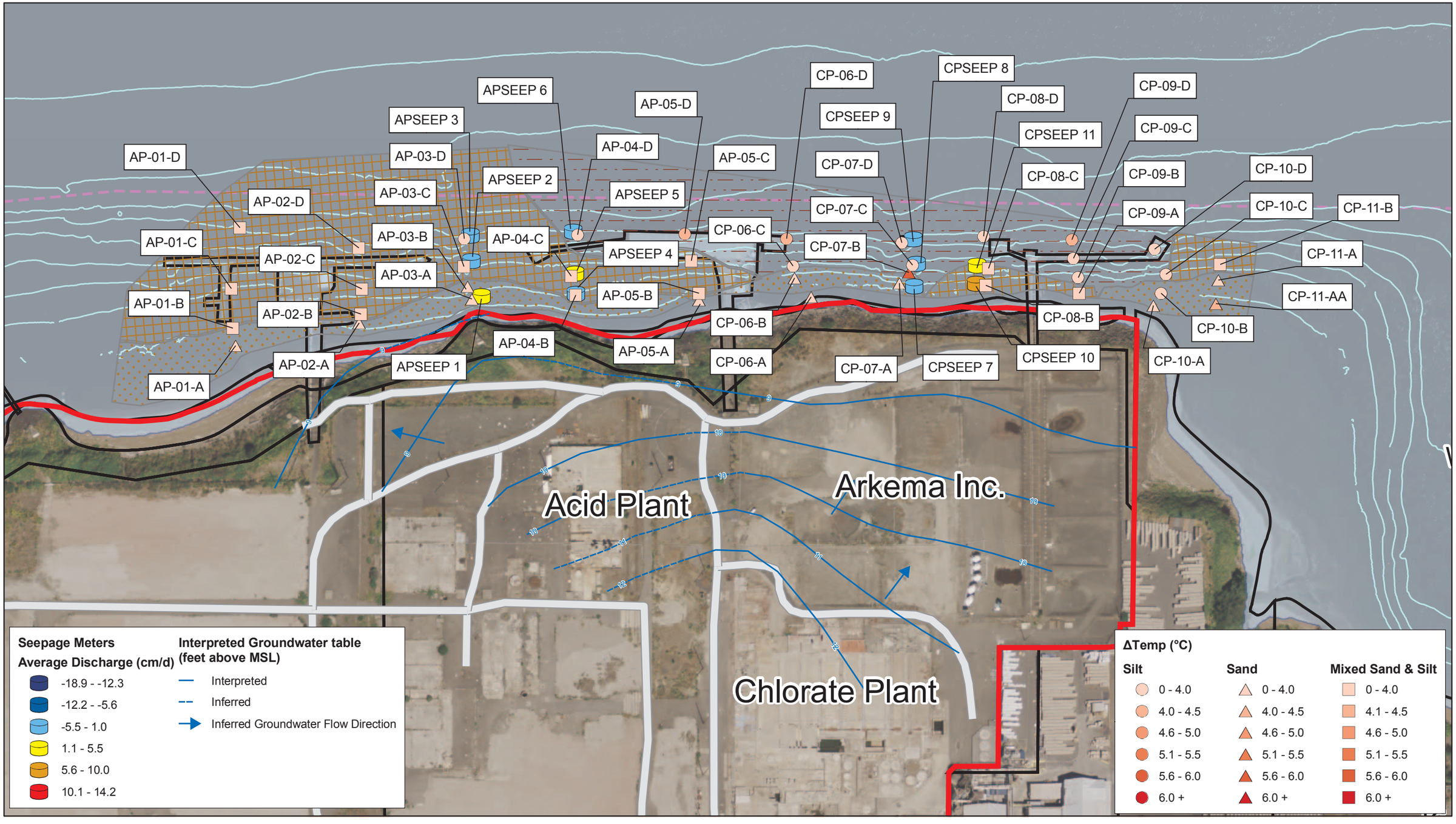
0 10 20 Feet
Vertical scale

0 40 80 Feet
Horizontal scale

Sample Concentration Range:
- ND
- < 1 µg/L
- 1 - 10 µg/L
- > 10 µg/L

Approximate groundwater elevation
NC - Not Collected
ND - Not Detected
J - Estimated
Upland groundwater data assumed to be unfiltered.
- Monitoring Well Screen

Figure C3.7-3d
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Stratigraphic Cross Section B-B' and
Concentrations of Total of 4,4'-DDx in Nearshore
Groundwater and Transition Zone Water



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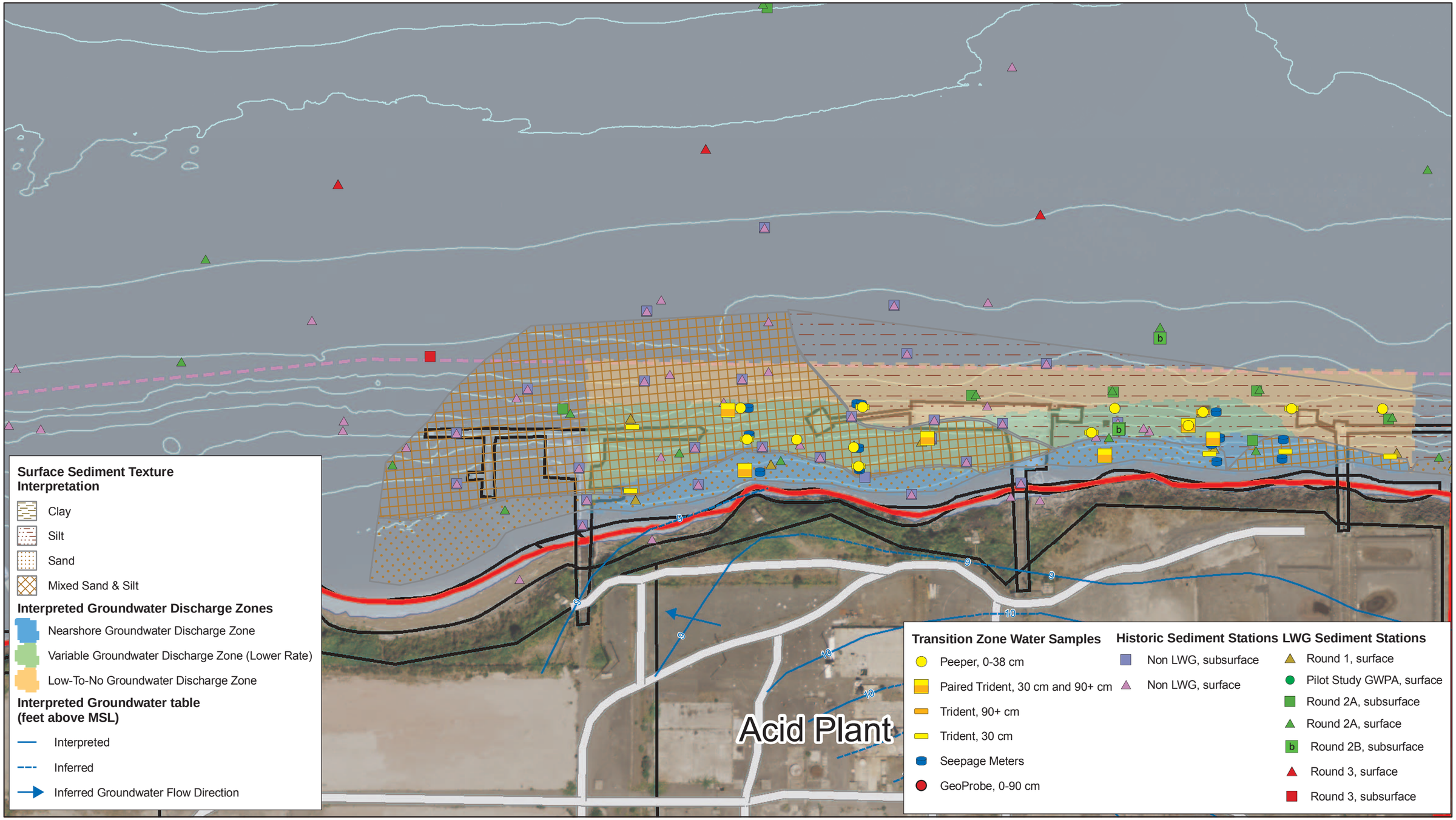
LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from ERM. 2004a.
Upland Remedial Investigation Report, Lots 3 & 4 and Tract A, ATOFINA Chemicals Facility, Portland, OR.
Prepared for ATOFINA Chemicals, Inc., Portland, OR. ERM-West, Inc., Bellvue, WA.
Groundwater Wells: locations are approximate and placed based on coordinates provided by the site.
Sitewide Groundwater Monitoring Report – April 2007 Monitoring Event, Arkema, Inc. Facility, Portland, Oregon, ERM, October 2007

Figure C3.7-4
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Trident Probe and Seepage Meter Results



LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007. Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater elevation contours and flow directions adapted from ERM 2005.
Upland Remedial Investigation Report Lots 3 & 4 and Tract A - Revision 1, Arkema, Inc. Portland Facility. December 2005.

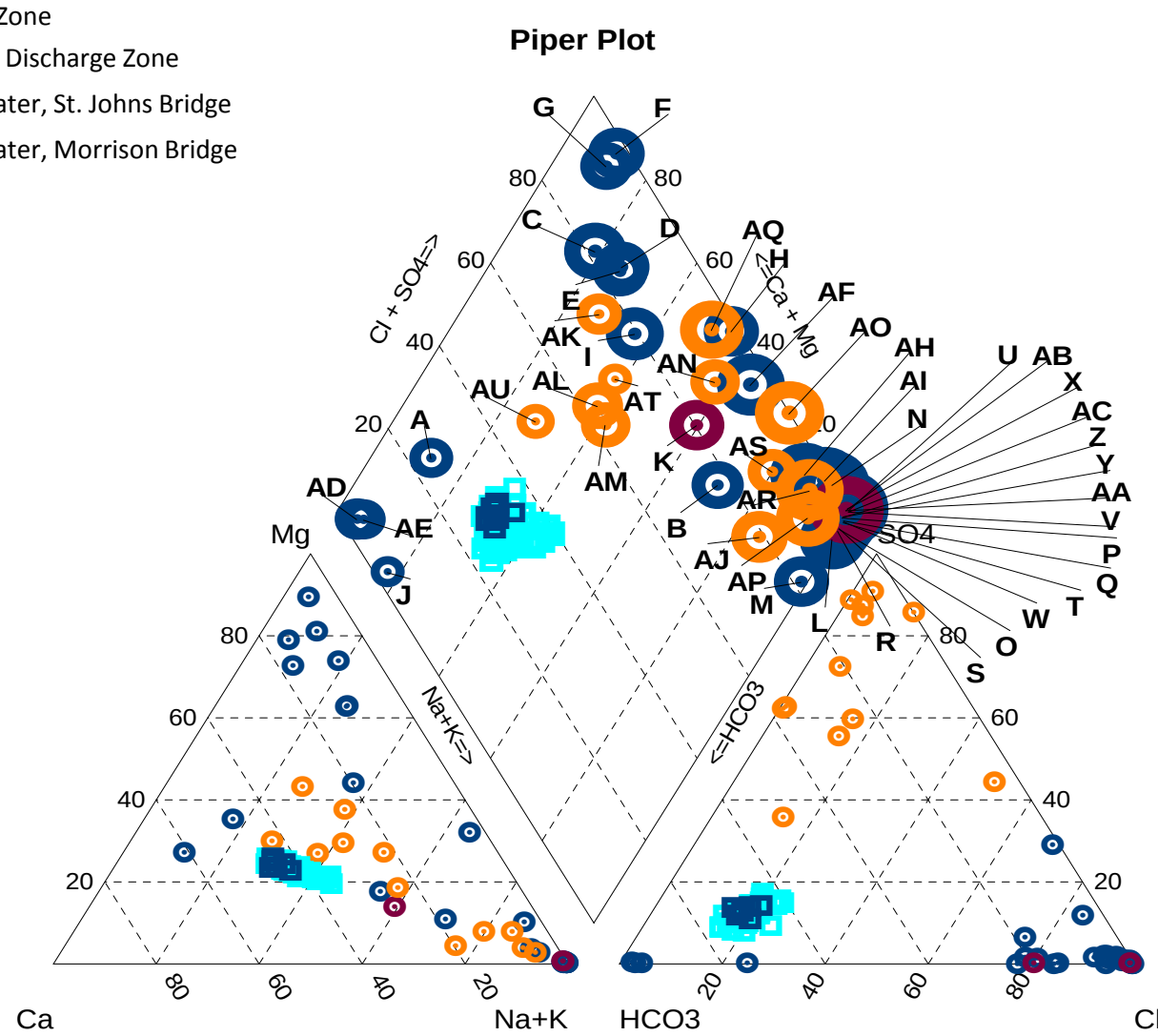
Figure C3.7-5
Portland Harbor RI/FS
Remedial Investigation Report
Arkema Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Logarithimic Scale To TDS)

- 10 mg/L
- 1,000,000 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	AP-02-A, Trident 30 cm	336	62.5	0.7	104	28	3.85	20.8	6.65	555.85
B	Groundwater Discharge Zone	AP-02-D, Trident 30 cm	480	913	0.15	135	48.2	7.42	590	6.36	2173.77
C	Groundwater Discharge Zone	AP-03-A, Trident 150 cm	1860	3610	421	260	1510	28.3	697	7.04	8386.3
D	Groundwater Discharge Zone	AP-03-A, Trident 30 cm	584	1740	0.6	161	520	11.8	393	6.48	3410.4
E	Groundwater Discharge Zone	AP-03-A, Trident 30 cm; FR	604	1690	0.6	150	497	11.2	377	6.49	3329.8
F	Groundwater Discharge Zone	AP-03-B, Trident 30 cm (PS)	132	3040	27.4	125	743	7.71	179		4254.11
G	Groundwater Discharge Zone	AP-03-B, Trident 30 cm (PS); FR	159	1300	0.45	195	500	6.68	129		2290.13
H	Groundwater Discharge Zone	AP-03-D, Trident 150 cm	44	1260	713	264	102	10.1	591	5.58	2984.1
I	Groundwater Discharge Zone	AP-04-B, Trident 30 cm (PS)	1300	2370	70.1	281	382	6.14	590		4999.24
J	Groundwater Discharge Zone	AP-04-C, Peeper 0 - 38 cm	124	1.6	0.4	8.85	3.97	0.54	3.36	7.42	142.72
K	Low-to-No Groundwater Discharge Zone	AP-04-D, Trident 30 cm (PS)	585	1150	0.45	242	76.1	6.47	612		2672.02
L	Groundwater Discharge Zone	CP-06-A, Trident 150 cm	786	5450	126	16.2	7.33	16.2	8410	6.49	14811.73
M	Groundwater Discharge Zone	CP-06-A, Trident 30 cm	486	1220	26.6	7.63	2.96	7.33	1130	7.27	2880.52
N	Groundwater Discharge Zone	CP-06-C, Trident 30 cm (PS)	259	30600	4.5	684	282	64.2	17350		49243.7
O	Groundwater Discharge Zone	CP-07-A, Trident 30 cm	810	9280	278	14.3	6.21	15.3	7720	7.26	18123.81
P	Groundwater Discharge Zone	CP-07-B, Trident 150 cm	582	12000	255	46.2	25.8	20.5	9280	7.65	22209.5
Q	Groundwater Discharge Zone	CP-07-B, Trident 30 cm	620	12700	292	22.8	9.27	22.5	10230	6.82	23896.57
R	Groundwater Discharge Zone	CP-07-B, Trident 30 cm (PS)	922	8370	241	11.5	7.15	28.1	7810		17389.75
S	Groundwater Discharge Zone	CP-07-B, Trident 30 cm (PS); FR	865	9090	217	10.2	5.91	27.2	7920		18135.31
T	Groundwater Discharge Zone	CP-07-B, Trident 60 cm (PS)	686	11300	235	10	7.64	17.4	8910		21166.04
U	Groundwater Discharge Zone	CP-07-D, Peeper 0 - 38 cm	289	51700	485	119	75.2	92.2	37490	6.76	90250.4
V	Groundwater Discharge Zone	CP-07-D, Trident 150 cm	402	41500	449	68.3	48	64.6	29420	6.15	71951.9
W	Groundwater Discharge Zone	CP-08-B, Trident 30 cm	502	9910	268	11	7.75	11.9	8670	7	19380.65
X	Groundwater Discharge Zone	CP-08-D, Trident 30 cm (PS)	520	88500	22.5	384	139	90.9	58650		148306.4
Y	Groundwater Discharge Zone	CP-09-A, Trident 30 cm	359	8660	124	46.6	11.1	12.2	6920	7.19	16132.9
Z	Groundwater Discharge Zone	CP-09-A, Trident 30 cm; FR	355	8950	126	41.1	9.16	11.8	6710	7.16	16203.06
AA	Low-to-No Groundwater Discharge Zone	CP-09-D, Peeper 0 - 38 cm	492	29100	47	164	75.9	47.8	25000	6.96	54926.7
AB	Low-to-No Groundwater Discharge Zone	CP-09-D, Peeper 0 - 38 cm; FR	399	25800	52	137	65.4	39.7	22780	7.07	49273.1
AC	Groundwater Discharge Zone	CP-10-A, Trident 30 cm (PS)	374	35600	9	77.9	50.3	26.6	29070		65207.8
AD	Groundwater Discharge Zone	R2-AP-01, Peeper 0 - 38 cm	658	11.1	0.5	9.61	91.6	1.76	8.22	8.1	780.79
AE	Groundwater Discharge Zone	R2-AP-01, Peeper 0 - 38 cm; FR	530	13.1	0.5	21.2	68.4	2.02	8.92	7.9	644.14
AF	Groundwater Discharge Zone	R2-AP-02, Trident 150 cm	1280	11800	2240	279	1720	29.6	6590	7.22	23938.6
AH	Groundwater Discharge Zone	R2-AP-02, Trident 30 cm	1430	14500	264	329	578	19.8	9320	7.13	26440.8
AI	Groundwater Discharge Zone	R2-CP-01, Peeper 0 - 38 cm	548	19600	238	770	307	194	14720	7.07	36377
Aj[c]	Upland Groundwater	WB-01 (-11.4 to -15.4) GW	550	100	1500	86	59	15	1200		3510
Ak[c]	Upland Groundwater	WB-01 (3.6 to -0.4) GW	69	25	130	150	130	23	140		667
Al[c]	Upland Groundwater	WB-02 (-0.3 TO -4.3) GW	420	5.8	570	140	130	11	240		1516.8
AM[c]	Upland Groundwater	WB-02 (-8.3 to -12.3) GW	380	4.1	500	120	74	13	190		1281.1
AN[c]	Upland Groundwater	WB-03 (-13.3 to -17.3) GW	140	4.4	920	40	19	2	110		1235.4
AO	Upland Groundwater	WB-09 (-25.9 to -29.9) GW	1	1600	13000	2000	270	85	8800		25756
AP	Upland Groundwater	WB-09 (-9.9 to -13.9) GW	710	160	5300	200	66	19	4200		10655
AQ	Upland Groundwater	WB-10 (-18.0 to -22.0) GW	540	3200	3800	810	600	28	2100		11078
AR	Upland Groundwater	WB-10 (-28.0 to -32.0) GW	650	260	8400	550	190	62	8200		18312
AS	Upland Groundwater	WB-15 (-36.8 to -40.8) GW	83	22	530	60	23	3.8	440		1161.8
AT	Upland Groundwater	WB-20 (-39.4 to -41.4) GW	38	11	56	18	8.3	2.1	21		154.4
AU	Upland Groundwater	WB-22 (-42.4 to -46.4) GW	100	16	56	33	14	2.6	23		244.6

Notes:

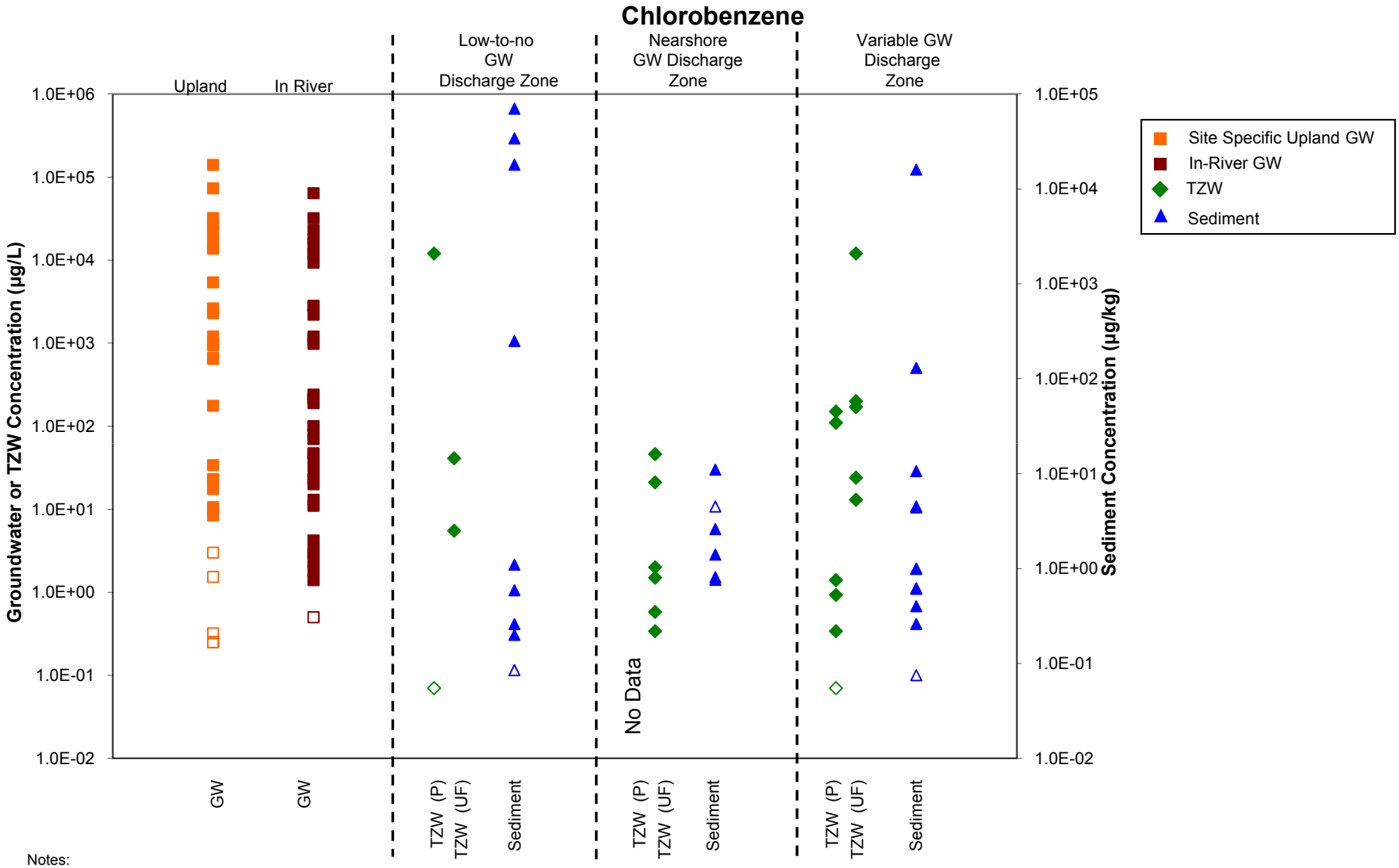
[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

[c] No alkalinity data available, use bicarbonate value.

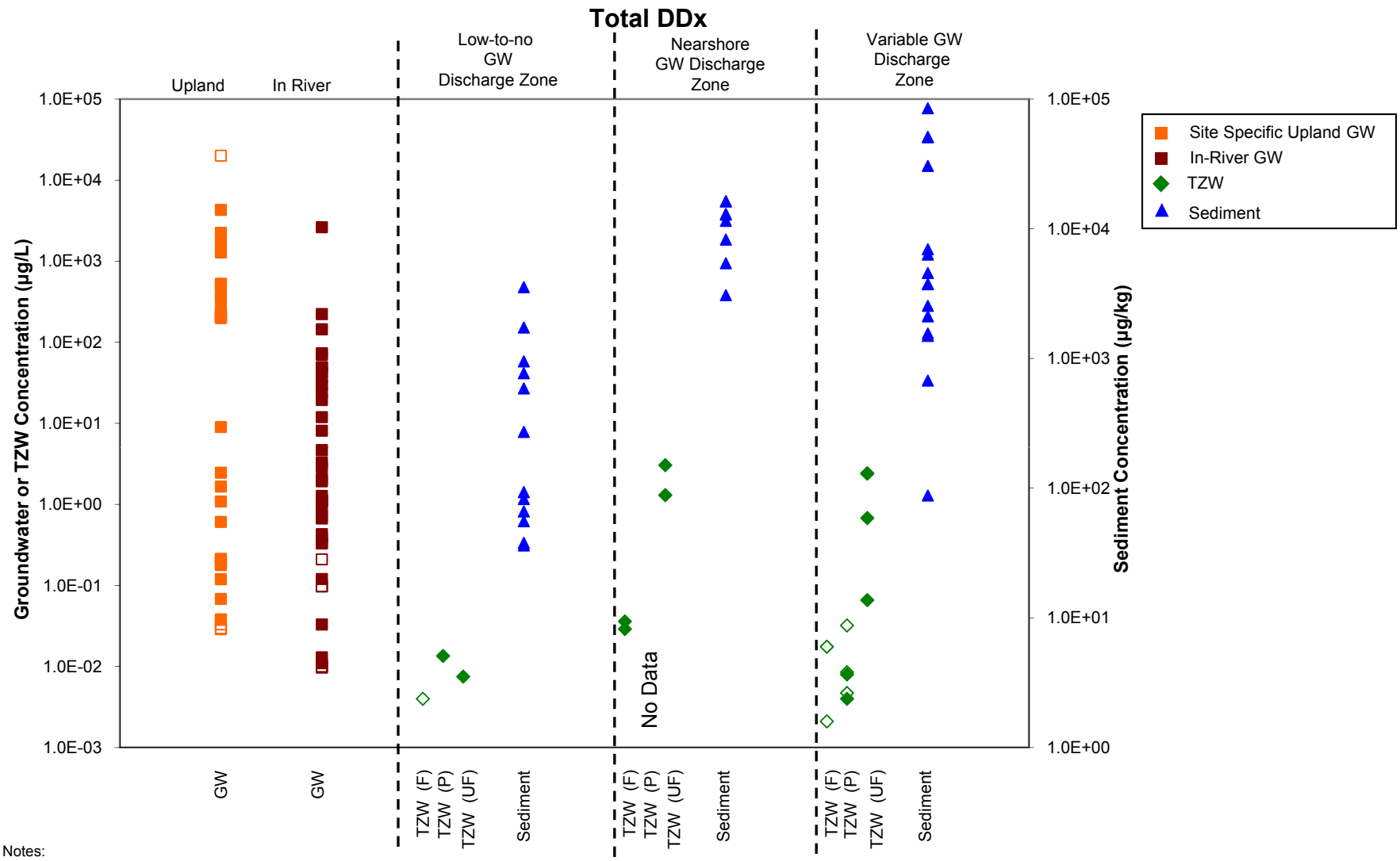
All concentrations as mg/L; pH in s.u.

Figure C3.7-6
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Arkema



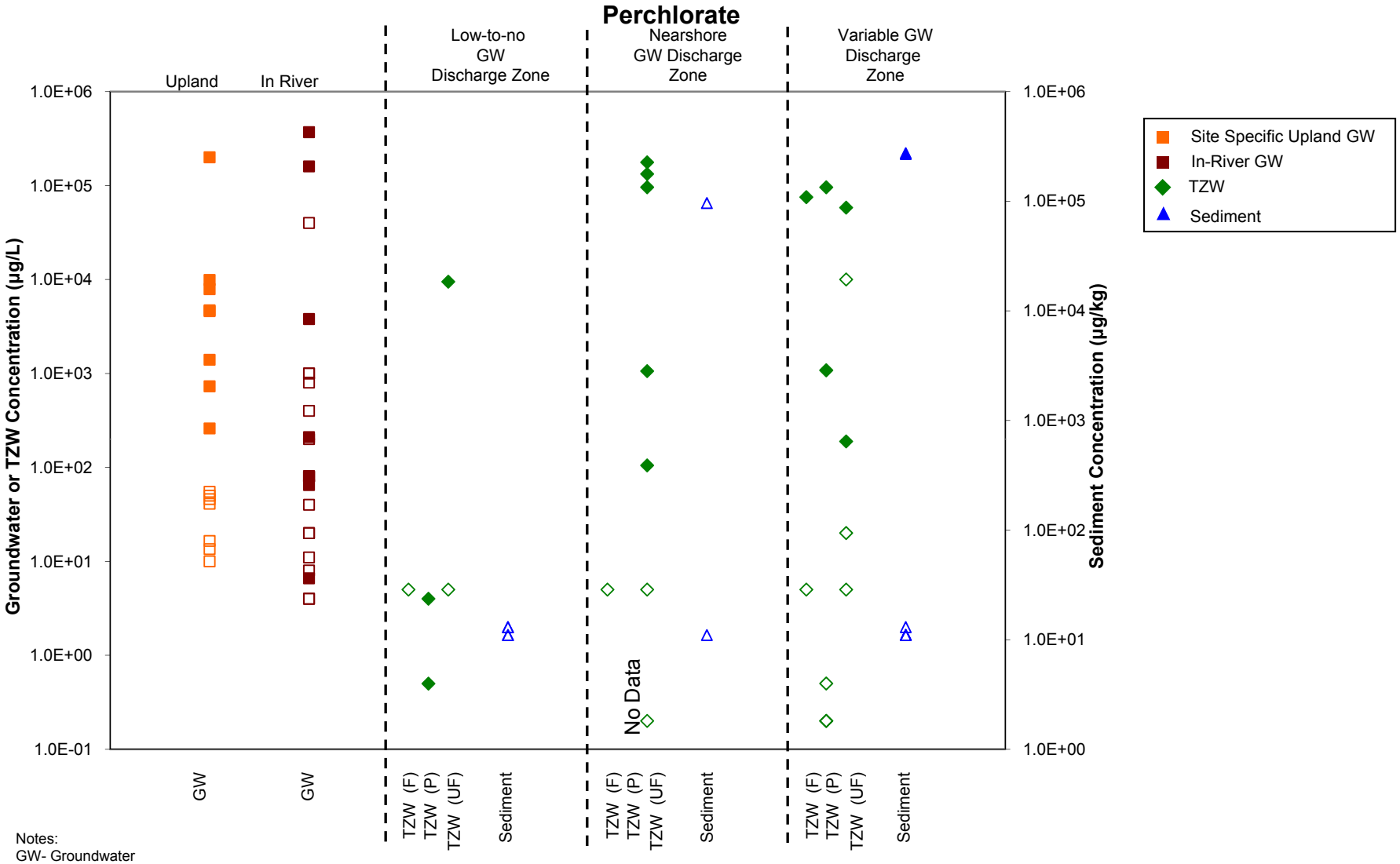
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.7-7a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Chlorobenzene - Arkema



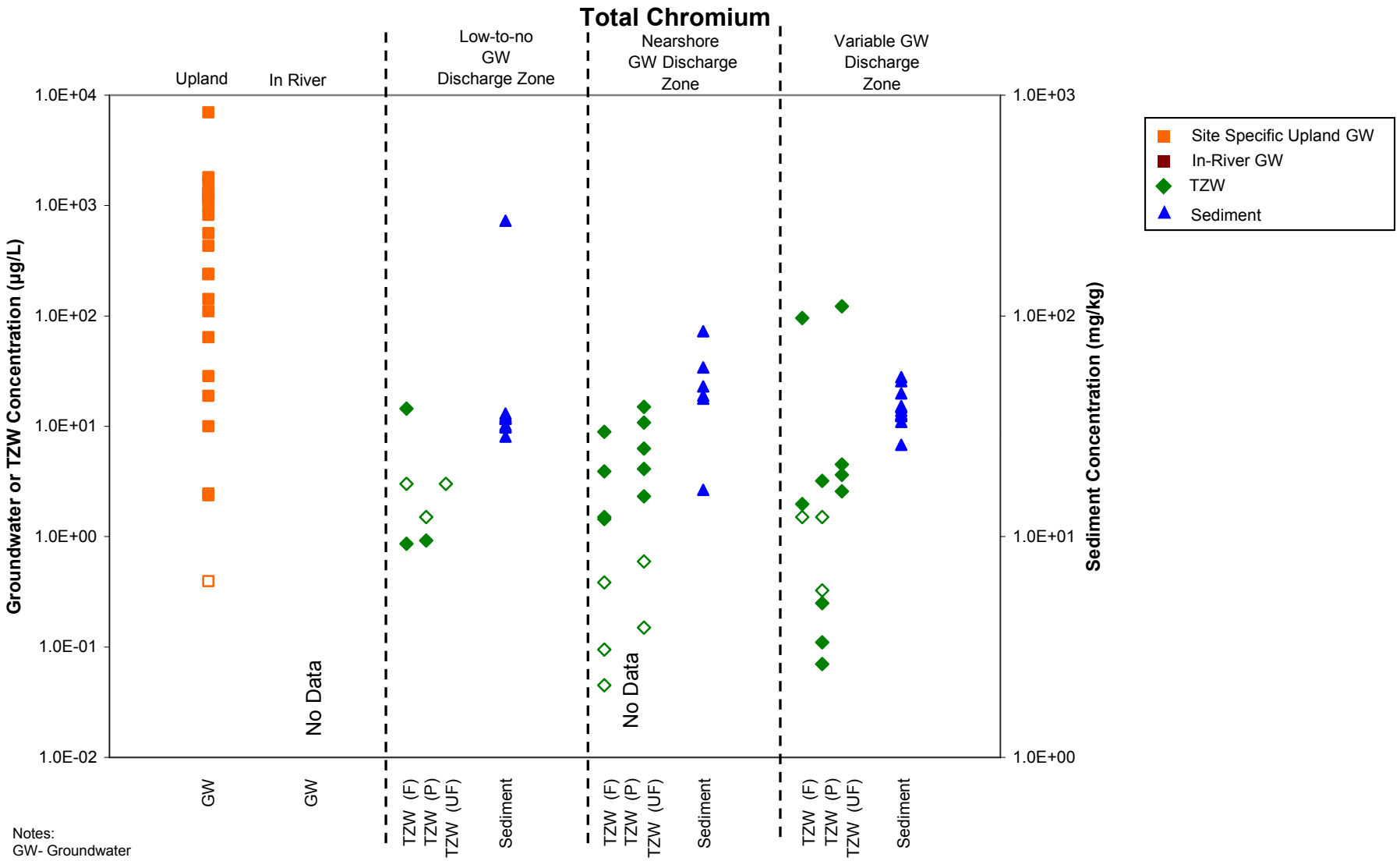
Notes:
*Total DDx data were not available for Upland Groundwater: total 4,4'-DDx data are shown for comparison.
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.7-7b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total DDx - Arkema



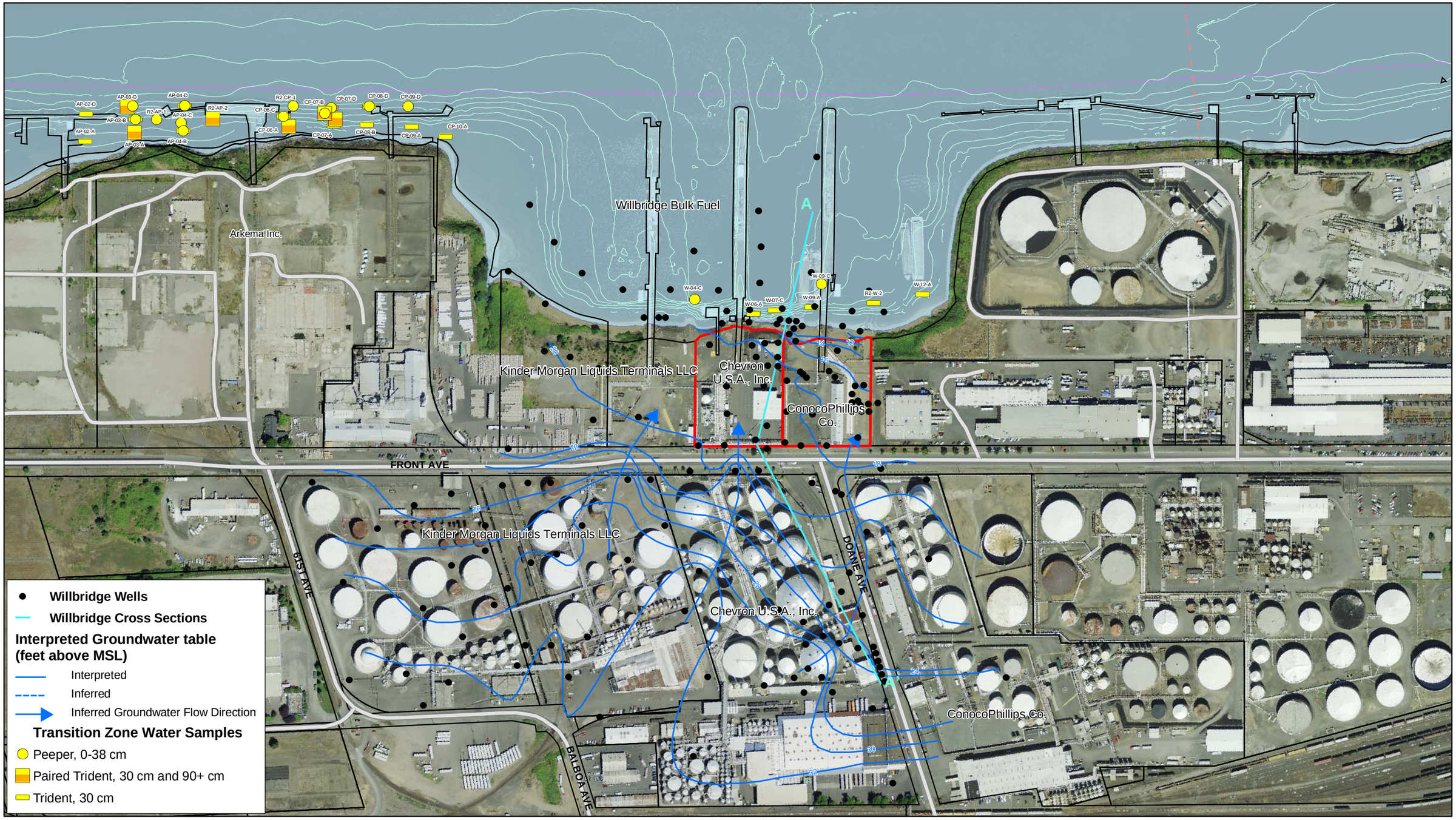
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.7-7c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Perchlorate - Arkema



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.7-7d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Chromium - Arkema



LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-1
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Overview and Cross Section Location

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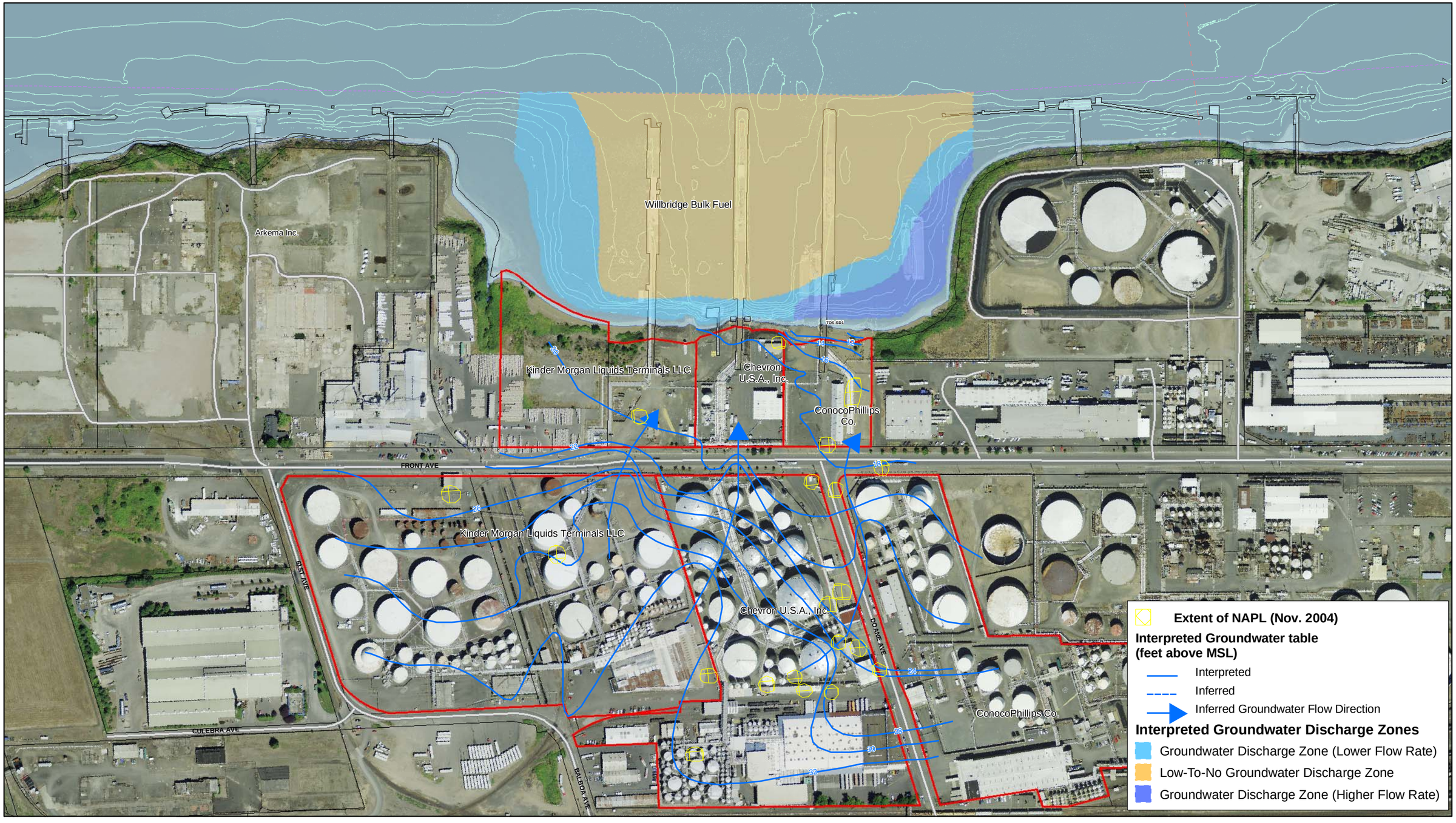

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LEGEND

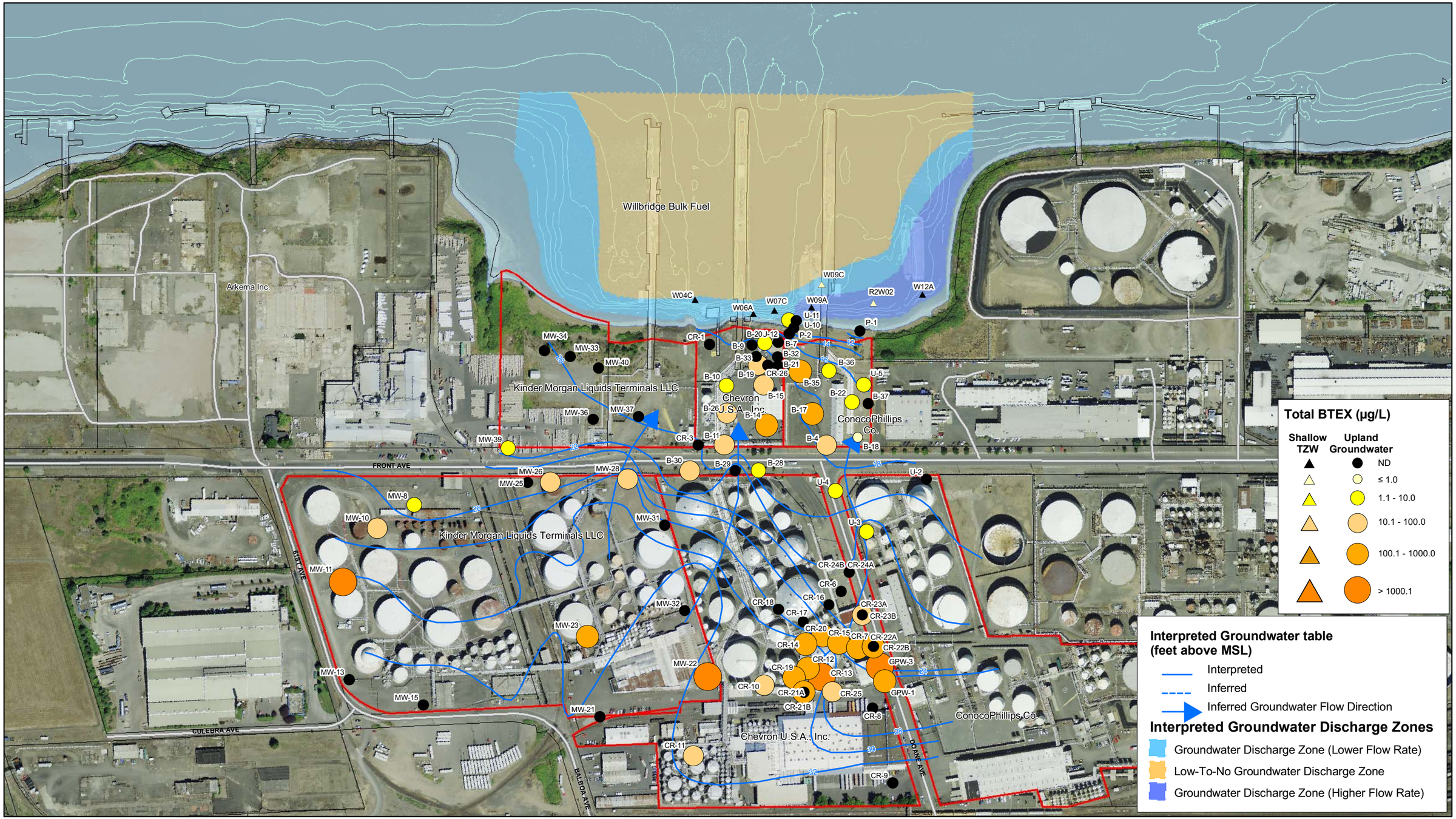
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.

Figure C3.8-2a
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Distribution of NAPL in Upland Groundwater



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LEGEND

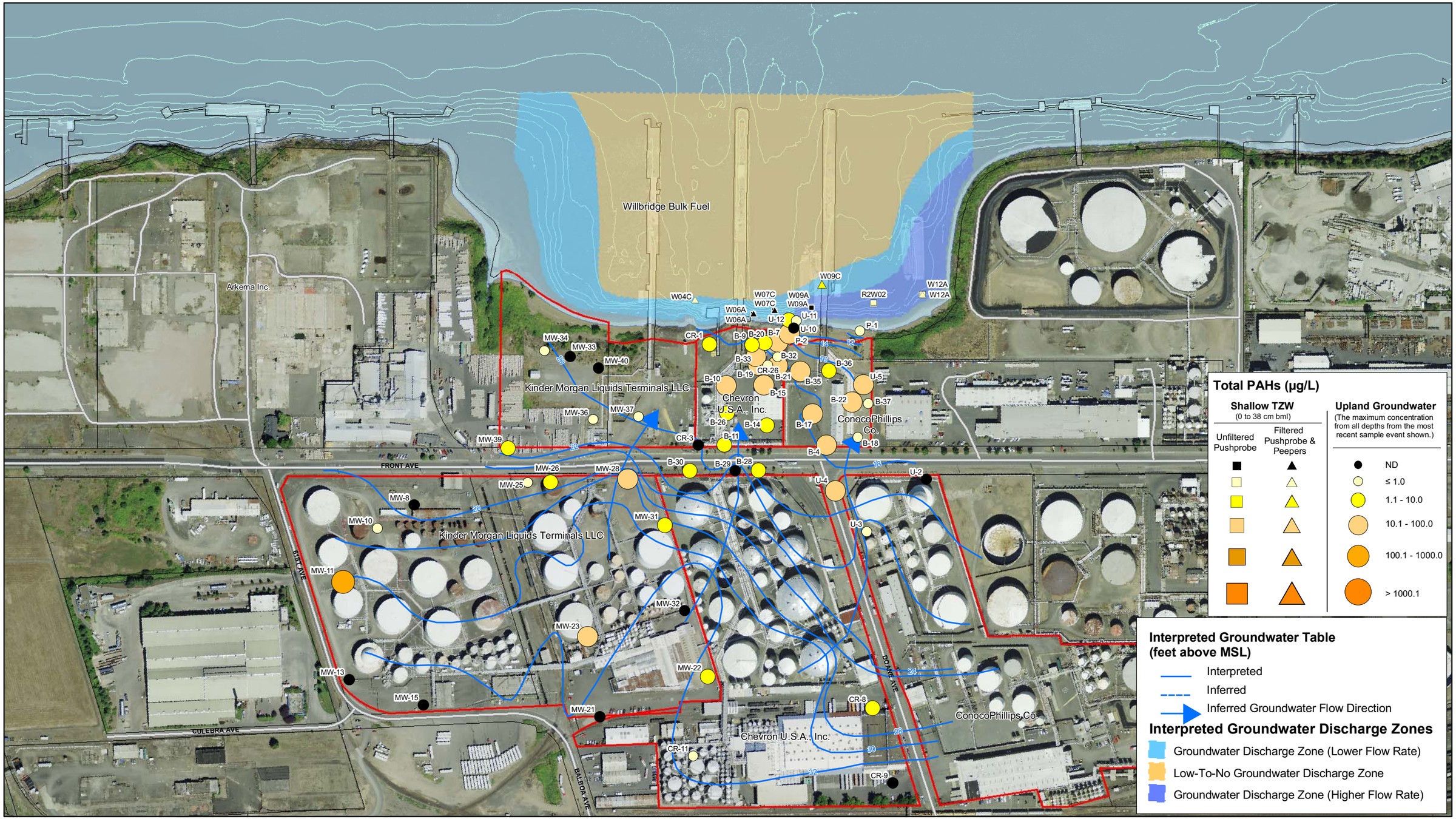
2003 Bathymetric 5 Ft. Contours (NAVD88)

Site Property Boundary

0 100 200
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-2b
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Total BTEX in Upland Groundwater and Shallow TZW



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LEGEND

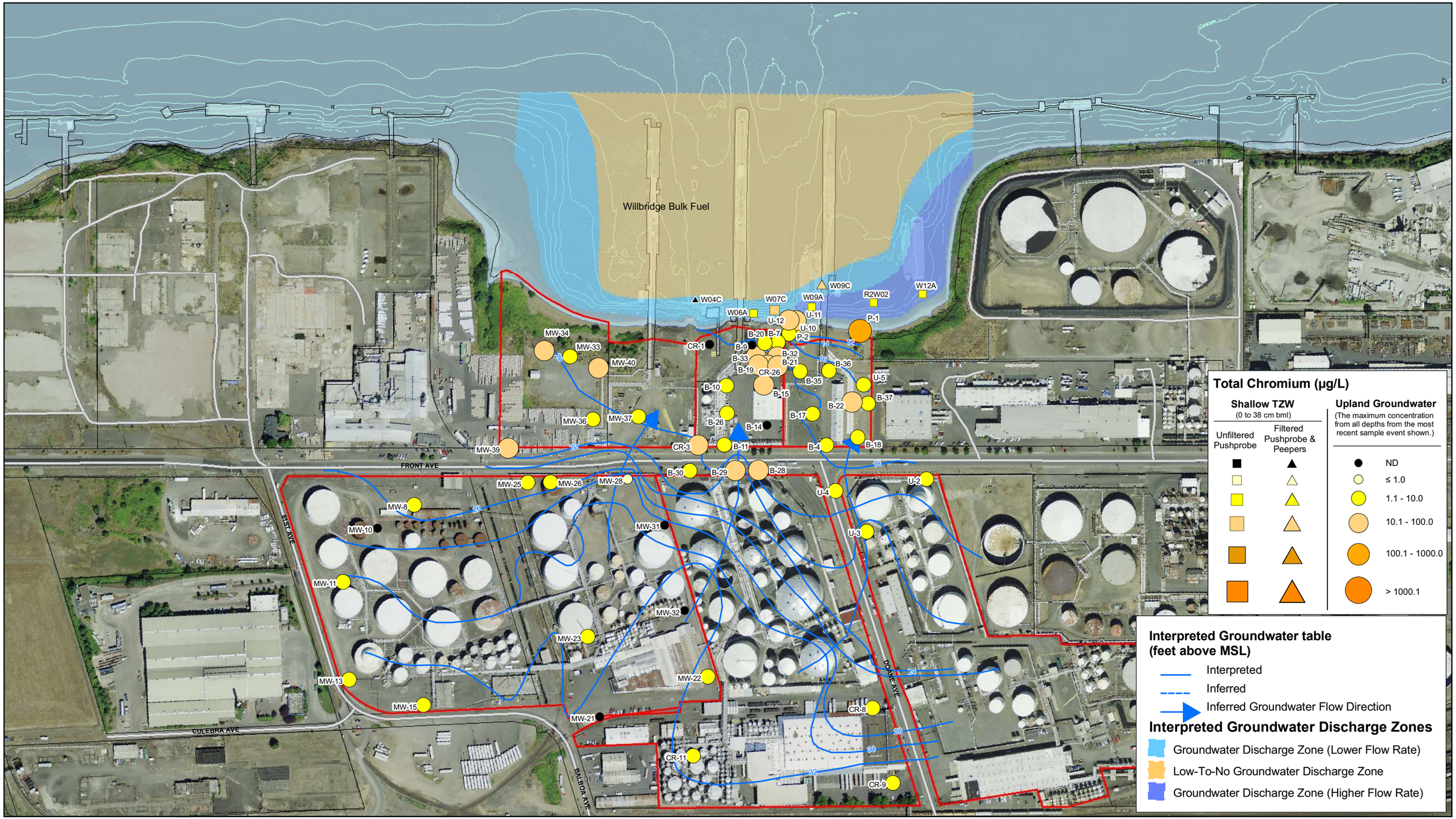
2003 Bathymetric 5 Ft. Contours (NAVD88)

Site Property Boundary

0 100 200
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-2c
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Total PAHs in Upland Groundwater and Shallow TZW



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LEGEND

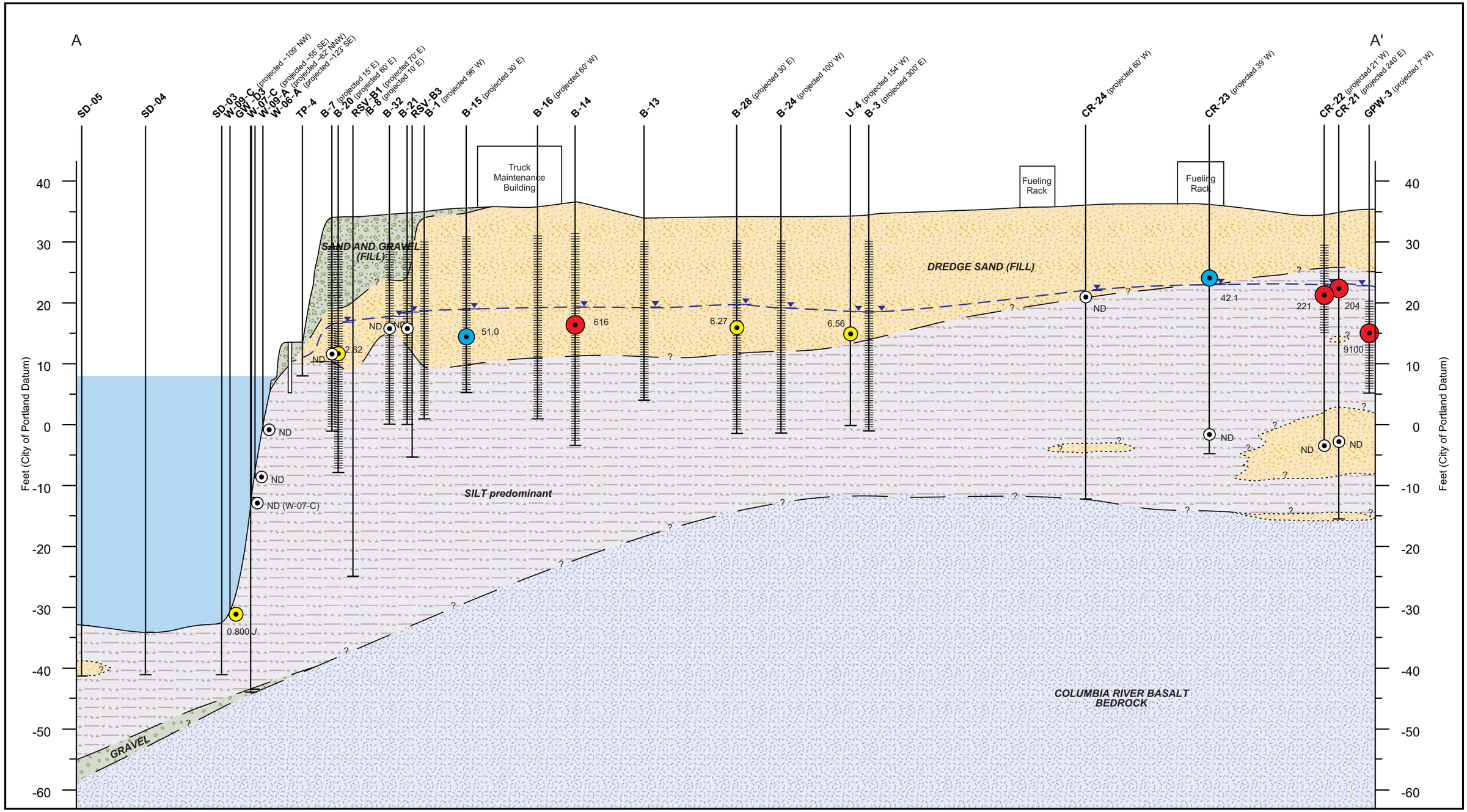
2003 Bathymetric 5 Ft. Contours (NAVD88)

Site Property Boundary

0 100 200
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-2d
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Total Chromium in Upland Groundwater and Shallow TZW



Base features from SAIC, 2005.
Locations should be considered approximate.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

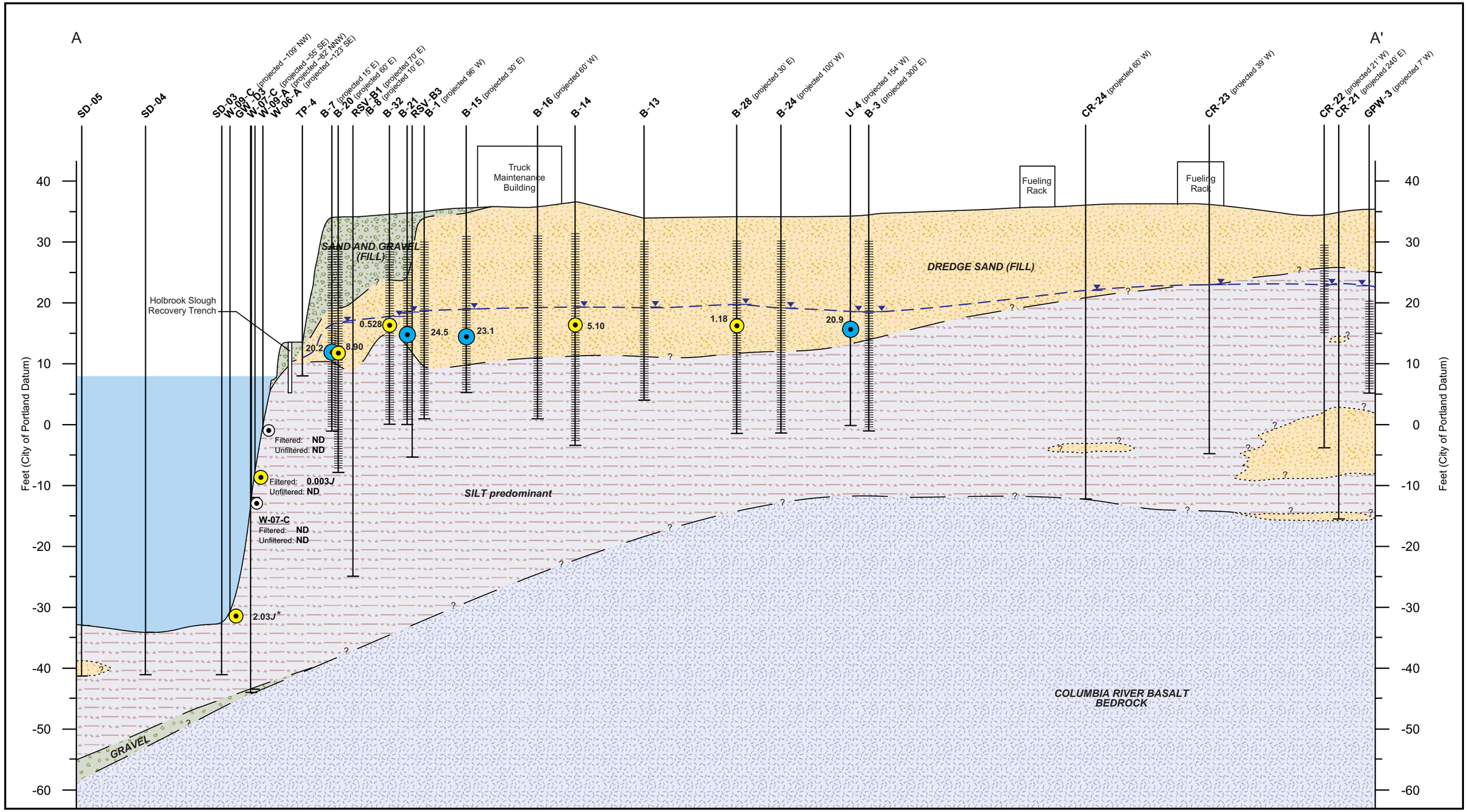
0 10 20 Feet
Vertical scale

0 200 400 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
J - Estimated
- Monitoring Well Screen

Figure C3.8-3a
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Stratigraphic Cross Section A-A' and Concentrations of Total BTEX in Nearshore Groundwater and Transition Zone Water



Base features from SAIC, 2005.
Locations should be considered approximate.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

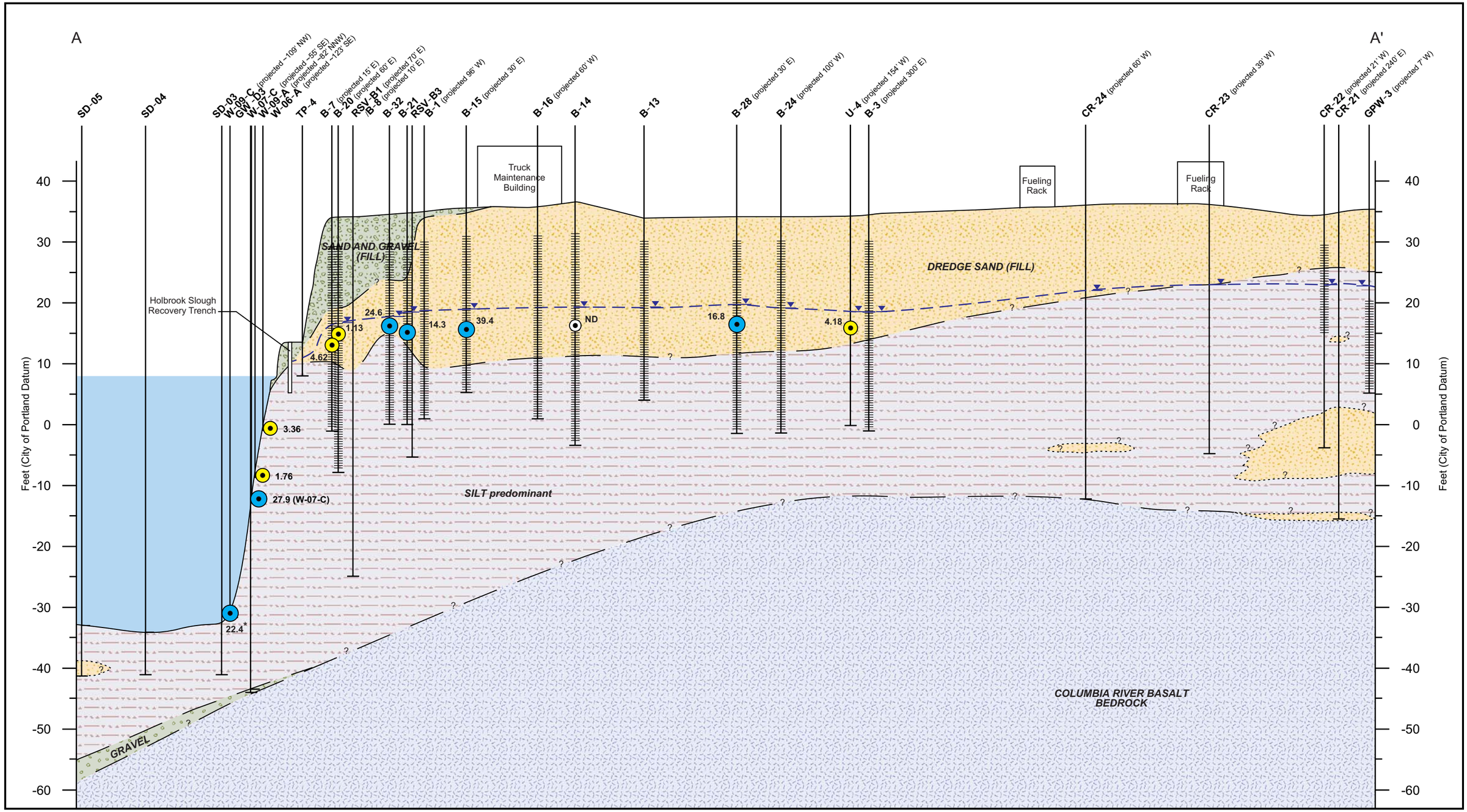
0 10 20 Feet
Vertical scale

0 200 400 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
J - Estimated
* - Sample collected with peeper method
Upland groundwater data assumed to be unfiltered.
- Monitoring Well Screen

Figure C3.8-3b
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Stratigraphic Cross Section A-A' and Concentrations of Total PAHs in Nearshore Groundwater and Transition Zone Water



Base features from SAIC, 2005.
Locations should be considered approximate.

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

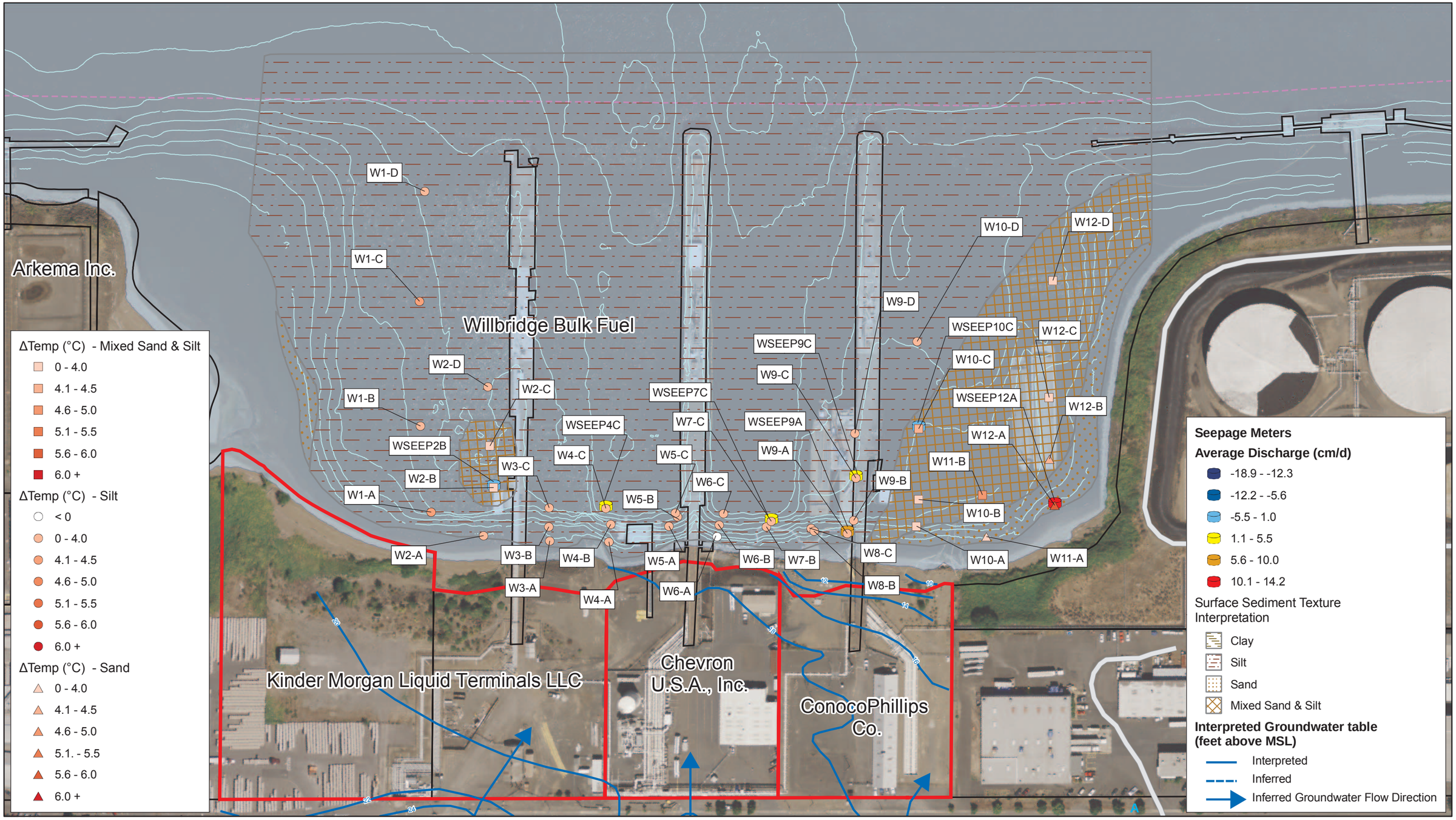
0 10 20 Feet
Vertical scale

0 200 400 Feet
Horizontal scale

Sample Concentration Range:
- ND
- DL - 10 µg/L
- 10 - 100 µg/L

Approximate groundwater elevation
DL - Detection Limit
ND - Not Detected
* - Sample collected with peeper method
Upland and in-water groundwater data are unfiltered total chromium.
- Monitoring Well Screen

Figure C3.8-3c
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Stratigraphic Cross Section A-A' and Concentrations of Total Chromium in Nearshore Groundwater and Transition Zone Water



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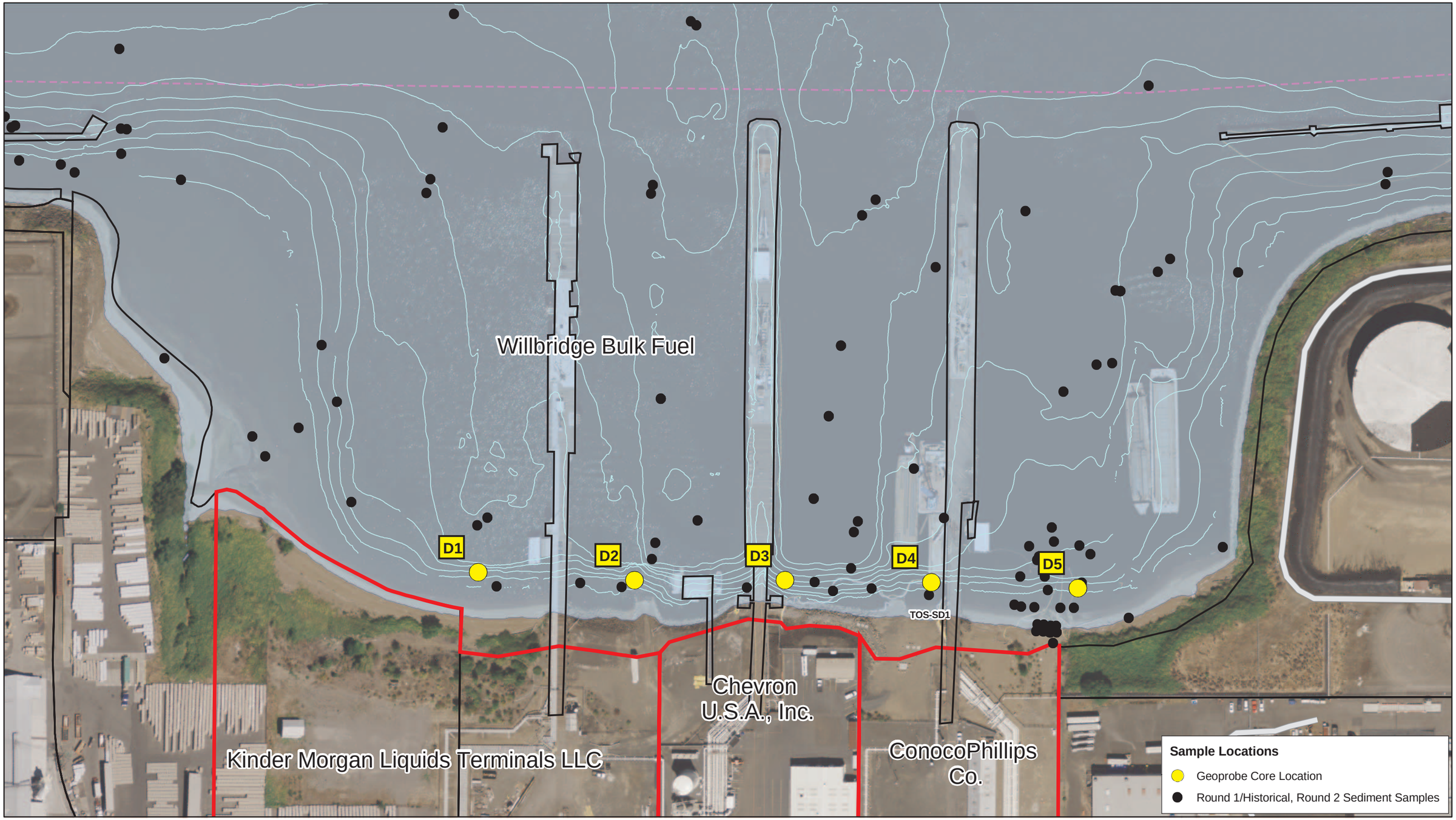
LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD88)
Navigation Channel
Site Property Boundary

0 50 100
Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-4
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Trident Probe and Seepage Meter Results



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LEGEND

River Miles

2003 Bathymetric 5 Ft. Contours (NAVD88)

Navigation Channel

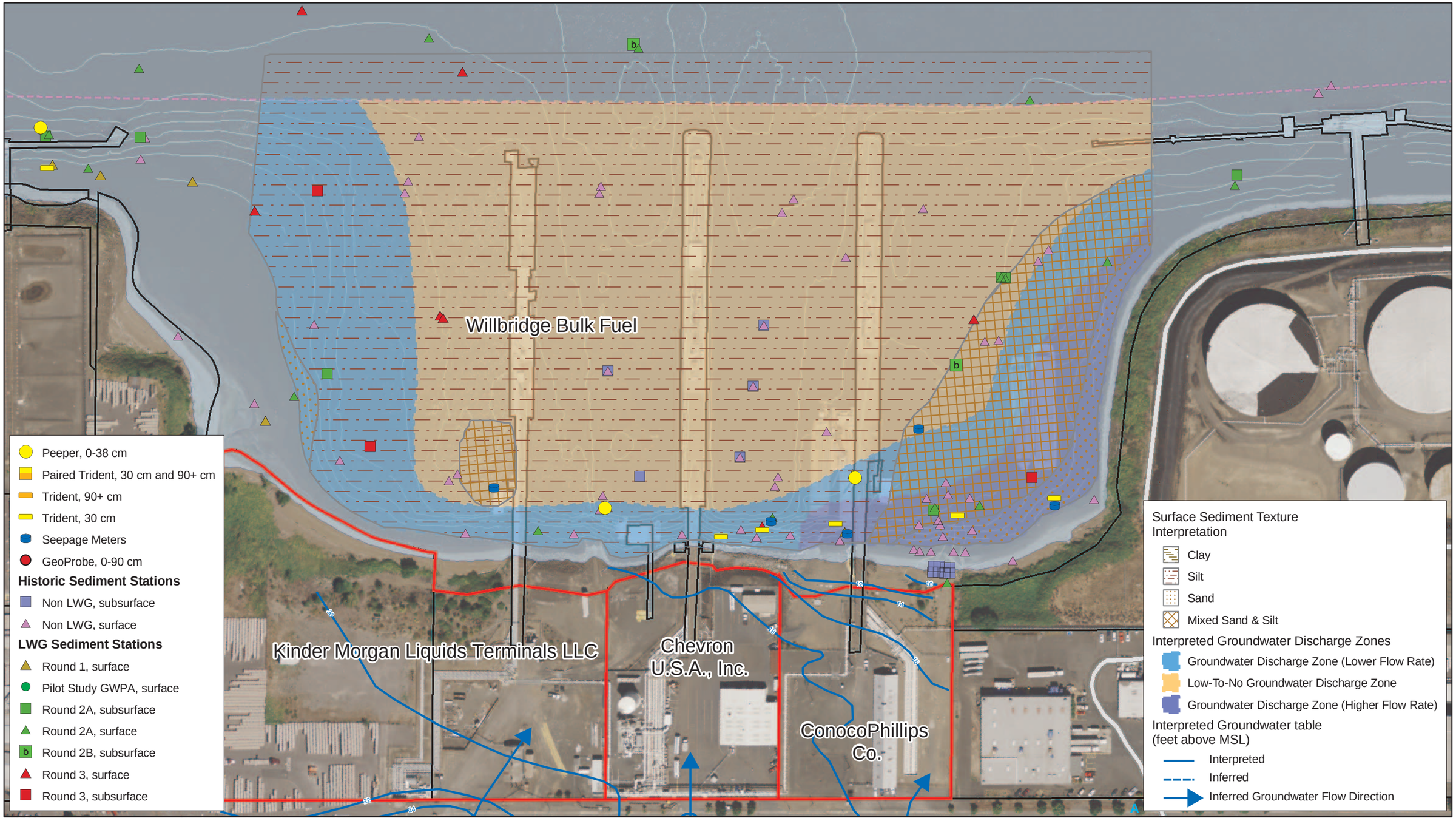
0 50 100

Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-5
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Locations of Round 2 GWPA Stratigraphic Cores



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 50 100
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Wells: locations are approximate and drawn from Delta Environmental Consultants 2005. Semi Annual Groundwater Monitoring Report (April 2004 through September 2004, Willbridge Bulk Fuel Terminals, March 15, 2005.

Figure C3.8-6
Portland Harbor RI/FS
Remedial Investigation Report
Willbridge Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

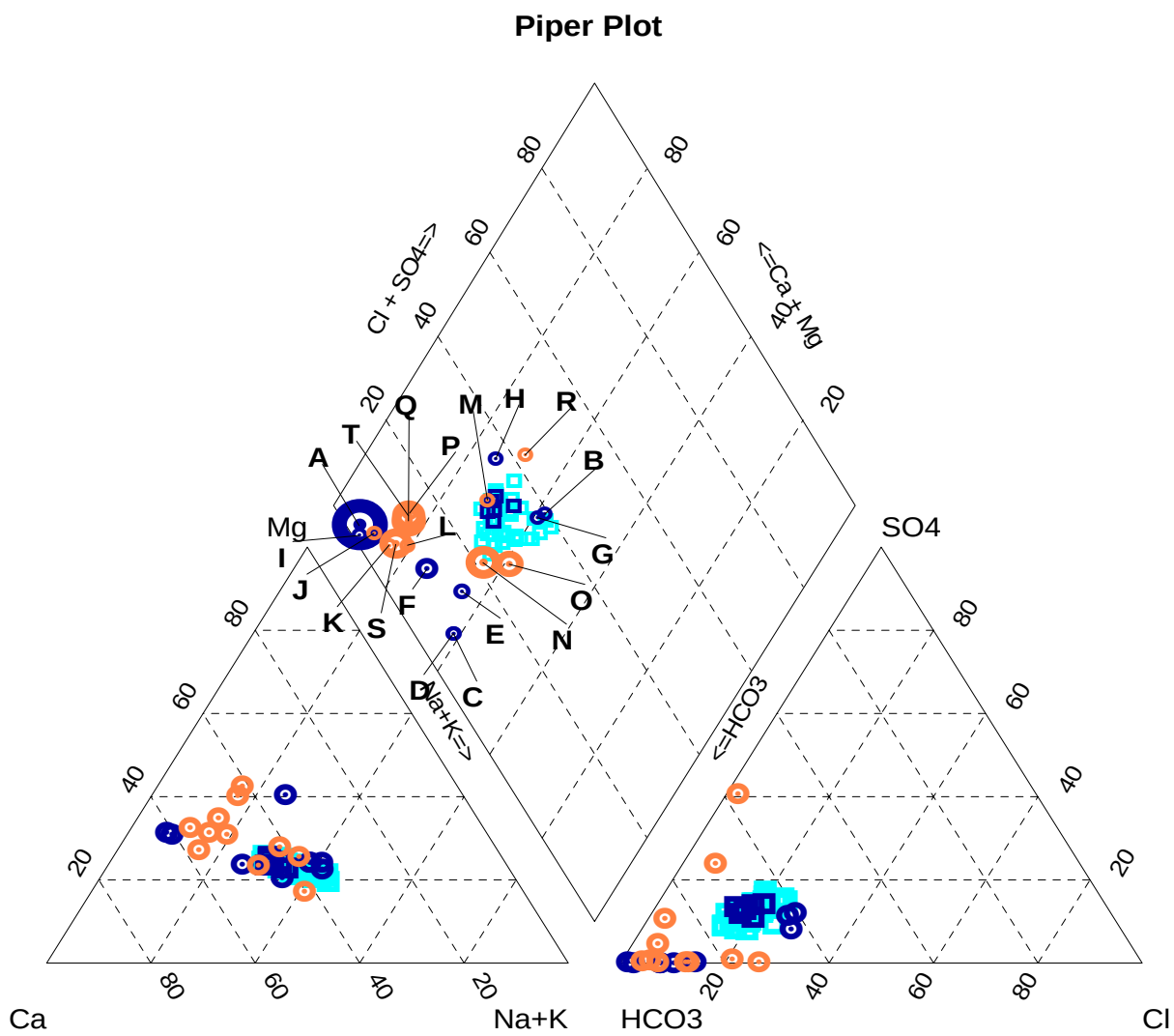
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	R2-W-02, Trident 30 cm	922	13	0.05	227	69.9	7.15	26.9	6.62	1266
B	Groundwater Discharge Zone	W-09-A, Trident 30 cm	31	8.1	4.8	7.83	2.97	1.3	9.6	7.35	65.6
C	Groundwater Discharge Zone	W-12-A, Trident 30 cm	213	10	0.05	34.8	13.6	3.05	39.2	6.75	313.7
D	Groundwater Discharge Zone	W-12-A, Trident 30 cm; FR	213	9.9	0.05	35.7	13.9	2.96	40.1	6.8	315.61
E	Groundwater Discharge Zone	W-04-C, Peeper 0 - 38 cm	263	24.7	0.19	50	13.9	1.665	43.9	7.63	397.355
F	Groundwater Discharge Zone	W-04-C, Peeper 0 - 38 cm; FR	361	23.1	0.16	71.3	20.3	1.74	40.2	7.49	517.8
G	Groundwater Discharge Zone	W-06-A, Trident 30 cm	34	8.3	4.8	8.23	3.42	1.51	9.99	7.33	70.25
H	Groundwater Discharge Zone	W-07-C, Trident 30 cm	44	11.4	4.4	17.4	12.5	3.32	13	7.12	106.02
I	Groundwater Discharge Zone	W-09-C, Peeper 0 - 38 cm	232	1.7	0.2	53.9	16.6	2.37	7.36	6.76	314.13
J	Upland Groundwater	B-7	262	4.98	1	57	20	3.3	11		359.28
K	Upland Groundwater	B-9	227	6.05	1	39.6	14.1	2.38	11.8		301.93
L	Upland Groundwater	B-20	125	3.14	4.08	31	11.6	2.53	12		189.35
M	Upland Groundwater	CR-1	31.6	1.34	6.988	7.62	2.27	1.16	4.6		55.578
N	Upland Groundwater	CR-26	521	66.6	3.46	93.7	37.2	9.13	92.9		823.99
O	Upland Groundwater	CR-27C	380	64.8	1	82.5	20.6	6.2	88.1		643.2
P	Upland Groundwater	CR-31A	159	2.8	12.5	43.9	18.6	3.63	13.6		254.03
Q	Upland Groundwater	CR-31B	527	35.2	1	103	64.1	9.58	40.7		780.58
R	Upland Groundwater	CR-32A	94.3	1.7	43.1	25.4	10.4	2.03	20.4		197.33
S	Upland Groundwater	CR-32B	548	19.6	1	97.2	54.4	5.74	39.3		765.24
T	Upland Groundwater	CR-32C	452	31.7	1	153	43.7	8.27	43		732.67

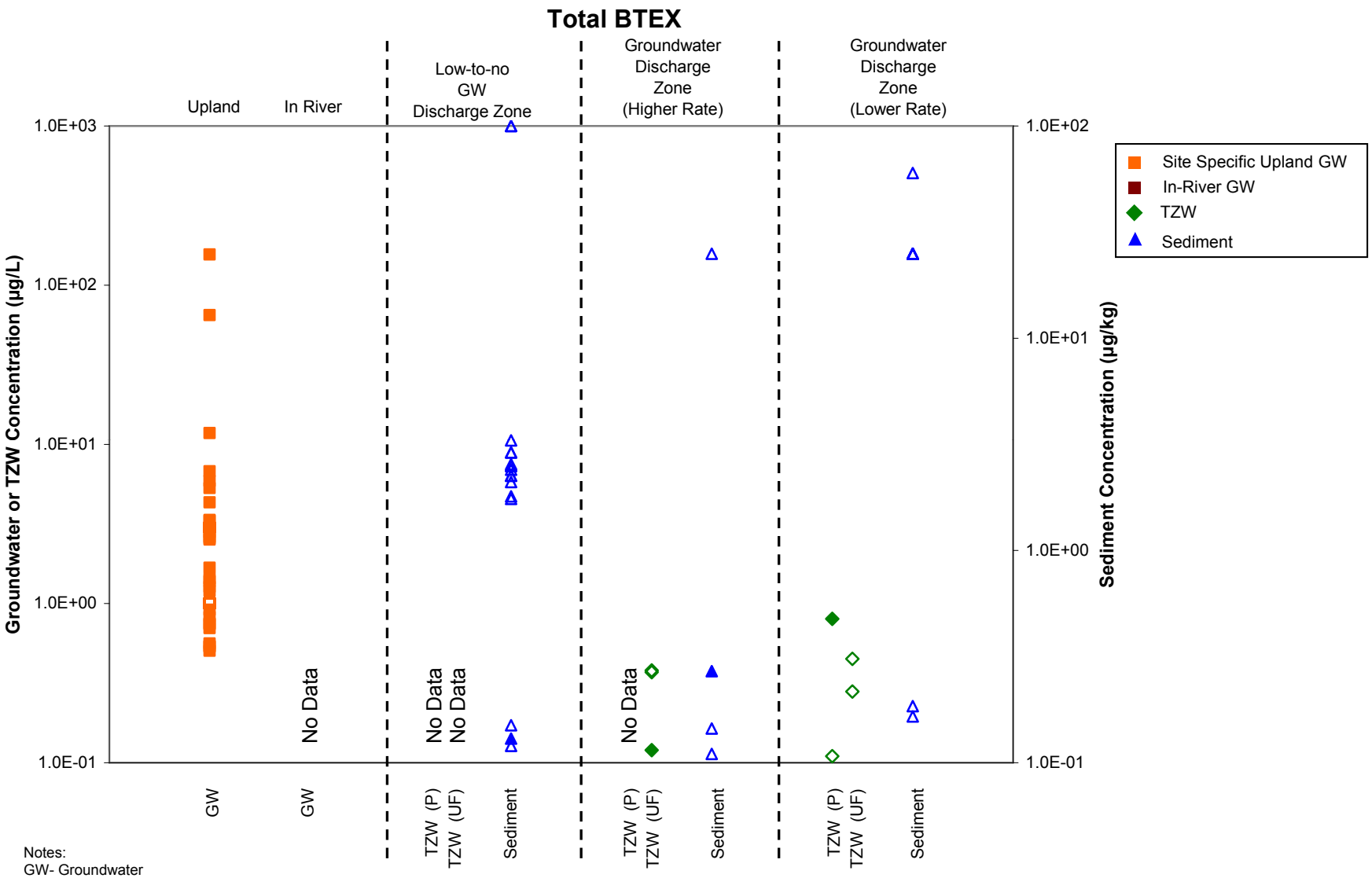
Notes:

[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

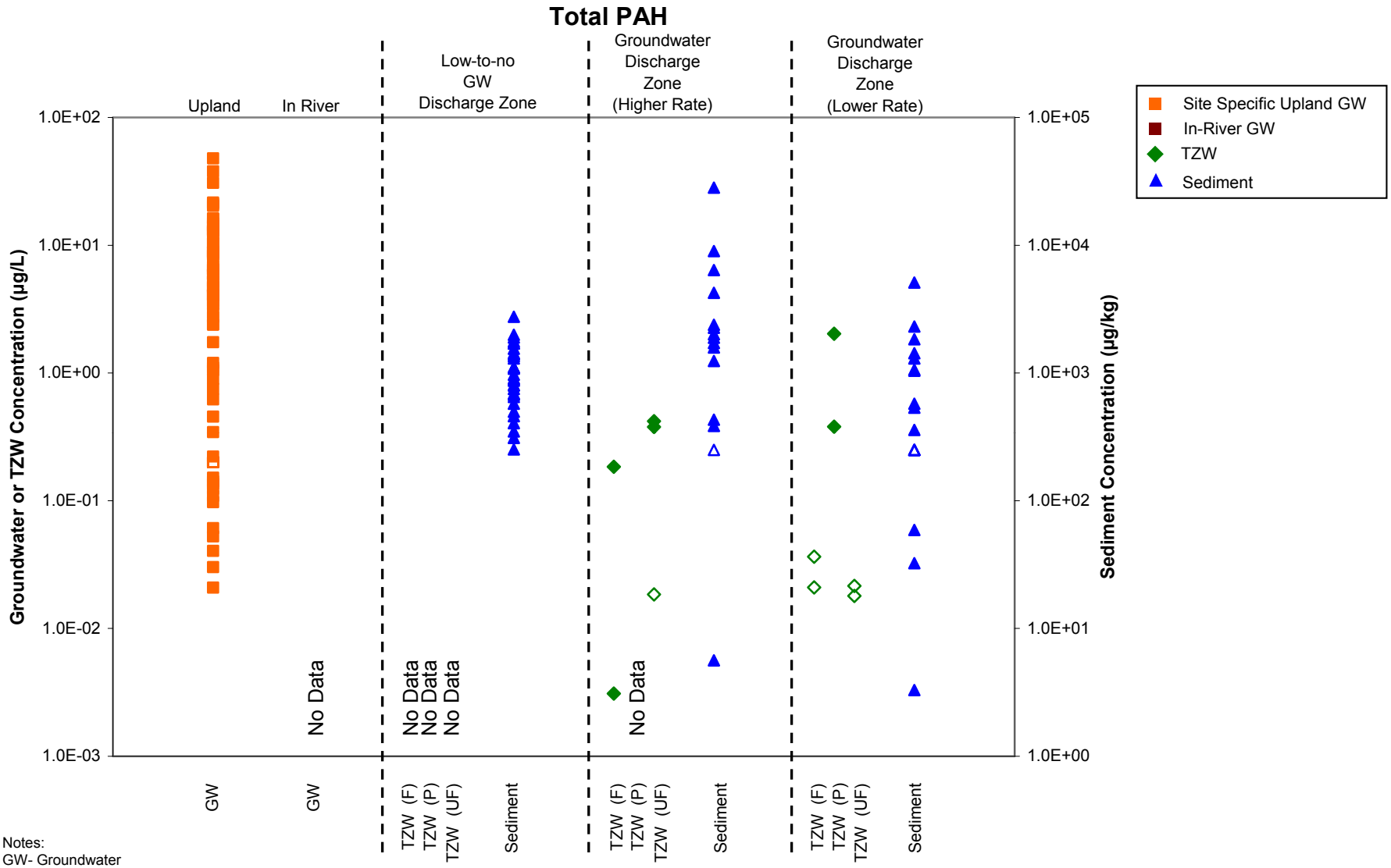
All concentrations as mg/L; pH in s.u.

Figure C3.8-7
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Willbridge



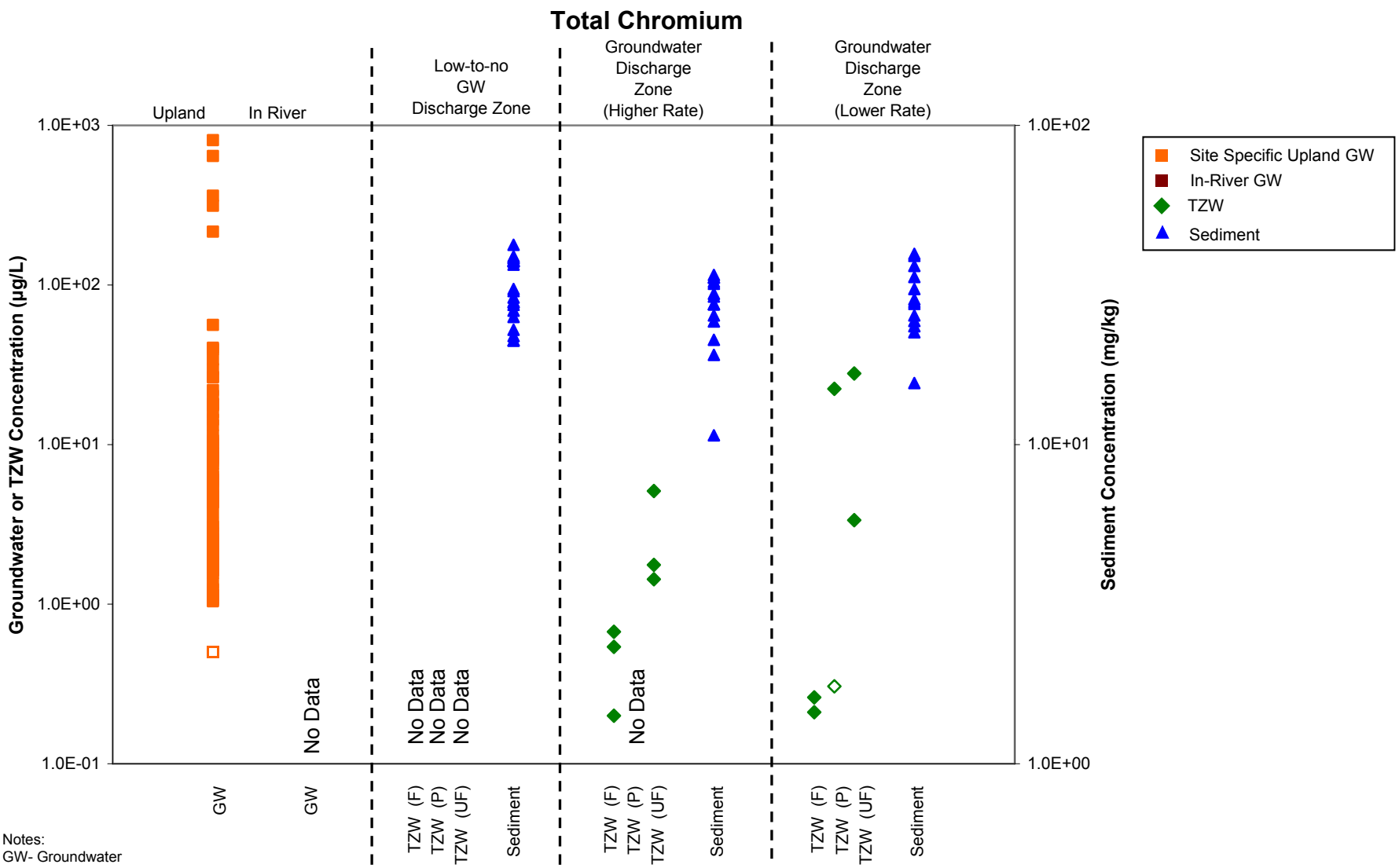
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-7, B-9, B-20, CR-1, MW-33, MW-34, MW-40, U-10, U-11, P-1, P-2.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.8-8a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total BTEX - Willbridge



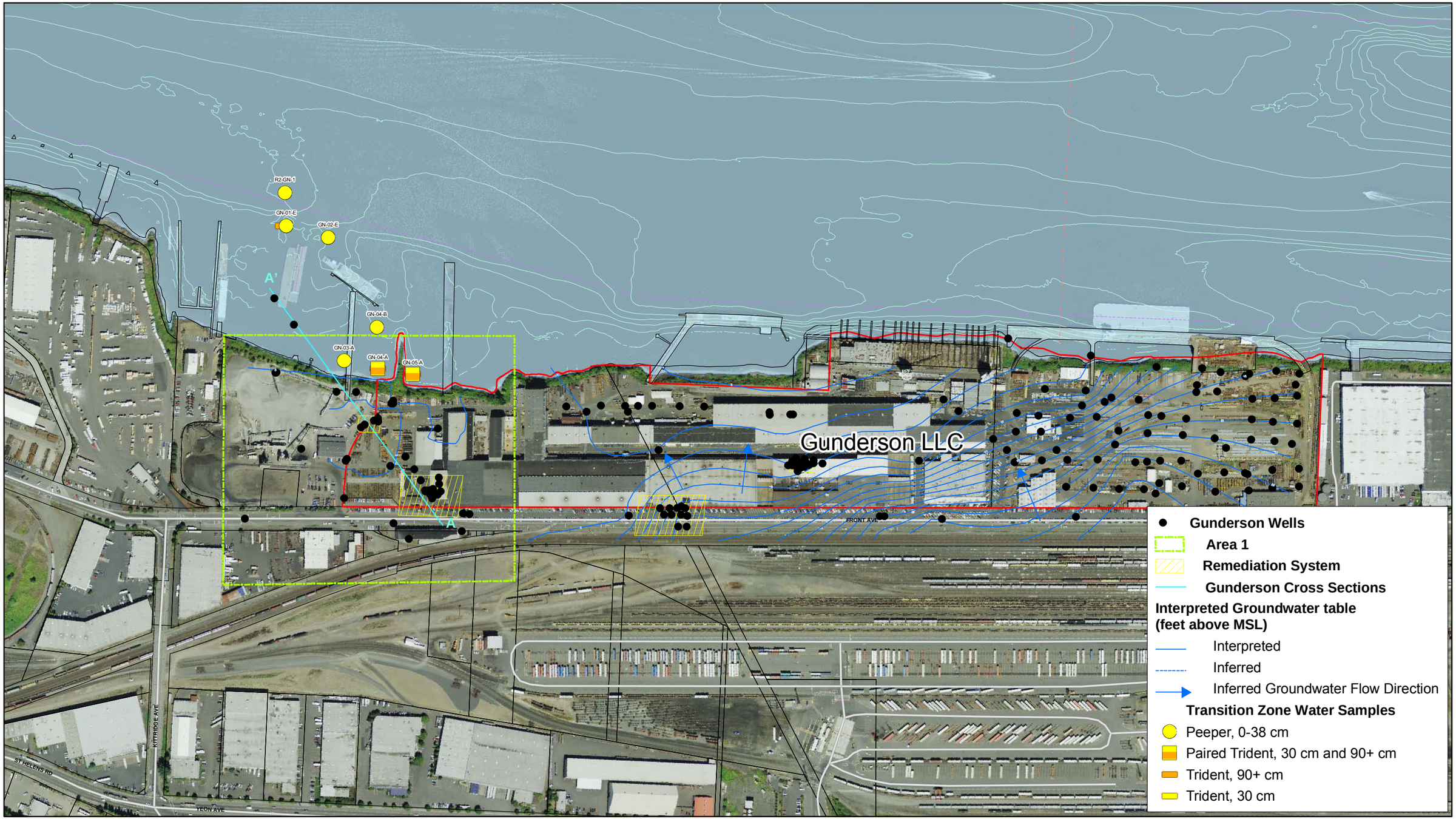
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-7, B-9, B-20, CR-1, MW-33, MW-34, MW-40, U-10, U-11, P-1, P-2.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.8-8b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total PAHs - Willbridge



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-7, B-9, B-20, CR-1, MW-33, MW-34, MW-40, U-10, U-11, P-1, P-2.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.8-8c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Chromium - Willbridge



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LEGEND

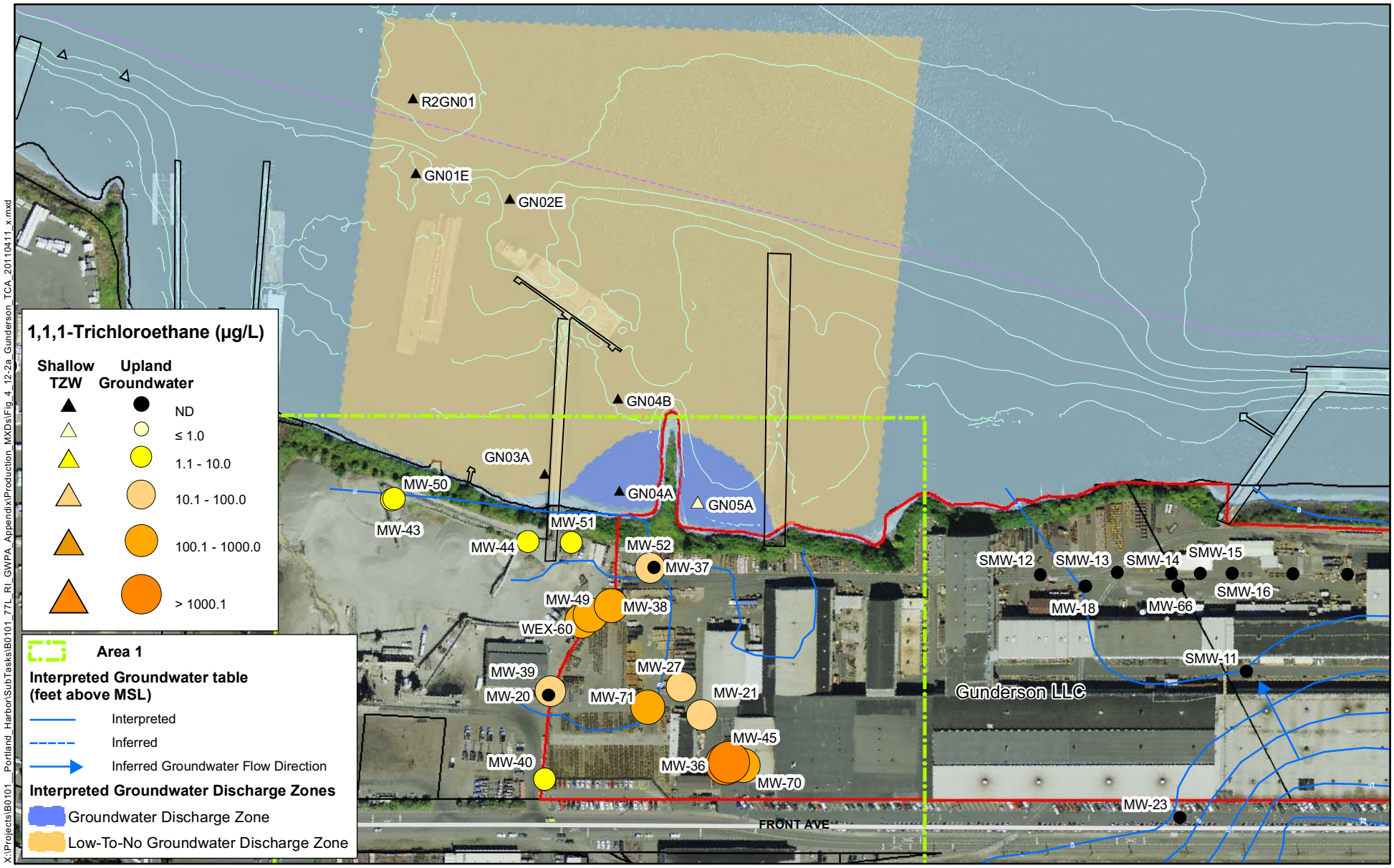
- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility). Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-1
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Overview and Cross Section Location



LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD88)
Navigation Channel
Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility).
Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-2a
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
1,1,1-Trichloroethane in
Upland Groundwater and Shallow TZW

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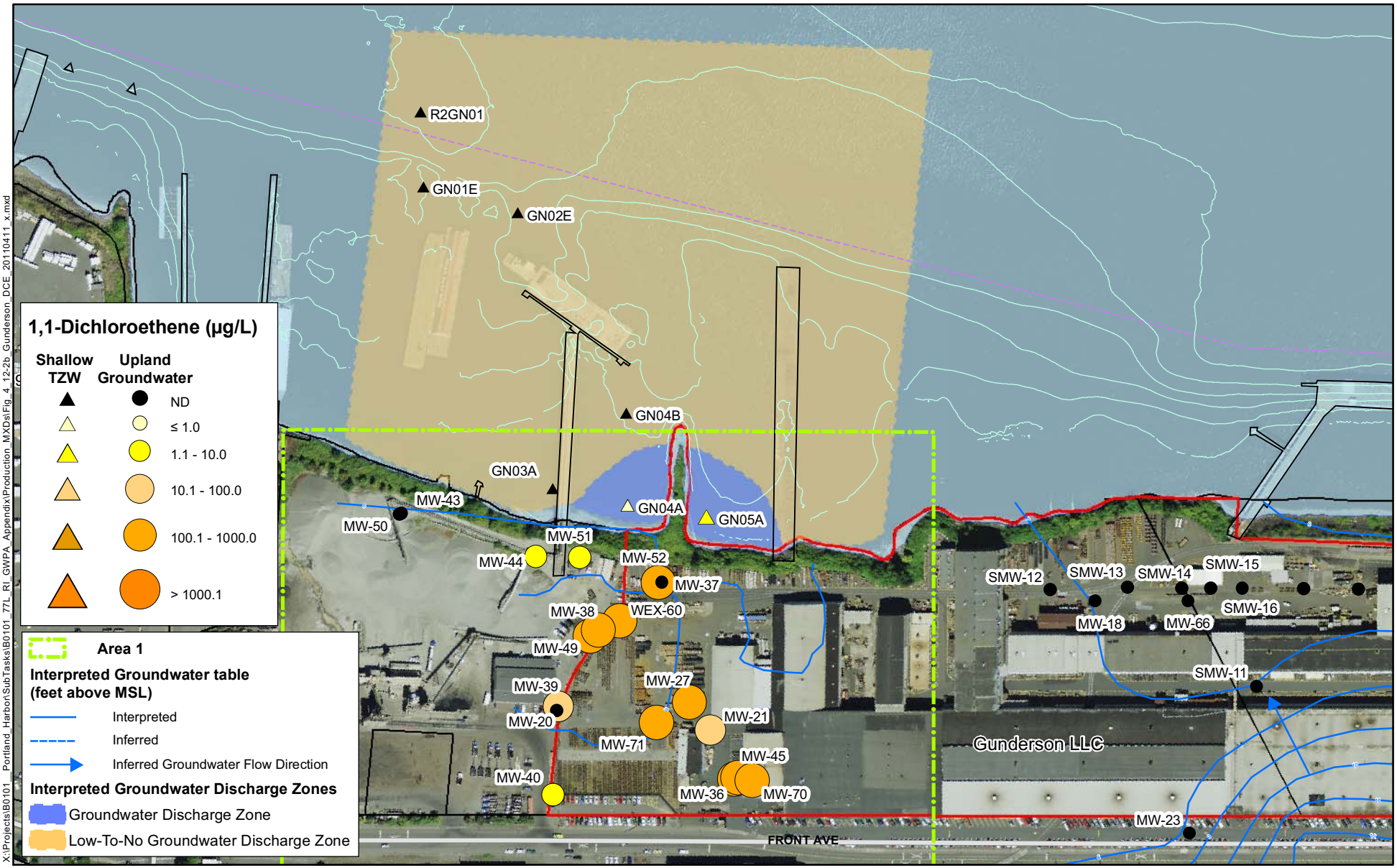

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LEGEND

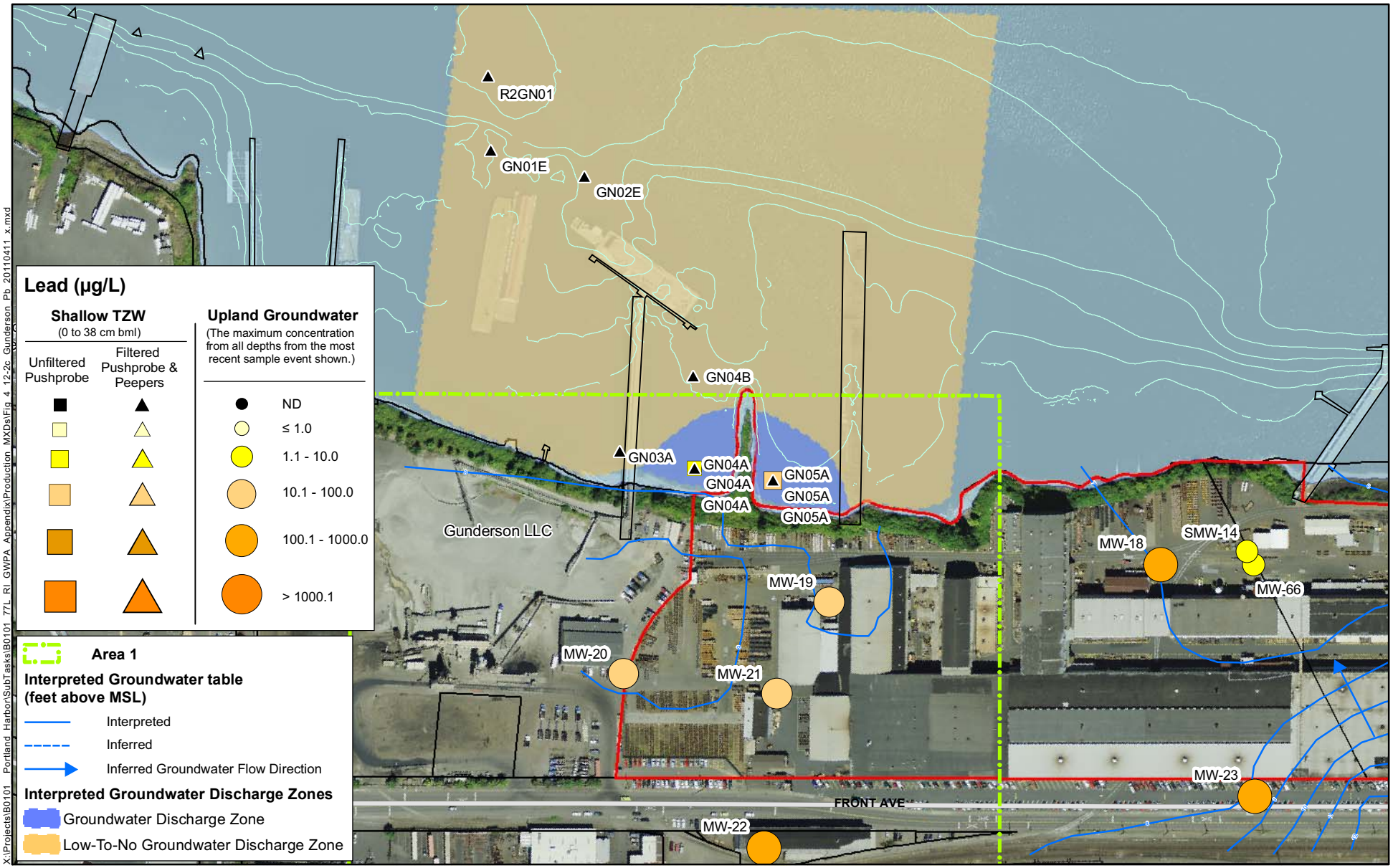
2003 Bathymetric 5 Ft. Contours (NAVD88)
Navigation Channel
Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility). Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-2b
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
1,1-Dichloroethene in
Upland Groundwater and Shallow TZW



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LEGEND

2003 Bathymetric 5 Ft. Contours (NAVD88)

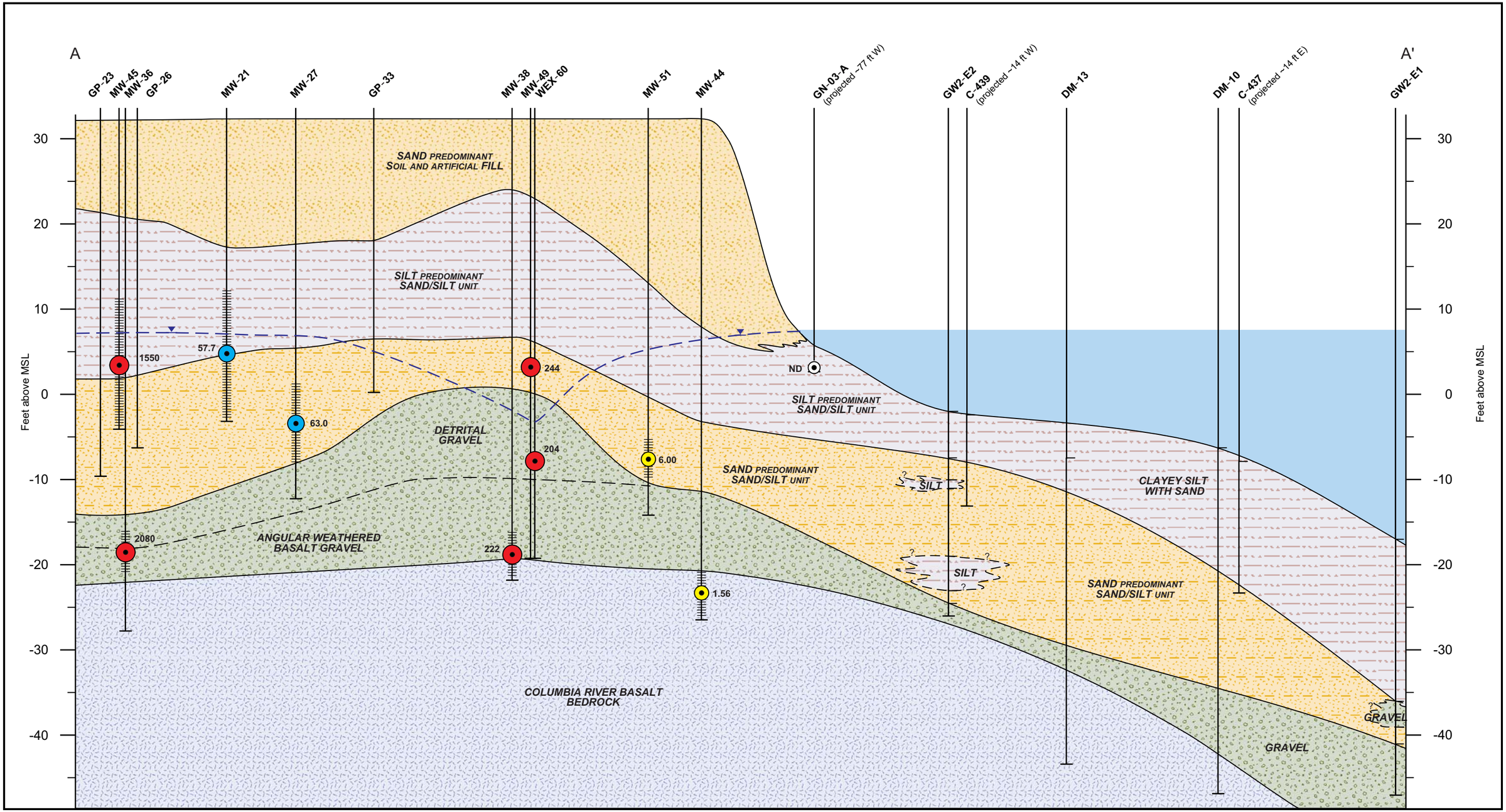
Site Property Boundary

0 100 200

Feet

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility).
Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-2c
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Total Lead in Upland Groundwater and Shallow TZW



Base features from SQUIER Associates, 2003.

Locations should be considered approximate.

Top of bank assumed at 32' amsl.

MW-27 is located on the basalt bench. Not used to develop this cross-section.

DM-10 and DM-13 are historical borings conducted off Lakeside Properties in 1973 (King 2005, pers. Comm.)

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:

- ND
- DL - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

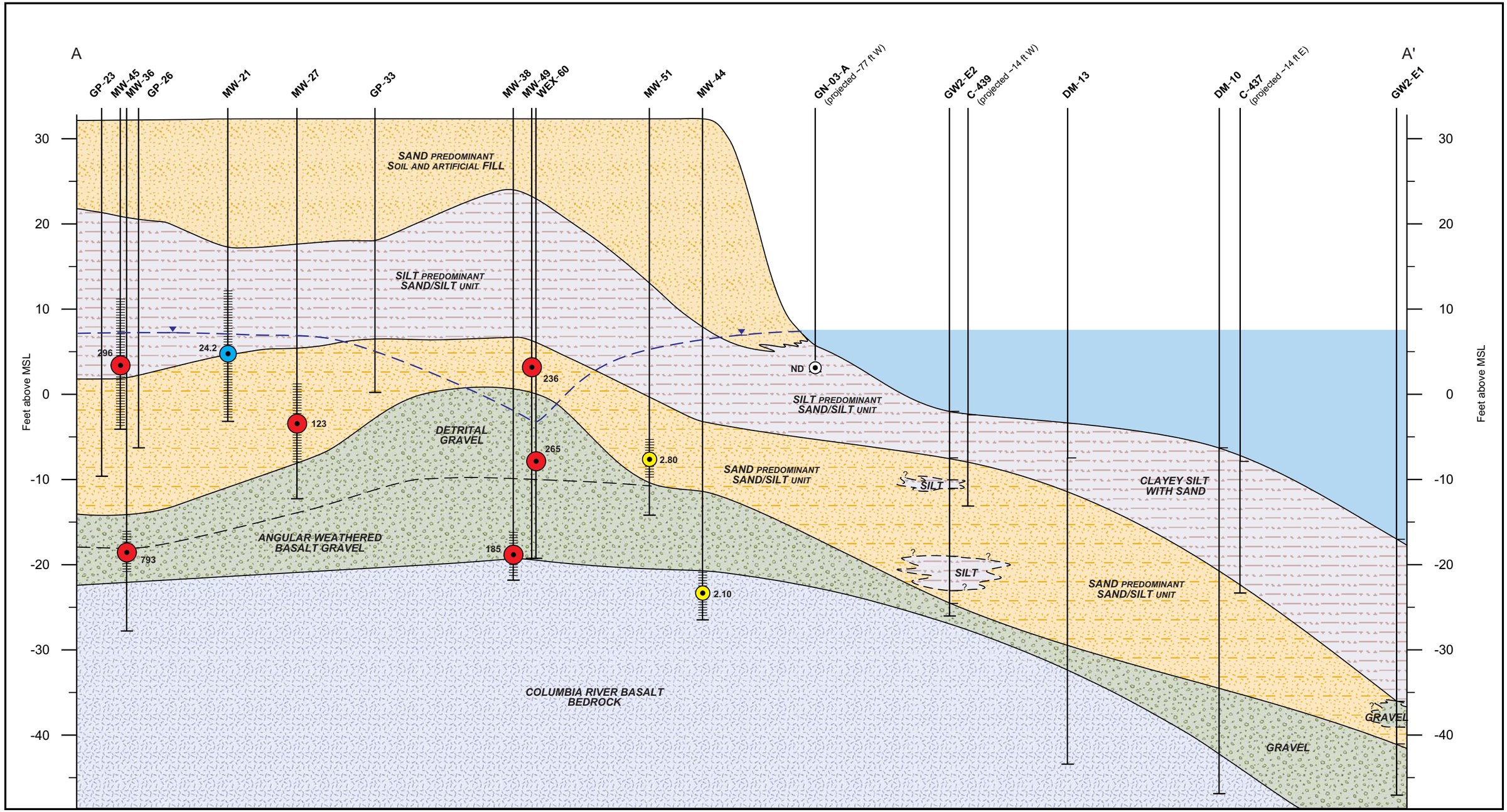
Approximate groundwater elevation

DL - Detection Limit

ND - Not Detected

- Monitoring Well Screen

Figure C3.9-3a
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Stratigraphic Cross Section A-A' and
Concentrations of TCA in Nearshore
Groundwater and Transition Zone Water



Base features from SQUIER Associates, 2003.

Locations should be considered approximate.

Top of bank assumed at 32' amsl.

MW-27 is located on the basalt bench. Not used to develop this cross-section.

DM-10 and DM-13 are historical borings conducted off Lakeside Properties in 1973 (King 2005, pers. Comm.)

Offshore core and surface grab data adapted from Round 2 sampling events, Integral Consulting, Inc. 2004-2005.

0 10 20 Feet
Vertical scale

0 100 200 Feet
Horizontal scale

Sample Concentration Range:

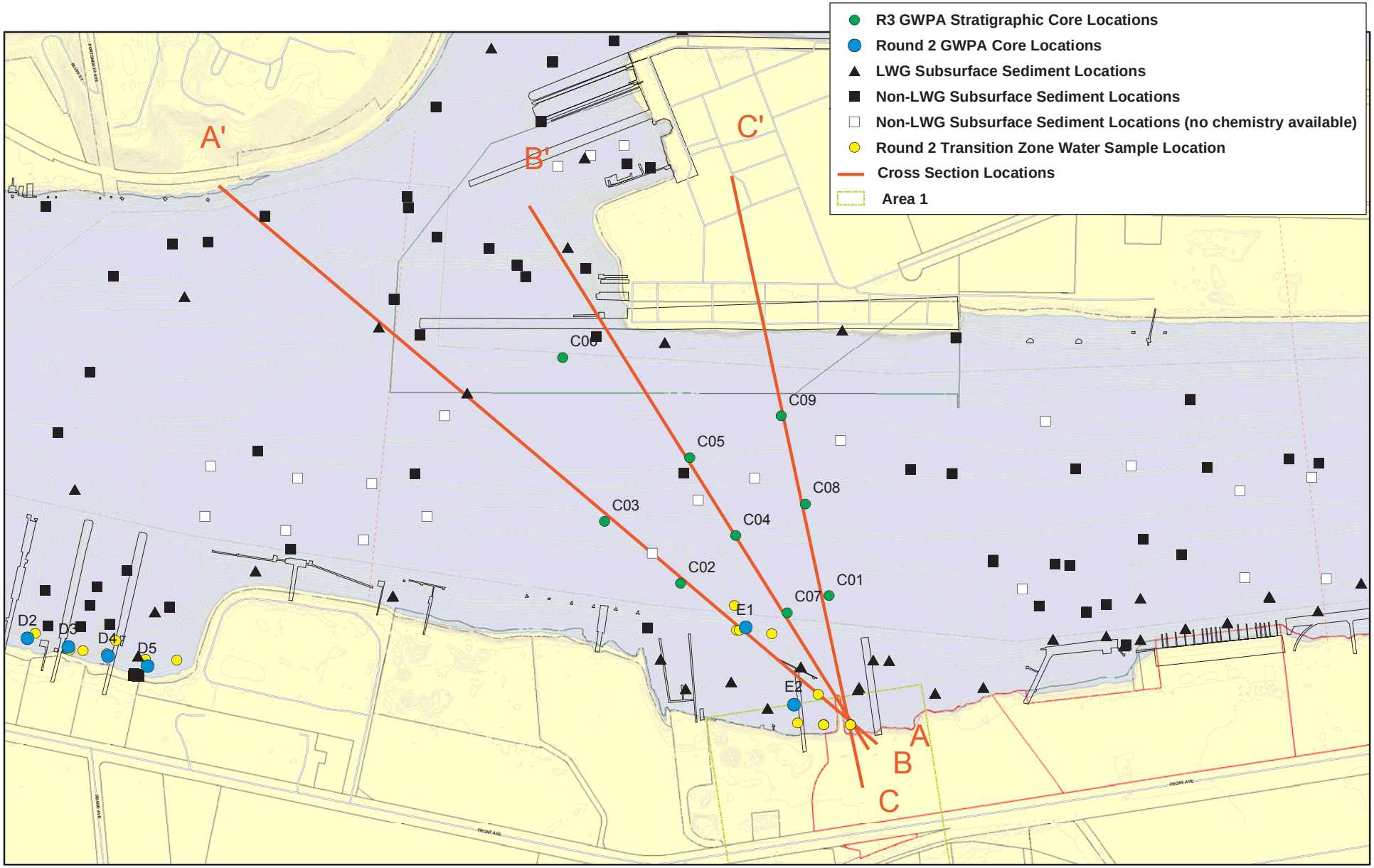
- ND
- 1 - 10 µg/L
- 10 - 100 µg/L
- > 100 µg/L

Approximate groundwater elevation

ND - Not Detected

- Monitoring Well Screen

Figure C3.9-3b
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Stratigraphic Cross Section A-A' and
Concentrations of 1,1-Dichloroethene in Nearshore
Groundwater and Transition Zone Water



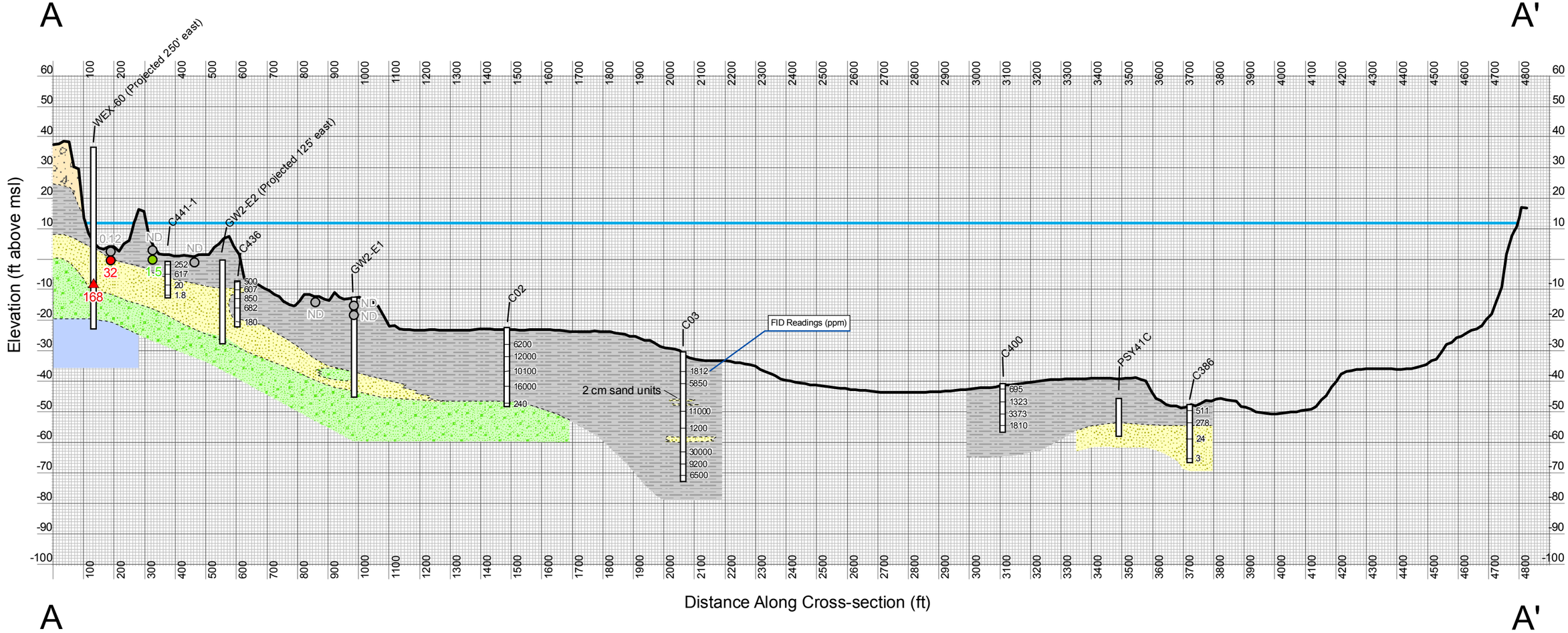
LEGEND

- River Miles
- Navigation Channel
- Site Property Boundary

0 300 Feet

FEATURE SOURCES:
Aerial Photo: Spencer B. Cross, October 2001.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility). Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-4a
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Offshore boring locations and
Stratigraphic Cross Sections



Round 2 Transition Zone Water Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Upland Monitoring Well Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Interpreted Subsurface Geology

- Fill
- Bedrock
- Gravel
- Gravely Sand
- Sand or Sand with Some Silt
- Silt

Figure C3.9-4b
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Stratigraphic Cross Section A-A'

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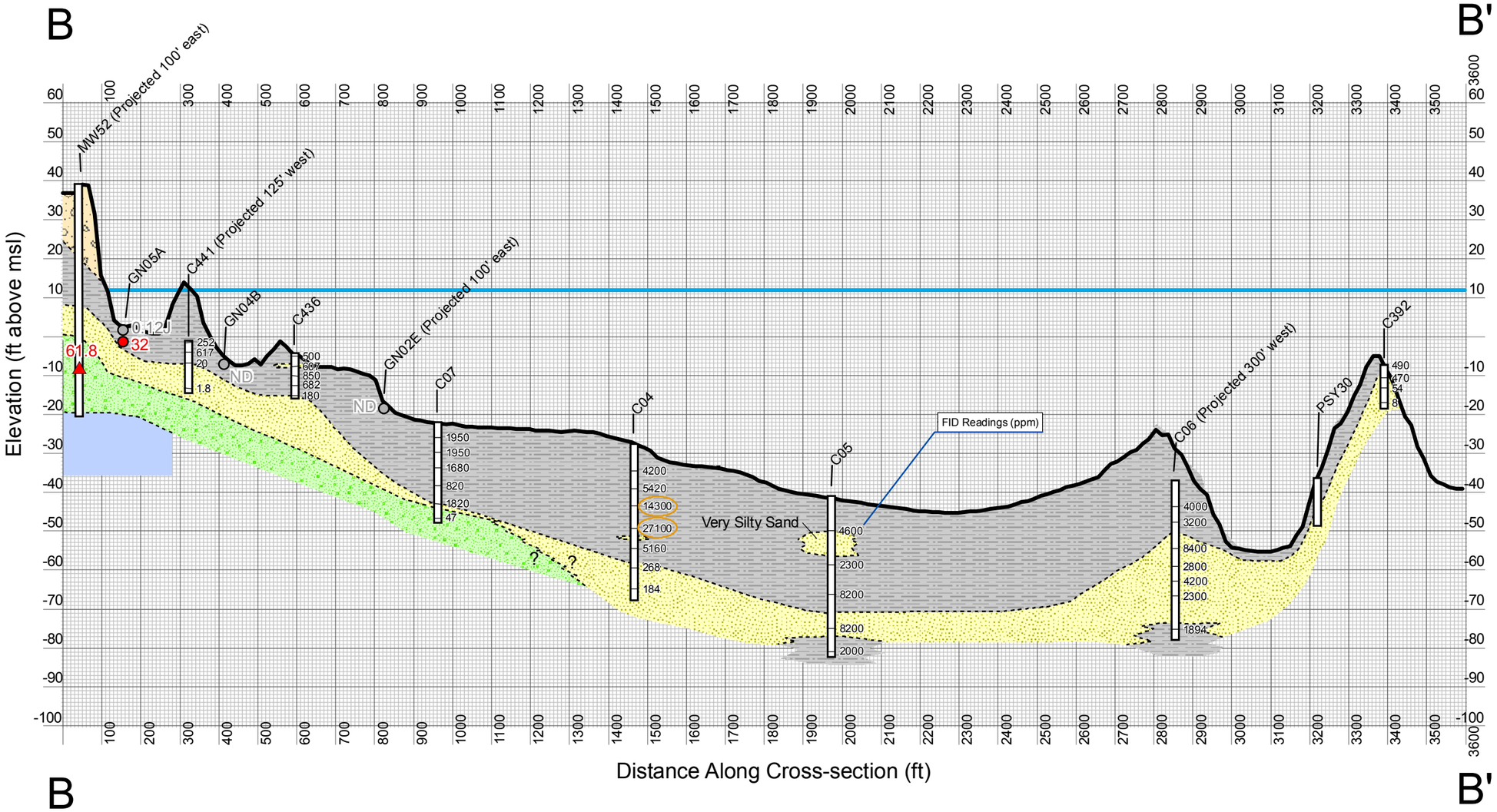

Round 2 Transition Zone Water Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Upland Monitoring Well Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Interpreted Subsurface Geology

- Fill
- Bedrock
- Gravel
- Gravely Sand
- Sand or Sand with Some Silt
- Silt

Figure C3.9-4c
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Stratigraphic Cross Section B-B'

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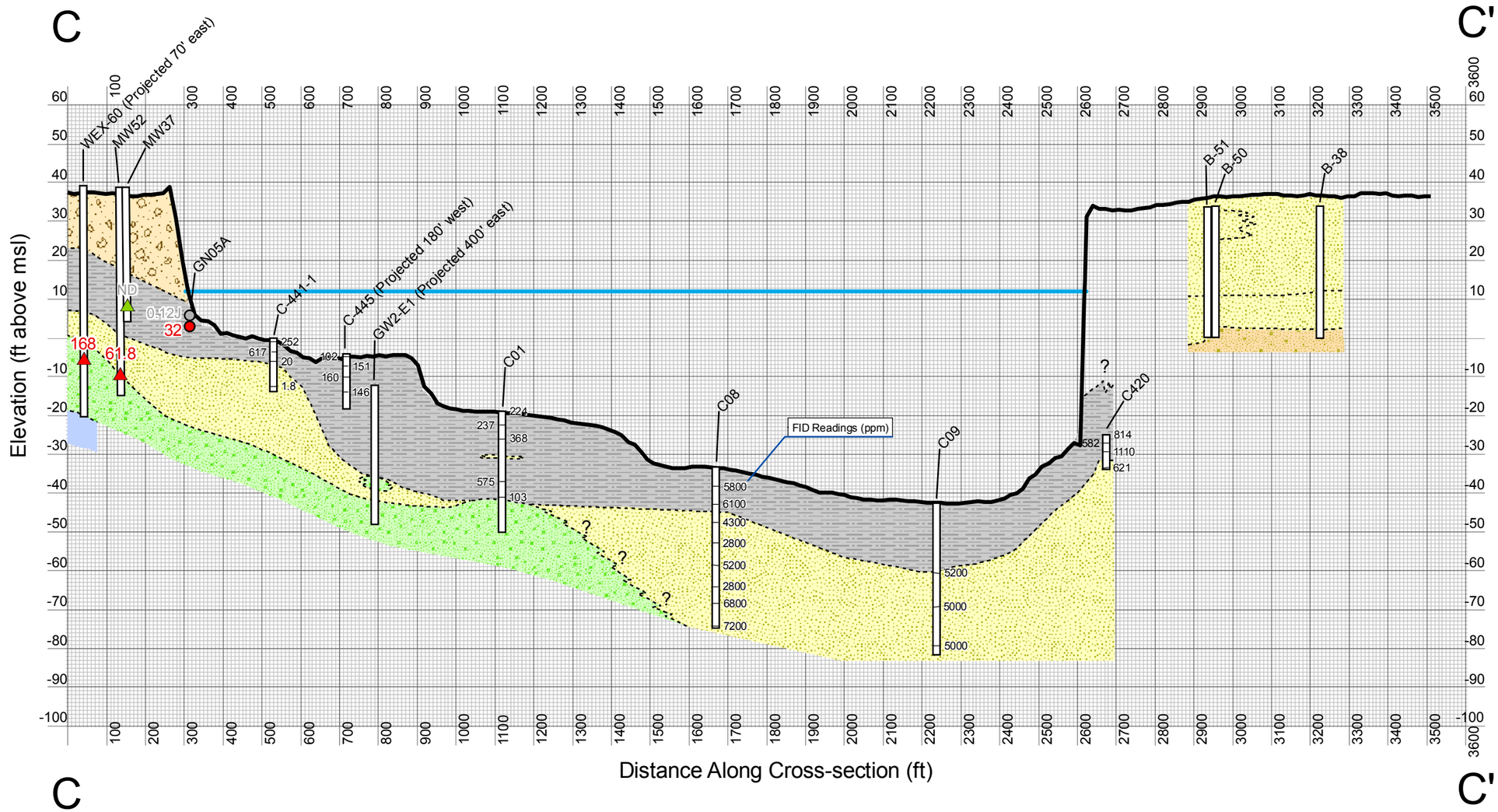

Round 2 Transition Zone Water Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Upland Monitoring Well Sample

1,1,1 - TCA Concentration (ug/L)

- < 0.12
- 0 - 5
- 5 - 10
- 10 -15
- > 15

Interpreted Subsurface Geology

Lithology

- Fill
- Bedrock
- Gravel
- Gravely Sand
- Sand or Sand with Some Silt
- Silt

Figure C3.9-4d
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Stratigraphic Cross Section C-C'

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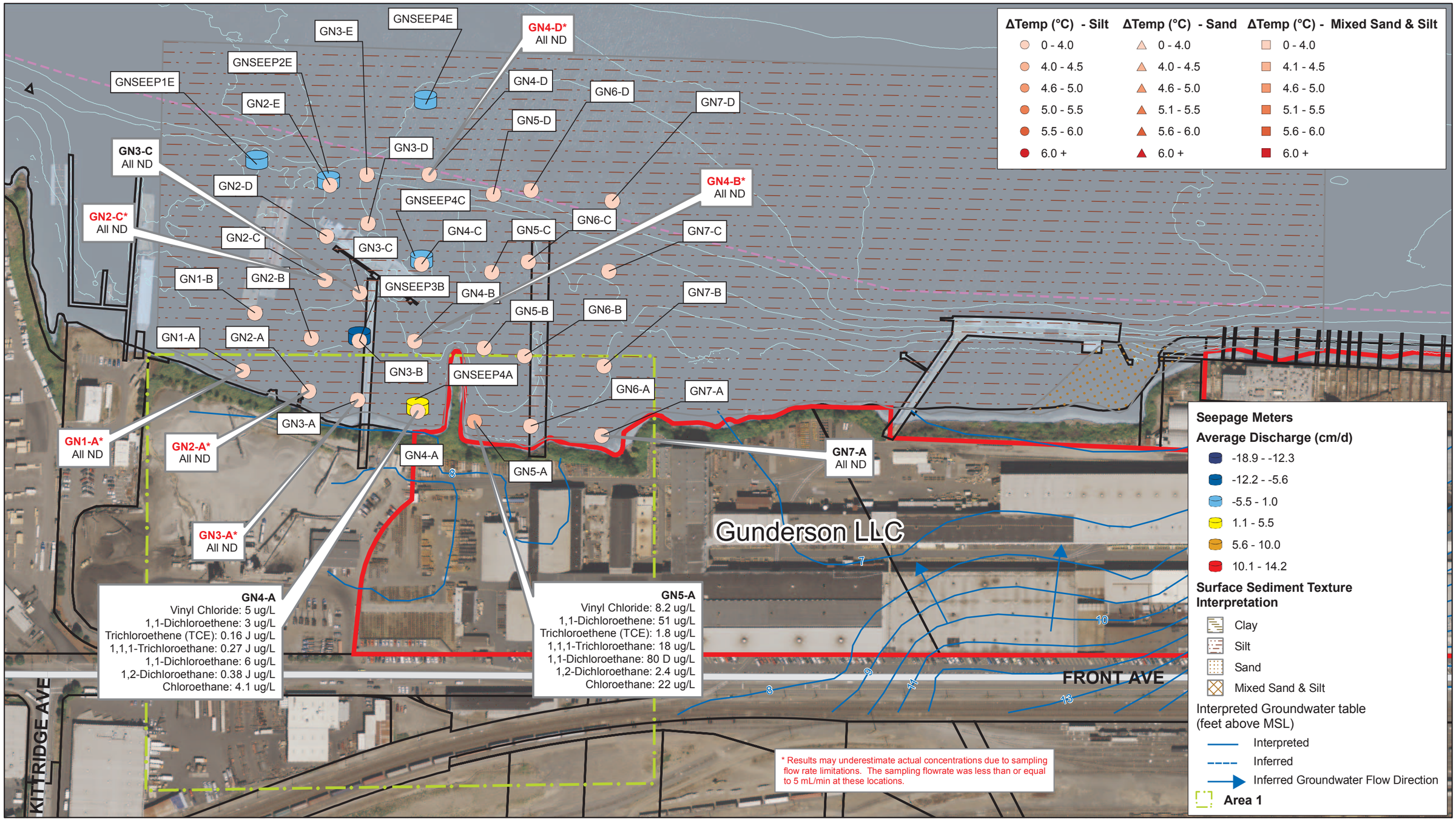

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LEGEND

- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc.
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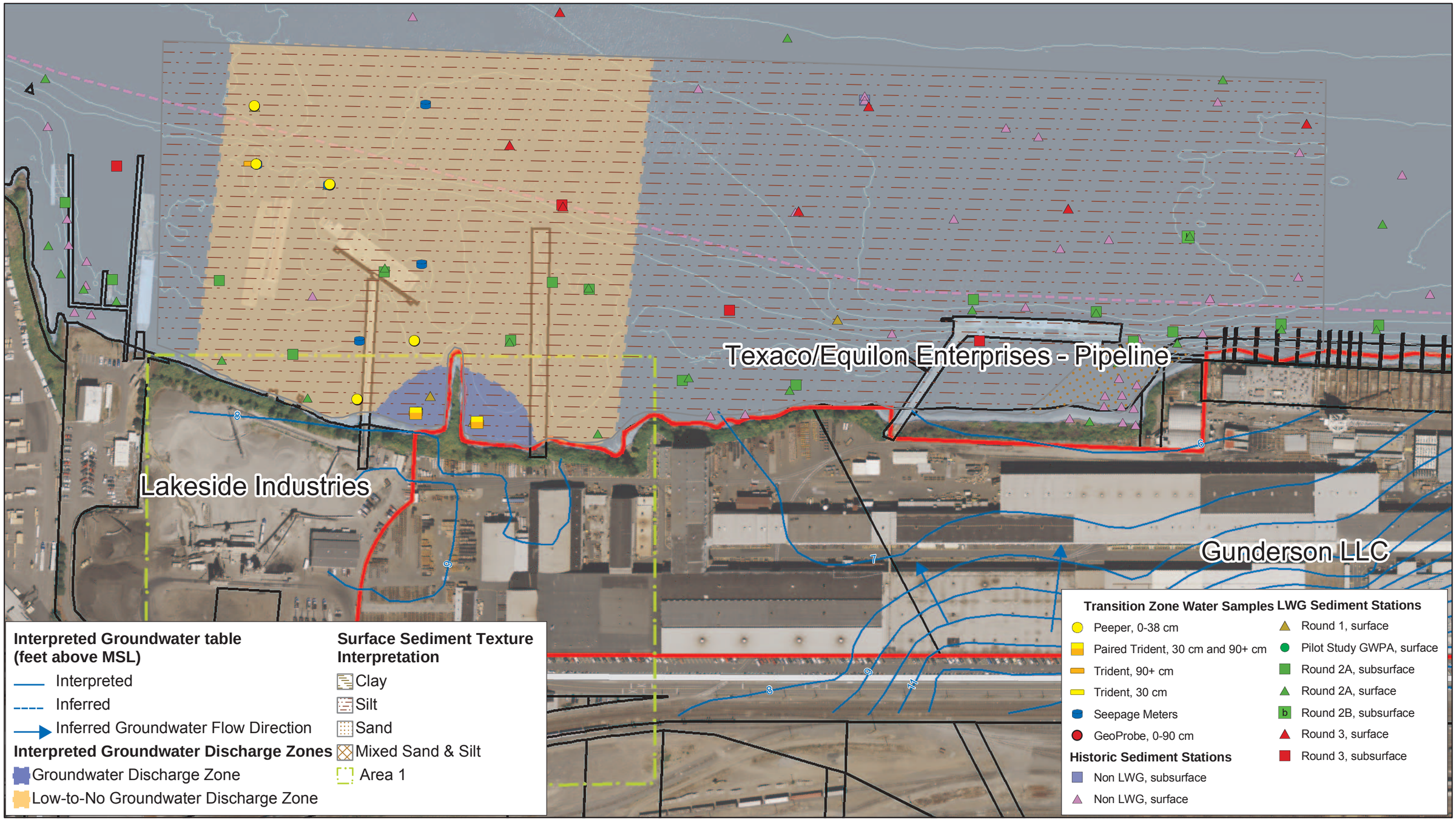
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility). Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-5
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Trident Probe and Seepage Meter Results



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LEGEND

- River Miles
- 2003 Bathymetric 5 Ft. Contours (NAVD88)
- Navigation Channel
- Site Property Boundary

0 100 200
Feet

N

FEATURE SOURCES:
Aerial Photo: Metro RLIS, 2007.
Base Map features from Portland Metro's RLIS.
Channel and River Miles: Developed from US Army Corps of Engineers information.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Groundwater Contours: locations are approximate and drawn from Squier/Kleinfelder, LLC. 2005. Gunderson, Inc. Groundwater Monitoring: Thirty-Fifth Quarterly Groundwater Sampling Event, ECSI #1155. Final ed.; Prepared for Gunderson, Inc. S090445.21. Rec#SQA0020.
Wells & Remediation Systems: locations are approximate and drawn from King, D. 2005c – Personal communication (telephone conversations with S. FitzGerald, Integral Consulting, Mercer Island, WA, on April 1 and 4, 2005 regarding the Gunderson Facility). Squier/Kleinfelder, Lake Oswego, OR.

Figure C3.9-6
Portland Harbor RI/FS
Remedial Investigation Report
Gunderson Site
Interpreted Groundwater Discharge Zones and Location of Transition Zone Water and Sediment Samples

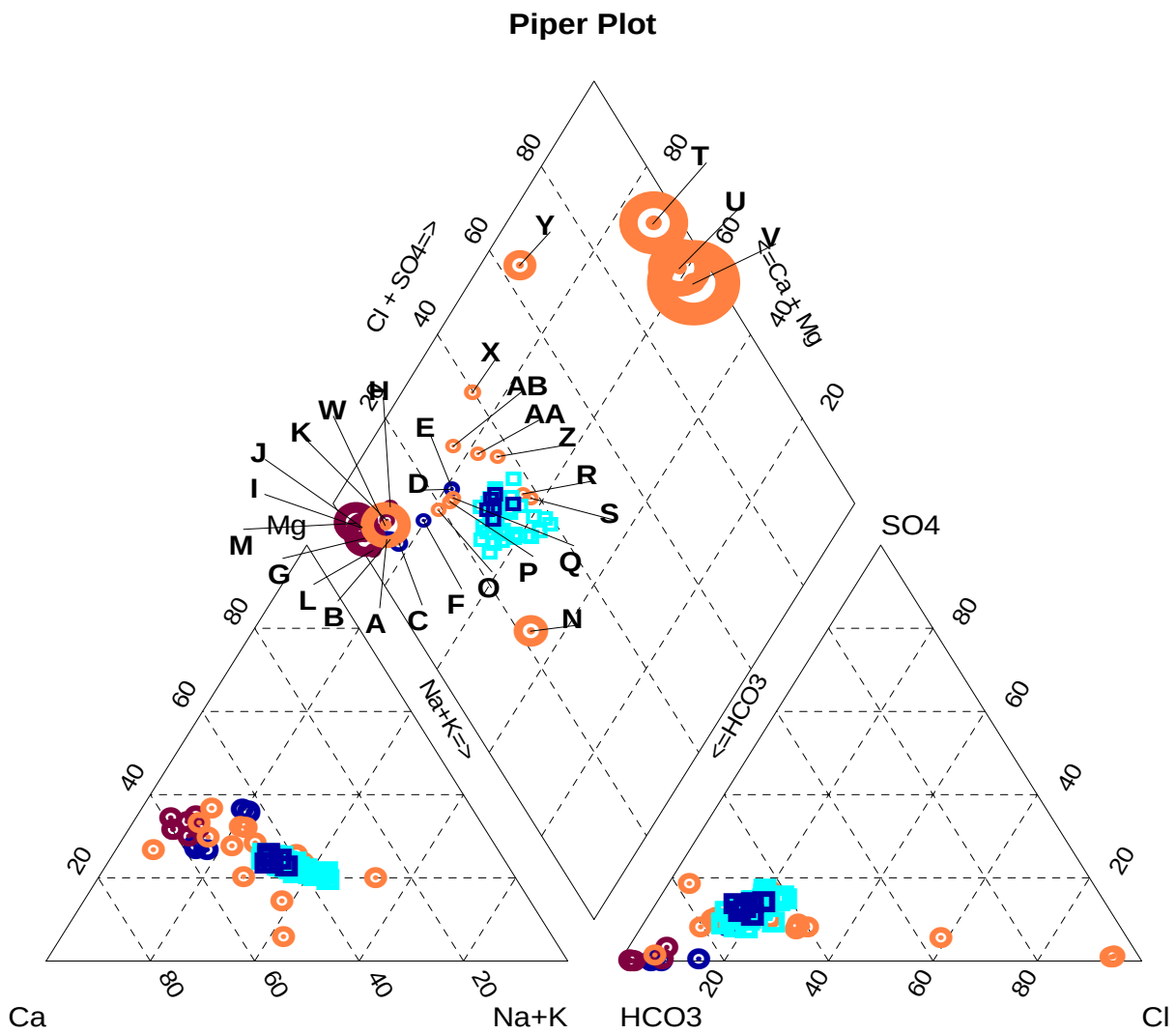
LEGEND

- Upland Groundwater
- Groundwater Discharge Zone
- Low-to-No Groundwater Discharge Zone
- Willamette R. Surface Water, St. Johns Bridge
- Willamette R. Surface Water, Morrison Bridge

Symbol Scale
(Linear Scale To TDS)

0 mg/L

2,200 mg/L



Sample	Description	Sample Information	Anions: Alkalinity[a]	Anions: Cl^-	Anions: SO_4^{2-}	Cations: Na^+	Cations: K^+	Cations: Ca^{2+}	Cations: Mg^{2+}	pH	TDS[b]
A	Groundwater Discharge Zone	GN-04-A, Trident 30 cm	306	10.9	0.06	70.3	20.5	3.87	18.2	6.61	429.83
B	Groundwater Discharge Zone	GN-04-A, Trident 30 cm; FR	279	11	0.3	66.5	18.8	3.69	18	6.6	397.29
C	Groundwater Discharge Zone	GN-04-A, Trident 90 cm	294	14.2	0.06	69.3	20.2	3.43	22.9	6.77	424.09
D	Groundwater Discharge Zone	GN-05-A, Trident 150 cm	135	16.4	11.8	31.6	15.6	4.12	15.1	6.47	229.62
E	Groundwater Discharge Zone	GN-05-A, Trident 150 cm; FR	138	17.1	11.8	32	16.1	4.22	15.3	6.52	234.52
F	Groundwater Discharge Zone	GN-05-A, Trident 30 cm	158	15.9	0.6	34.9	17.4	3.44	15.5	6.49	245.74
G	Low-to-No Groundwater Discharge Zone	GN-01-E, Peeper 0 - 38 cm	750	7.4	0.6	137	49.5	8	24	6.81	976.5
H	Low-to-No Groundwater Discharge Zone	GN-01-E, Trident 150 cm	158	7.3	4.3	93.2	36.4	6.36	18.8	6.37	324.36
I	Low-to-No Groundwater Discharge Zone	GN-02-E, Peeper 0 - 38 cm	519	7.5	0.19	121	38.7	5.32	16.5	6.9	708.21
J	Low-to-No Groundwater Discharge Zone	GN-02-E, Peeper 0 - 38 cm; FR	501	7.7	0.2	120	38.5	5.28	16.4	6.92	689.08
K	Low-to-No Groundwater Discharge Zone	GN-03-A, Peeper 0 - 38 cm	40	2	0.14	5.91	1.85	0.445	1.2	6.46	51.545
L	Low-to-No Groundwater Discharge Zone	GN-04-B, Peeper 0 - 38 cm	60	0.7	0.03	2.91	1.02	0.199	0.695	6.85	65.554
M	Low-to-No Groundwater Discharge Zone	R2-GN-01, Peeper 0 - 38 cm	756	8.2	0.15	179	63.4	7.61	18.9	6.73	1033.26
N[c]	Upland Groundwater	Boring B-47, W4 Upland Groundwater	543	16.4	102	39	17.4	2.43	86.9		807.13
O[c]	Upland Groundwater	Boring B-47, W3A Upland Groundwater	171	14	13.4	43.1	18	4.96	19.4		283.86
P[c]	Upland Groundwater	Boring B-47, W3B Upland Groundwater	154	14.7	15.4	39	16.5	4.72	18.9		263.22
Q[c]	Upland Groundwater	Boring B-47, W3C Upland Groundwater	149	15.1	15.9	39.2	16.6	4.76	19.2		259.76
R[c]	Upland Groundwater	Boring B-47, W2B Upland Groundwater	130	36.2	12.4	39.1	15.4	7.44	35.9		276.44
S[c]	Upland Groundwater	Boring B-47, W2C Upland Groundwater	148	41.6	16.7	37.6	13.9	6.83	37.3		301.93
T[c]	Upland Groundwater	Boring B-48, W9 Upland Groundwater	70	749	10.6	388	91.4	42.1	212		1563.1
U[c]	Upland Groundwater	Boring B-48, W7 Upland Groundwater	75	743	10.5	282	51.2	38.3	236		1436
V[c]	Upland Groundwater	Boring B-48, W8 Upland Groundwater	72	825	13	612	41.9	42.3	554		2160.2
W[c]	Upland Groundwater	MW-37 Upland Groundwater	773	28.7	9.26	205	76.3	7.1	51		1150.36
X[c]	Upland Groundwater	MW-37 Upland Groundwater	91.8	28.3	9.86	146	64.8	5.3	41.6		387.66
Y[c]	Upland Groundwater	MW-45 Upland Groundwater	178	170	22.1	279	68.3	15.7	25.4		758.5
Z[c]	Upland Groundwater	MW-42 Upland Groundwater	70	13.1	14.8	31.5	11.8	4.15	18		163.35
AA[c]	Upland Groundwater	MW-36 Upland Groundwater	63.6	13.2	7.66	26.4	8.72	3.53	11		134.11
AB[c]	Upland Groundwater	MW-38 Upland Groundwater	110	16.5	14.5	40.9	13.6	3.91	11.7		211.11

Notes:

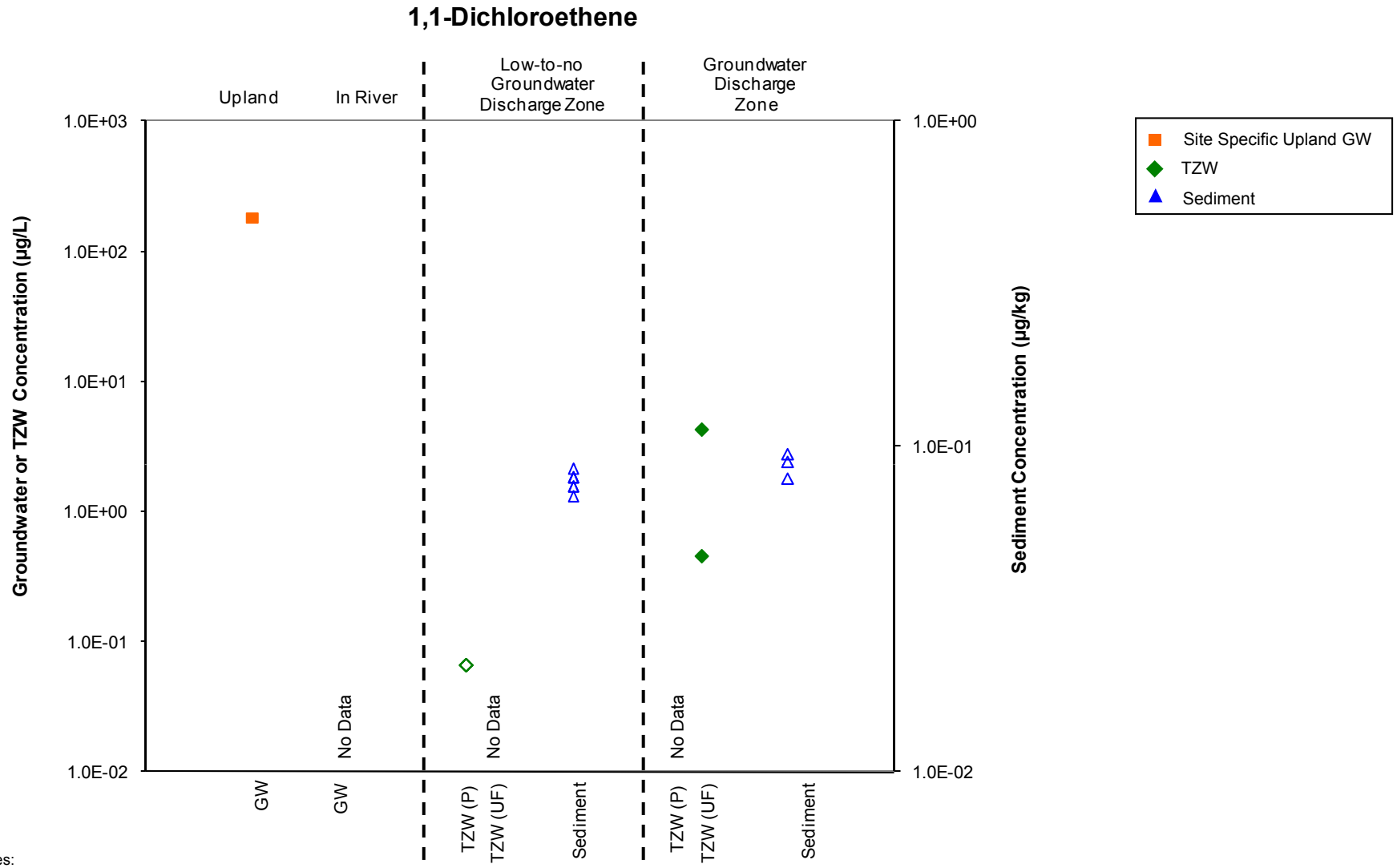
[a] Alkalinity speciated to HCO_3^- and CO_3^{2-} using PHREEQC module within AquaChem (Waterloo Hydrologic 2005).

[b] TDS calculated as sum of anions and cations.

[c] No alkalinity data; use bicarbonate.

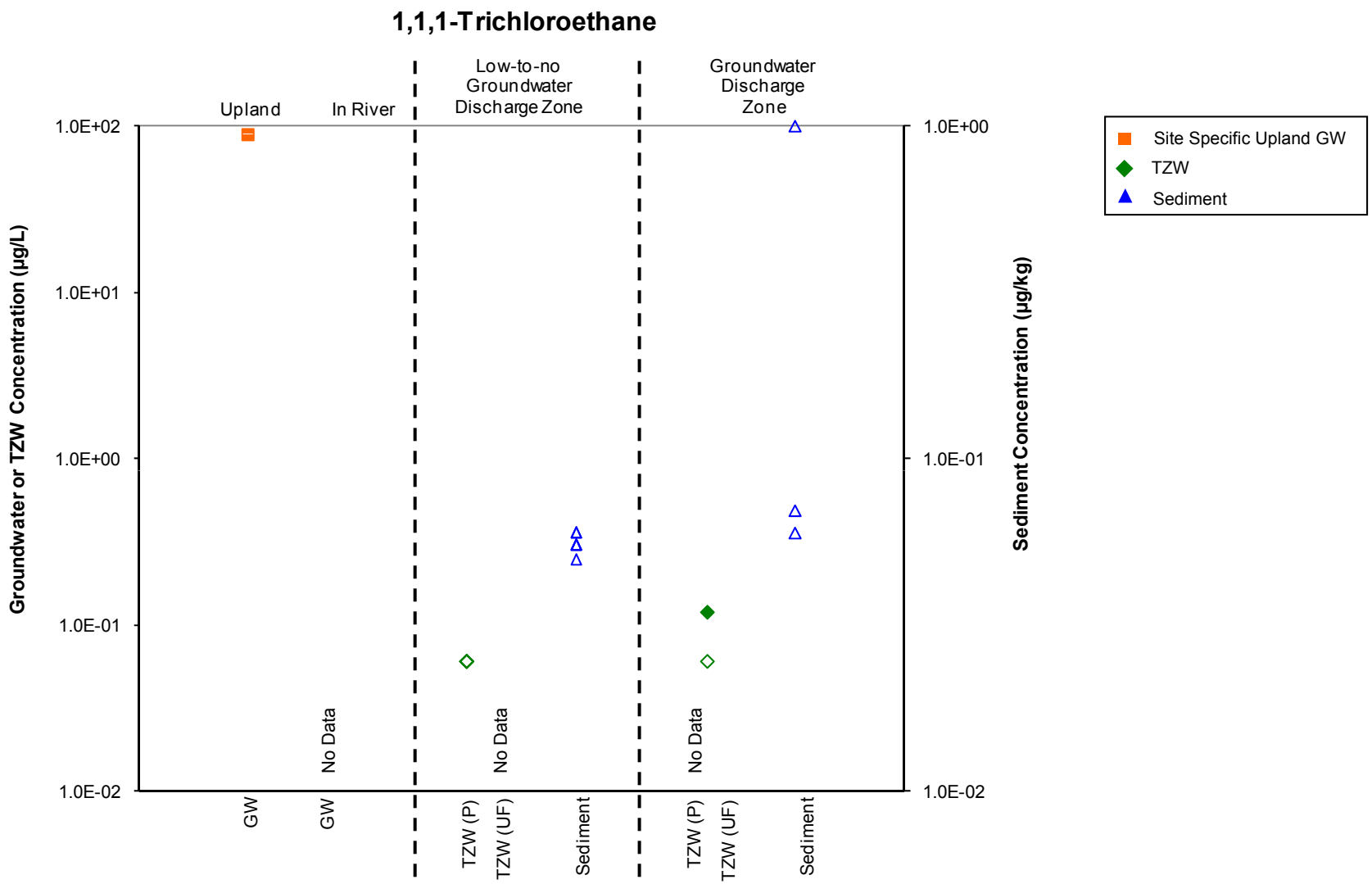
All concentrations as mg/L; pH in s.u.

Figure C3.9-7
Portland Harbor RI/FS
Remedial Investigation Report
Piper Diagram - Comparison of Major Ion Chemistry
Upland Groundwater, Transition Zone Water, and Surface Water
Gunderson



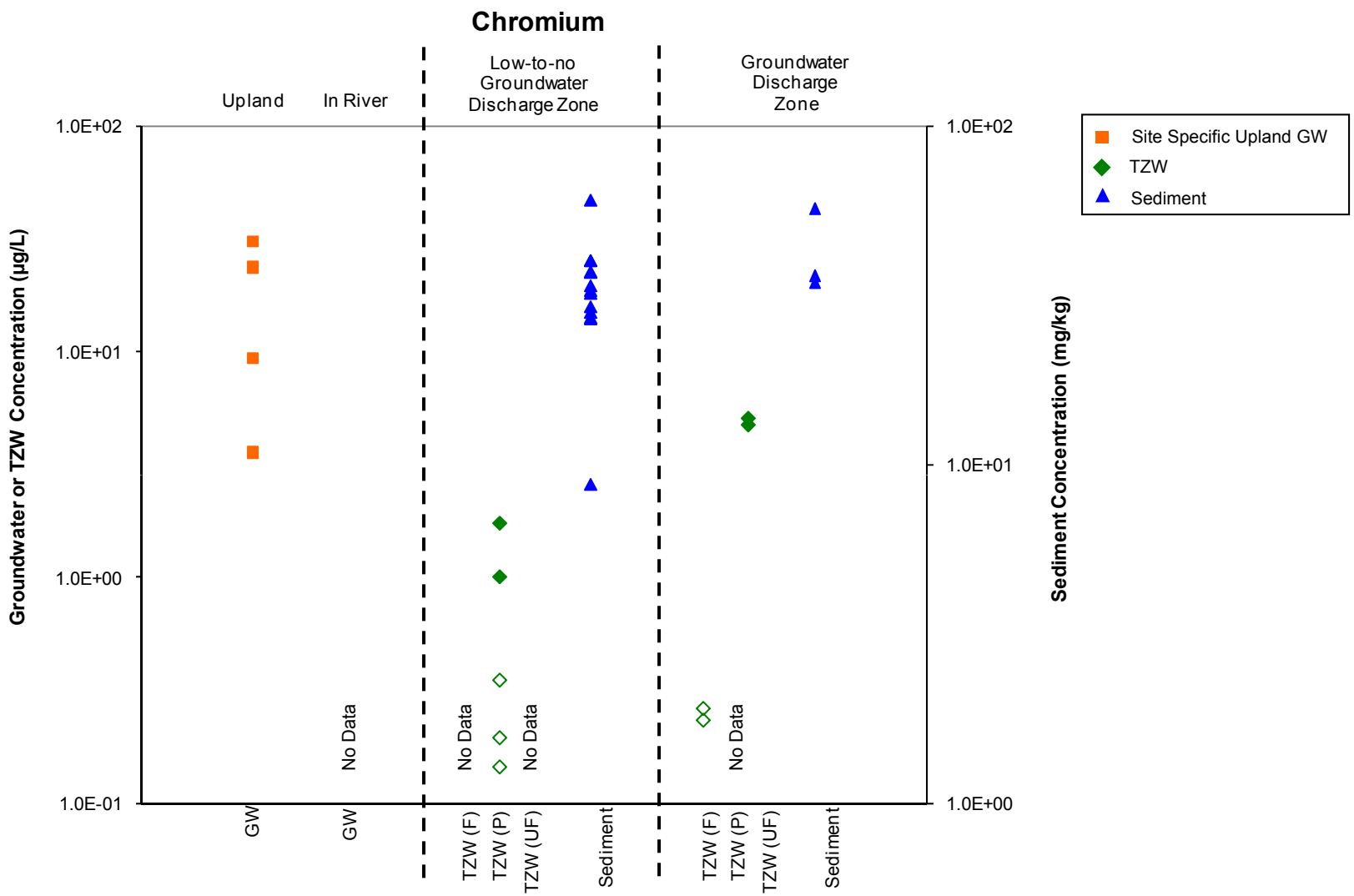
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: CP-586, GP-301, GP-303, GP-312, GP-313, GP-314, GP-315, GP-318, MW-10, MW-14, MW-15, MW-18, MW-28, MW-29, MW-32, MW-33, MW-37, MW-52, MW-53, SMW-12, SMW-13, SMW-14, SMW-15, SMW-17, SMW-18, HA-34, HA-35.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.9-8a
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
1,1-Dichloroethene - Gunderson



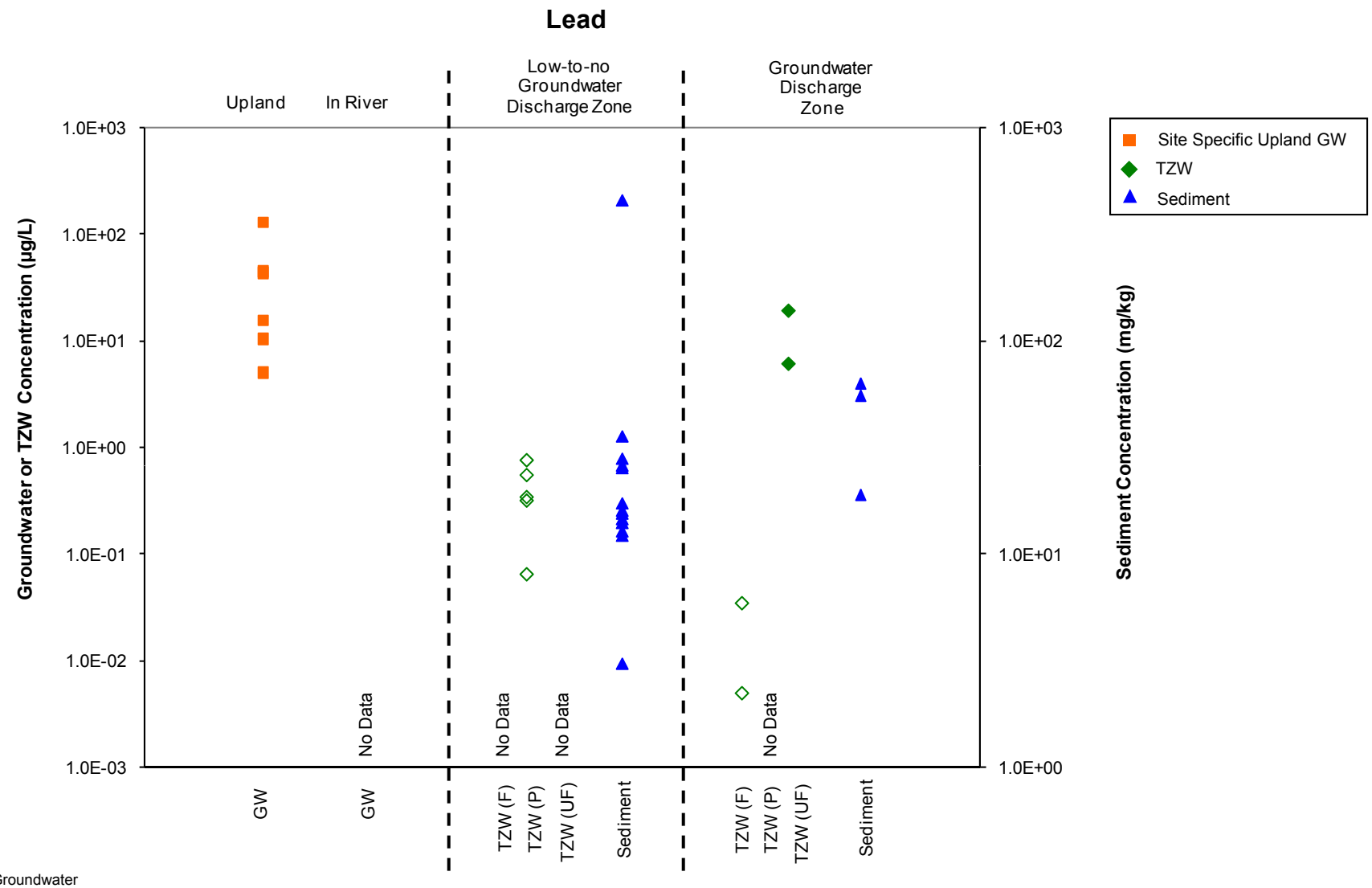
Notes:
GW- Groundwater
TZW-Transition Zone Water; P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: CP-586, GP-301, GP-303, GP-312, GP-313, GP-314, GP-315, GP-318, MW-10, MW-14, MW-15, MW-18, MW-28, MW-29, MW-32, MW-33, MW-37, MW-52, MW-53, SMW-12, SMW-13, SMW-14, SMW-15, SMW-17, SMW-18, HA-34, HA-35.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.9-8b
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
1,1,1-Trichloroethane - Gunderson



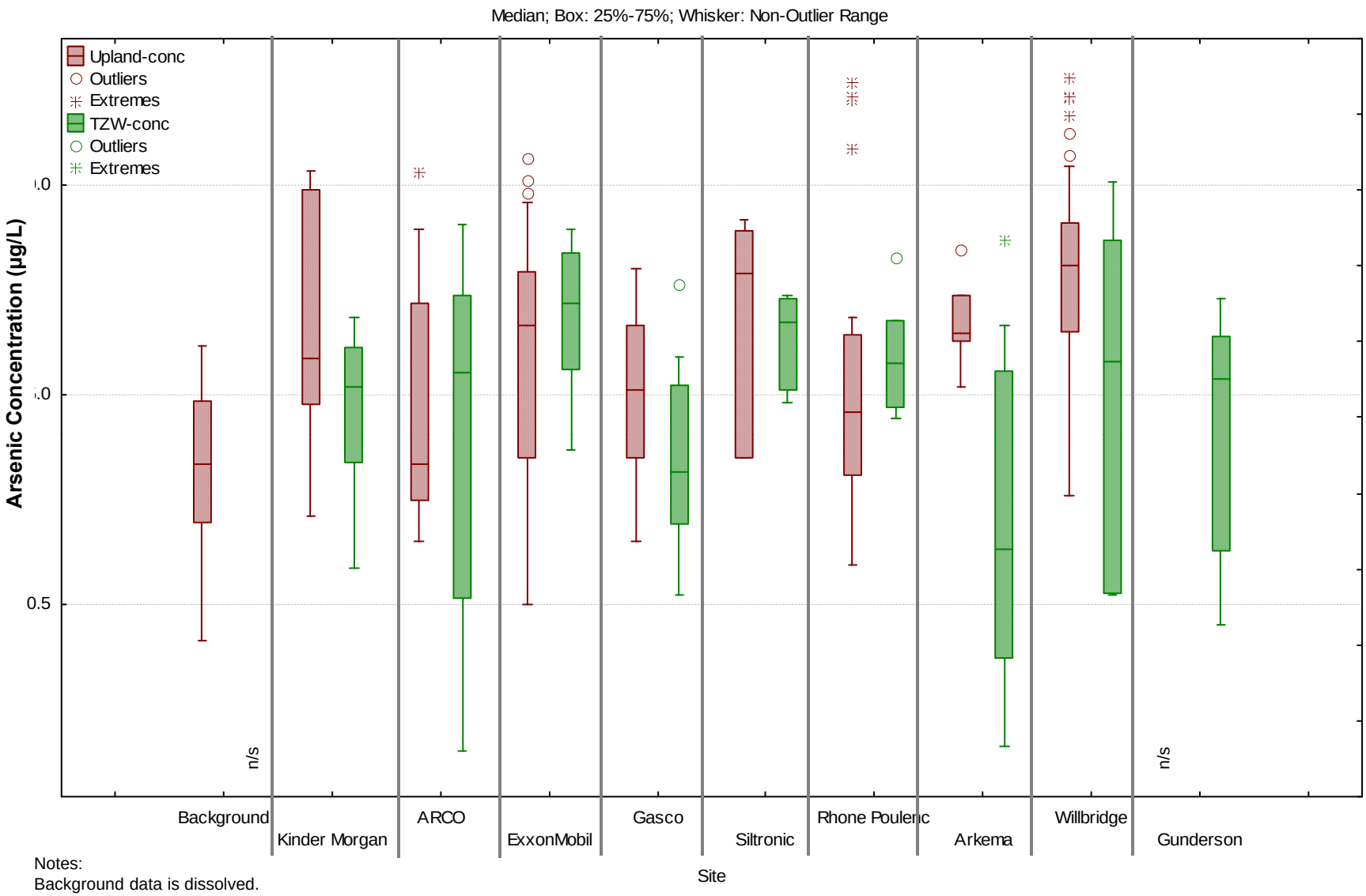
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: CP-586, GP-301, GP-303, GP-312, GP-313, GP-314, GP-315, GP-318, MW-10, MW-14, MW-15, MW-18, MW-28, MW-29, MW-32, MW-33, MW-37, MW-52, MW-53, SMW-12, SMW-13, SMW-14, SMW-15, SMW-17, SMW-18, HA-34, HA-35.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.9-8c
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total Chromium - Gunderson



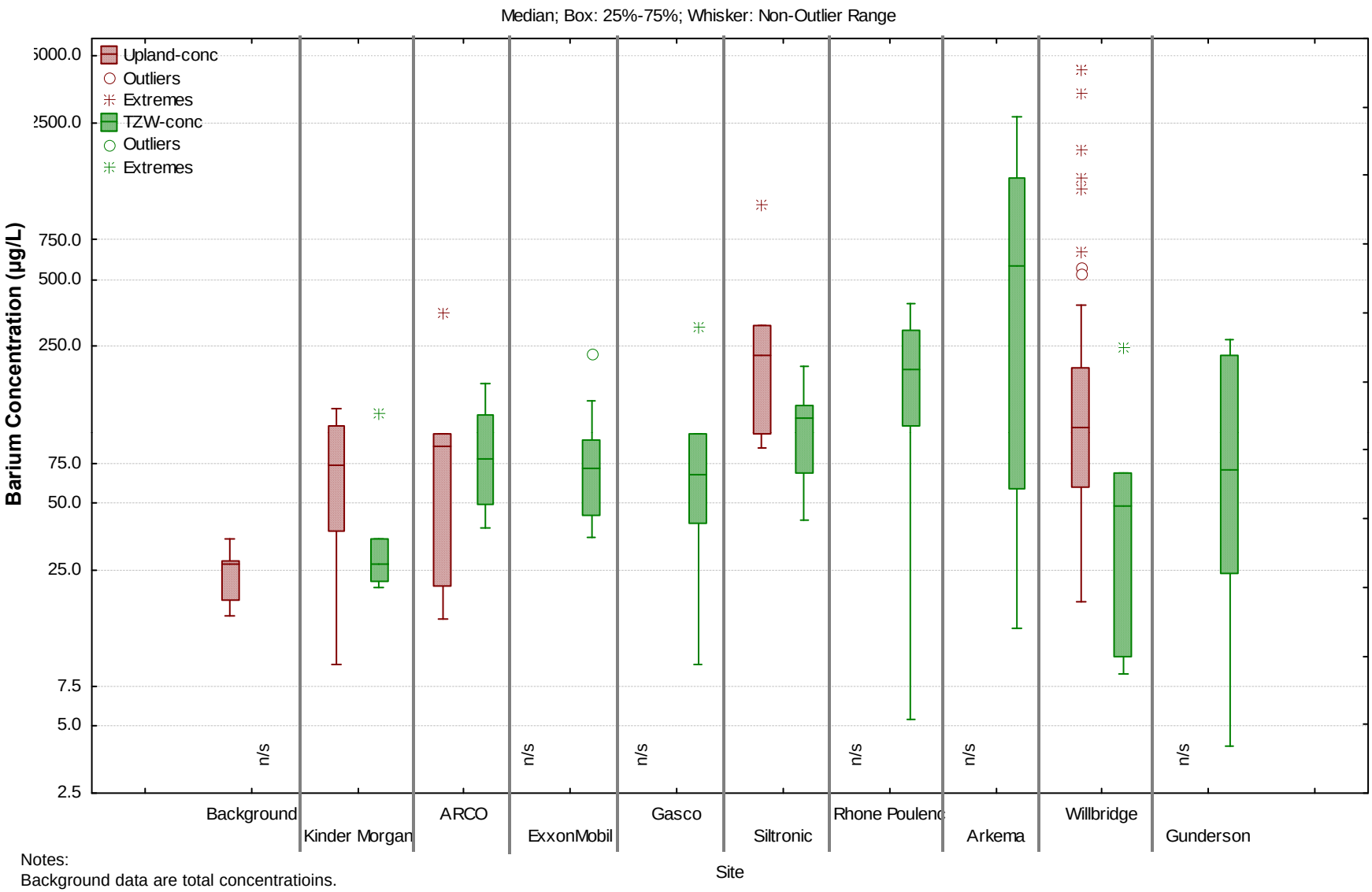
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: CP-586, GP-301, GP-303, GP-312, GP-313, GP-314, GP-315, GP-318, MW-10, MW-14, MW-15, MW-18, MW-28, MW-29, MW-32, MW-33, MW-37, MW-52, MW-53, SMW-12, SMW-13, SMW-14, SMW-15, SMW-17, SMW-18, HA-34, HA-35.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C3.9-8d
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations of Select COIs in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones
Total Lead - Gunderson



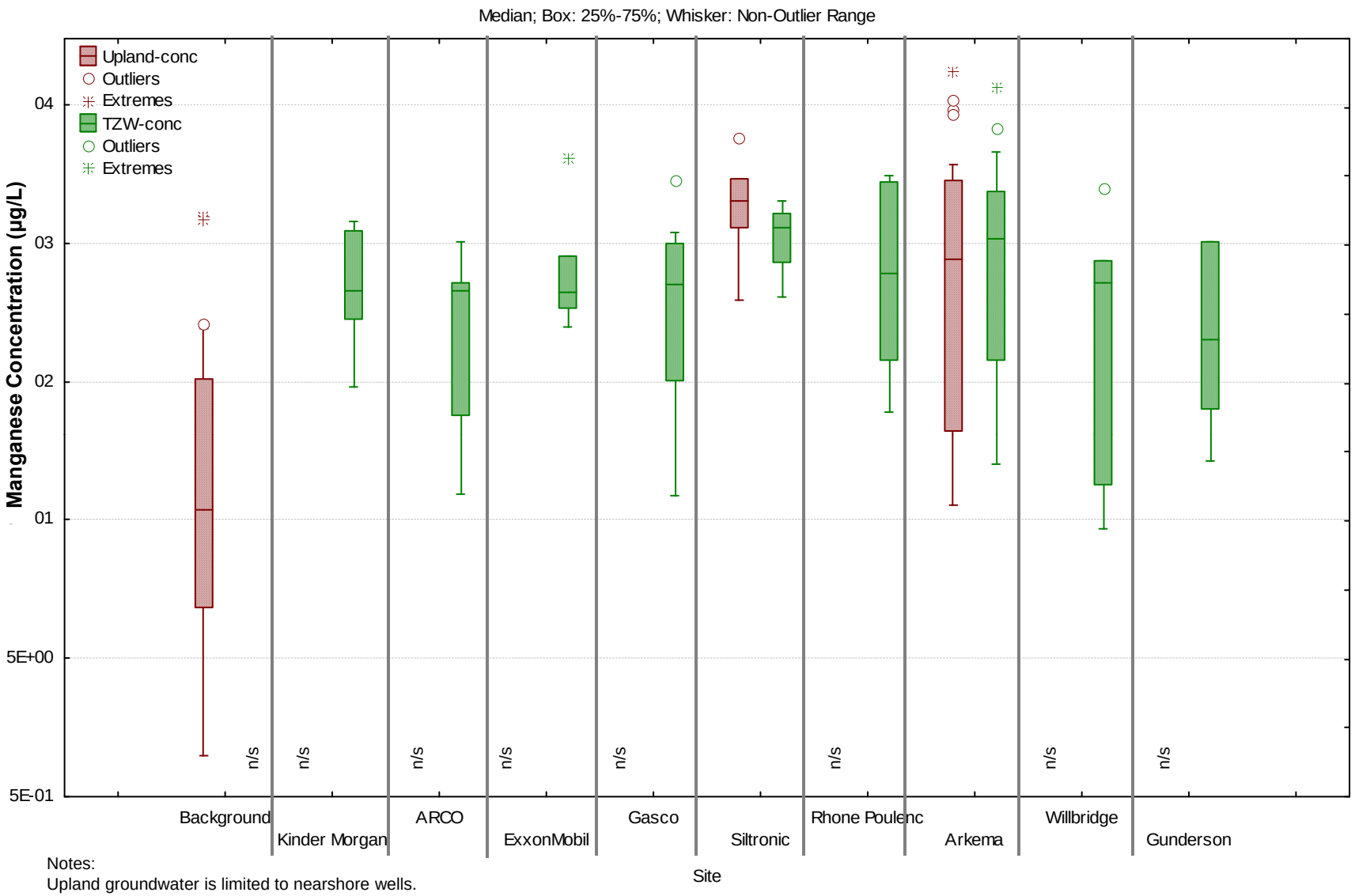
Notes:
Background data is dissolved.
TZW data only includes filtered and peeper samples.
TZW non-detects included at ½ of detection limit.
Upland GW non-detects excluded (no information on DL).
Upland groundwater is limited to nearshore wells.
n/s- not sampled

Figure C4.1-1
Portland Harbor RI/FS
Remedial Investigation Report
Concentrations in TZW, Nearshore Upland Groundwater
and Background Groundwater by Site
Arsenic



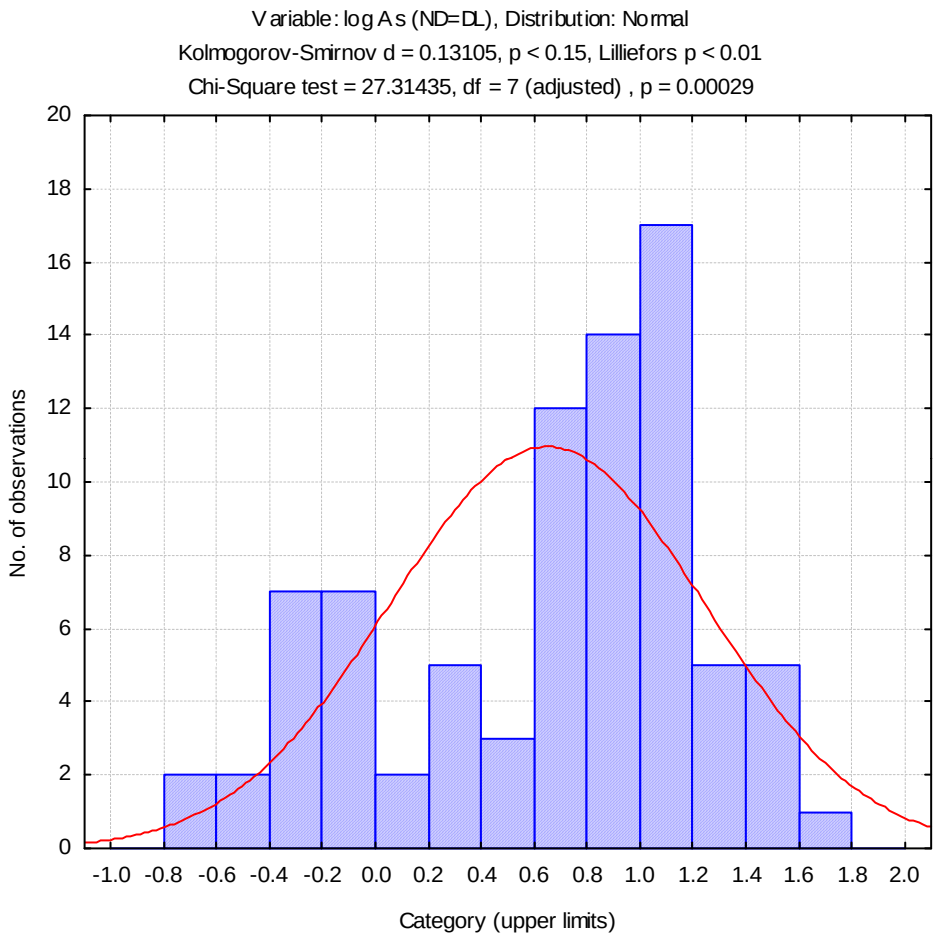
Notes:
Background data are total concentratioins.
Upland groundwater is limited to nearshore wells.
TZW data incluedes only filtered and peeper samples.
n/s- not sampled

Figure C4.1-2
Portland Harbor RI/FS
Remedial Investigation Report
Comparison of Groundwater Concentrations by Site
Background Groundwater, Upland Groundwater, Transition Zone Water
Barium

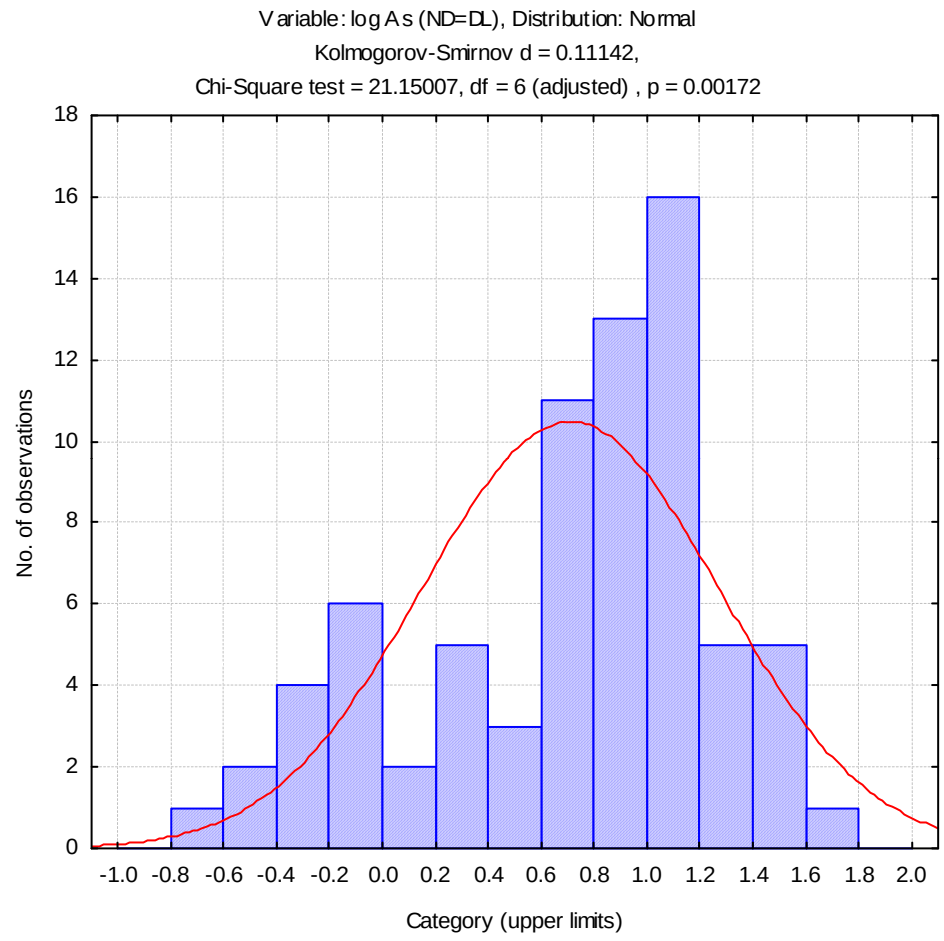


Notes:
Upland groundwater is limited to nearshore wells.
Background data are total concentrations.
TZW data includes only filtered and peeper samples.
n/s- not sampled.

Figure C4.1-3
Portland Harbor RI/FS
Remedial Investigation Report
Comparison of Groundwater Concentrations by Site
Background Groundwater, Upland Groundwater, Transition Zone Water
Manganese

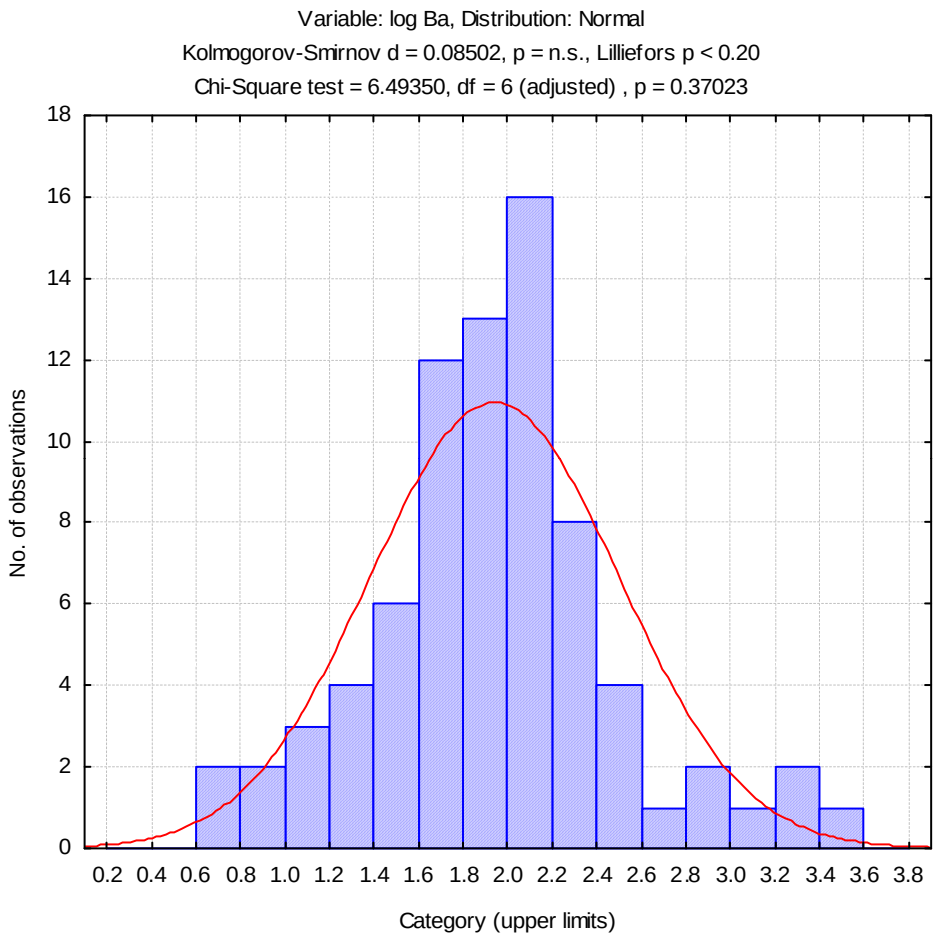


All Data



Chlorate Plant Excluded

Figure C4.1-4
Portland Harbor RI/FS
Remedial Investigation Report
Shapiro-Wilk Goodness of Fit Test
Arsenic in TZW



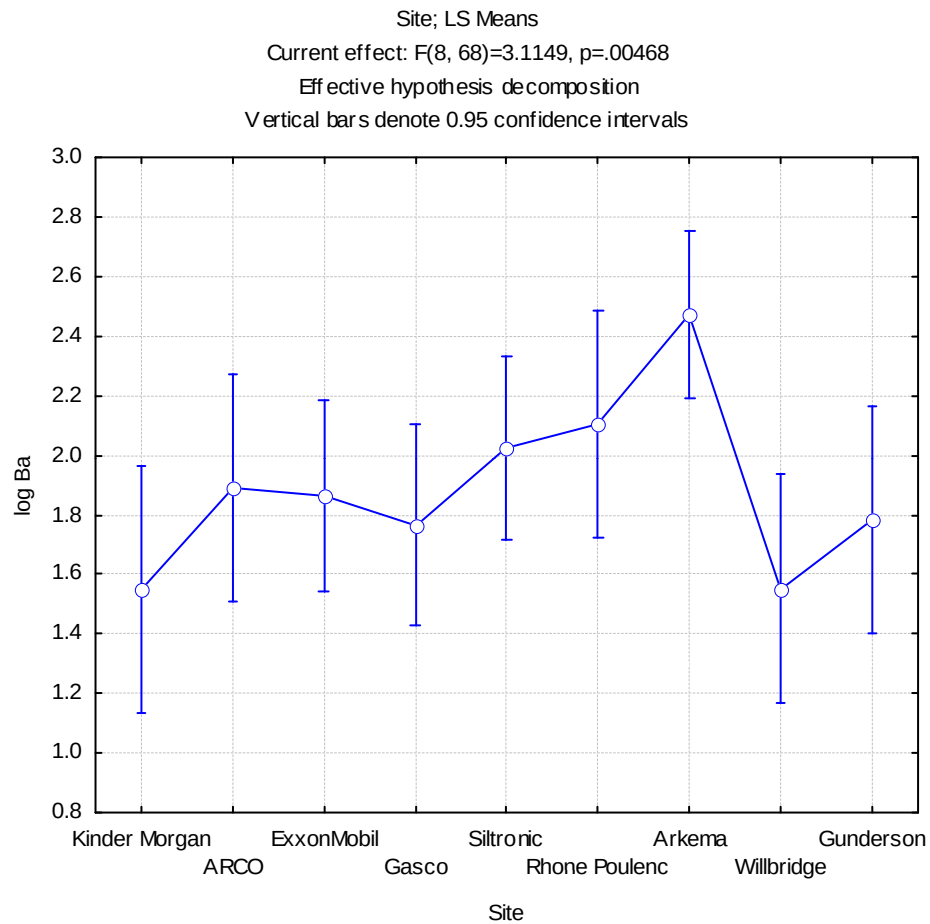
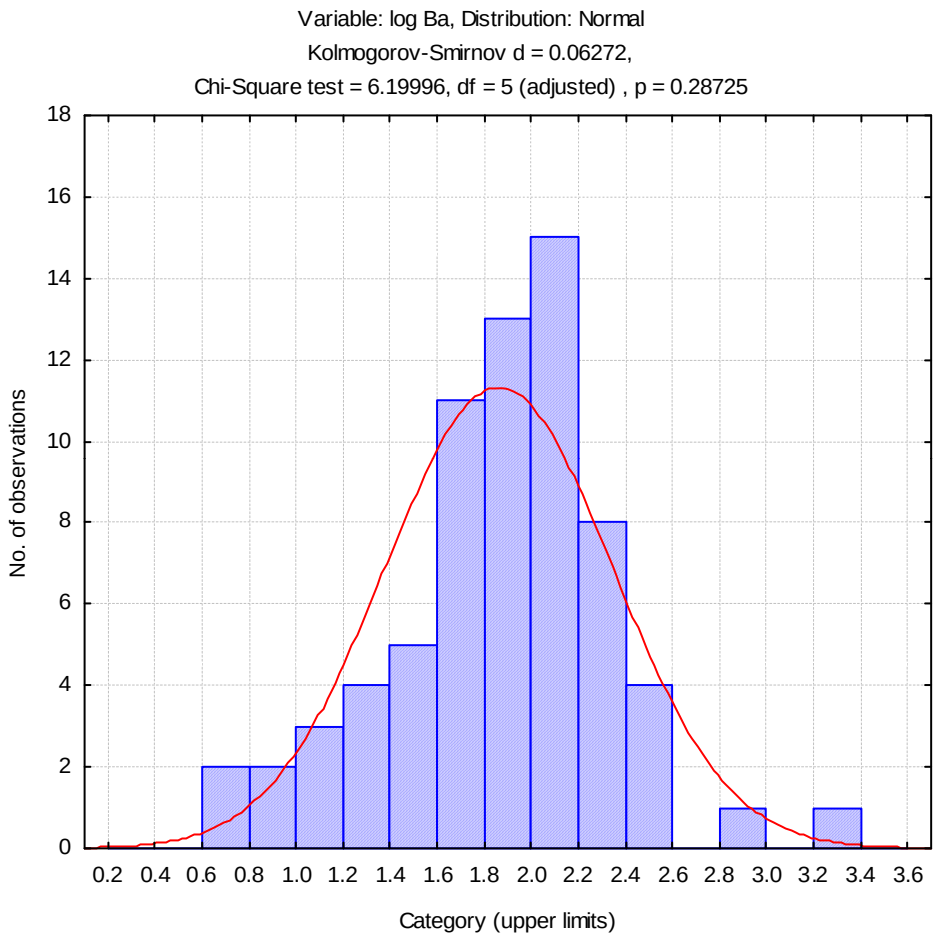


Figure C4.1-5a
Portland Harbor RI/FS
Remedial Investigation Report
Komogorov-Smirnov Goodness of Fit Test and ANOVA Results
Barium in TZW (All Data)



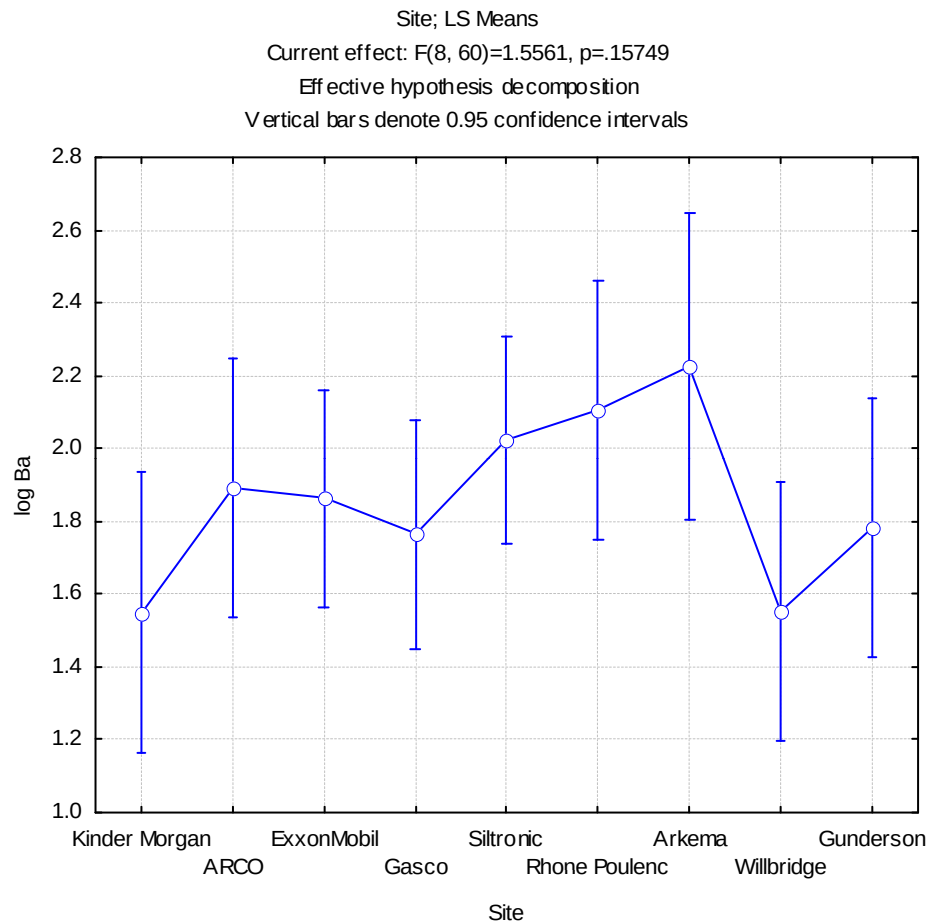
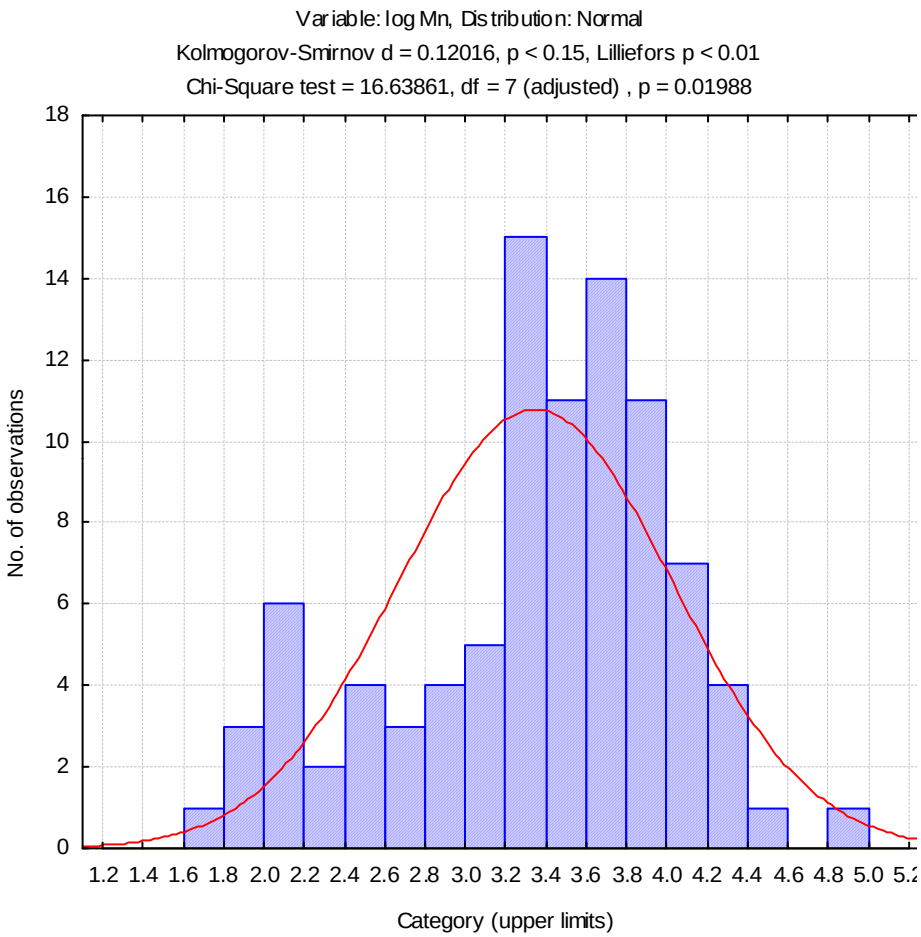


Figure C4.1-5b
Portland Harbor RI/FS
Remedial Investigation Report
Komogorov-Smirnov Goodness of Fit Test and ANOVA Results
Barium in TZW (Chlorate Plant Excluded)



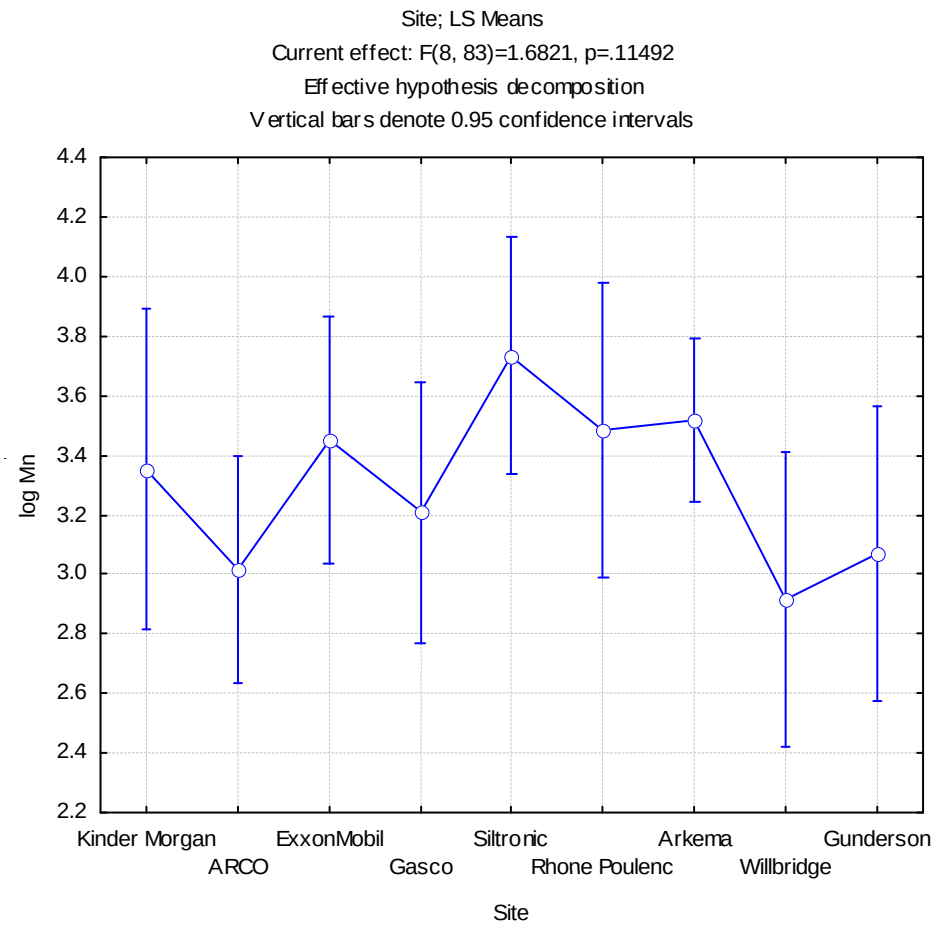
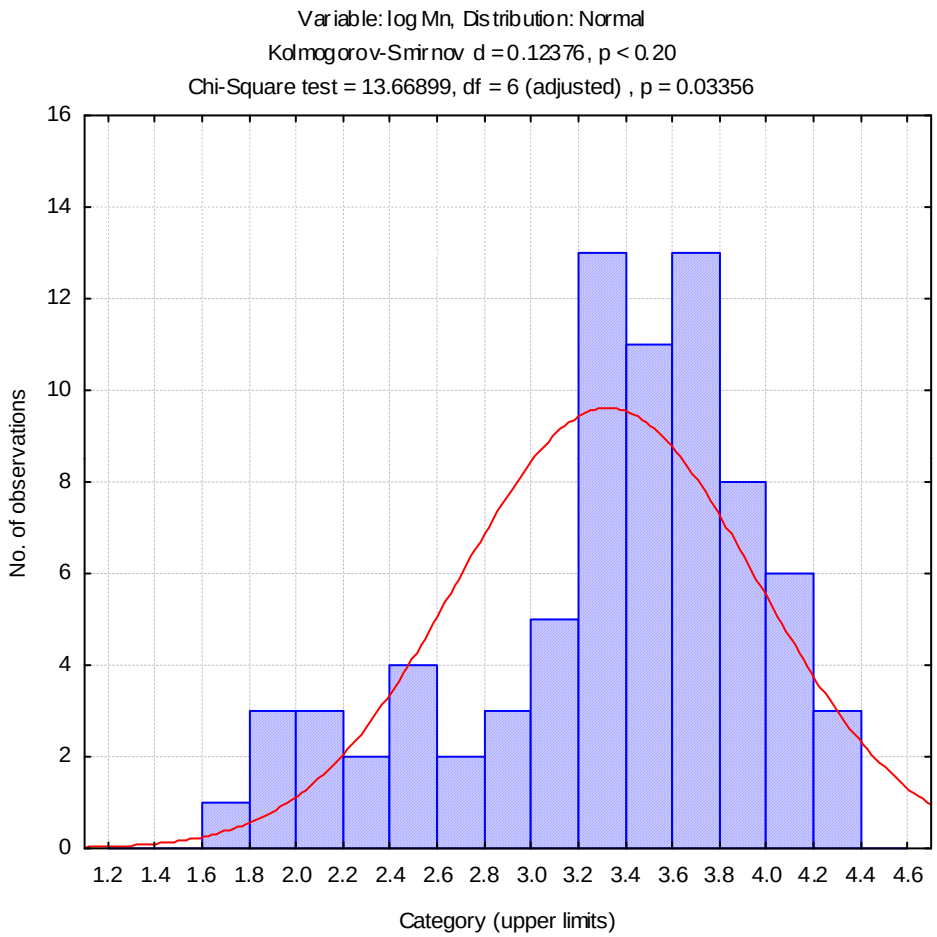


Figure C4.1-6a
Portland Harbor RI/FS
Remedial Investigation Report
Komogorov-Smirnov Goodness of Fit Test and ANOVA Results
Manganese in TZW (All Data)



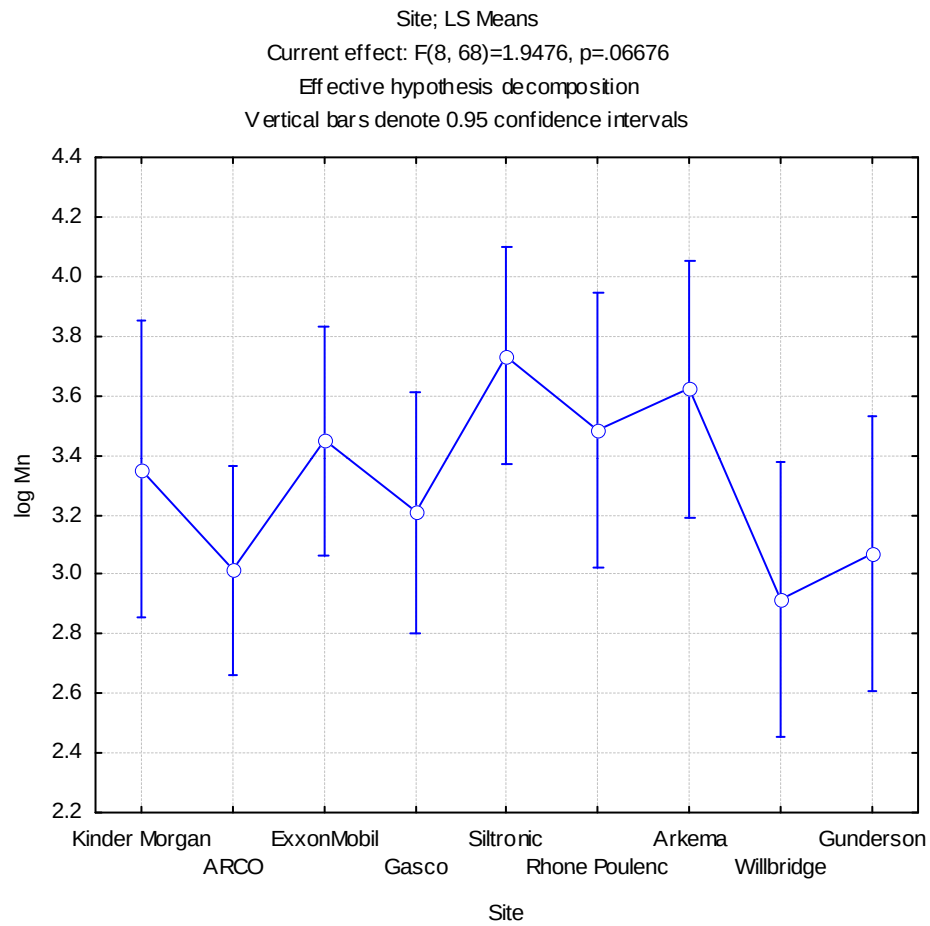
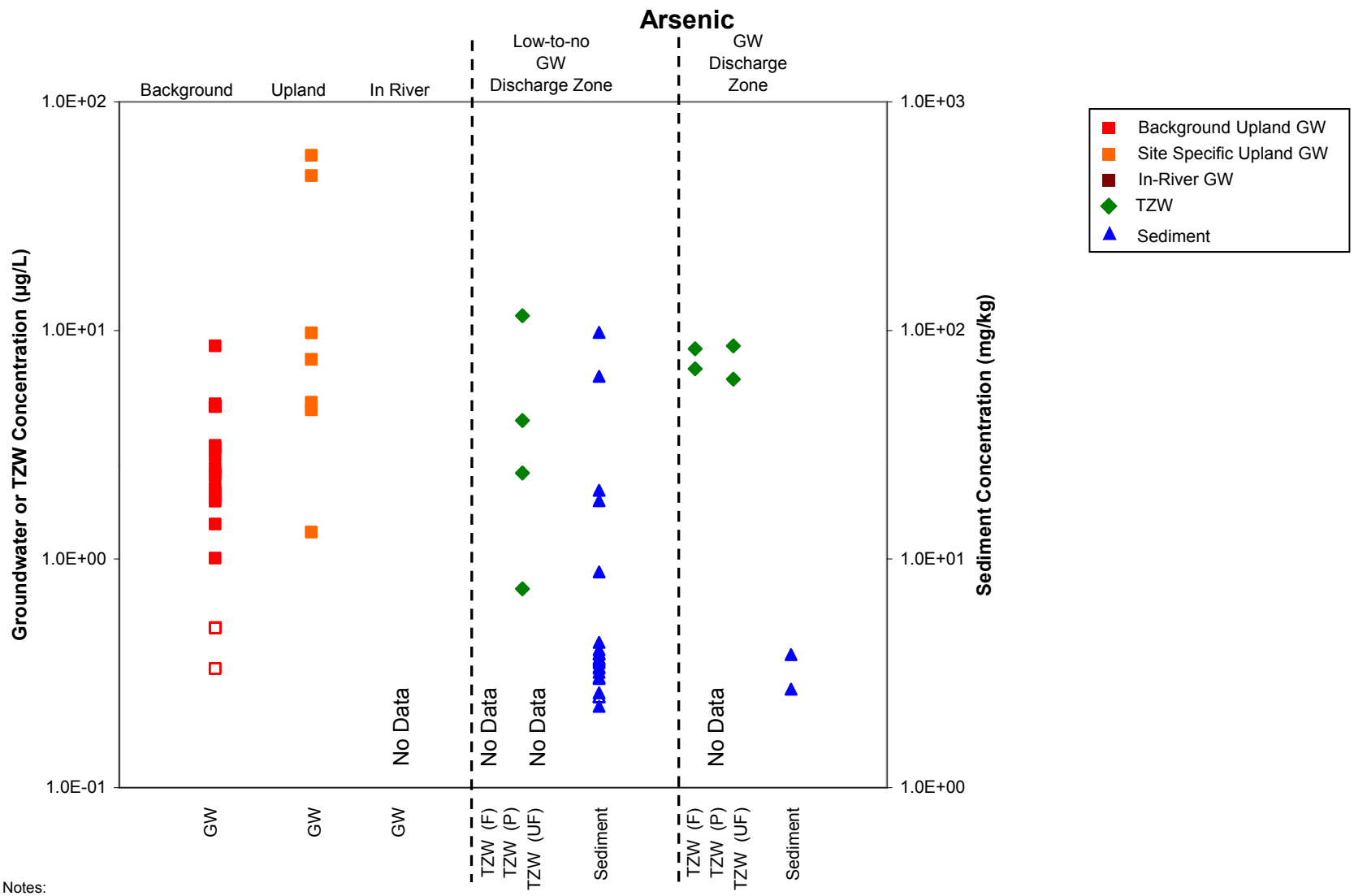
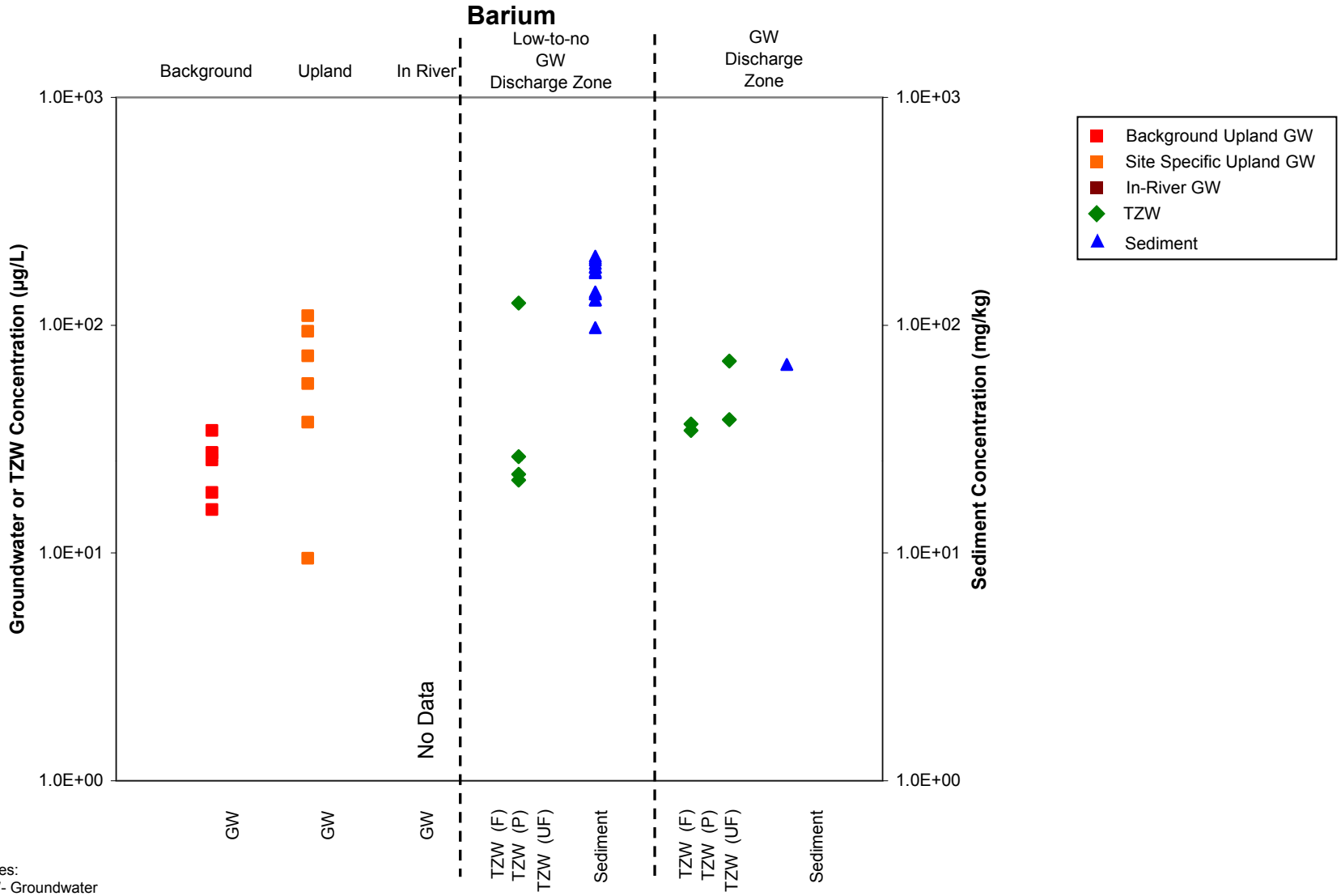


Figure C4.1-6b
Portland Harbor RI/FS
Remedial Investigation Report
Komogorov-Smirnov Goodness of Fit Test and ANOVA Results
Manganese in TZW (Chlorate Plant Excluded)



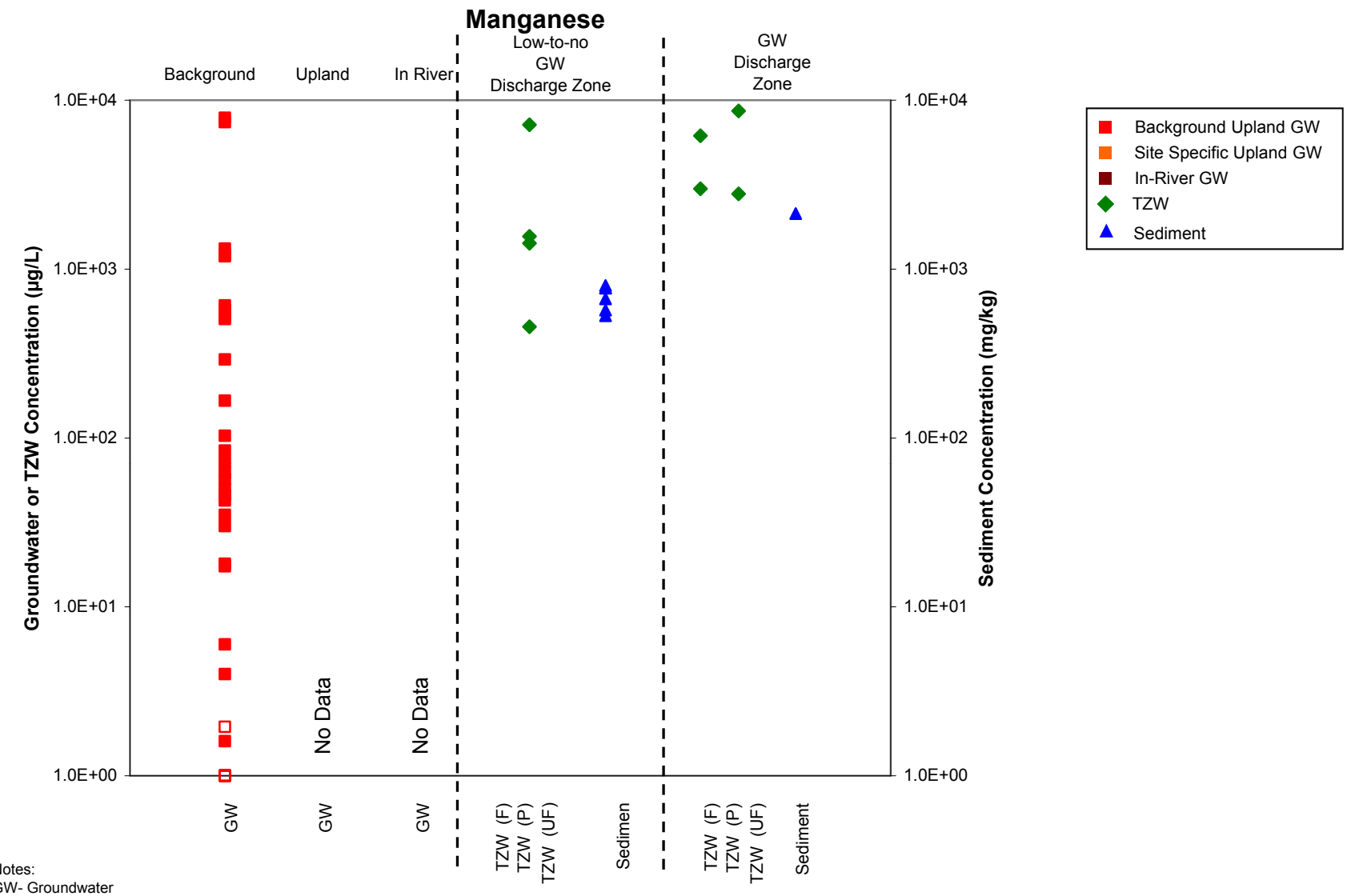
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MW-1,MW-2,MW-3,MW-4,MW-7,MW-8,MW-10,MW-12,MW-13,MW-20,MW-21.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-1
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Kinder Morgan



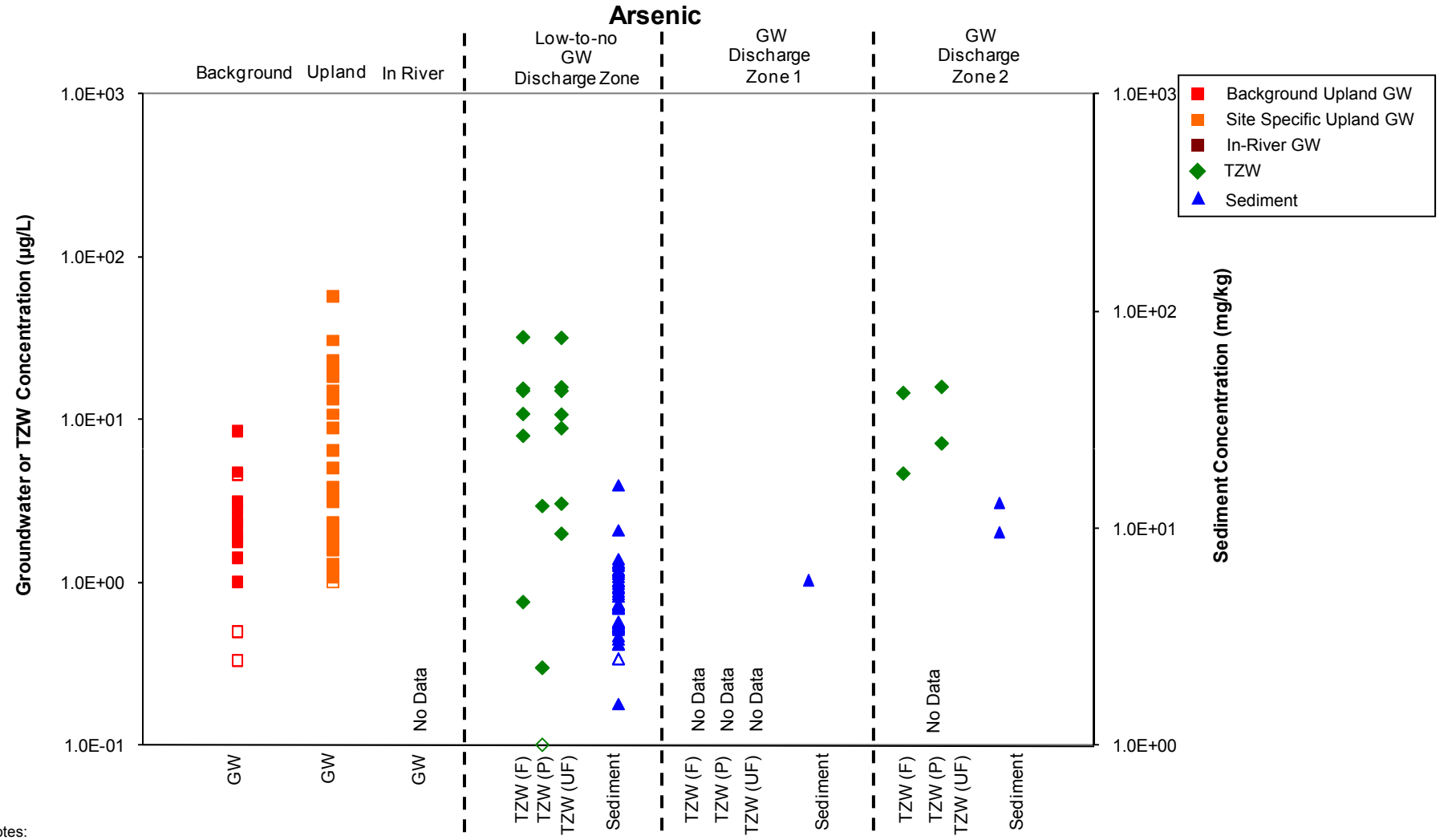
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes dissolved data for wells: MW-1,MW-2,MW-3,MW-4,MW-7,MW-8,MW-10,MW-12,MW-13,MW-20,MW-21.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-2
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater,
Transition Zone Water, and Sediment Associated with
Interpreted Groundwater Discharge Zones – Kinder Morgan



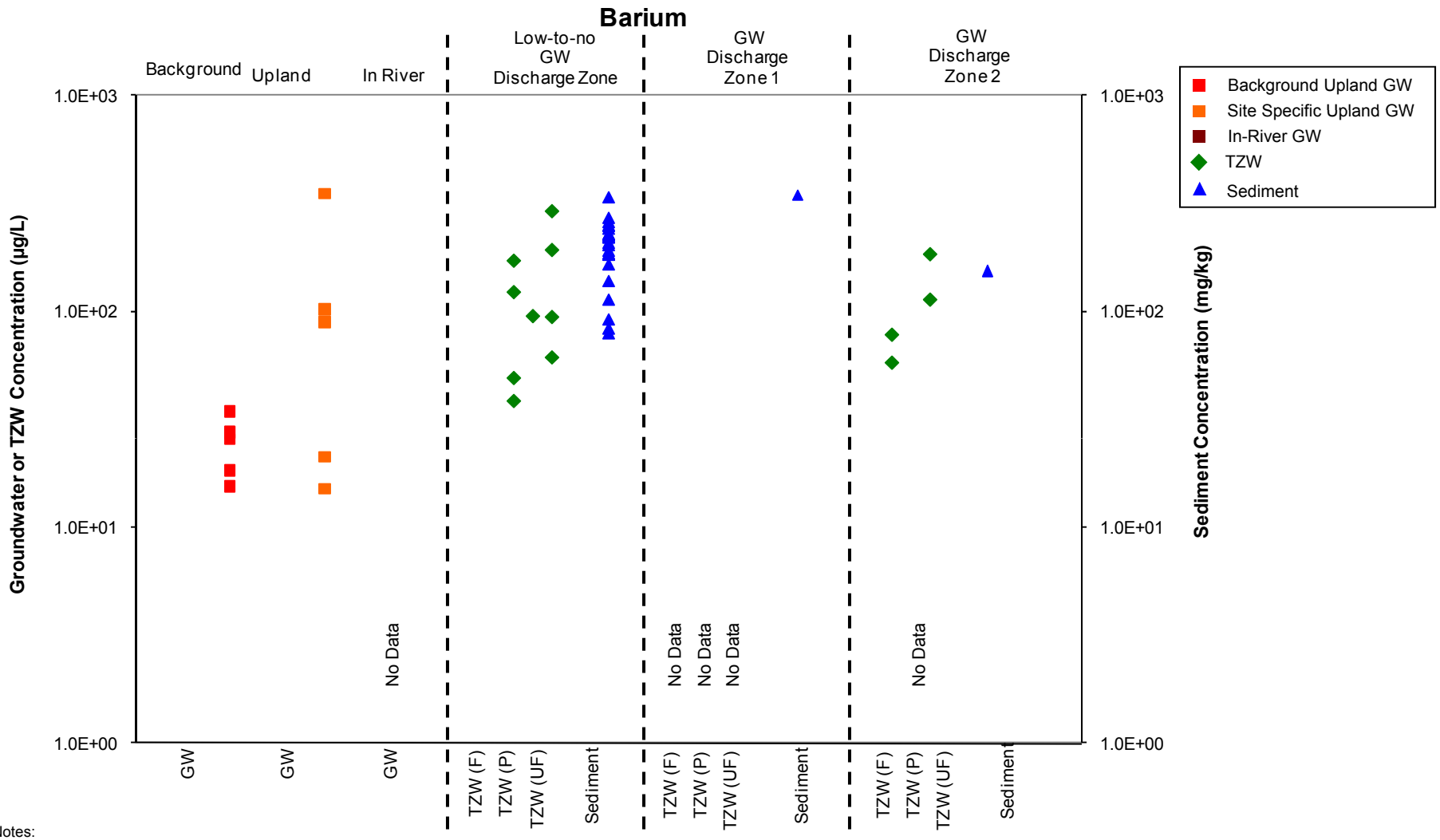
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-3
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Kinder Morgan



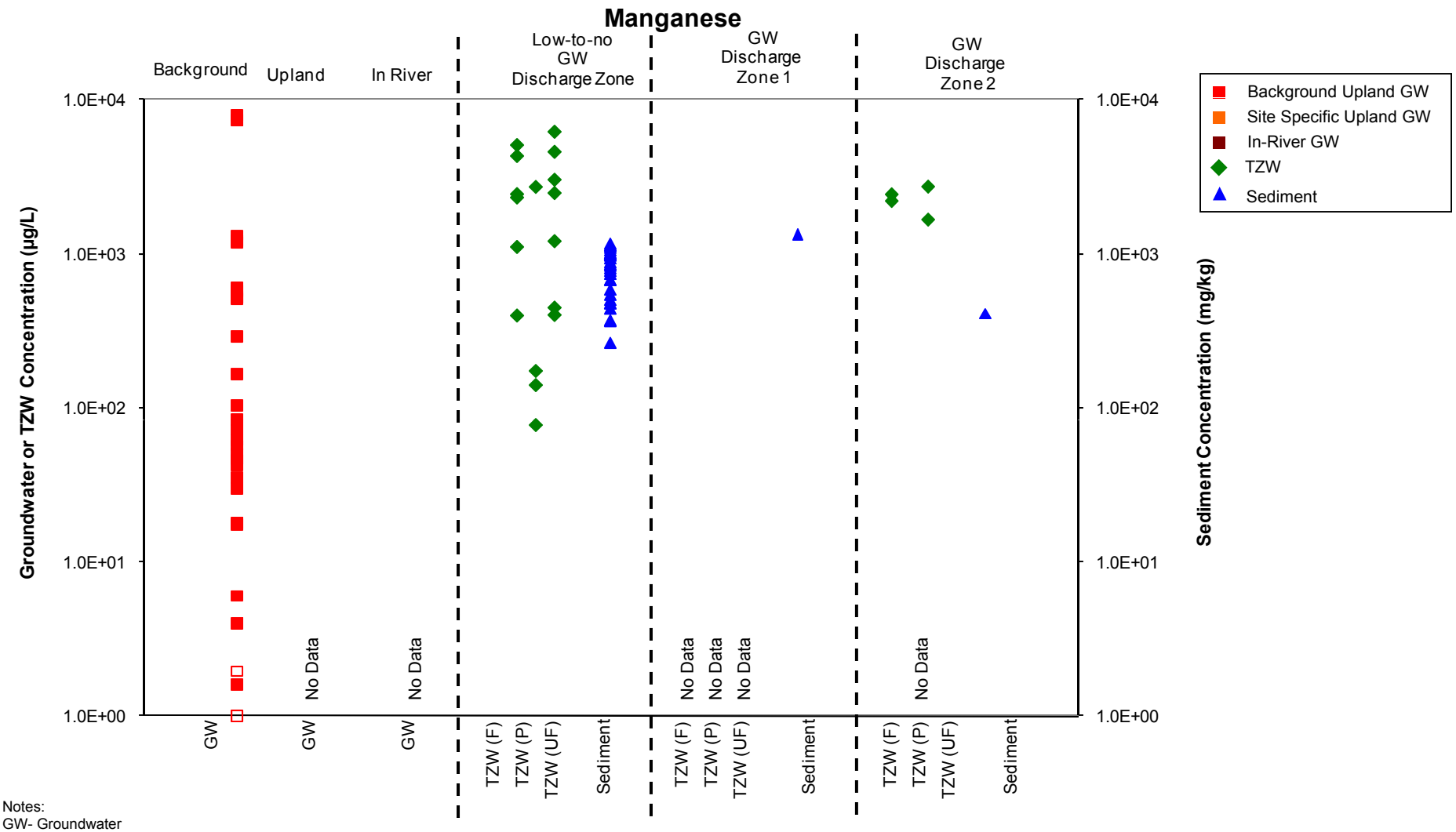
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-4
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ARCO



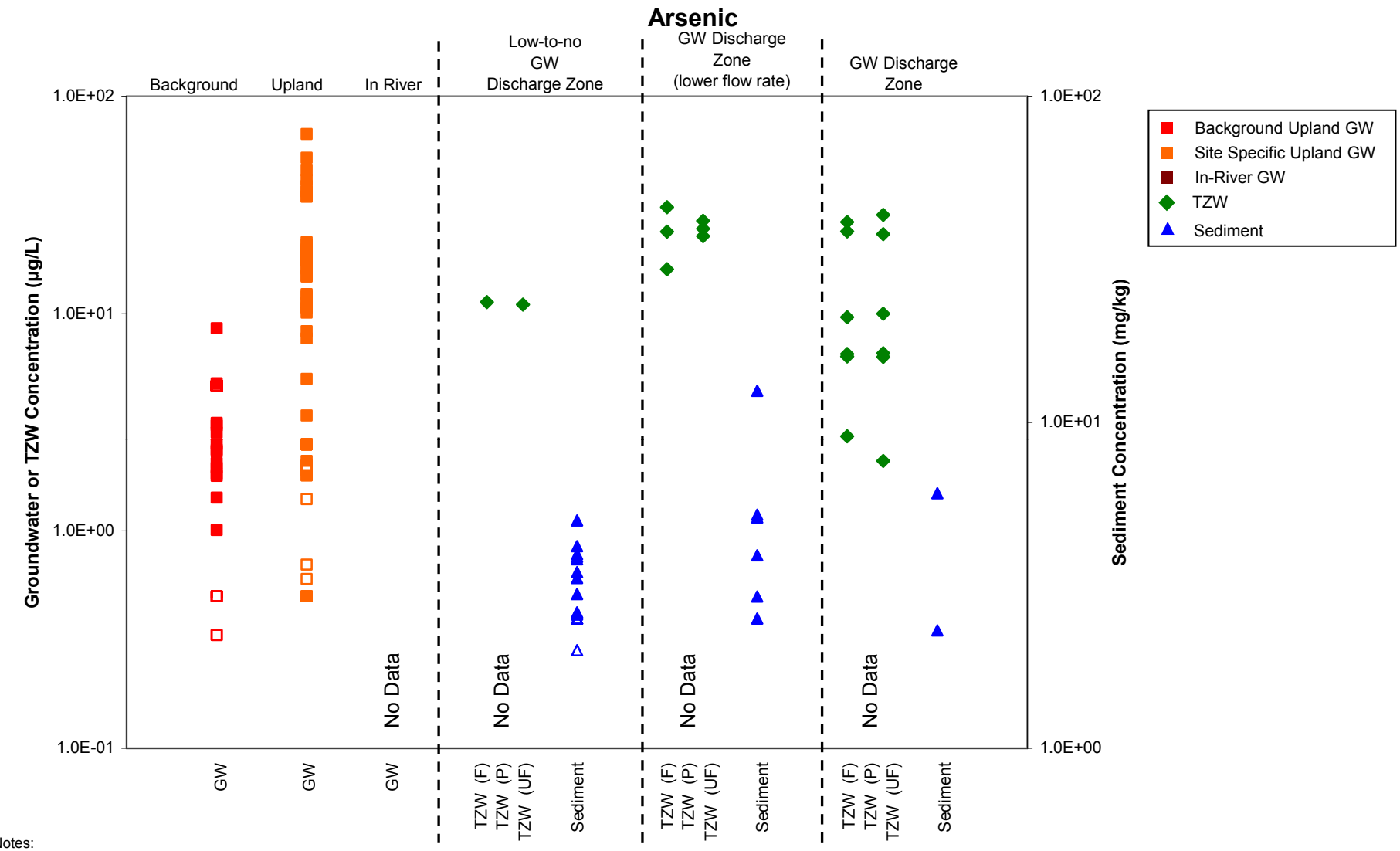
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes unfiltered data from wells: GP-1, GP-3, GP-4, GP-6, IW-1, IW-2, IW-3, IW-6, P-7, REV-1, REV-2, REV-3, REV-4, REV-5.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-5
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ARCO



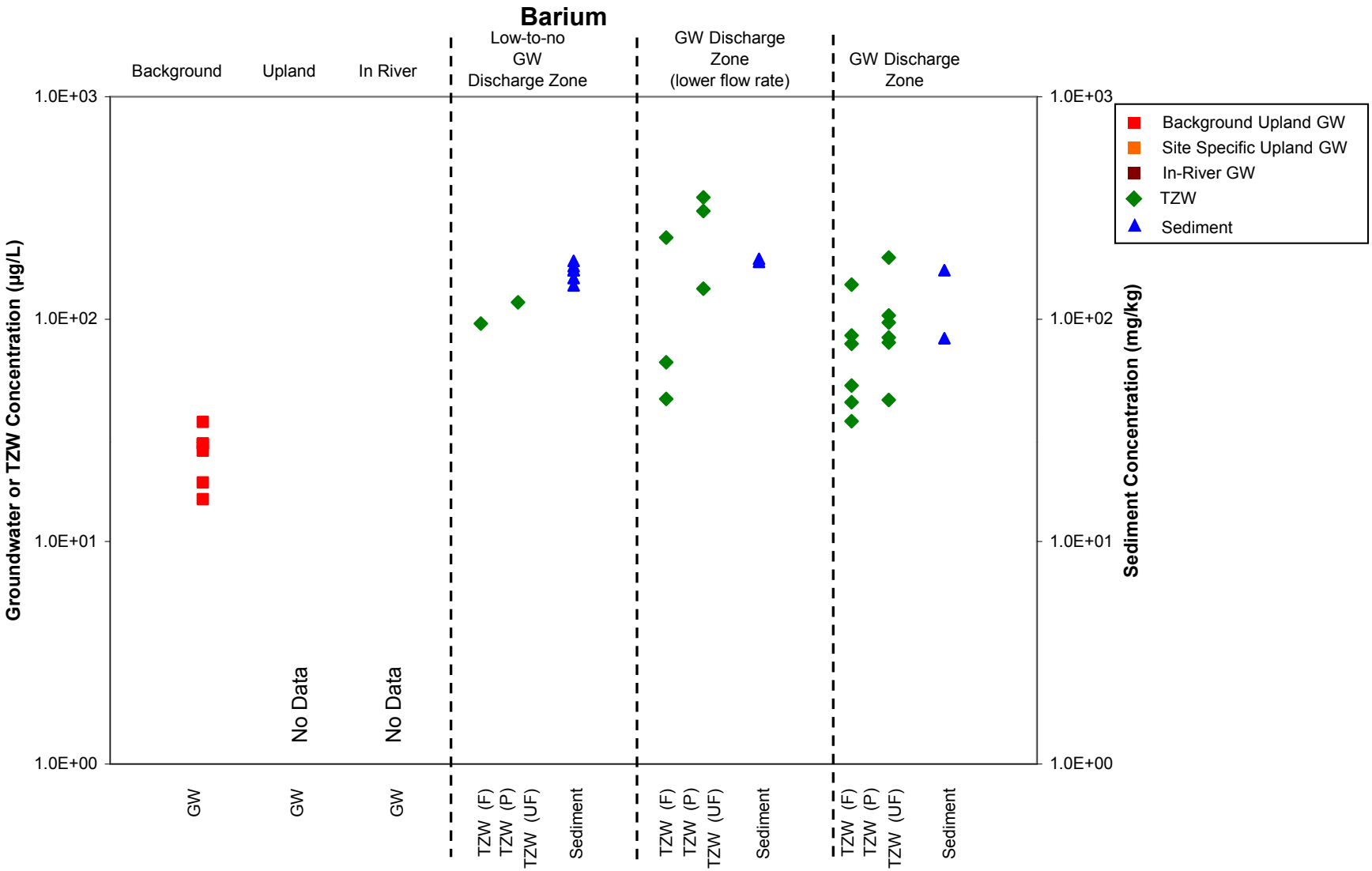
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-6
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ARCO



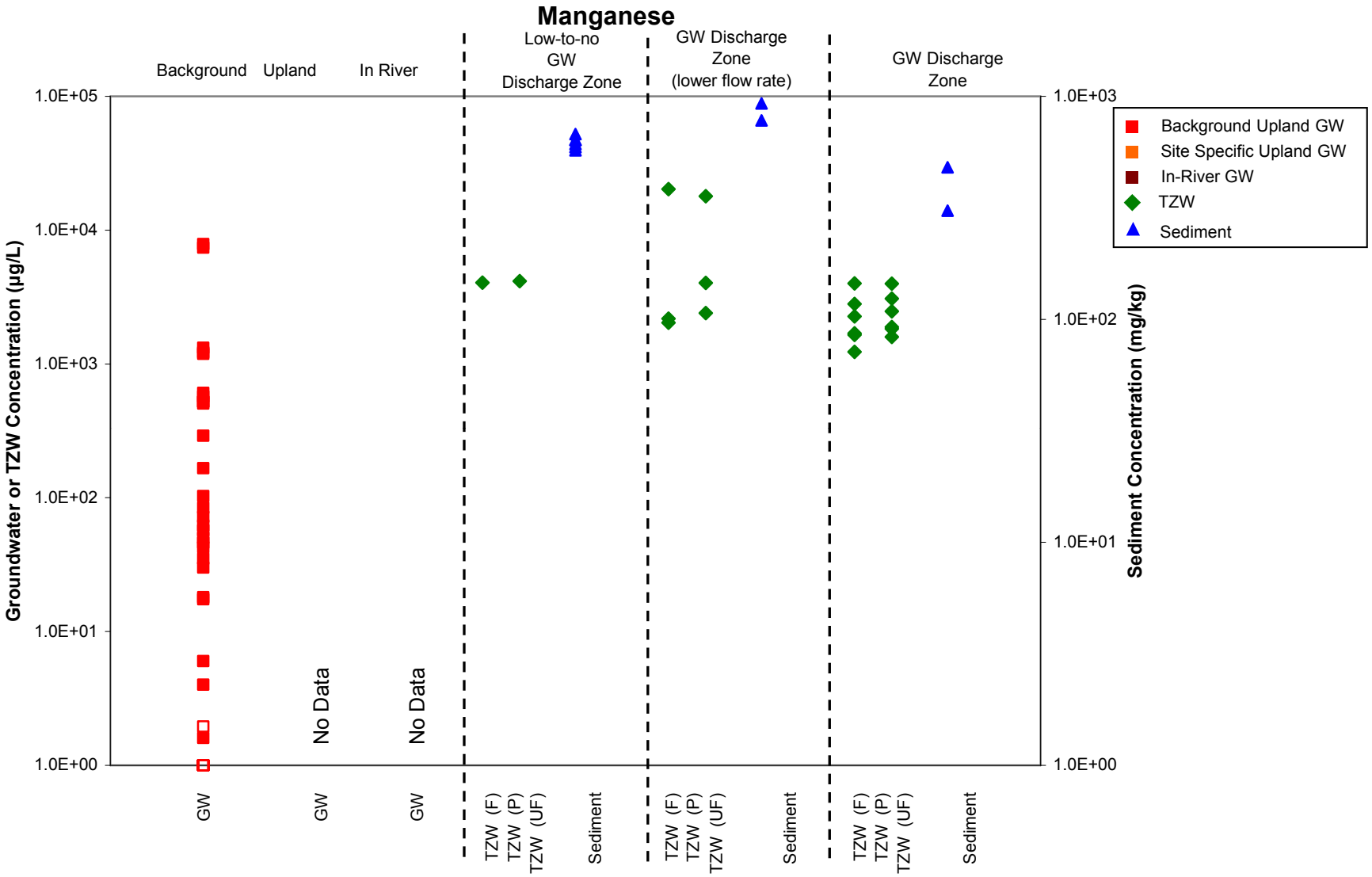
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: W-1, W-4,W-5,W-6, W-7, W-8, W-9, W-10, W-11,W-12,W-13,W-14,W-15,W-16,W-17,W-18,W-19,W-20,W-21,W-22; sampled between 5/3/1991 and 10/3/2003.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-7
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ExxonMobil



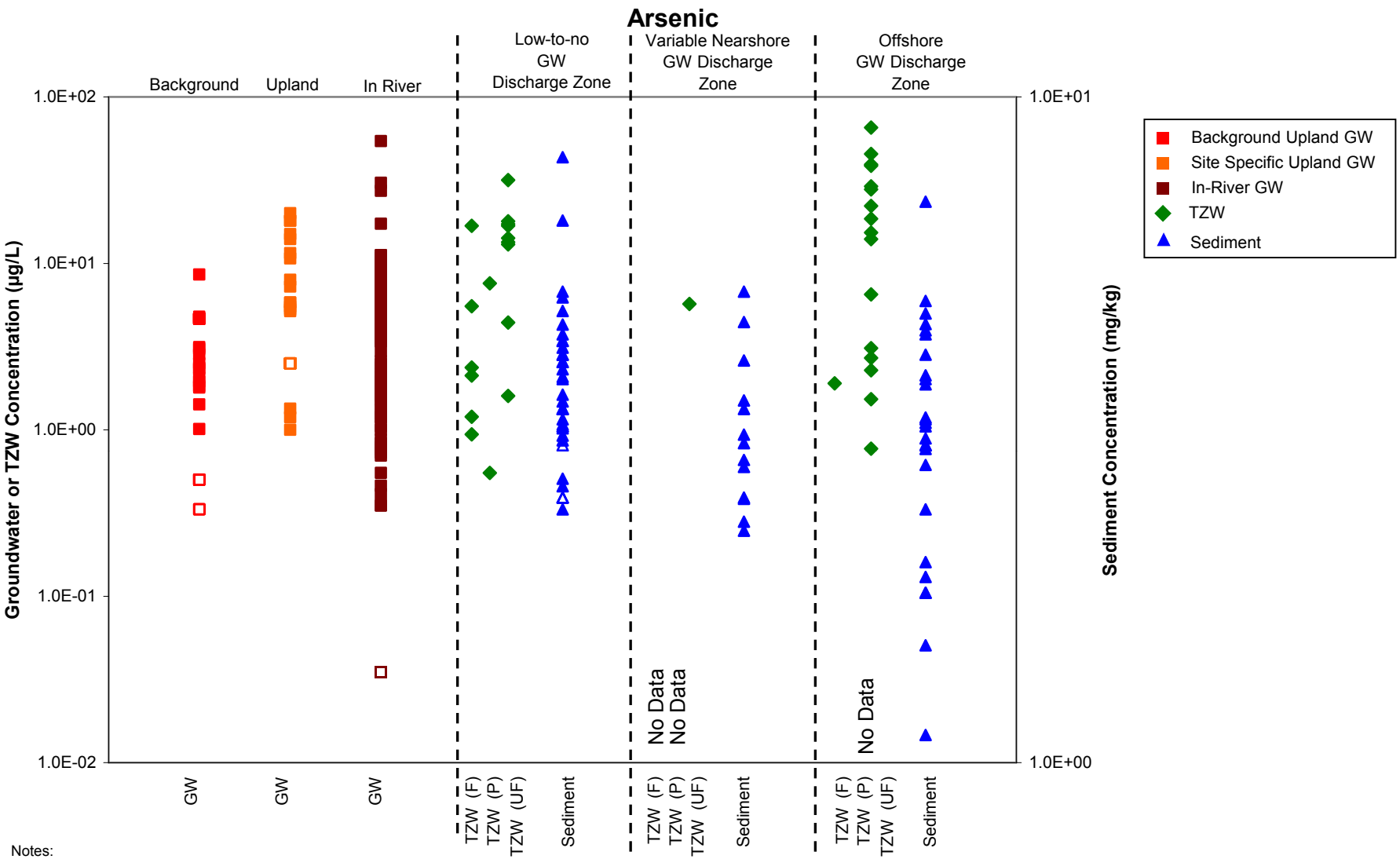
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.

Figure C4.2-8
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ExxonMobil



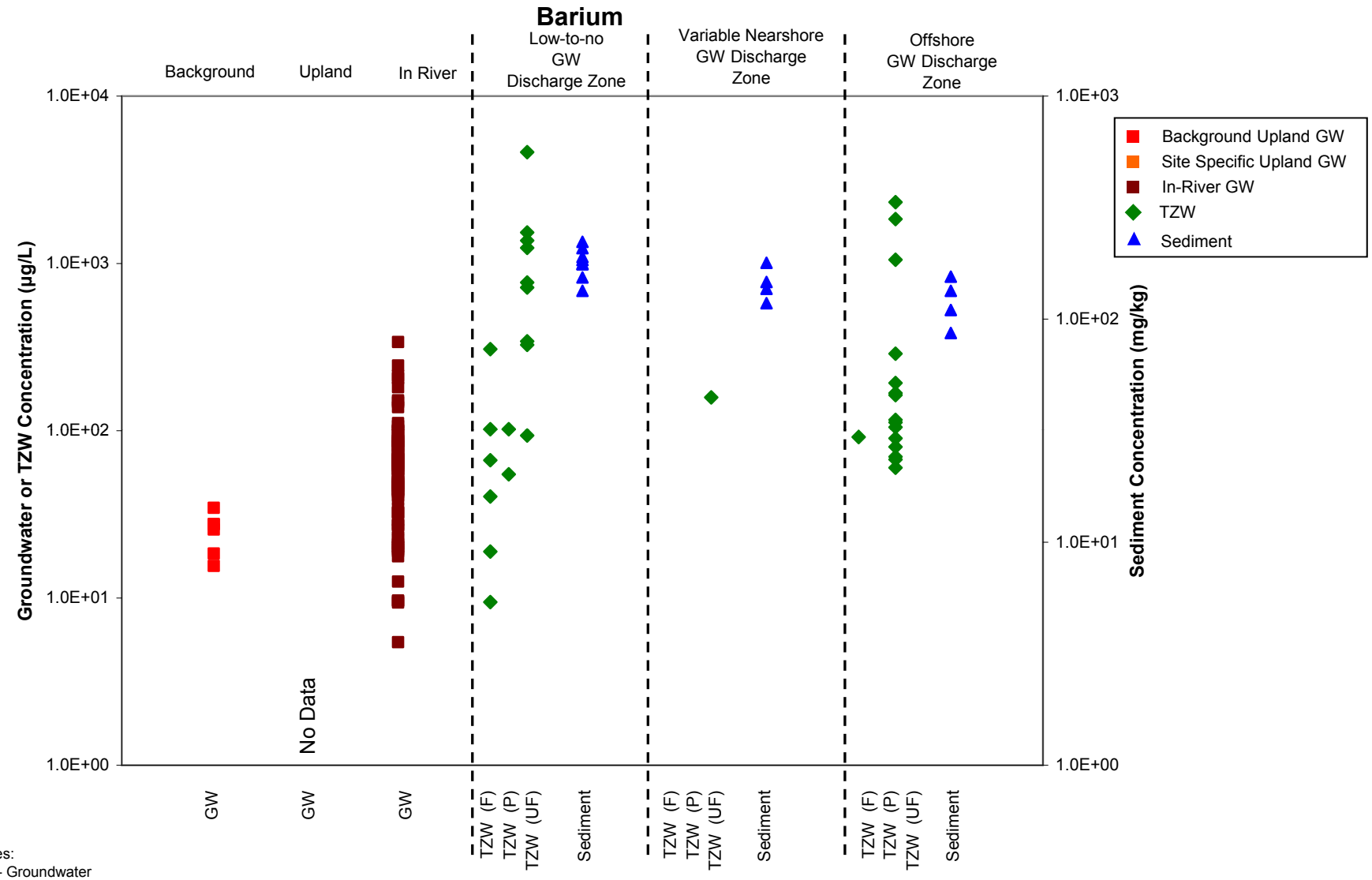
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.

Figure C4.2-9
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – ExxonMobil



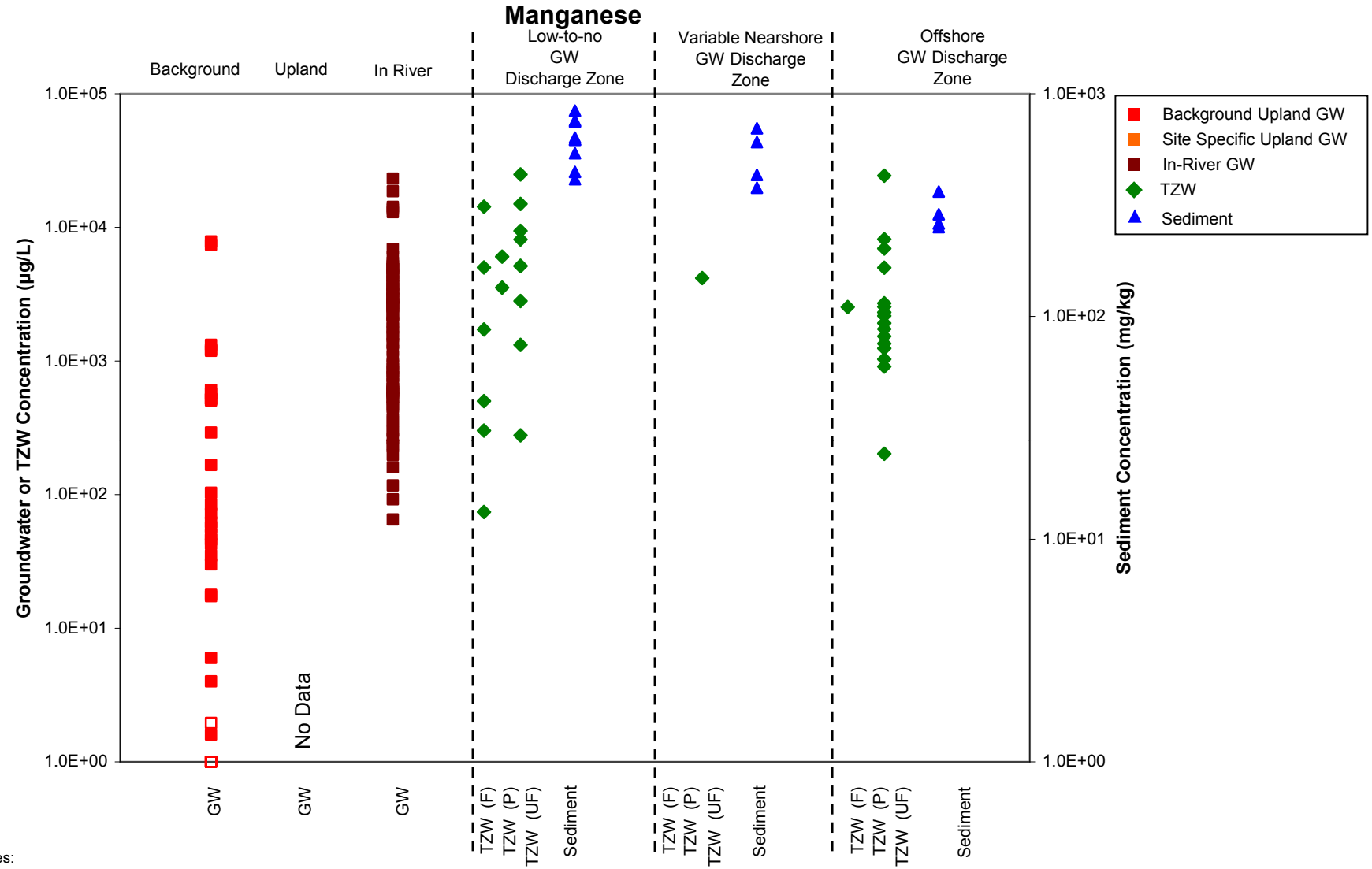
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-01, B-31, B-56A, B-56B, MW-1, MW-2, MW-3, MW-4, MW-5; sampled between 9/20/1991 and 8/24/2000.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-10
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gasco



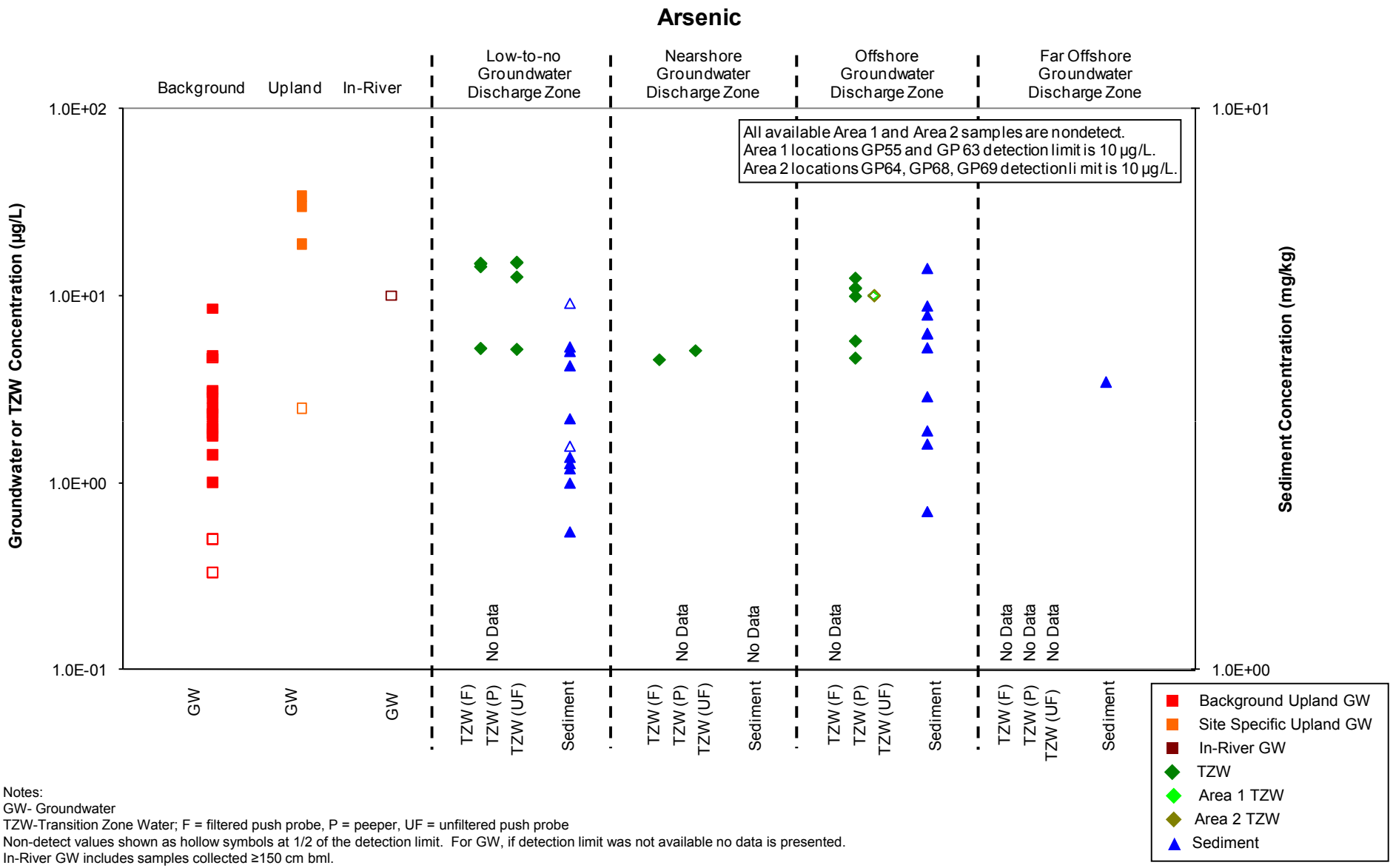
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes dissolved samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-11
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gasco



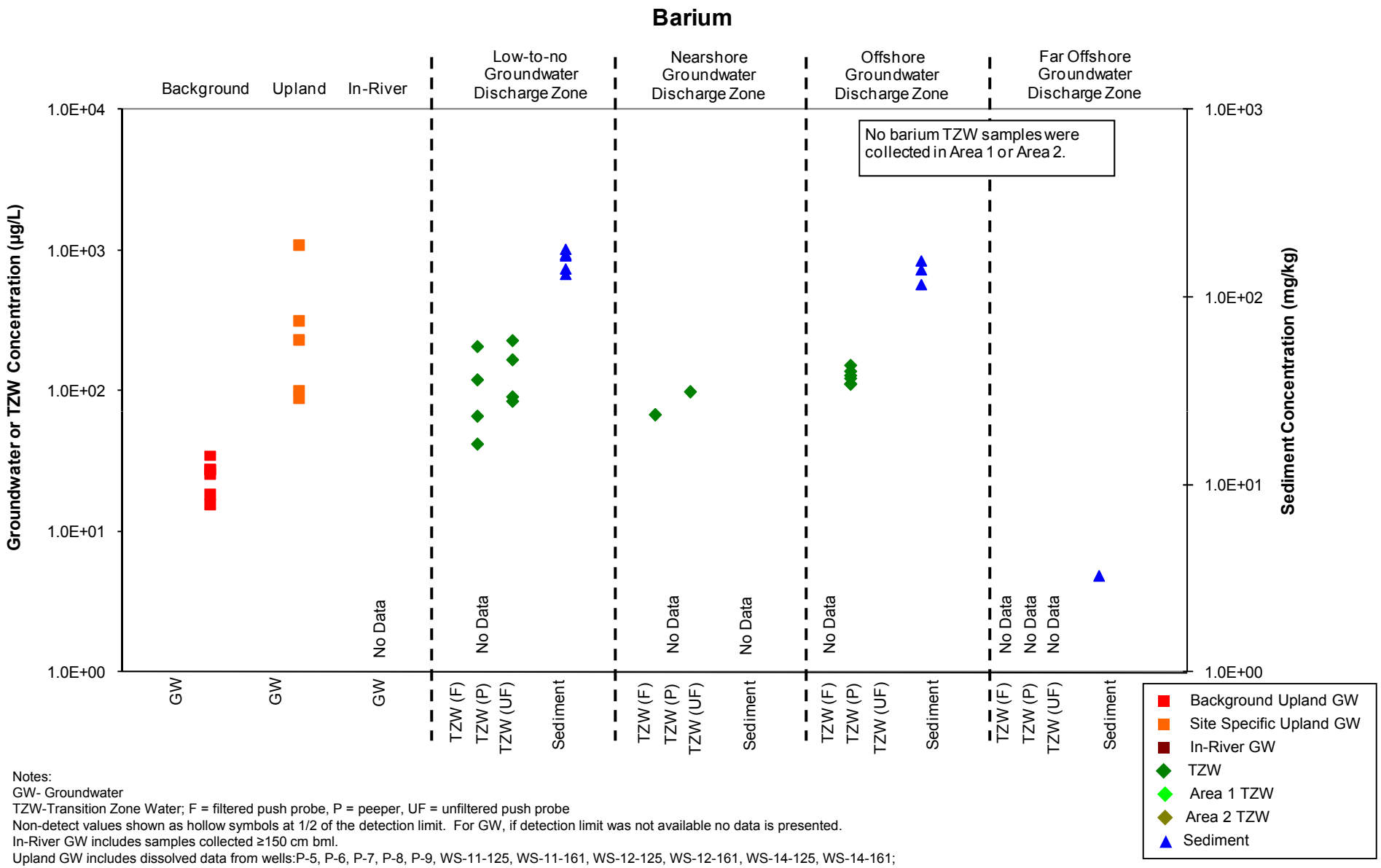
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes dissolved samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 90 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-12
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gasco



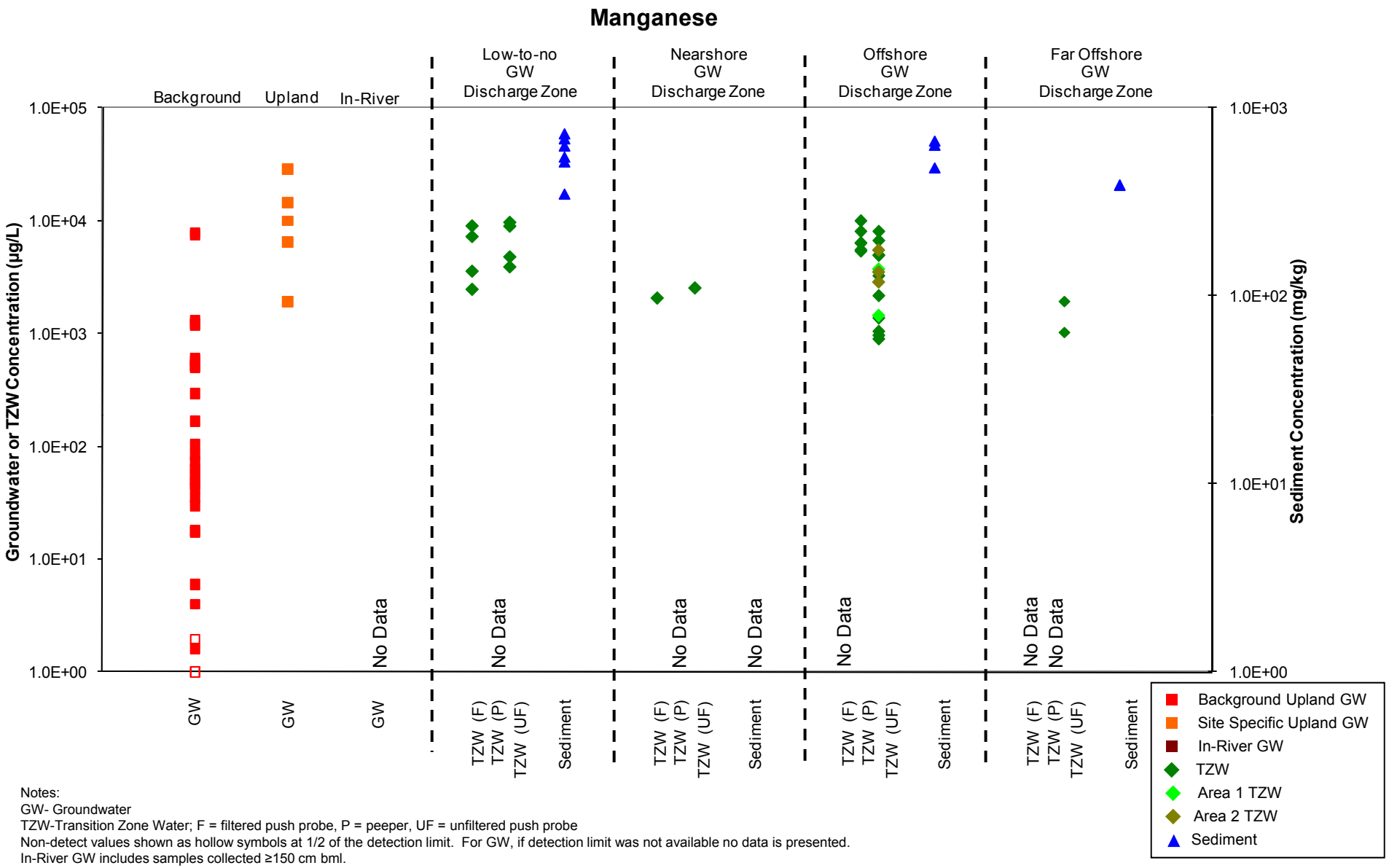
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells:P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-13
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Siltronic



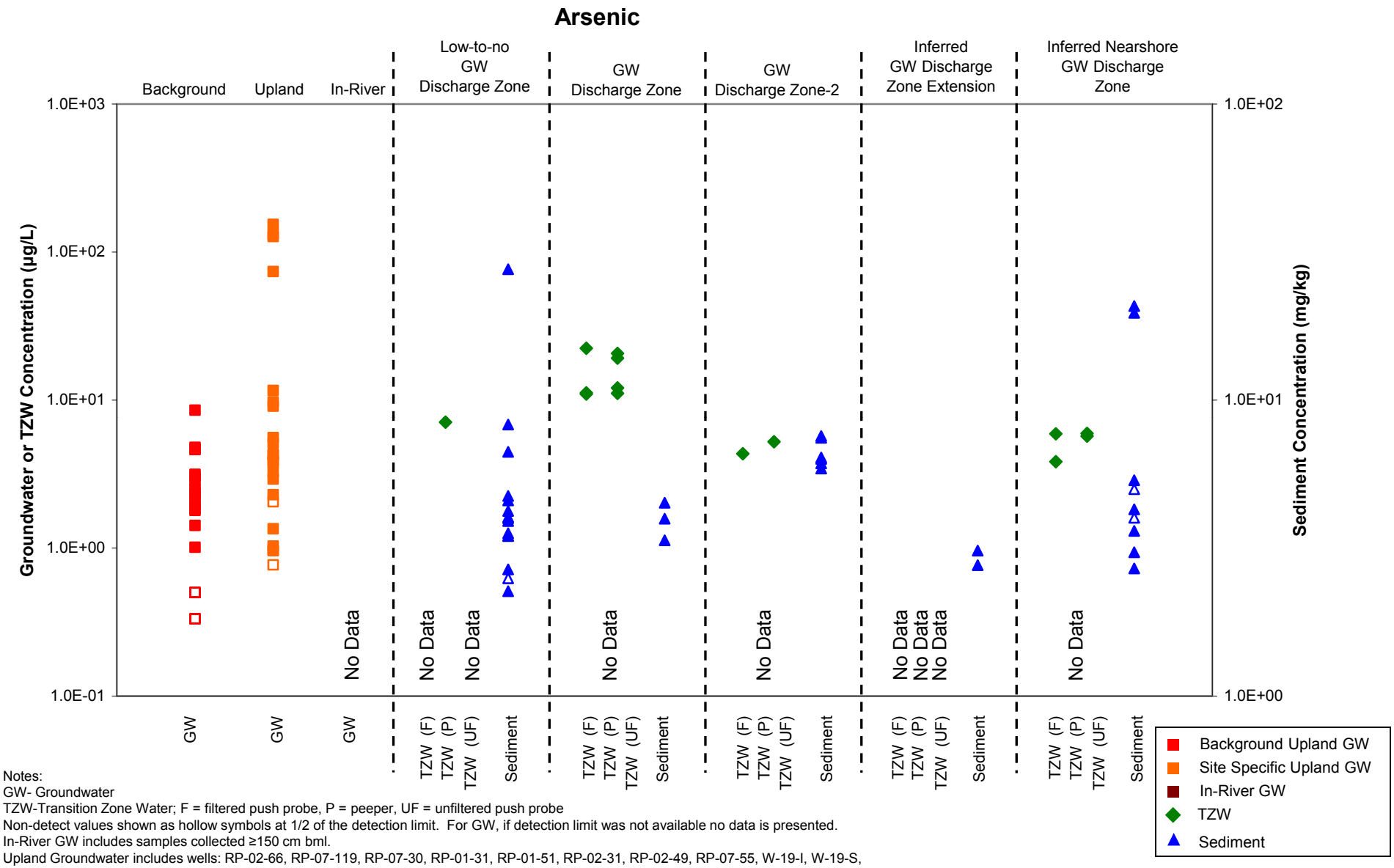
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes dissolved data from wells:P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-14
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Siltronic



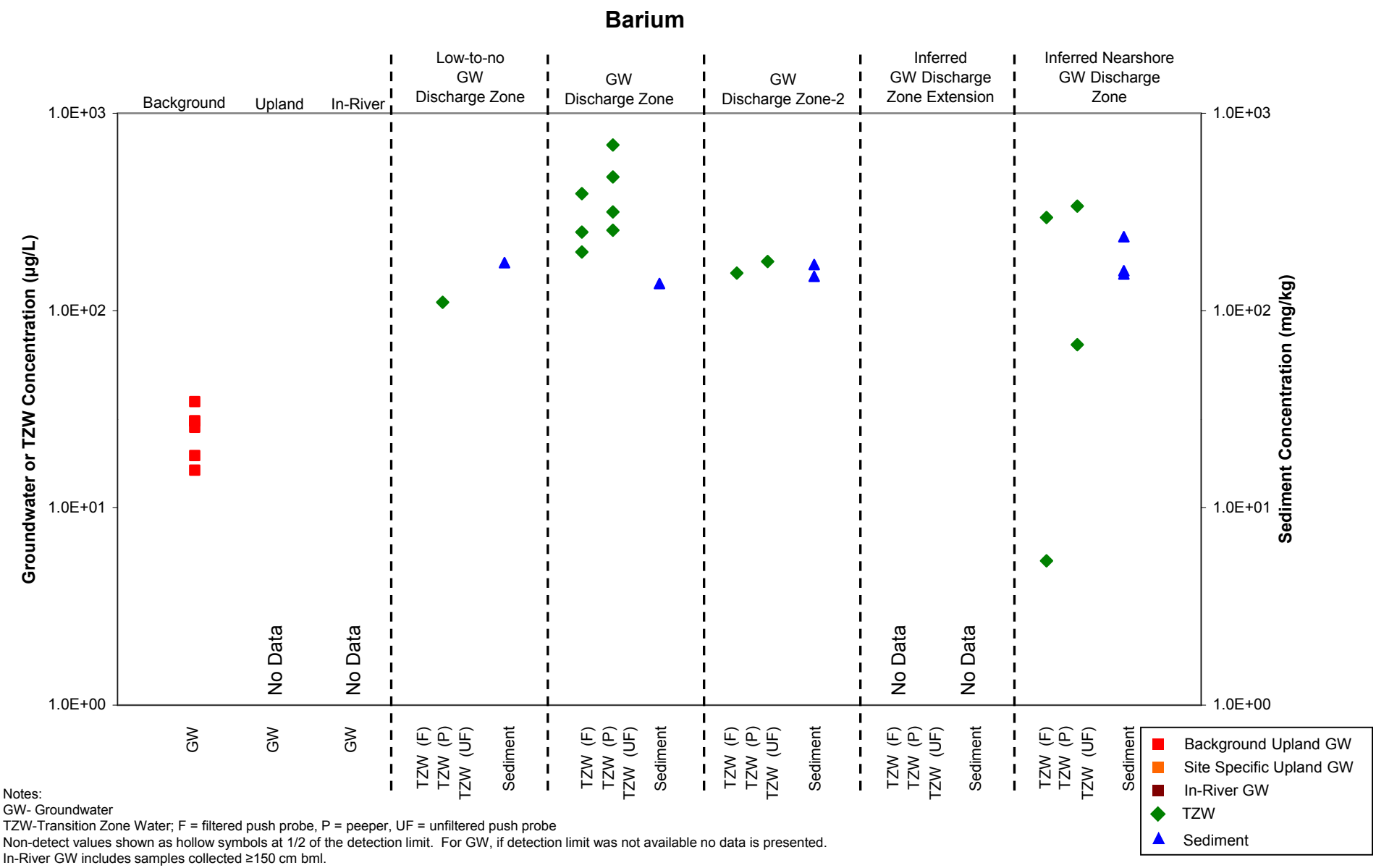
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes dissolved data from wells:P-5, P-6, P-7, P-8, P-9, WS-11-125, WS-11-161, WS-12-125, WS-12-161, WS-14-125, WS-14-161; sampled between 8/2/2001 and 11/17/2004.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-15
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Siltronic



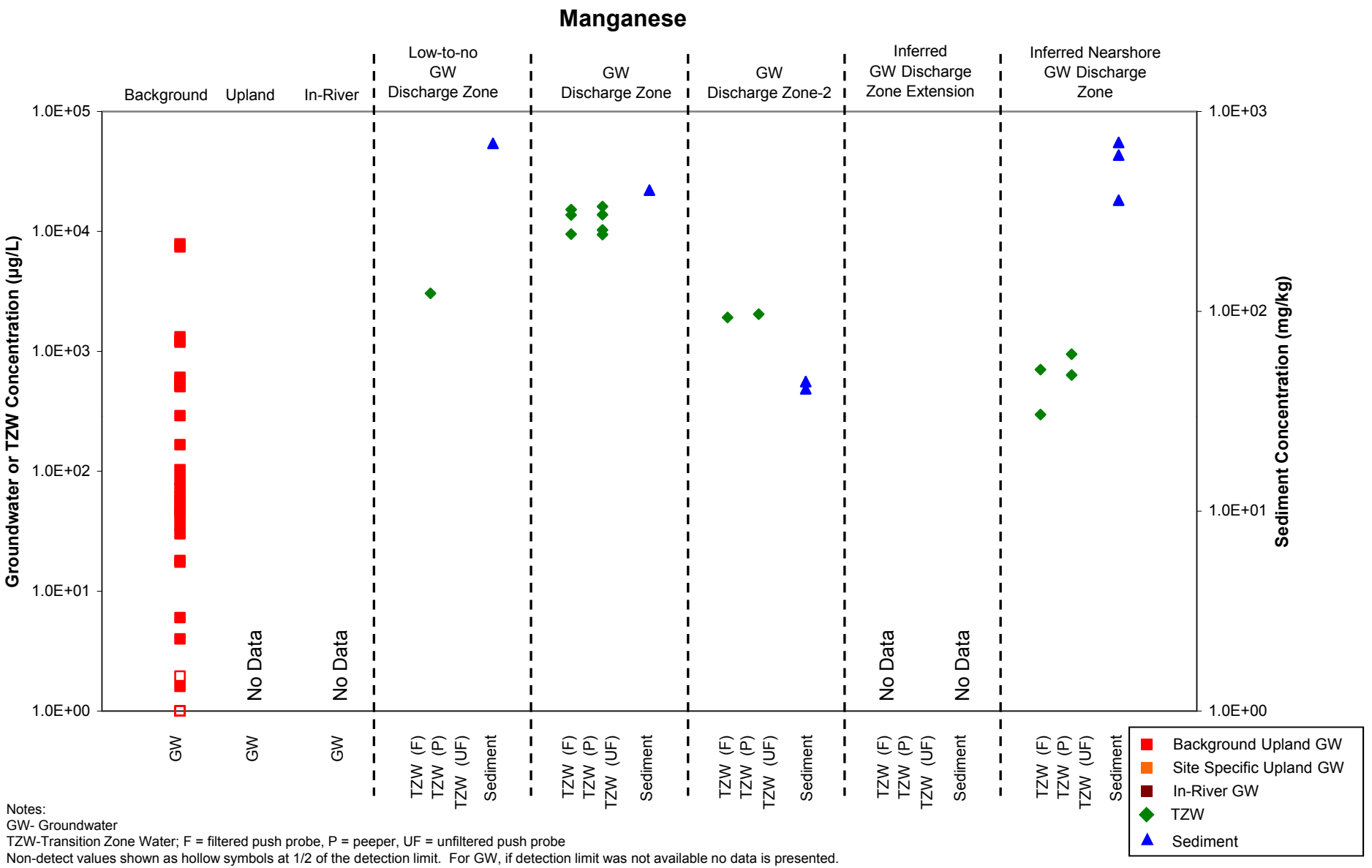
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: RP-02-66, RP-07-119, RP-07-30, RP-01-31, RP-01-51, RP-02-31, RP-02-49, RP-07-55, W-19-I, W-19-S, W-19-D, RP-02-66, RP-01-65, RP-01-119.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-16
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Rhone Poulenc



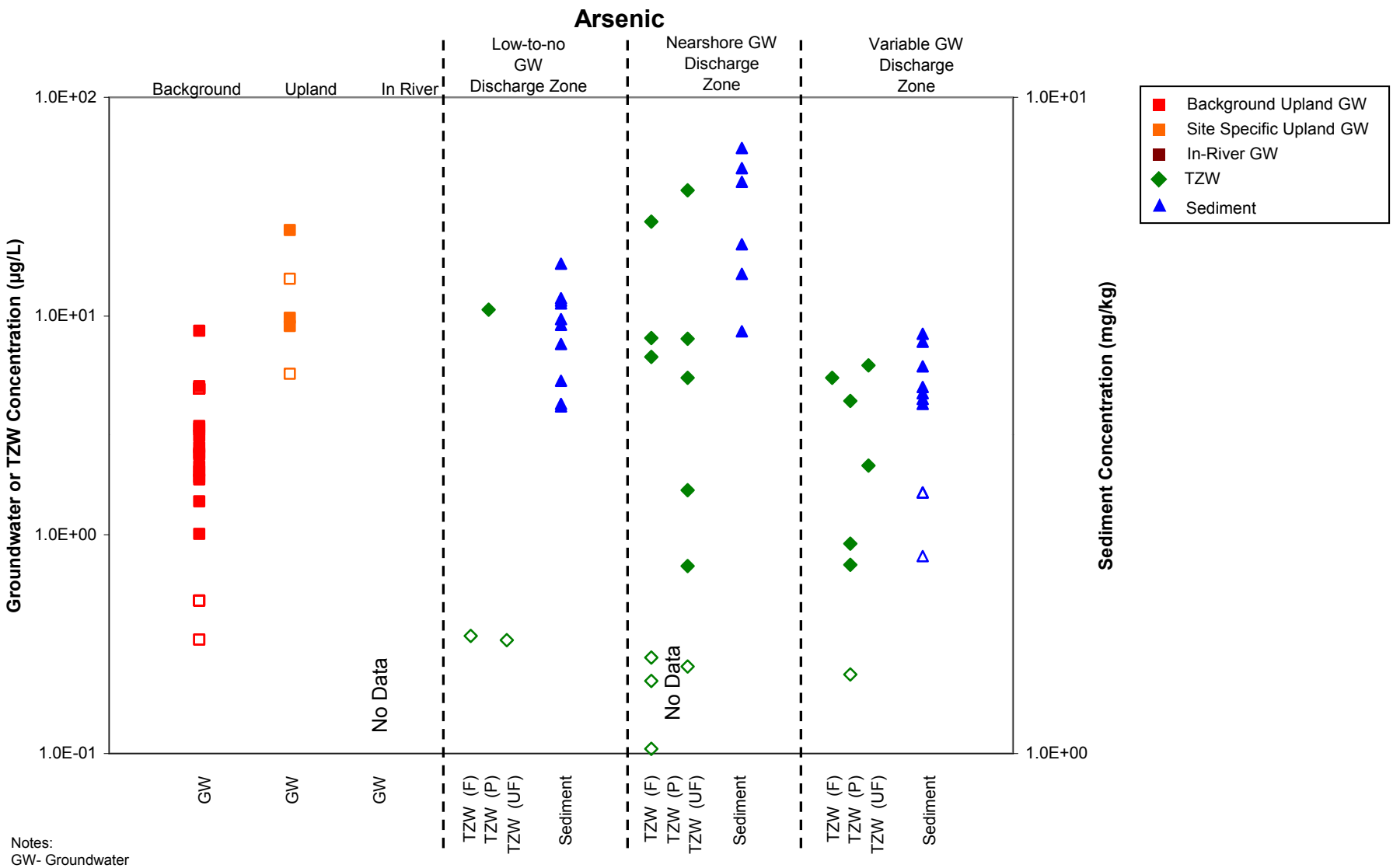
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-17
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Rhone Poulenc



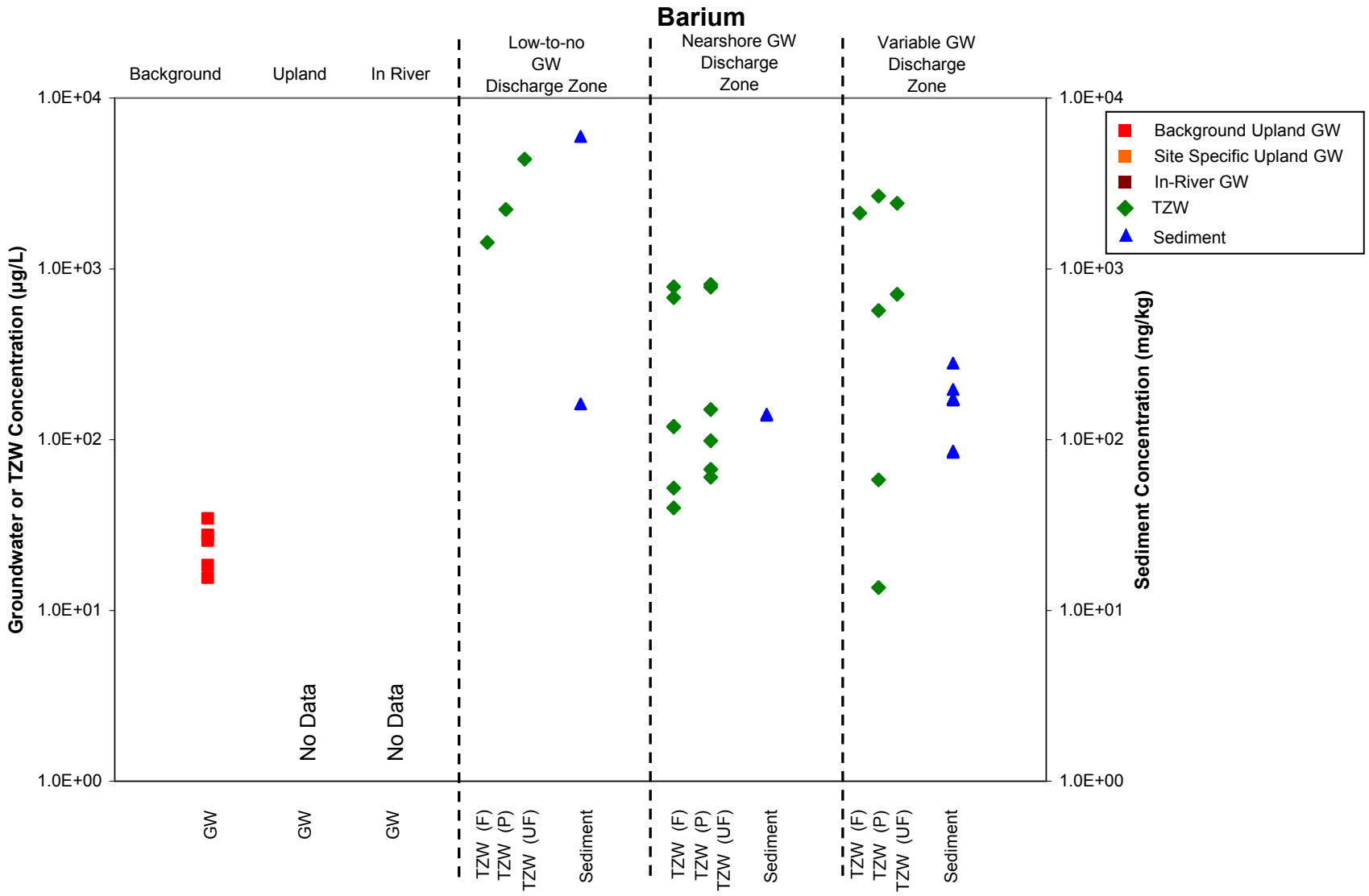
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-18
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Rhone Poulenc



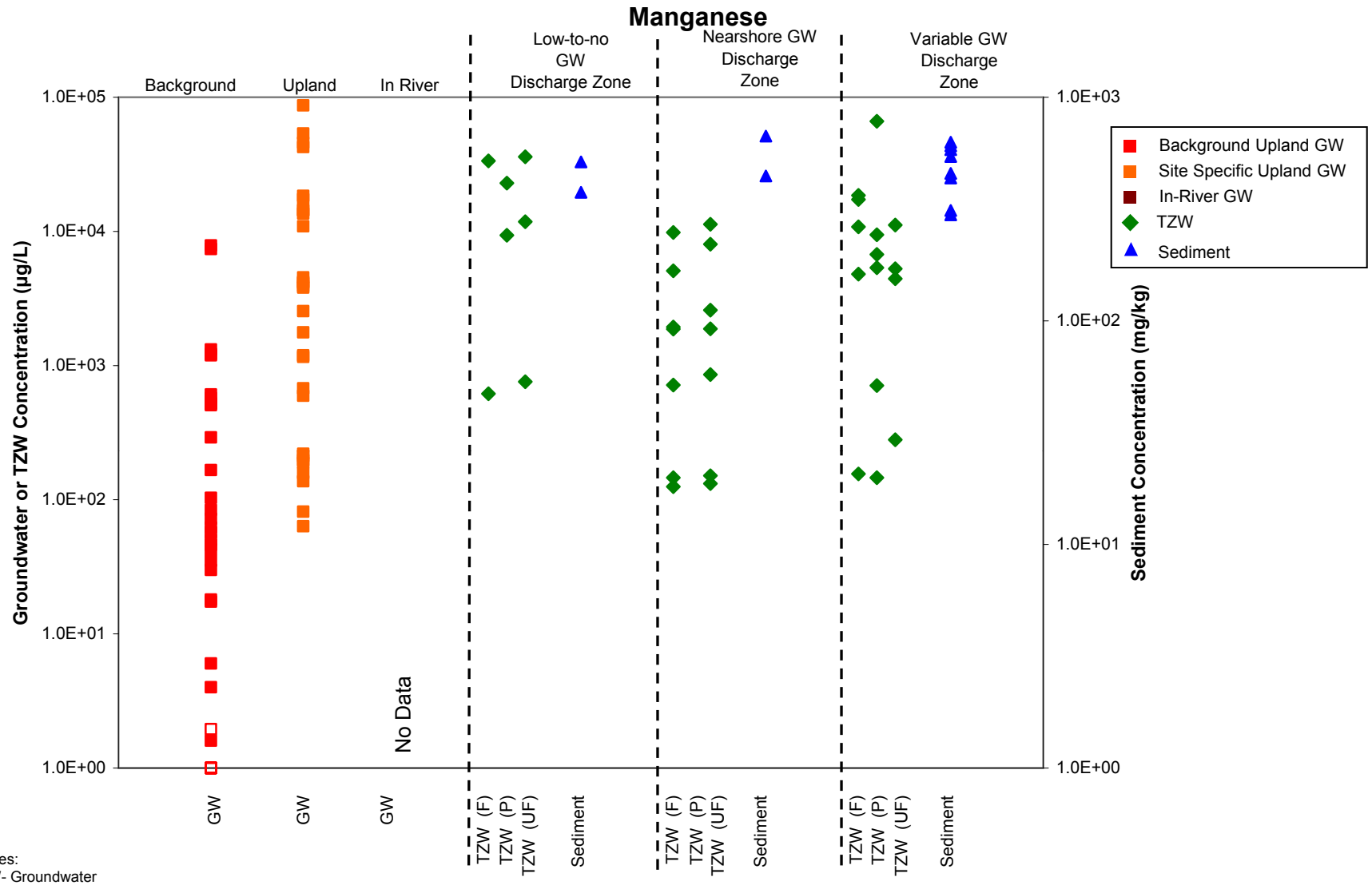
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-19
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Arkema



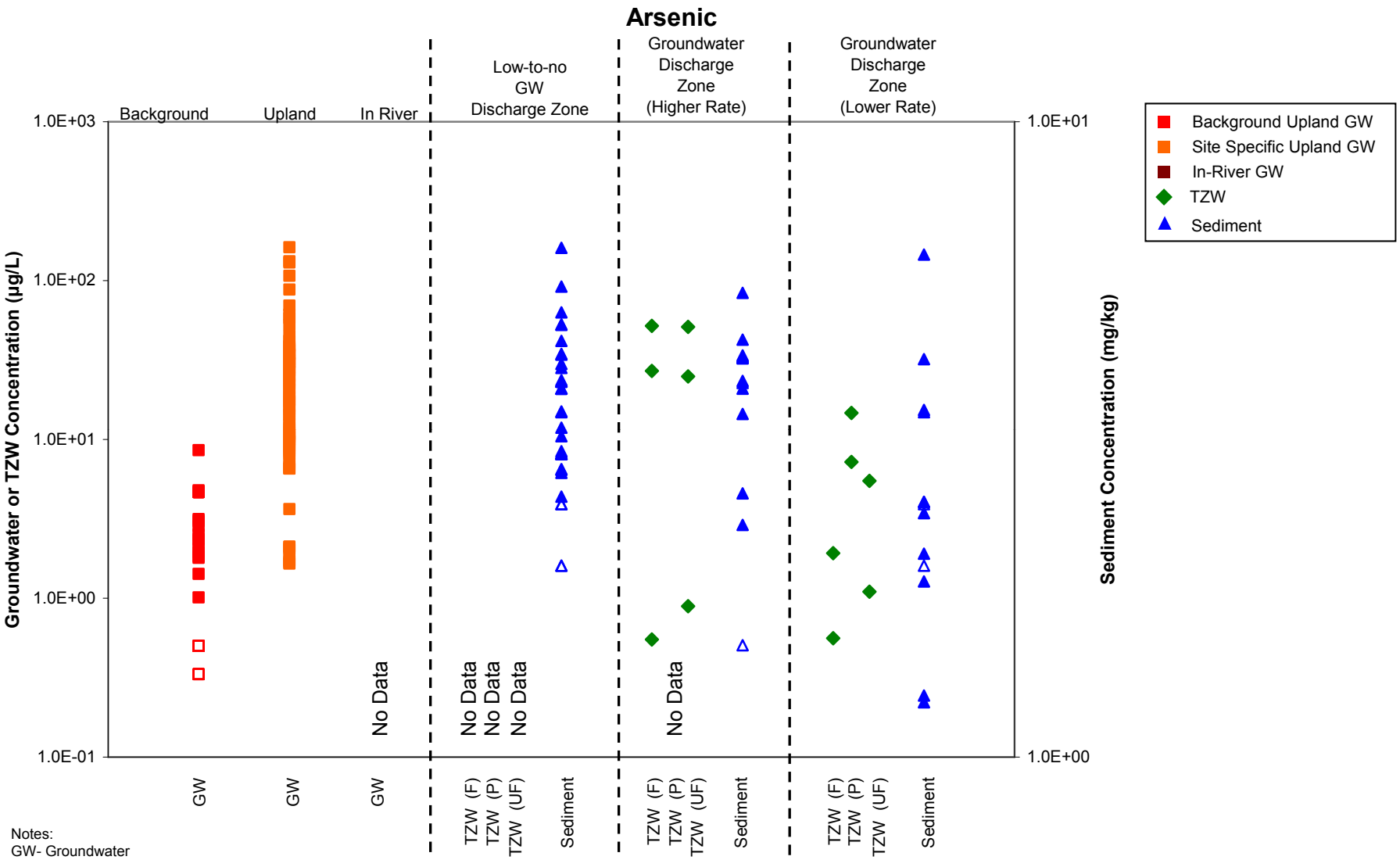
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-20
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Arkema



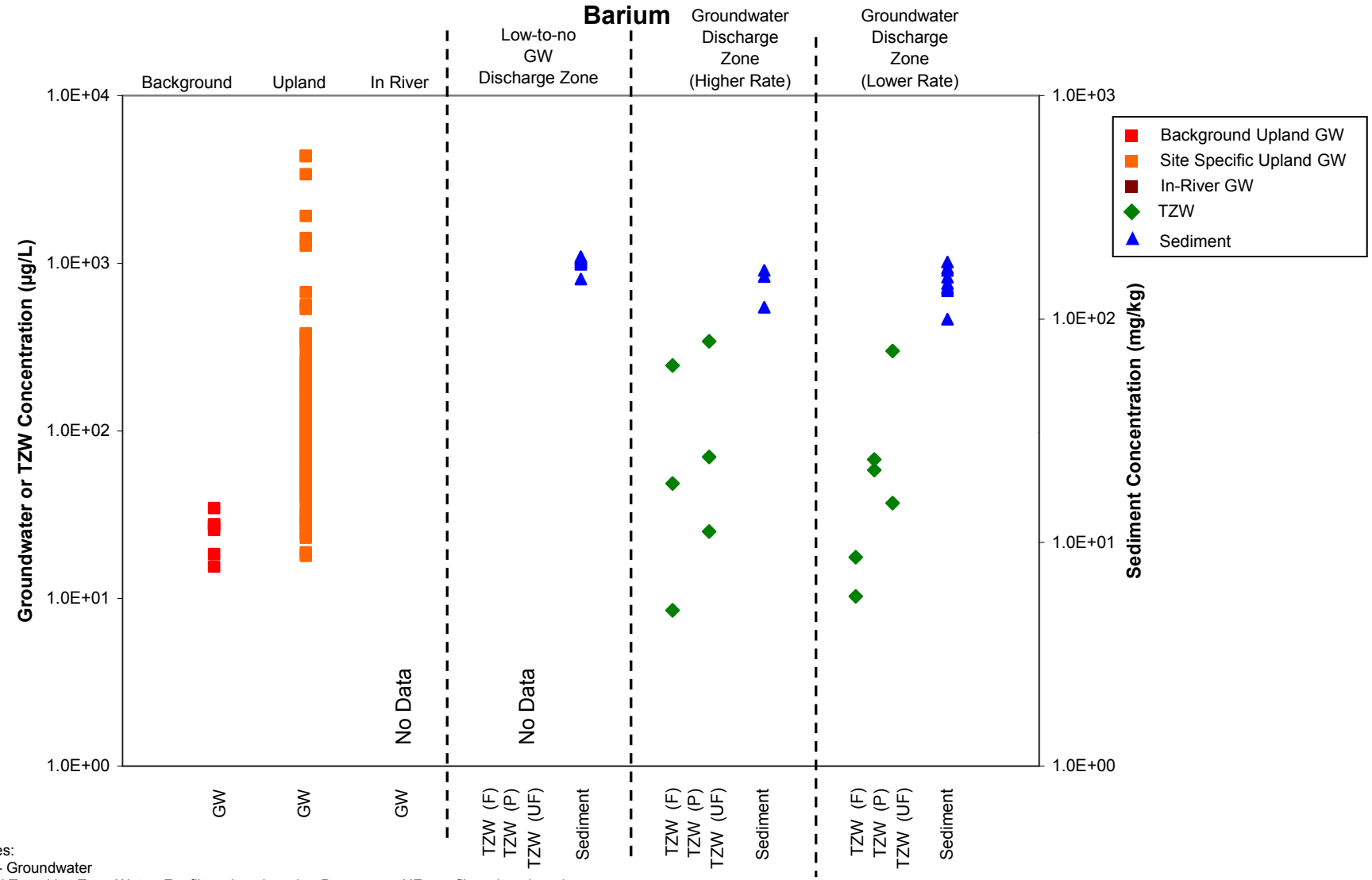
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes dissolved data from wells: MWA-2, MWA-3, MWA-4, MWA-5, MWA-6, MWA-6r, MWA-8i, MWA-9i, MWA-10i, MWA-13d, MWA-14i, MWA-16i, MWA-17si, MWA-18, MWA-19, MWA-29, MWA-30, MWA-31i, MWA-32ia, MWA-34ia.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-21
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Arkema



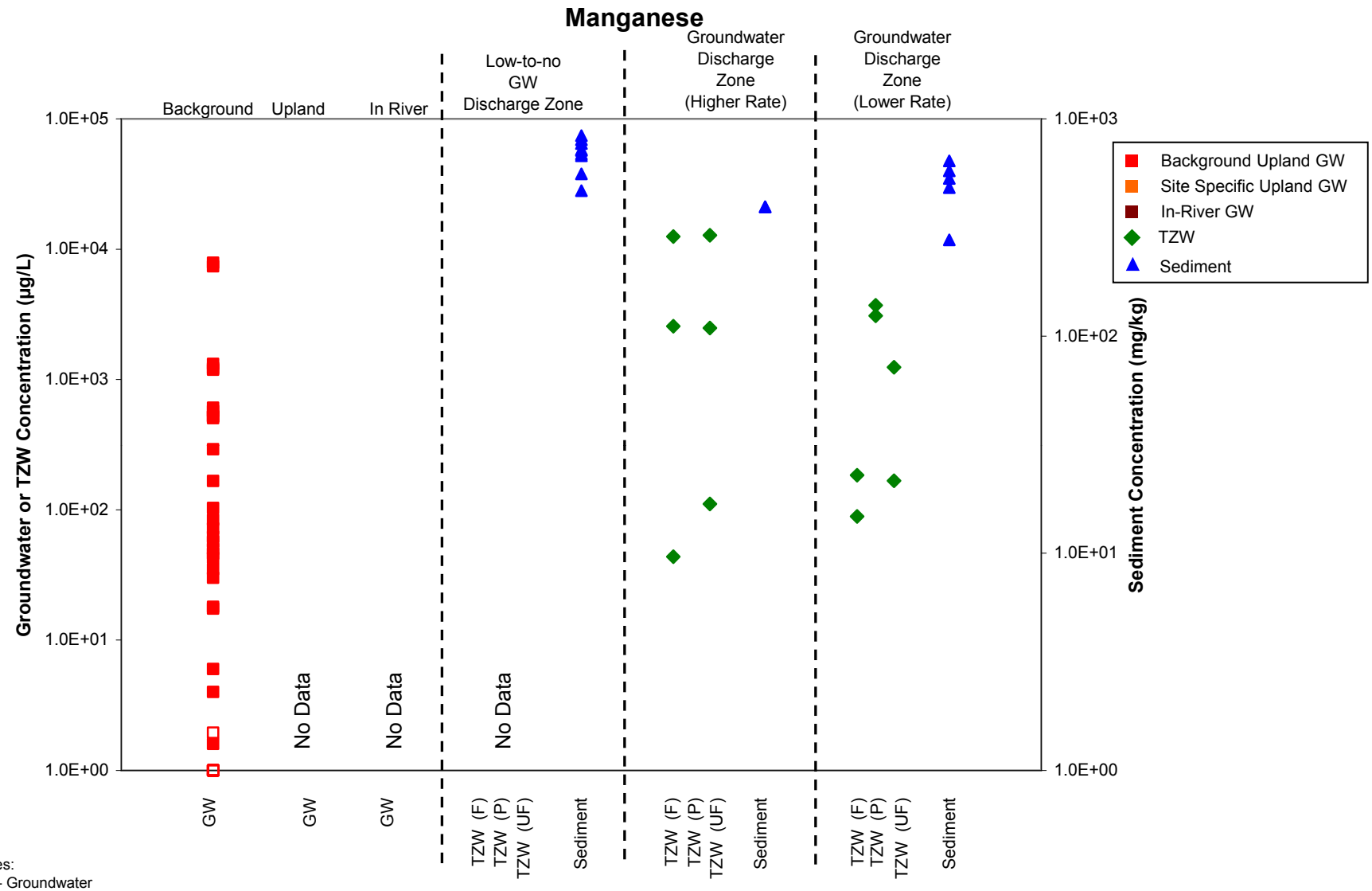
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: B-7, B-9, B-20, CR-1, MW-33, MW-34, MW-40, U-10, U-11, P-1, P-2.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-22
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Willbridge



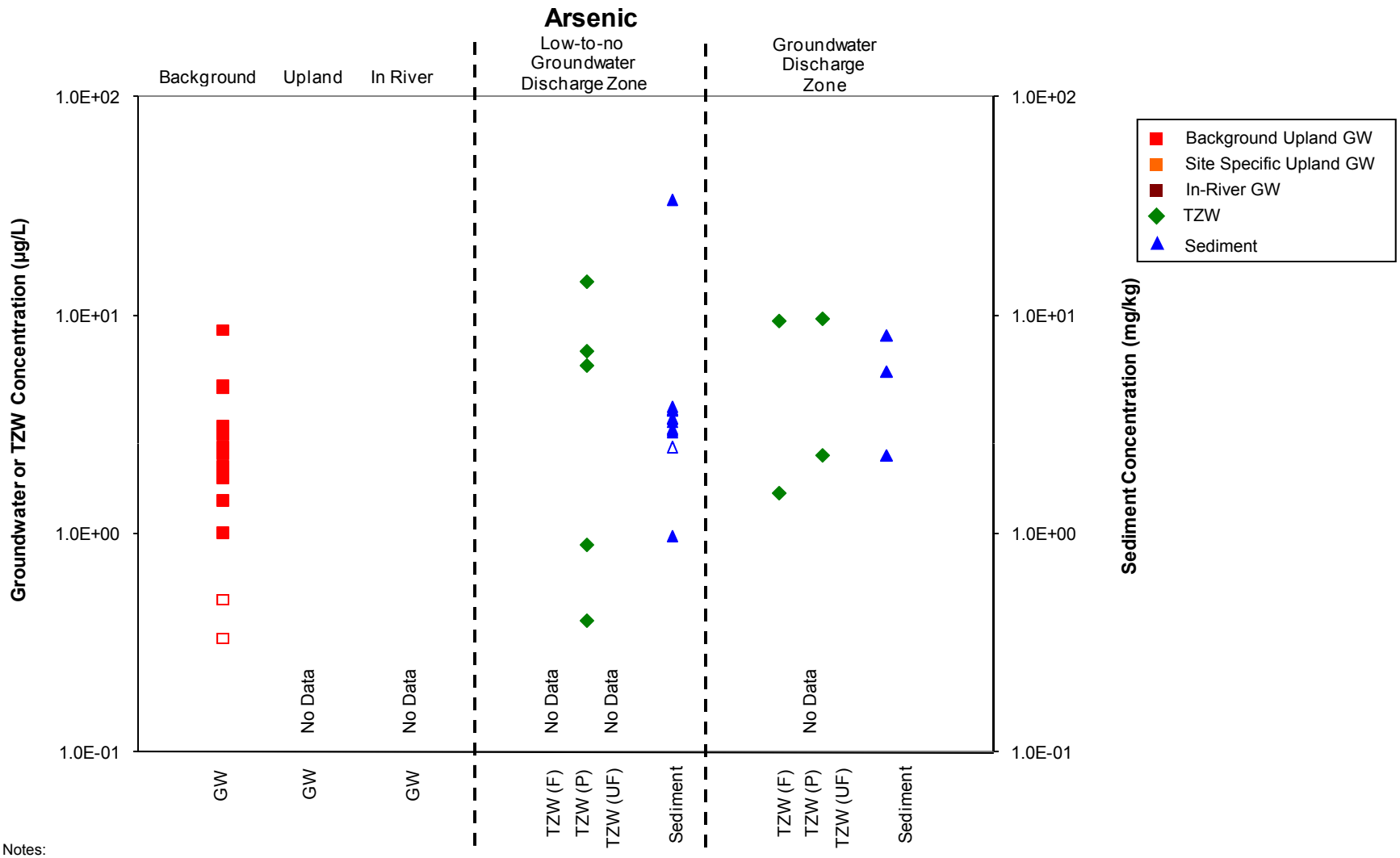
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland GW includes unfiltered data for wells: B-7, B-9, B-20, CR-1, MW-33, MW-34, MW-40, U-10, U-11, P-1, P-2.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-23
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Willbridge



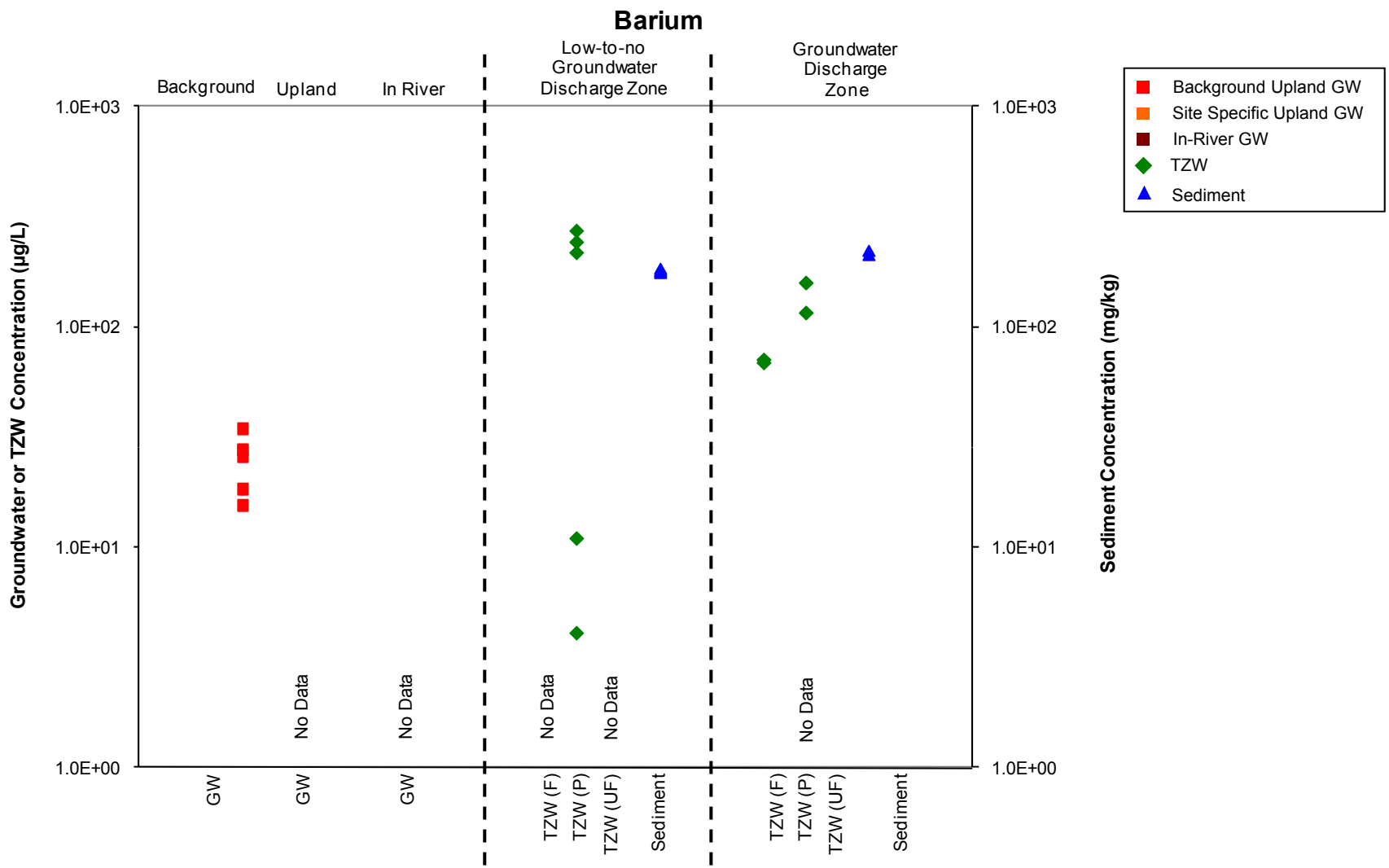
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-24
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Willbridge



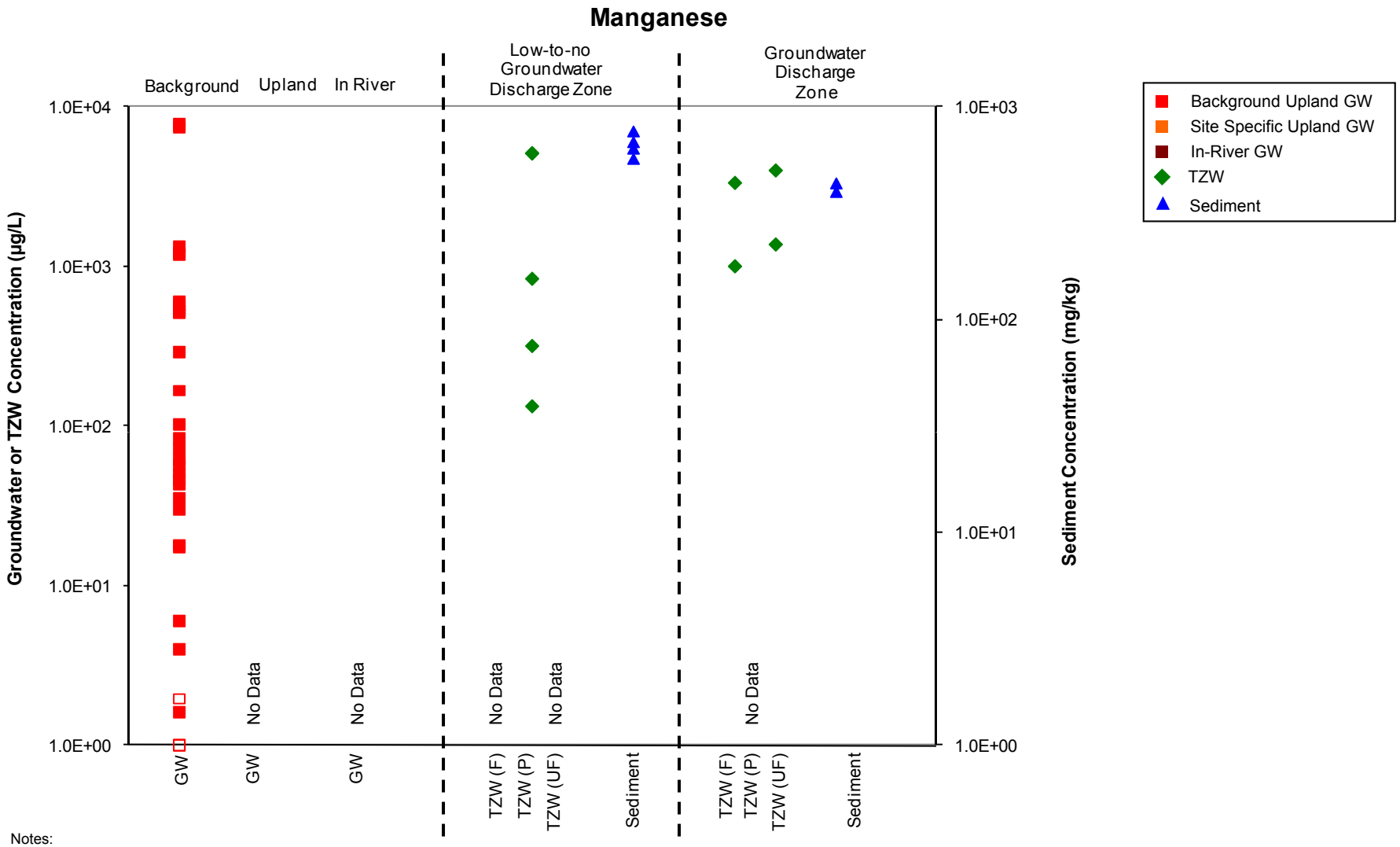
Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Upland Groundwater includes wells: CP-586, GP-301, GP-303, GP-312, GP-313, GP-314, GP-315, GP-318, MW-10, MW-14, MW-15, MW-18, MW-28, MW-29, MW-32, MW-33, MW-37, MW-52, MW-53, SMW-12, SMW-13, SMW-14, SMW-15, SMW-17, SMW-18, HA-34, HA-35.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-25
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gunderson



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-26
Portland Harbor RI/FS
Remedial Investigation Report
Barium Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gunderson



Notes:
GW- Groundwater
TZW-Transition Zone Water; F = filtered push probe, P = peeper, UF = unfiltered push probe
Non-detect values shown as hollow symbols at 1/2 of the detection limit. For GW, if detection limit was not available no data is presented.
In-River GW includes samples collected ≥150 cm bml.
Background GW data are unfiltered.
TZW includes samples collected from 0 to 38 cm bml.
Sediment includes samples collected from 0 to 60 cm bml.

Figure C4.2-27
Portland Harbor RI/FS
Remedial Investigation Report
Manganese Concentrations in Nearshore Groundwater, Transition Zone Water, and Sediment Associated with Interpreted Groundwater Discharge Zones – Gunderson

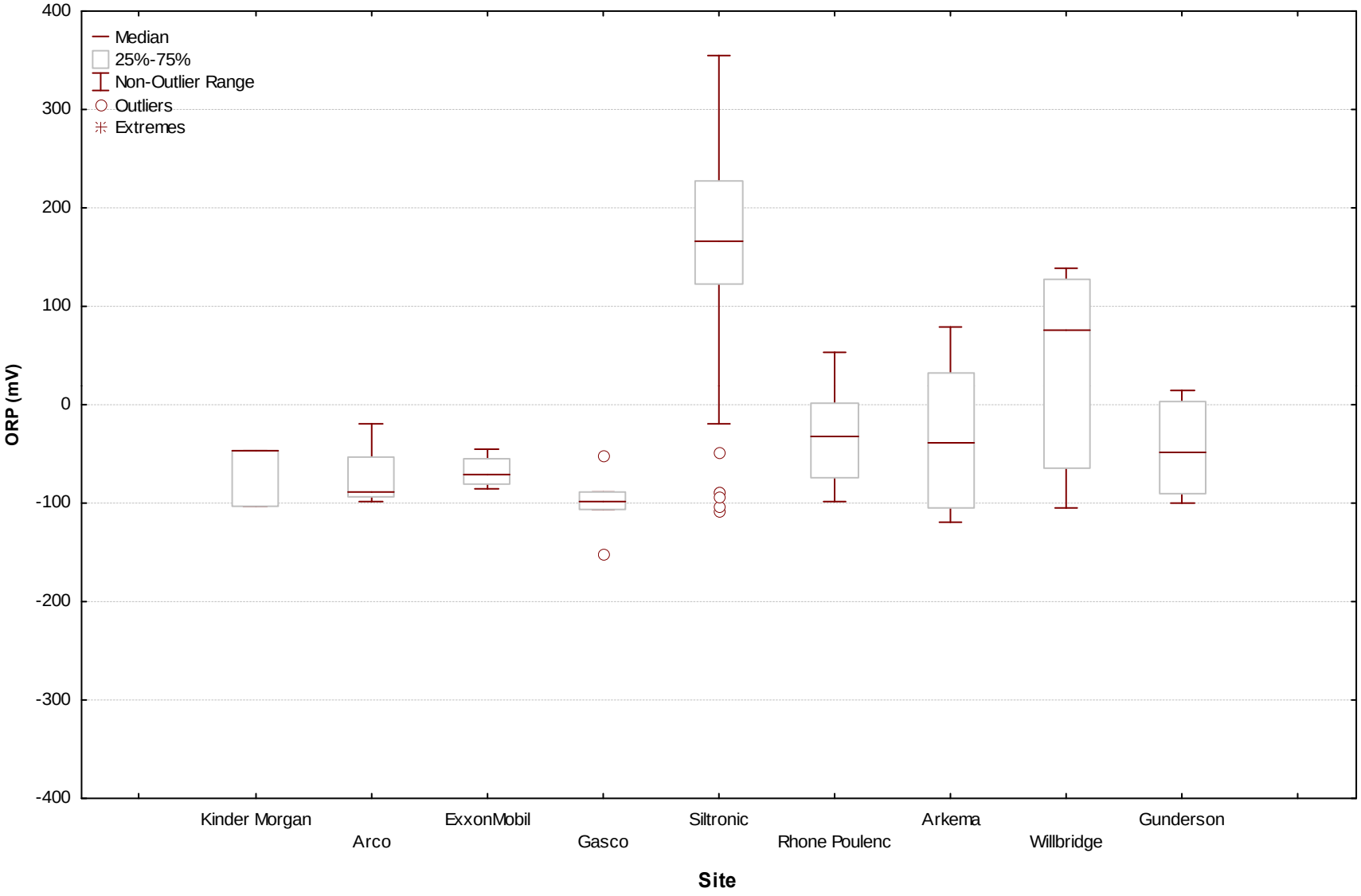
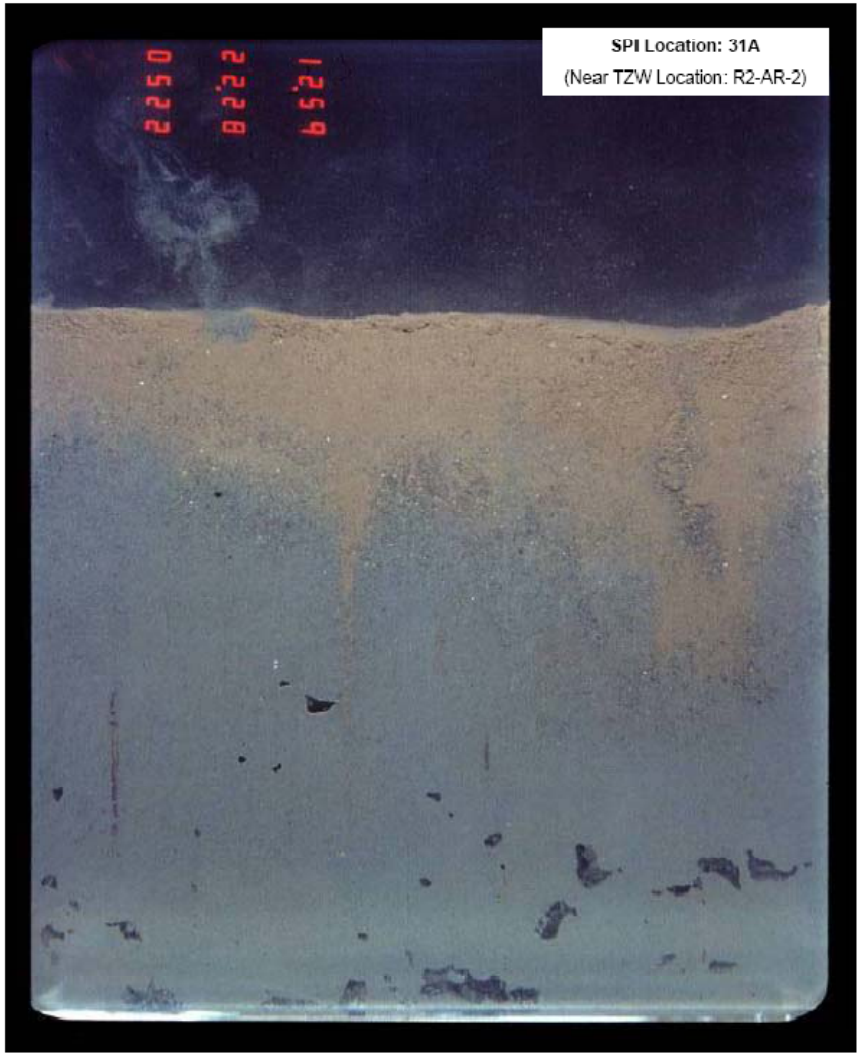
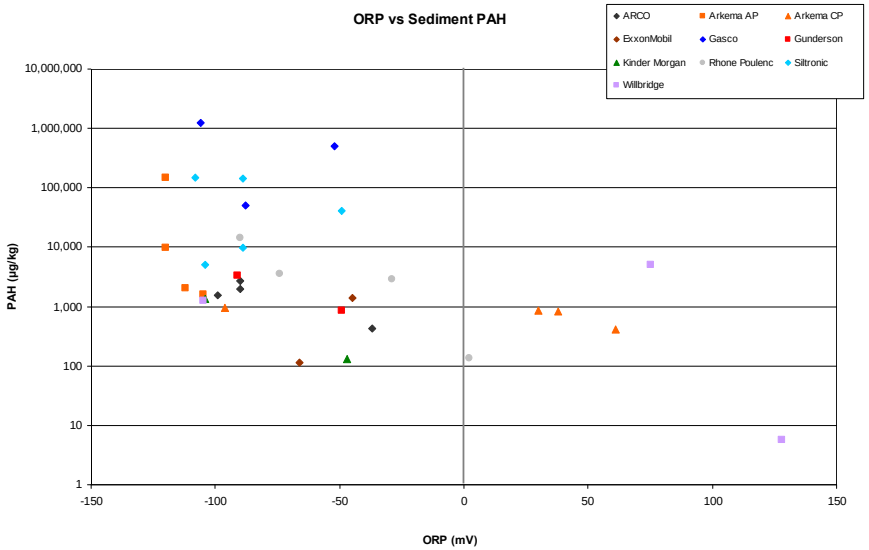


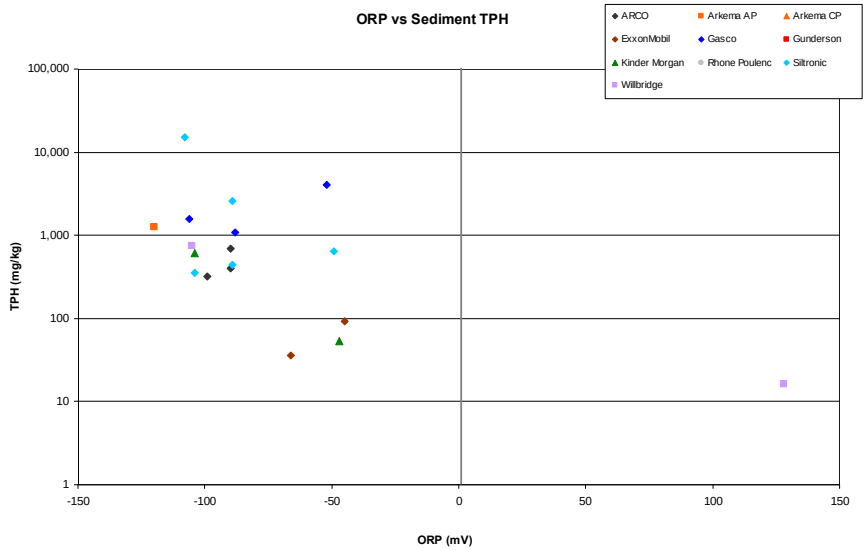
Figure C4.3-1
Portland Harbor RI/FS
Remedial Investigation Report
Oxidation Reduction Potential in Transition Zone Water



Note: depth of sediment profile shown is ~15 cm

Figure C4.3-2
Portland Harbor RI/FS
Remedial Investigation Report
Sediment Profile Imaging Illustrating the Apparent
Redox Potential Depth in Willamette River Bed Sediments





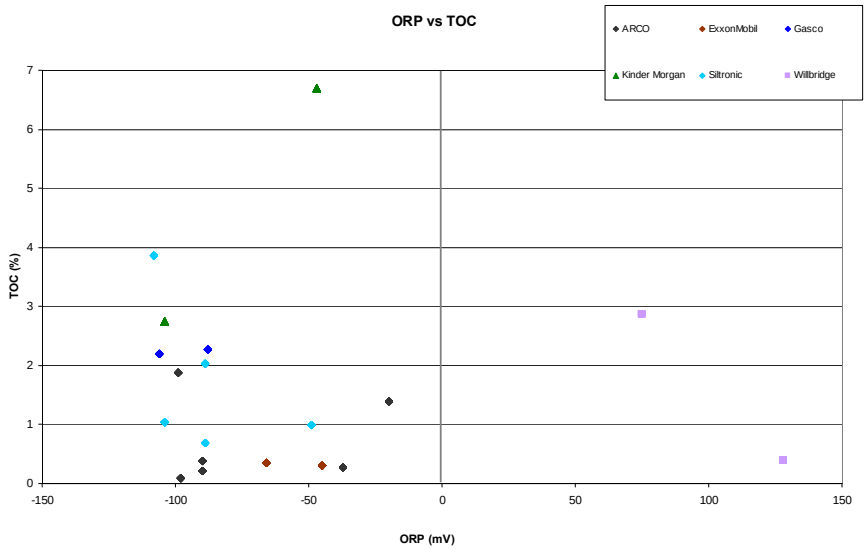
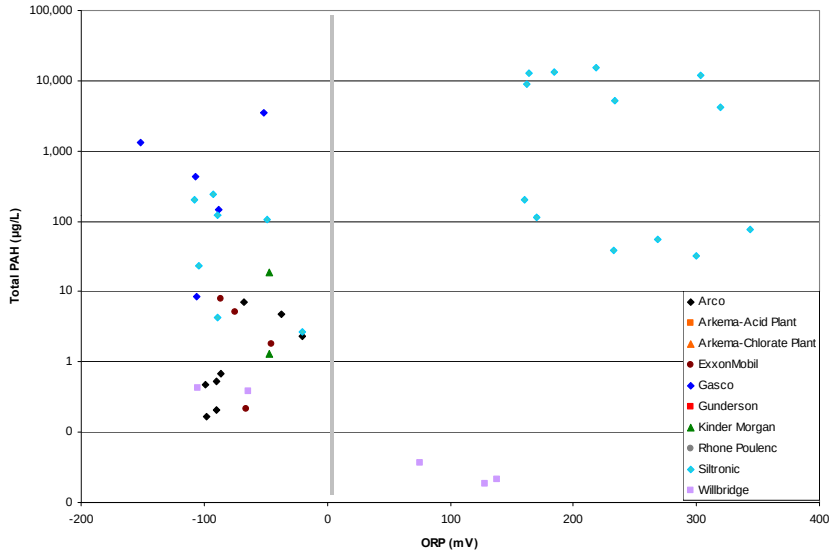


Figure C4.3-3
Portland Harbor RI/FS
Remedial Investigation Report
Oxidation Reduction Potential in TZW versus
Total PAHs, TPH, and TOC in Sediment



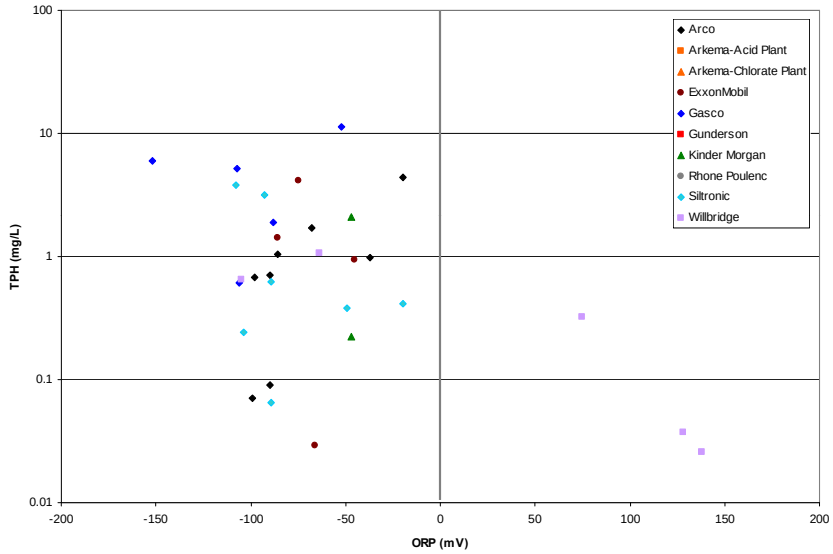


Figure C4.3-4
Portland Harbor RI/FS
Remedial Investigation Report
Oxidation Reduction Potential in TZW versus
Total PAHs and TPH in TZW

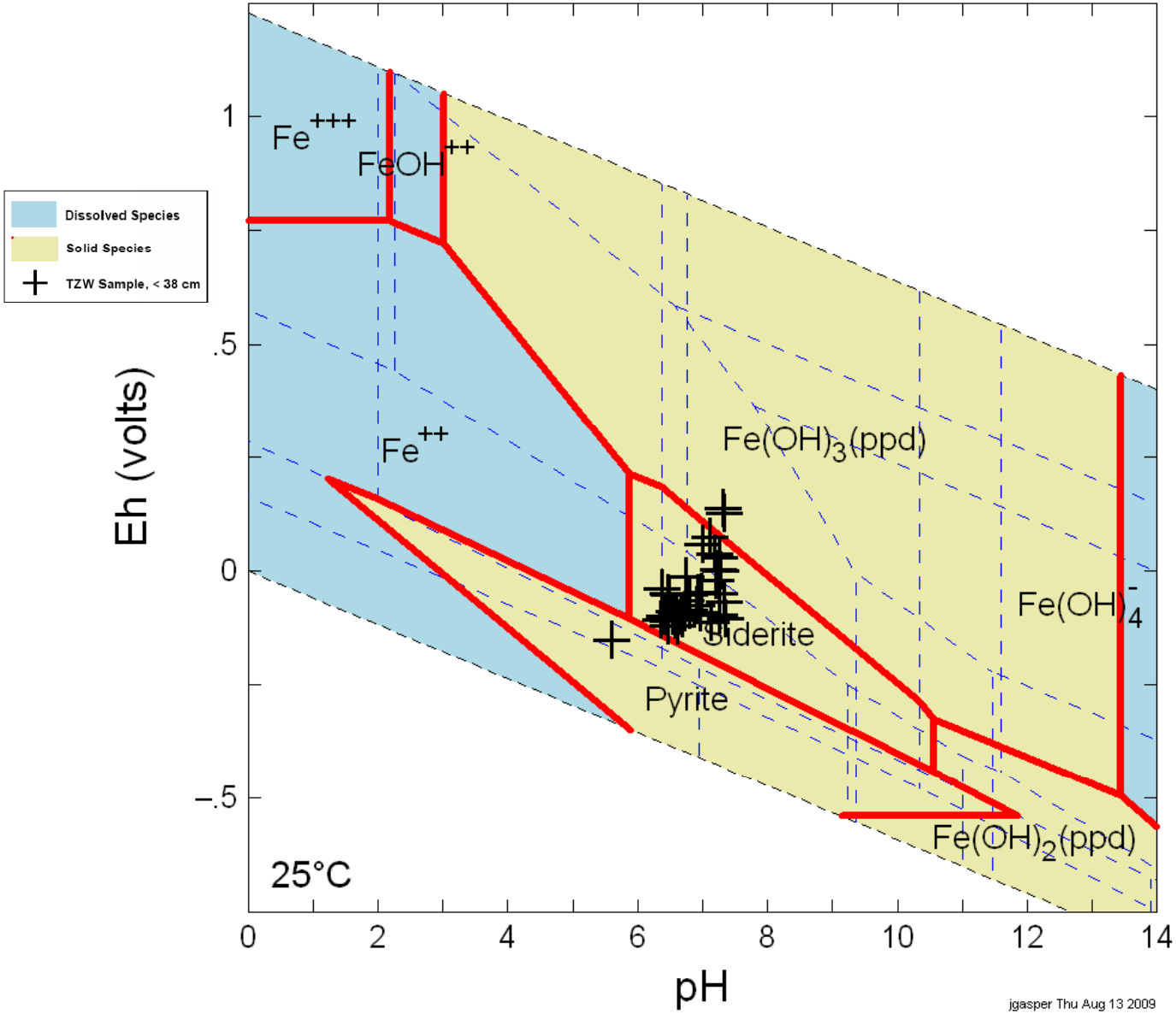


Diagram Fe^{++}, T = 25 °C, P = 1.013 bars, a [main] = $10^{-3.32}$, a [H_2O] = 1, a [$As(OH)_3^0$] = $10^{-7.08}$ (speciates), a [Ba^{++}] = $10^{-5.35}$, a [Mn^{++}] = $10^{-4.47}$ (speciates), a [HCO_3^-] = $10^{-2.28}$ (speciates), a [SO_4^{--}] = $10^{-5.43}$ (speciates), a [Ca^{++}] = $10^{-3.03}$, a [Cl^-] = $10^{-3.66}$, a [K^+] = $10^{-4.05}$, a [Mg^{++}] = $10^{-3.21}$, a [Na^+] = $10^{-3.14}$; Suppressed: Hematite, $Ba_3(AsO_4)_2$(c), Ferrite-Mg, Troilite, FeO(c), Goethite, Magnetite, Akermanite, Ferrite-Ca, Ferrite-2-Ca, Pyrrhotite

Figure C4.3-5
Portland Harbor RI/FS
Remedial Investigation Report
Eh-pH Stability Diagram
Iron

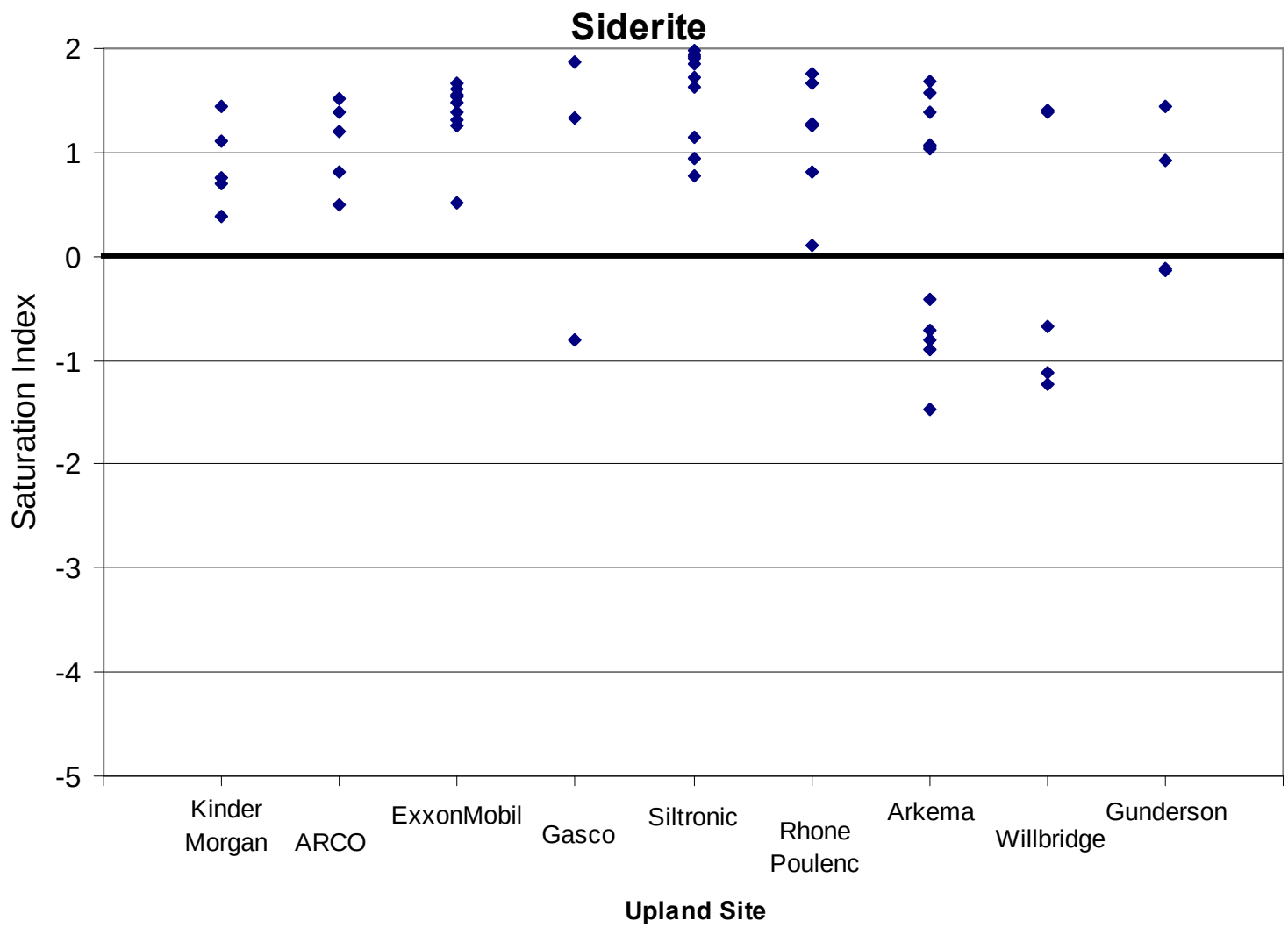


Figure C4.3-6
Portland Harbor RI/FS
Remedial Investigation Report
Saturation Indices for Siderite
in TZW by Site

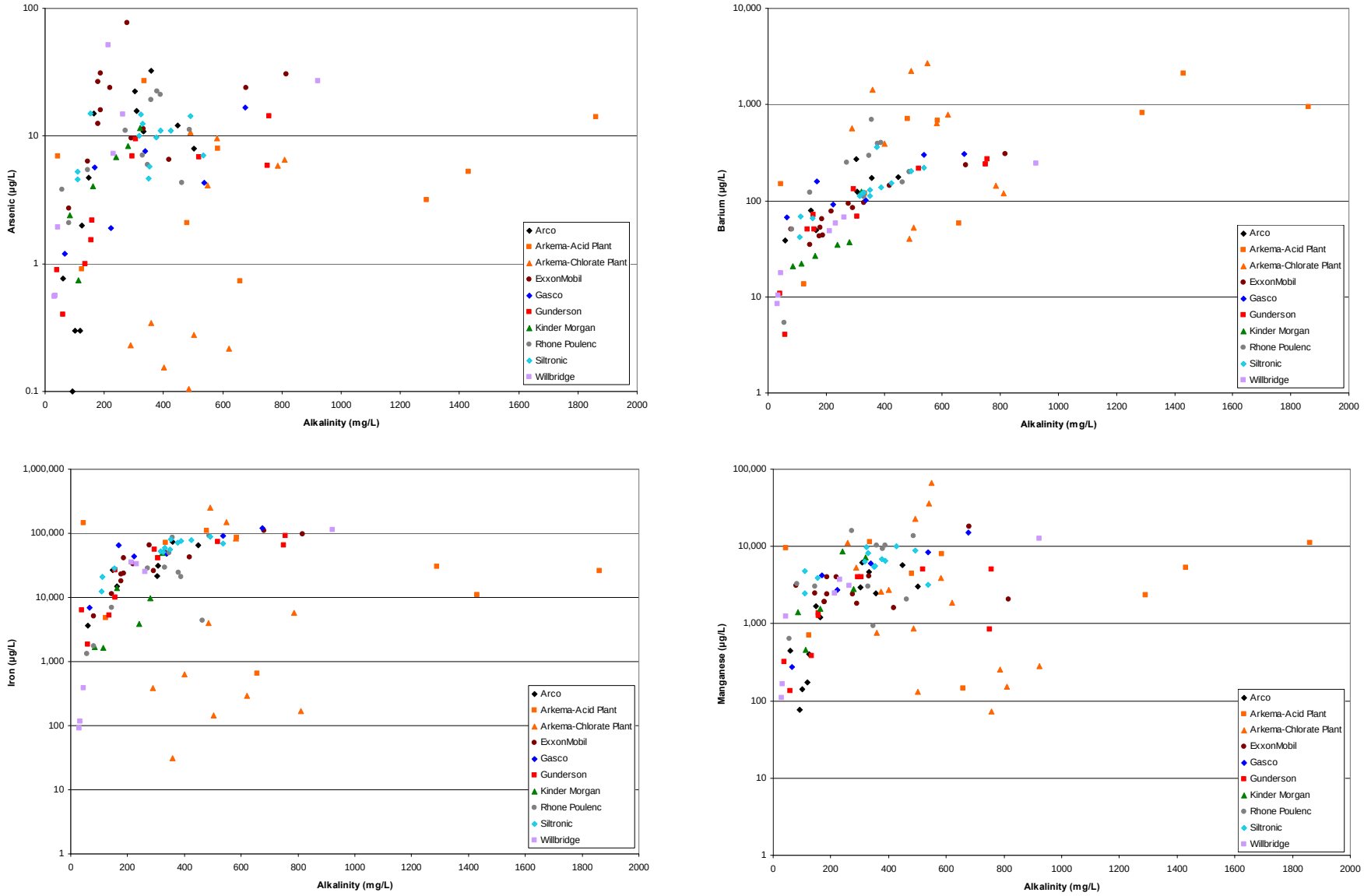


Figure C4.3-7
Portland Harbor RI/FS
Remedial Investigation Report
Alkalinity in TZW versus
Arsenic, Barium, Iron, and Manganese in TZW

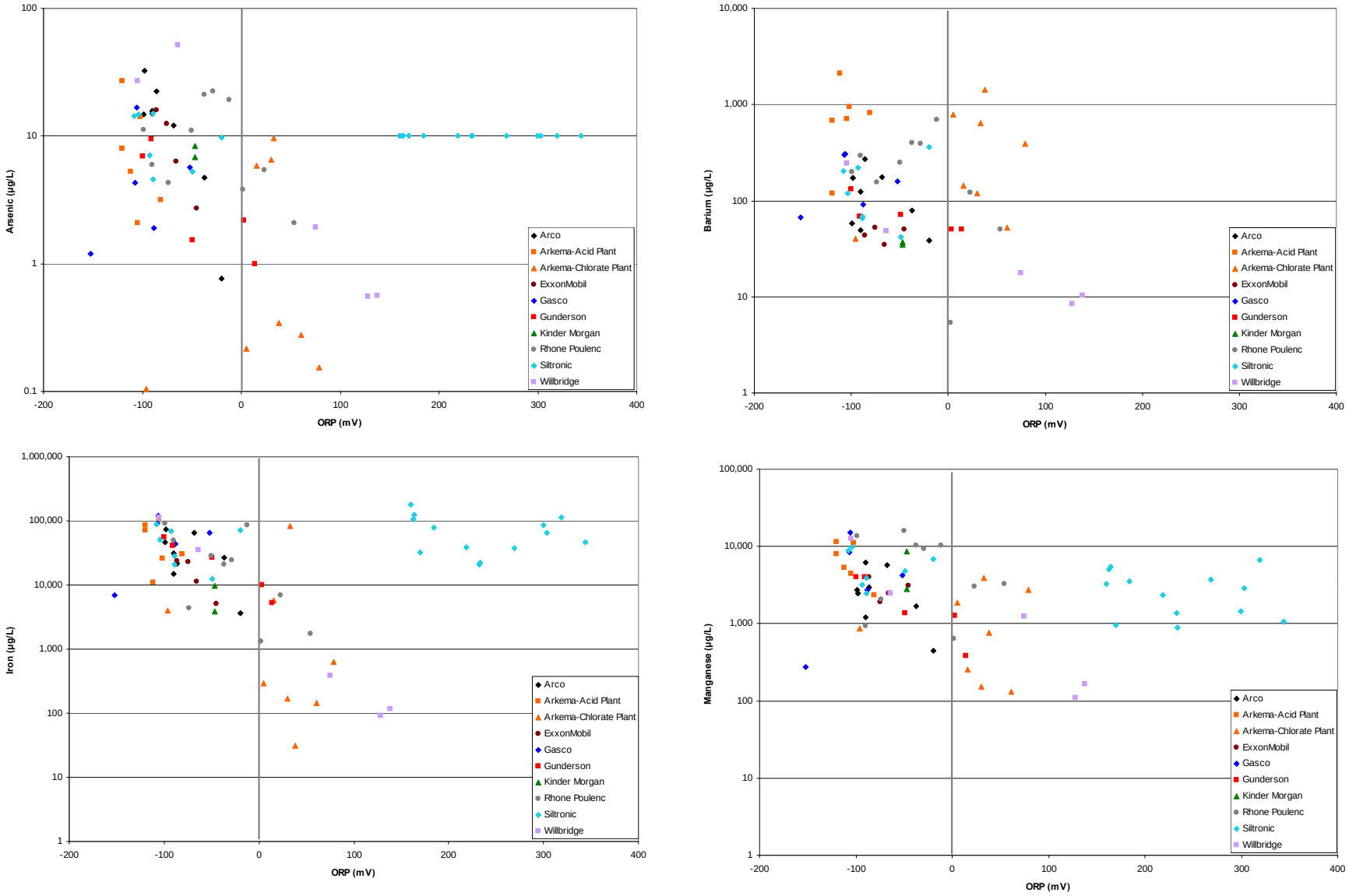
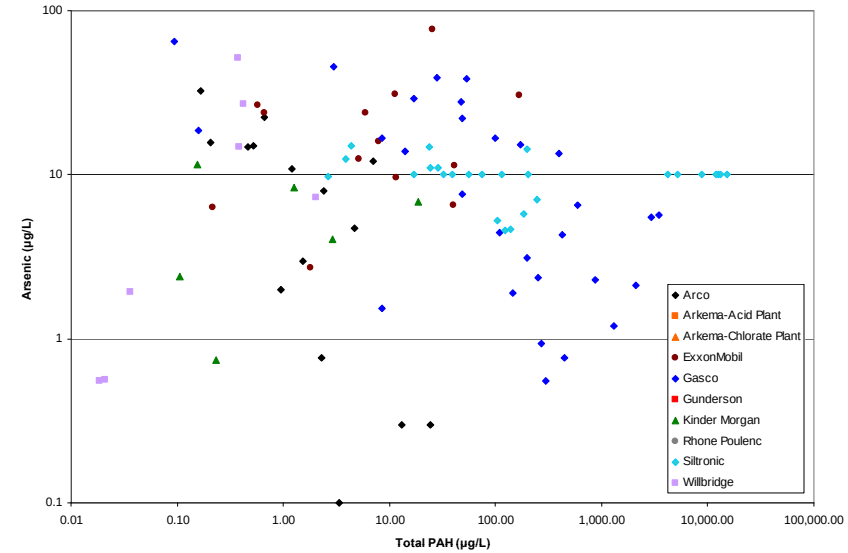
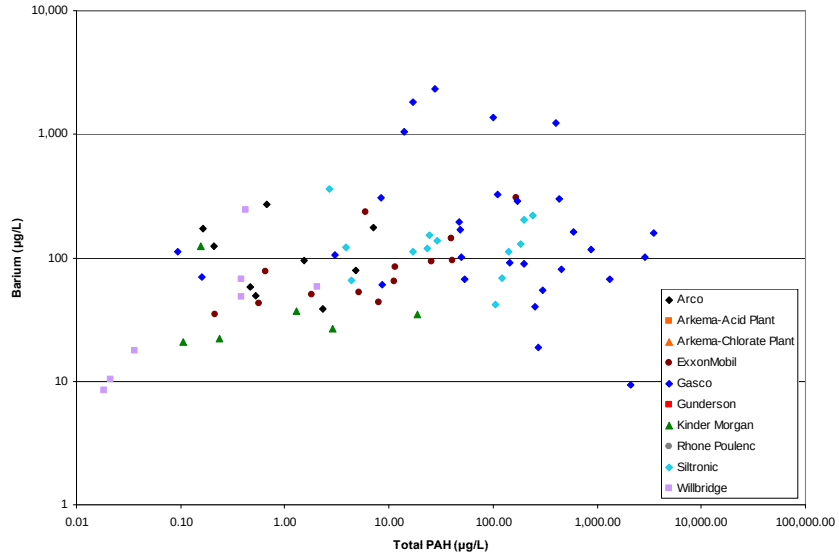
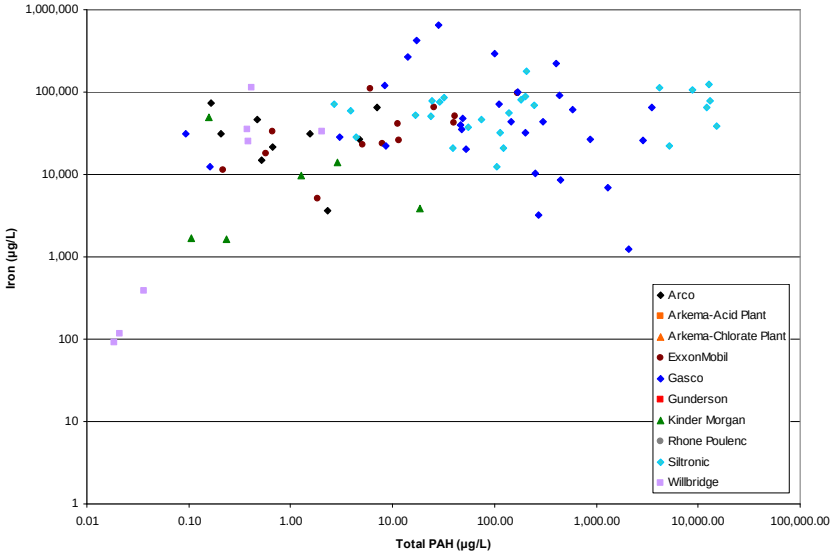


Figure C4.3-8
Portland Harbor RI/FS
Remedial Investigation Report
Oxidation Reduction Potential in TZW versus
Arsenic, Barium, Iron, and Manganese in TZW







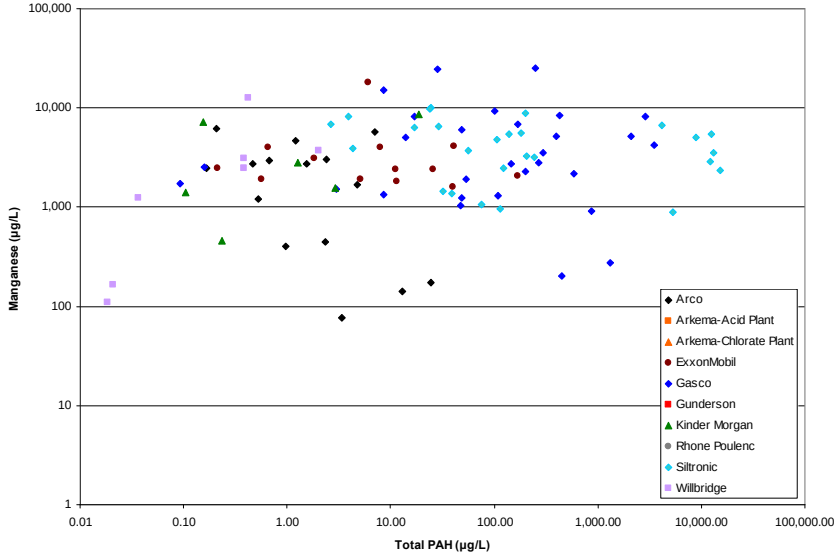


Figure C4.3-9
Portland Harbor RI/FS
Remedial Investigation Report
Total PAHs in TZW versus
Arsenic, Barium, Iron, and Manganese in TZW

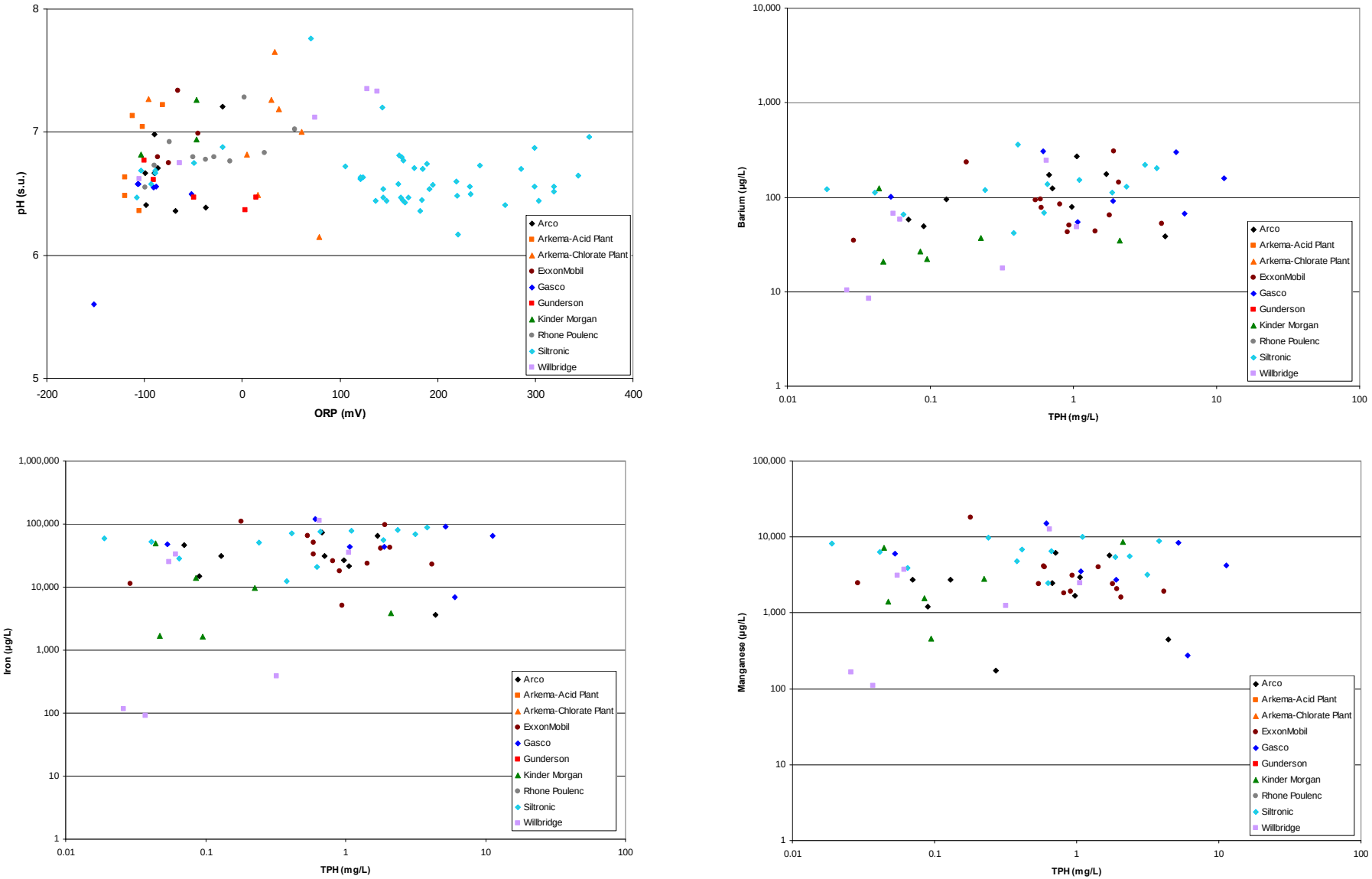
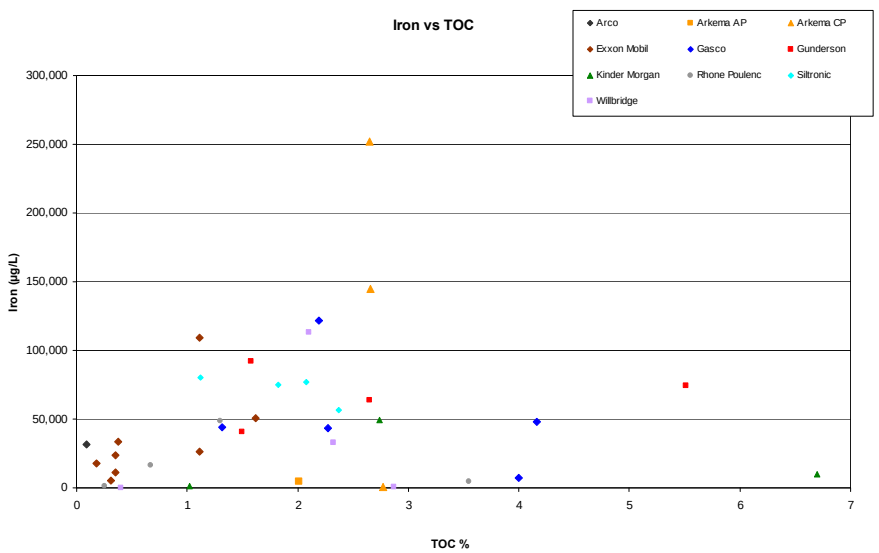
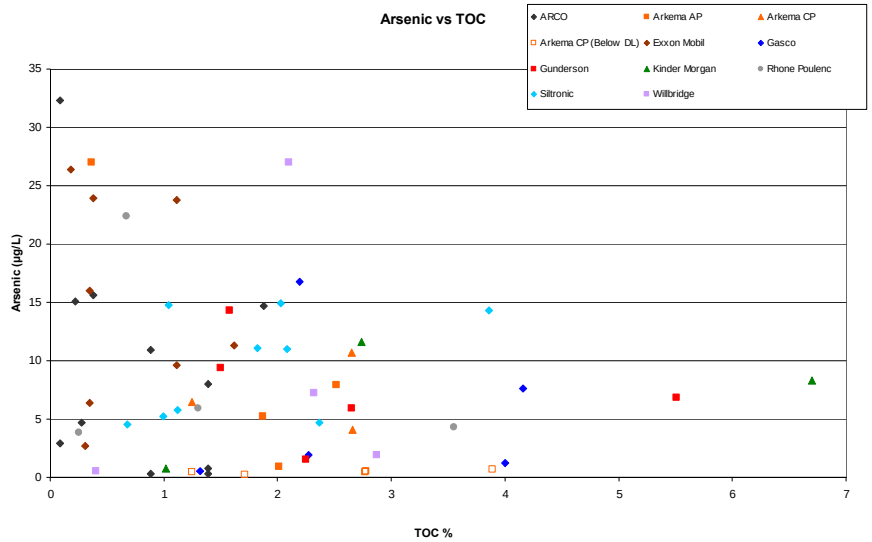
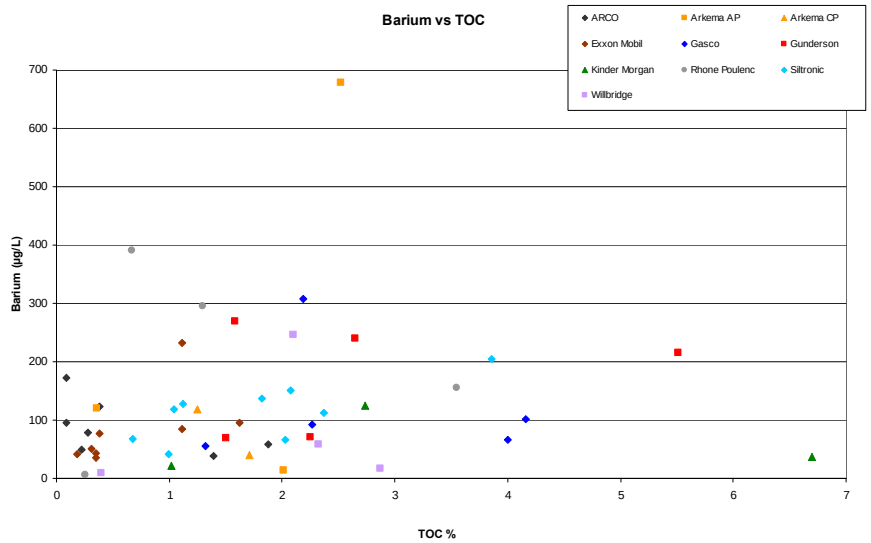


Figure C4.3-10
Portland Harbor RI/FS
Remedial Investigation Report
TPH in TZW versus
Arsenic, Barium, Iron, and Manganese in TZW







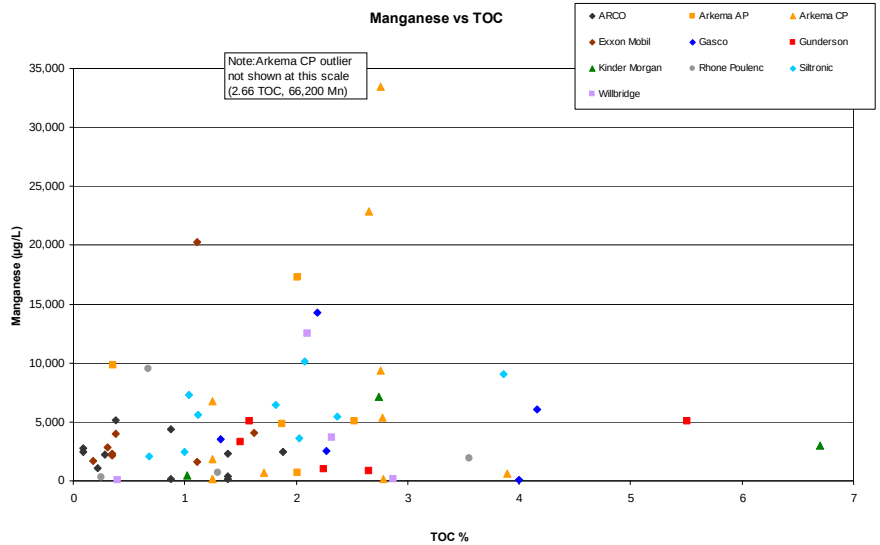


Figure C4.3-11
Portland Harbor RI/FS
Remedial Investigation Report
Sediment TOC versus Collocated
Arsenic, Barium, Iron, and Manganese in TZW

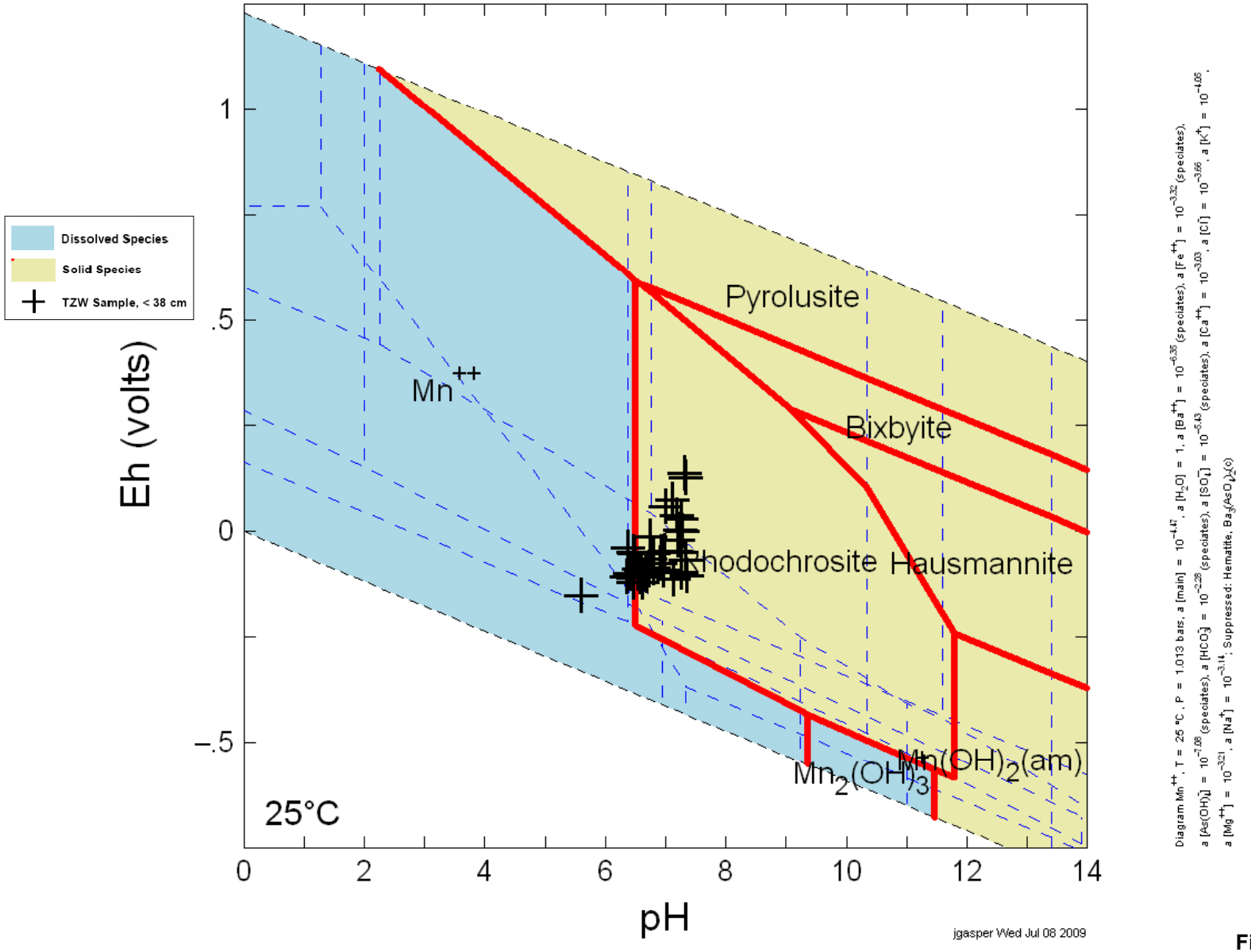


Figure C4.3-12
Portland Harbor RI/FS
Remedial Investigation Report
Eh-pH Stability Diagram
Manganese

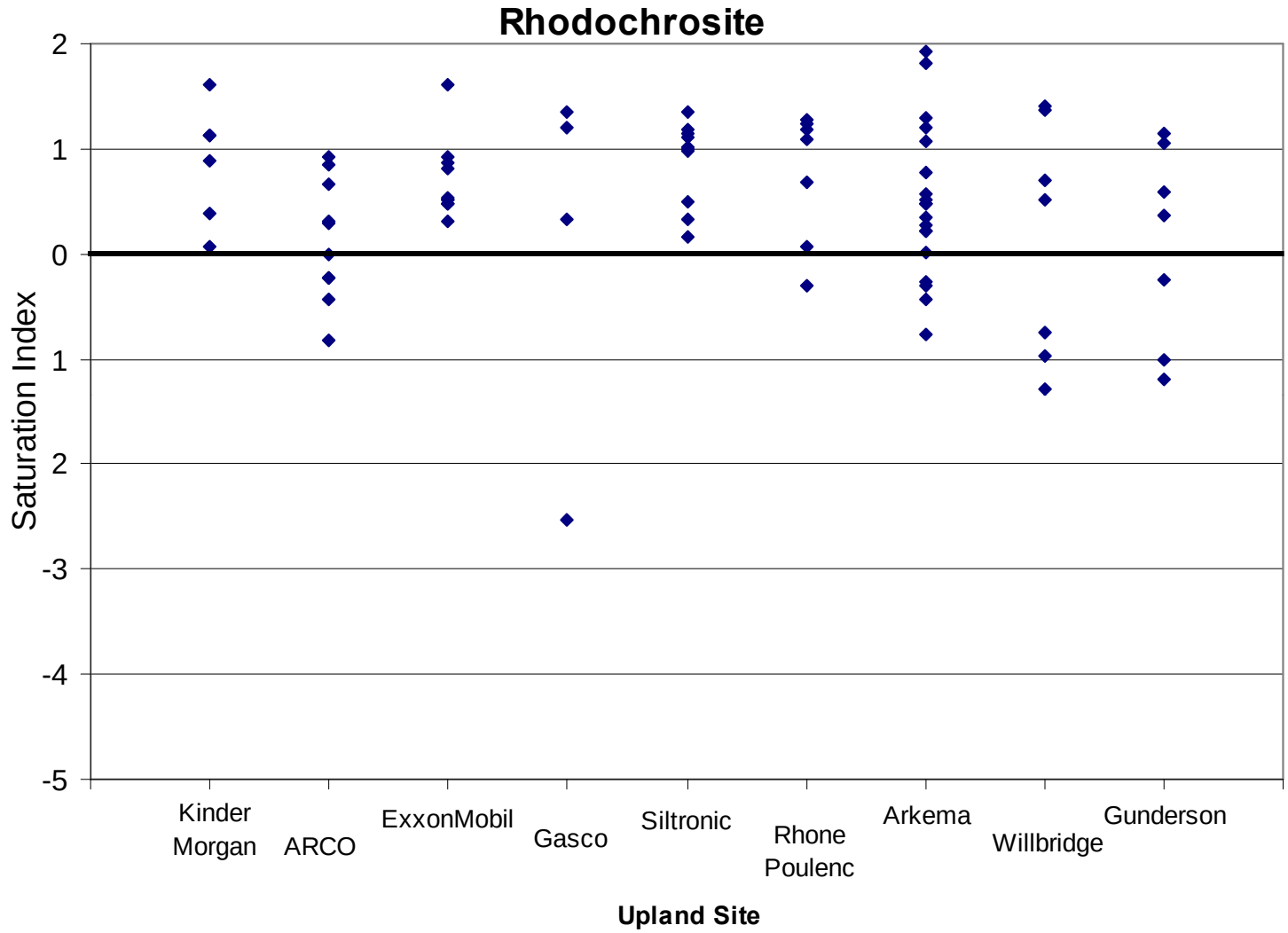


Figure C4.3-13
Portland Harbor RI/FS
Remedial Investigation Report
Saturation Indices for Rhodochrosite
in TZW by Site

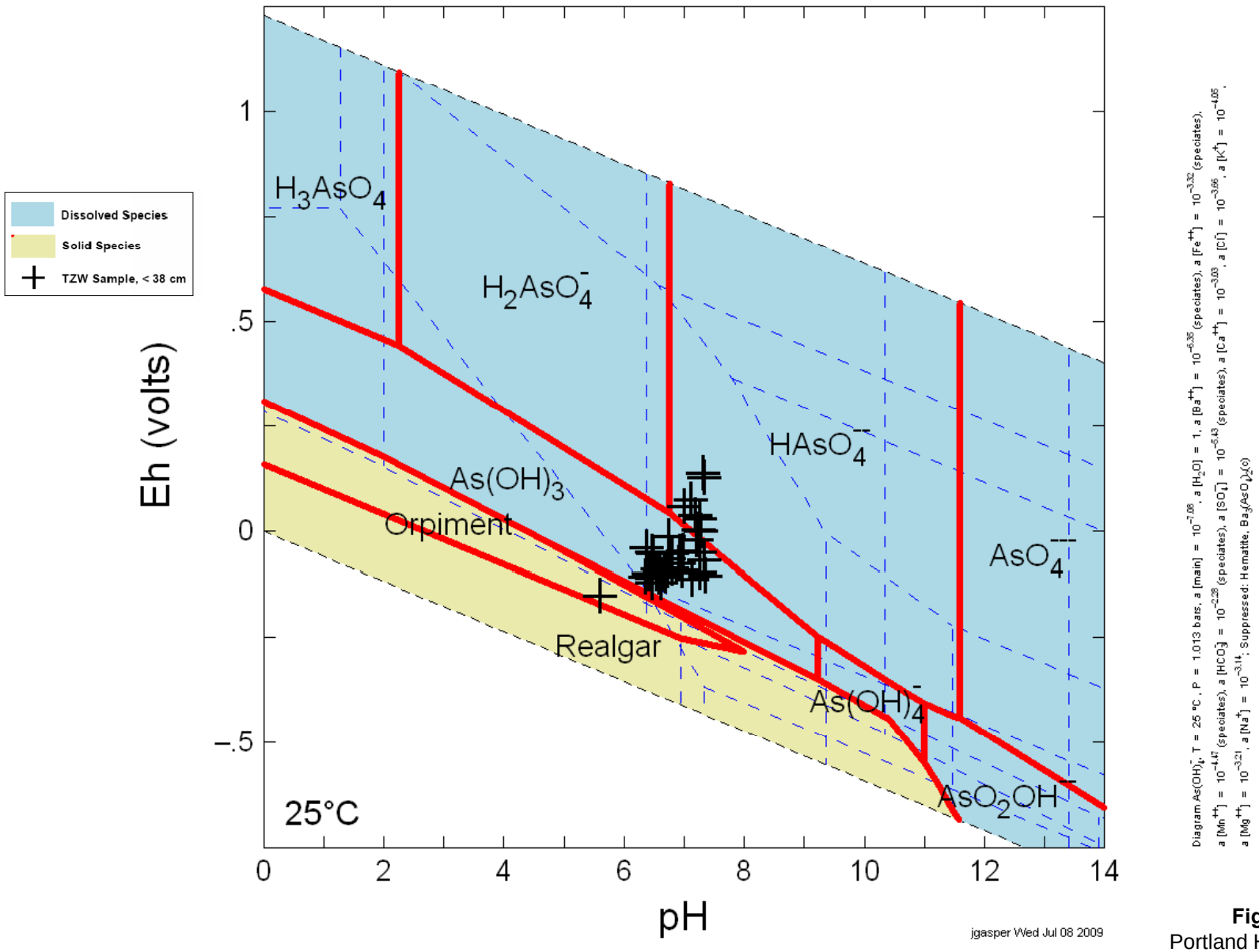
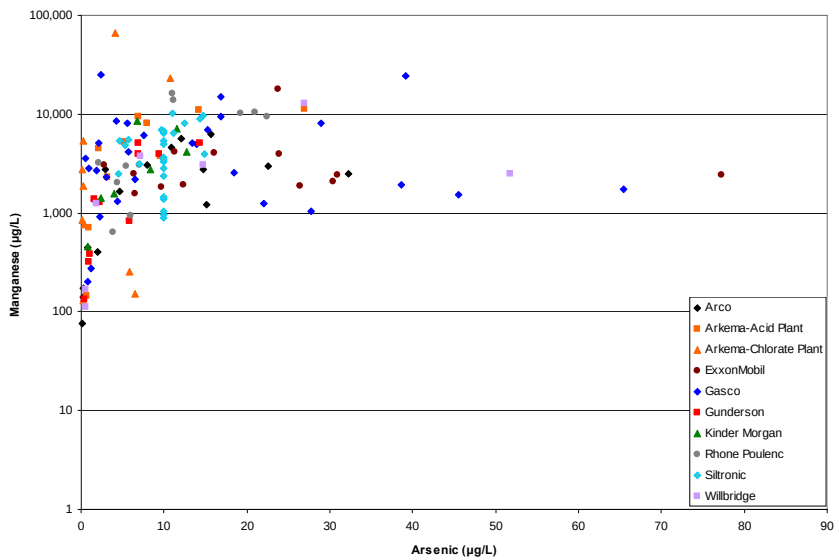


Figure C4.3-14
Portland Harbor RI/FS
Remedial Investigation Report
Eh-pH Stability Diagram
Arsenic



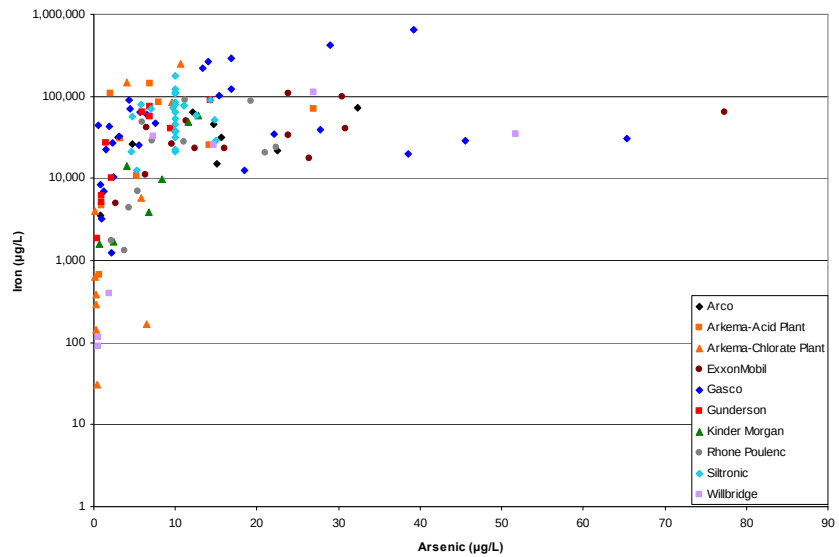


Figure C4.3-15
Portland Harbor RI/FS
Remedial Investigation Report
Arsenic in TZW versus
Iron and Manganese in TZW

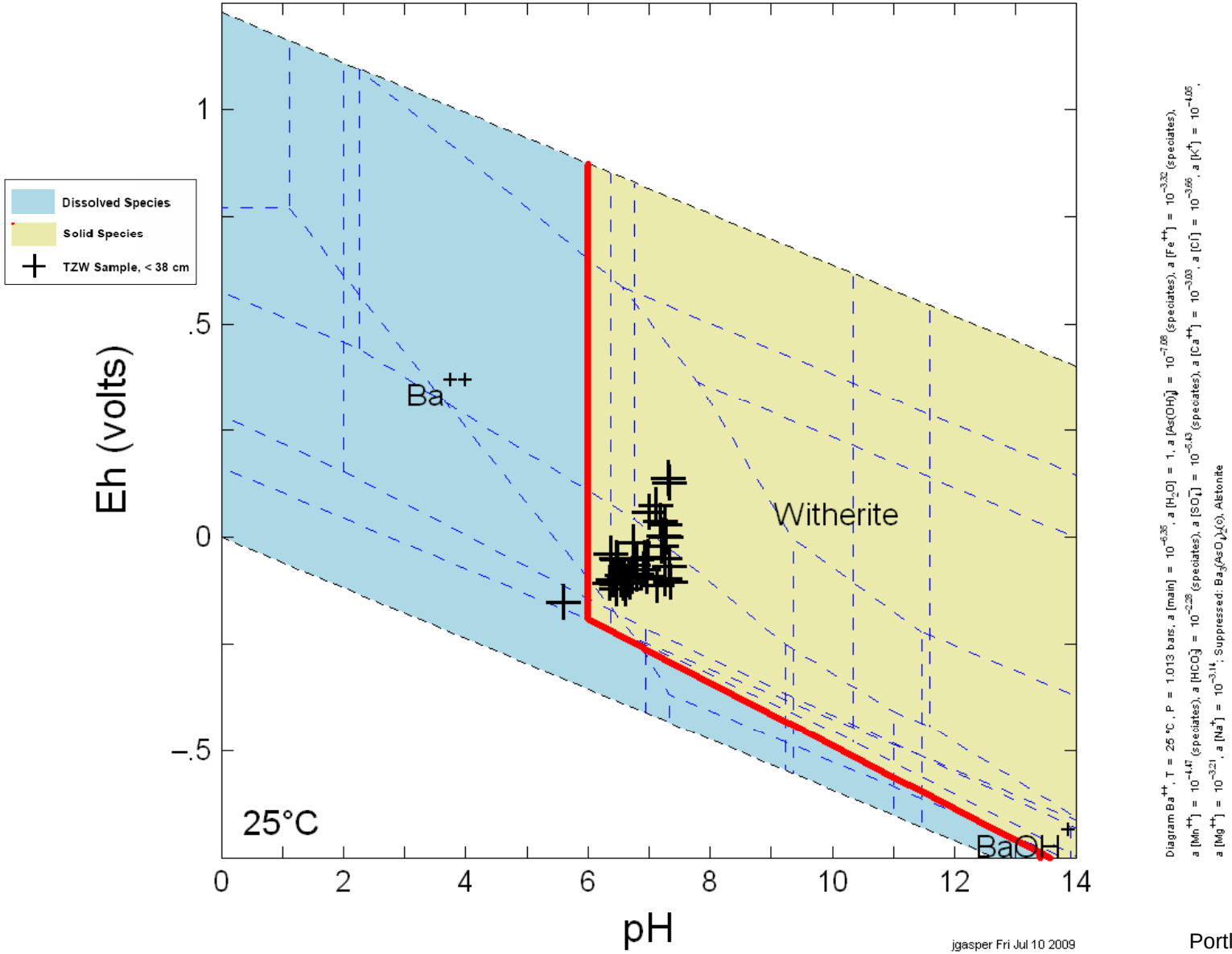


Figure C4.3-16
Portland Harbor RI/FS
Remedial Investigation Report
Eh-pH Stability Diagram
Barium

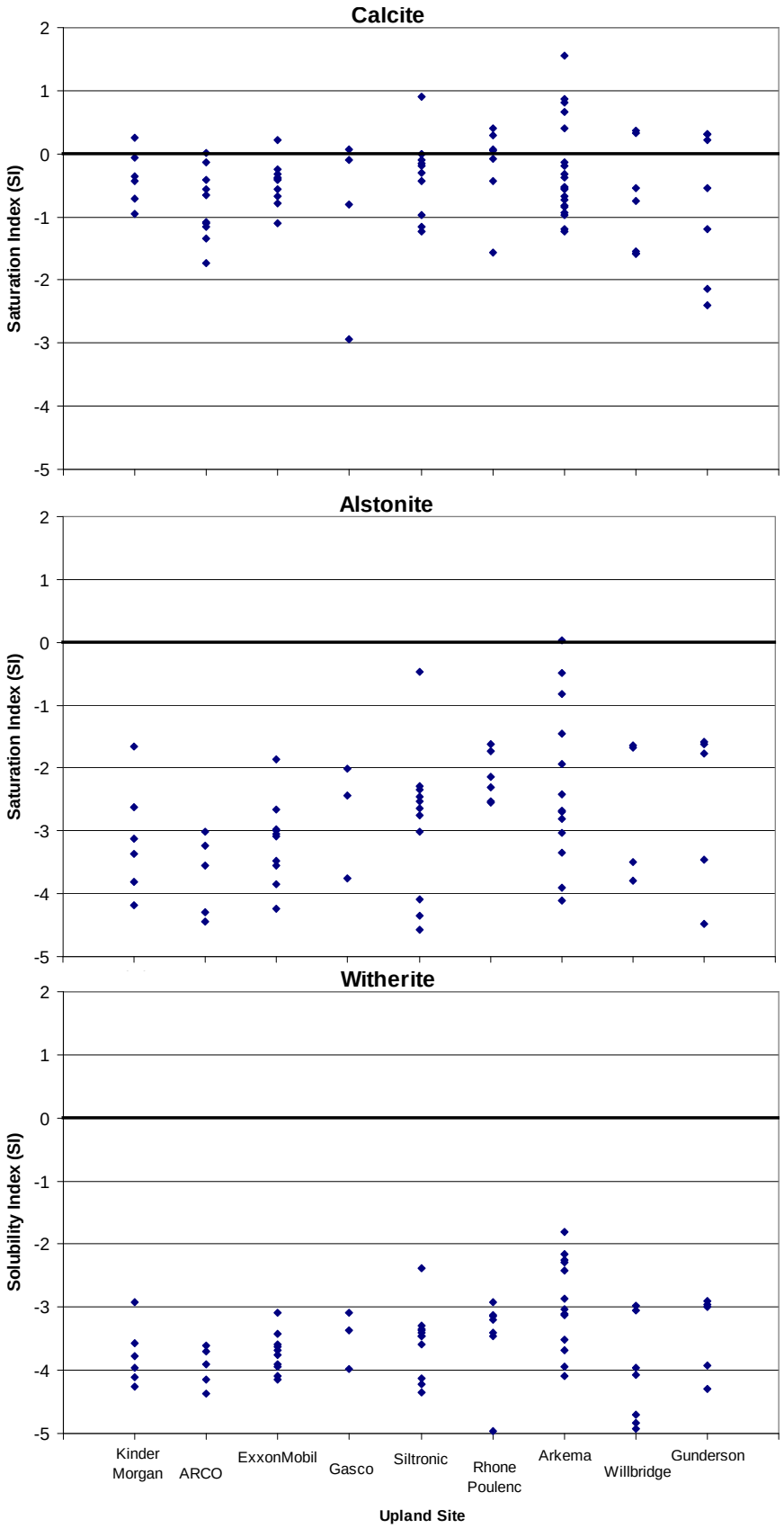


Figure C4.3-17
Portland Harbor RI/FS
Remedial Investigation Report
Saturation Indices for Calcite, Alstonite
and Witherite in TZW by Site

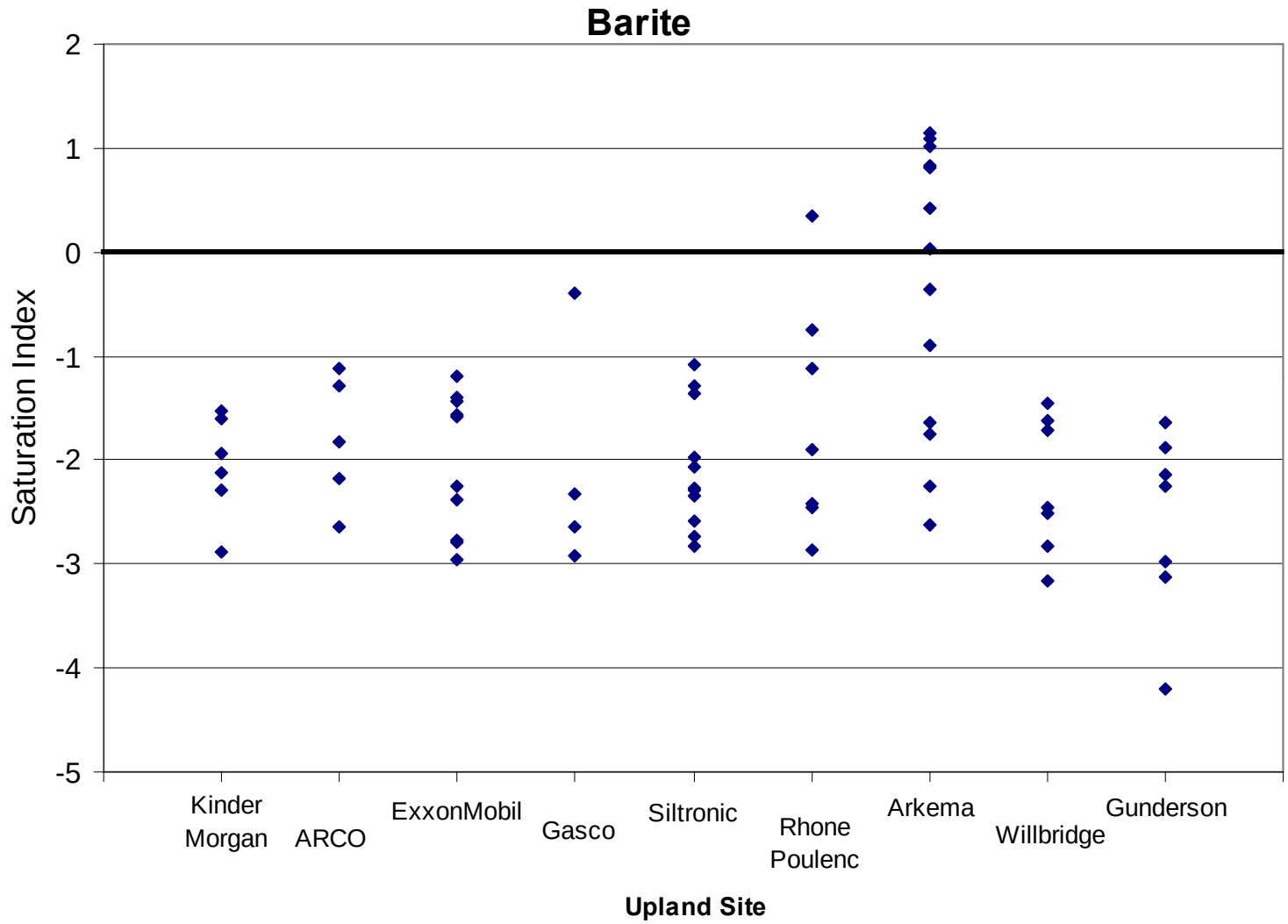
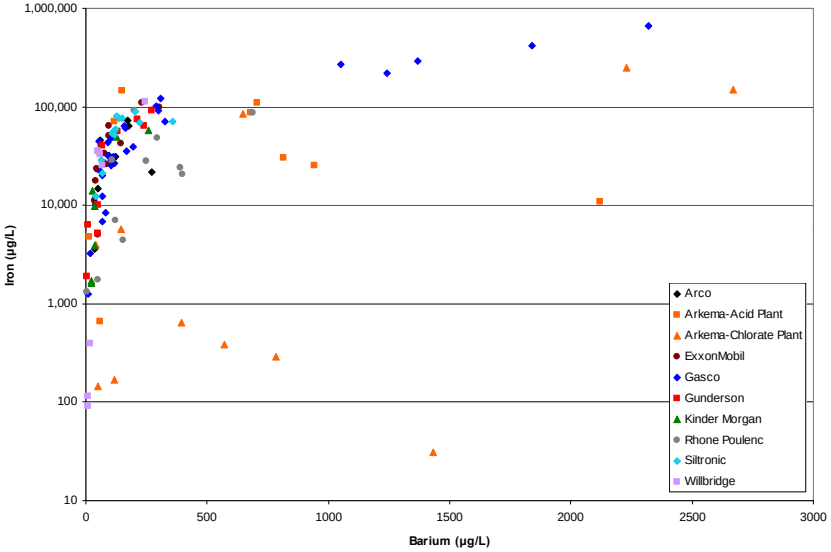


Figure C4.3-18
Portland Harbor RI/FS
Remedial Investigation Report
Saturation Indices for Barite
in TZW by Site



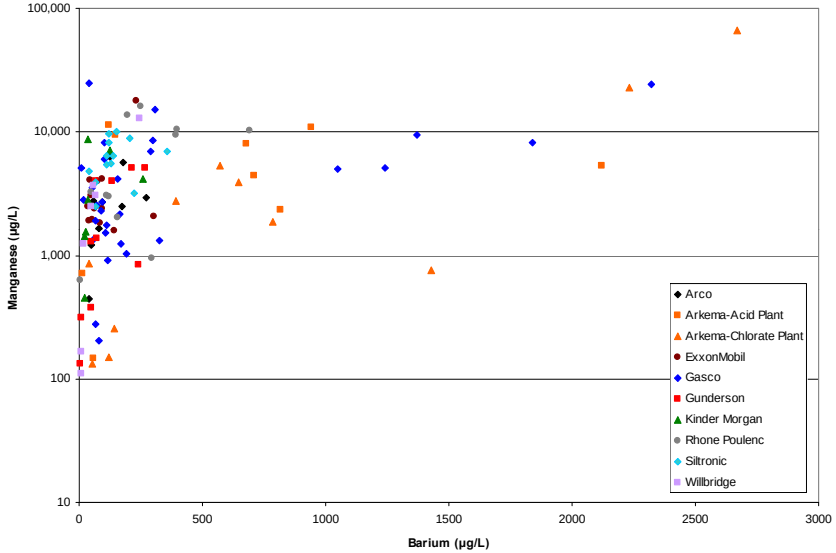


Figure C4.3-19
Portland Harbor RI/FS
Remedial Investigation Report
Barium in TZW versus
Iron and Manganese in TZW

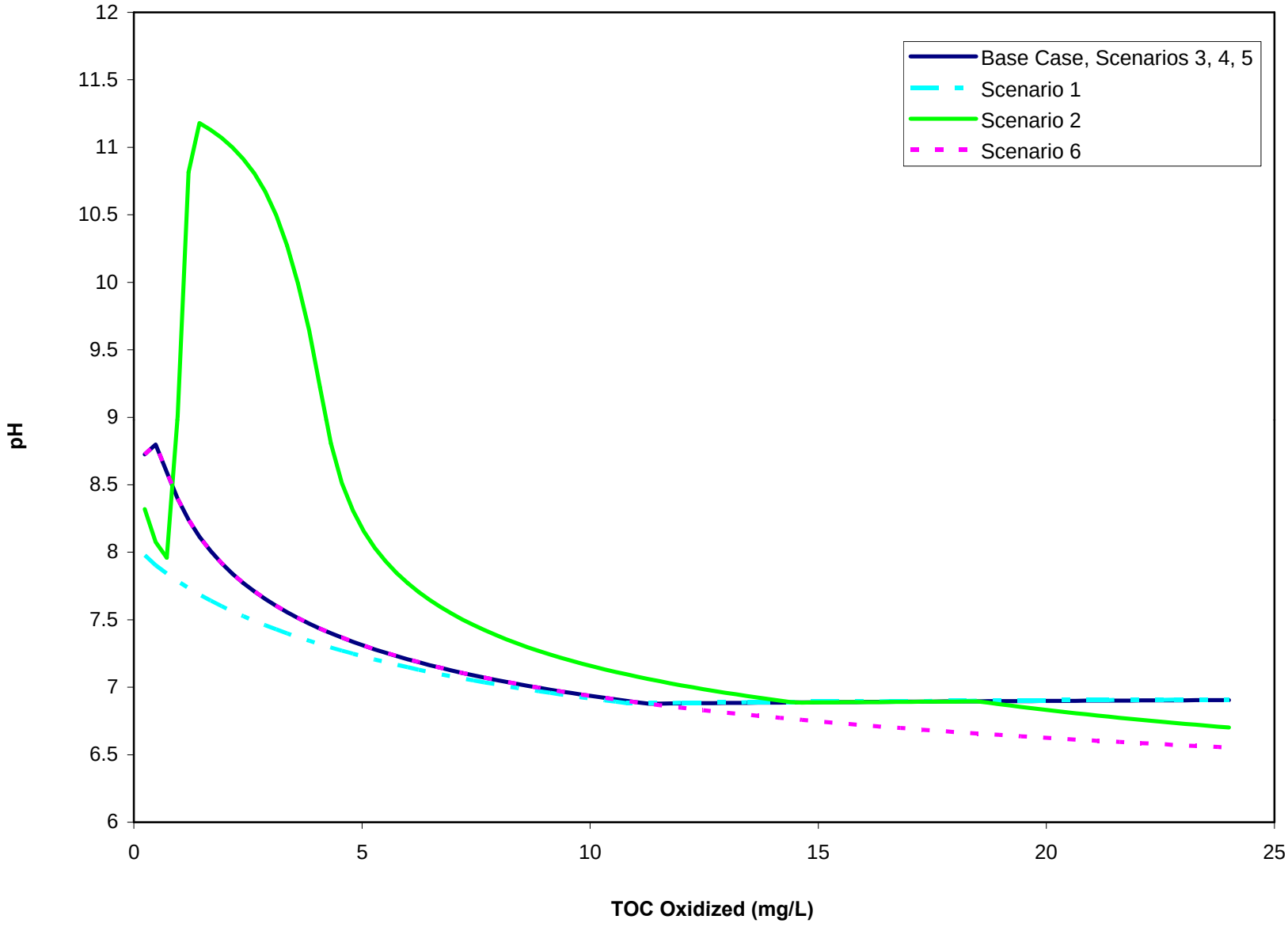


Figure C4.3-20
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for pH

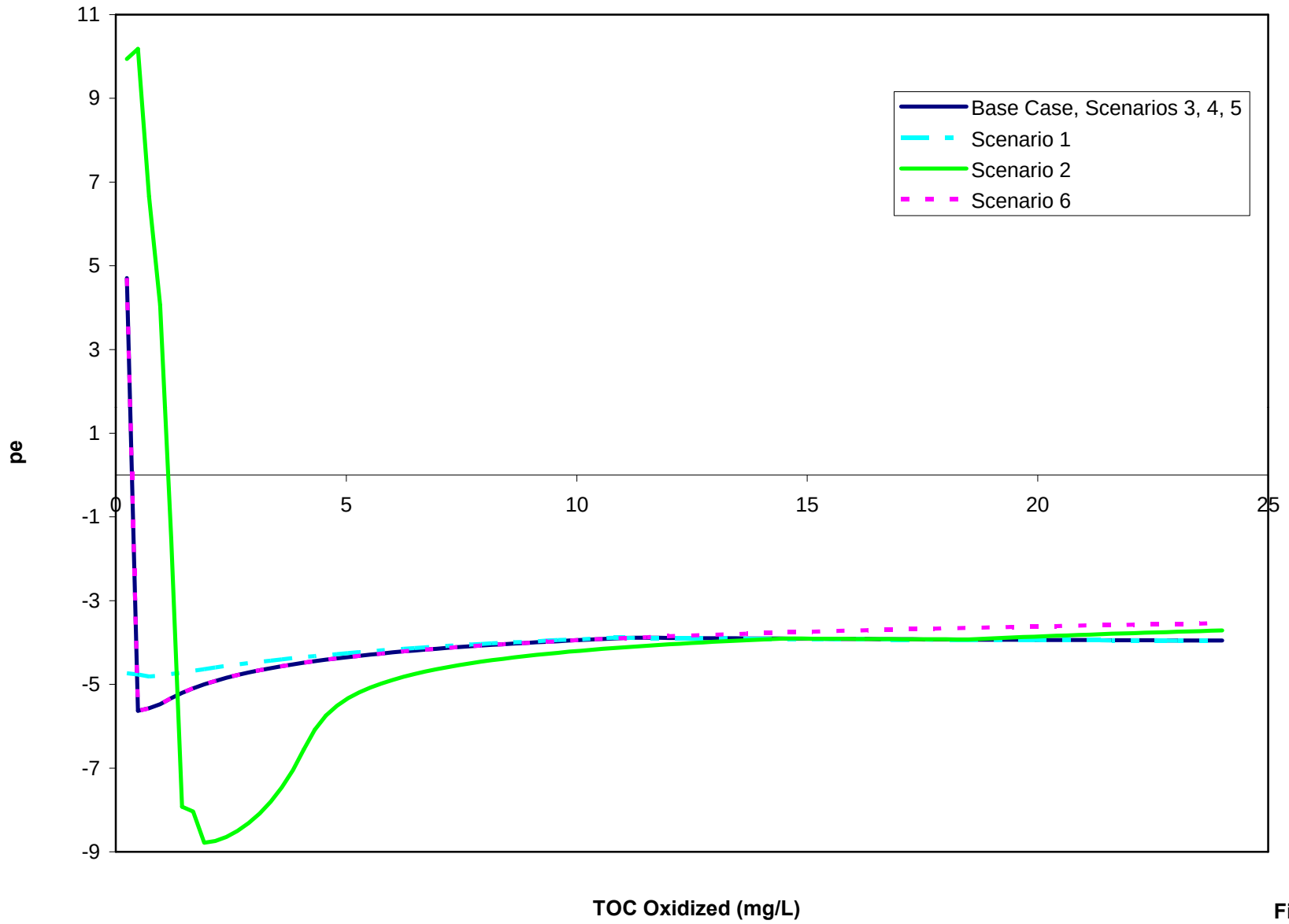


Figure C4.3-21
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for pe

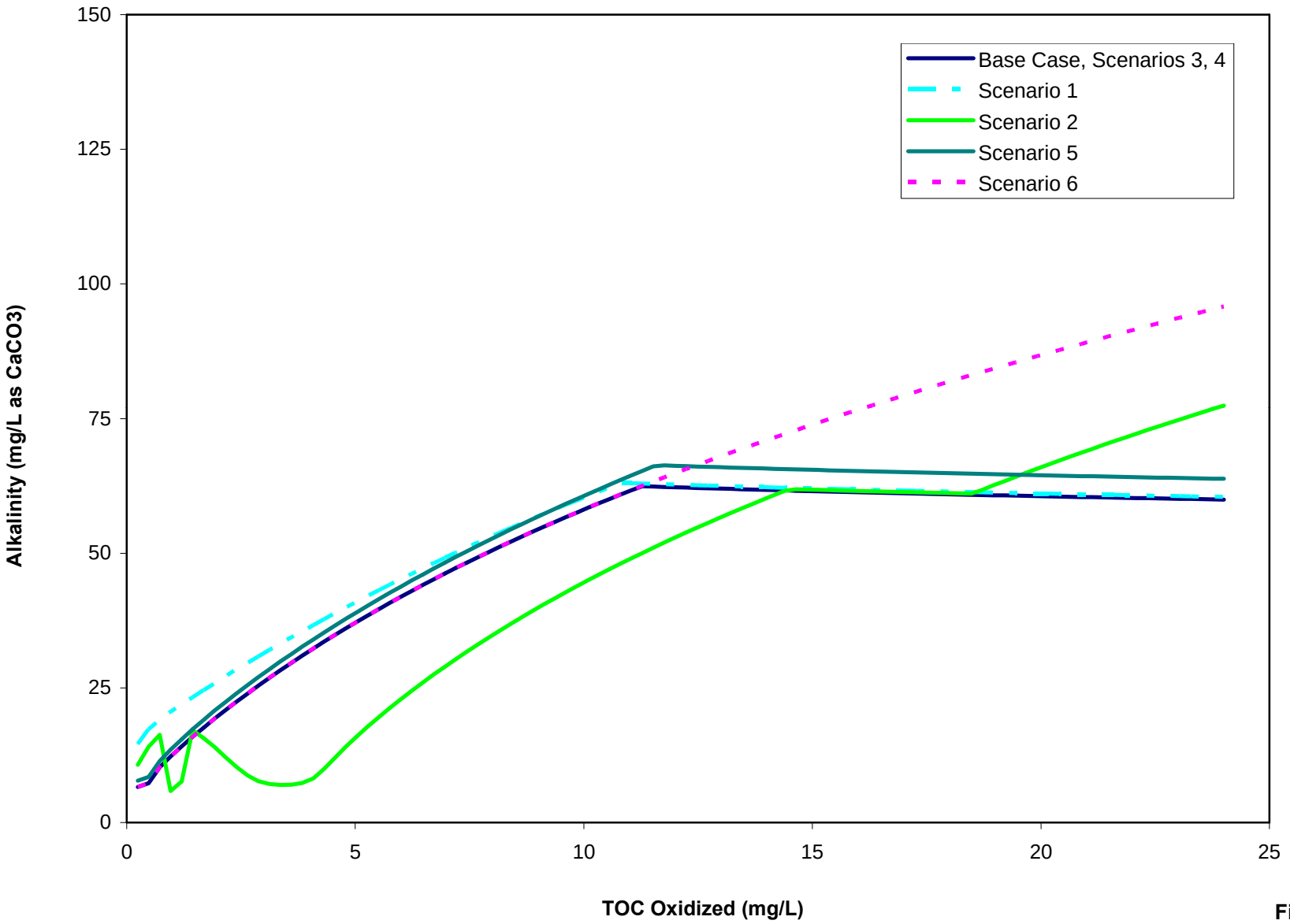


Figure C4.3-22
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for Alkalinity

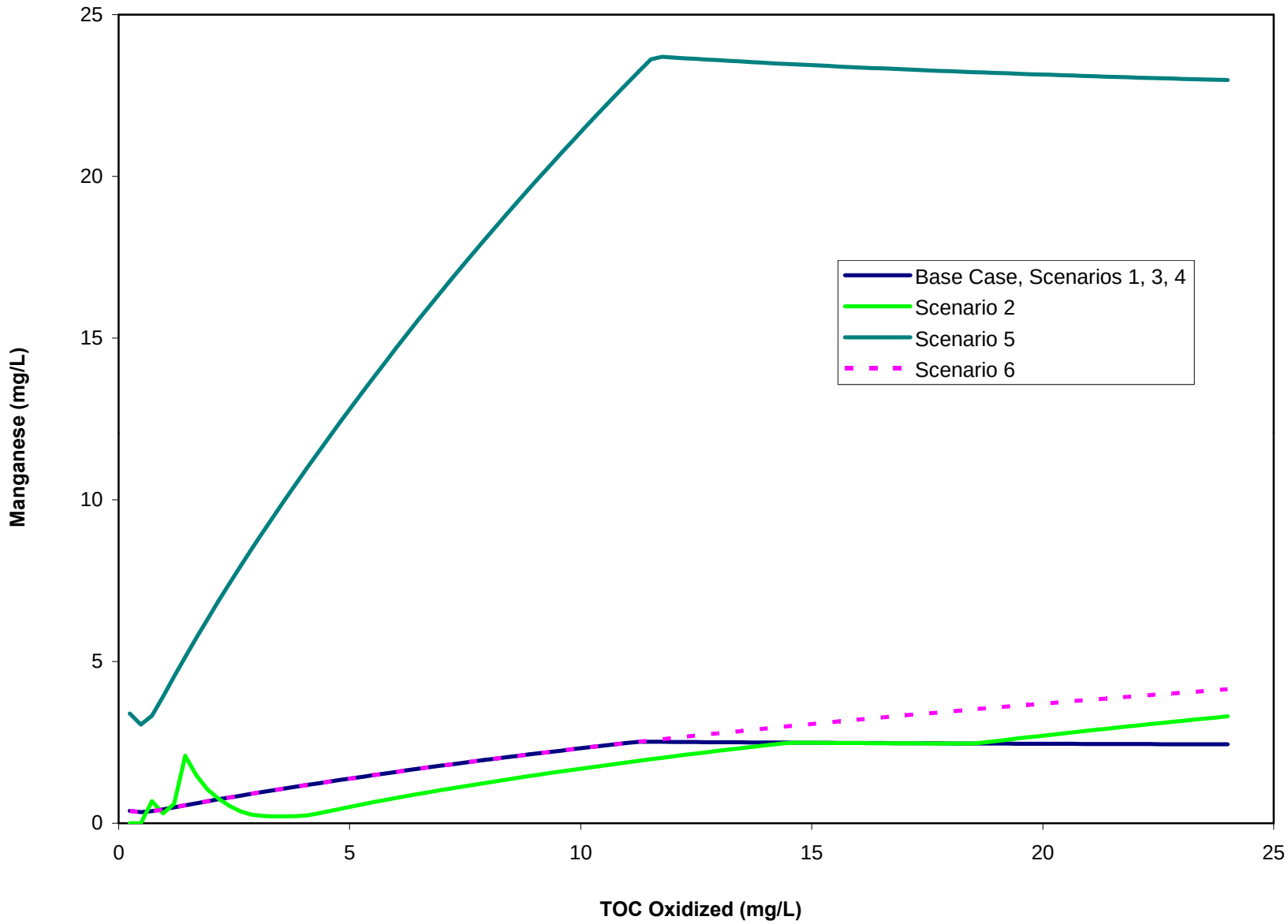


Figure C4.3-23
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for Manganese

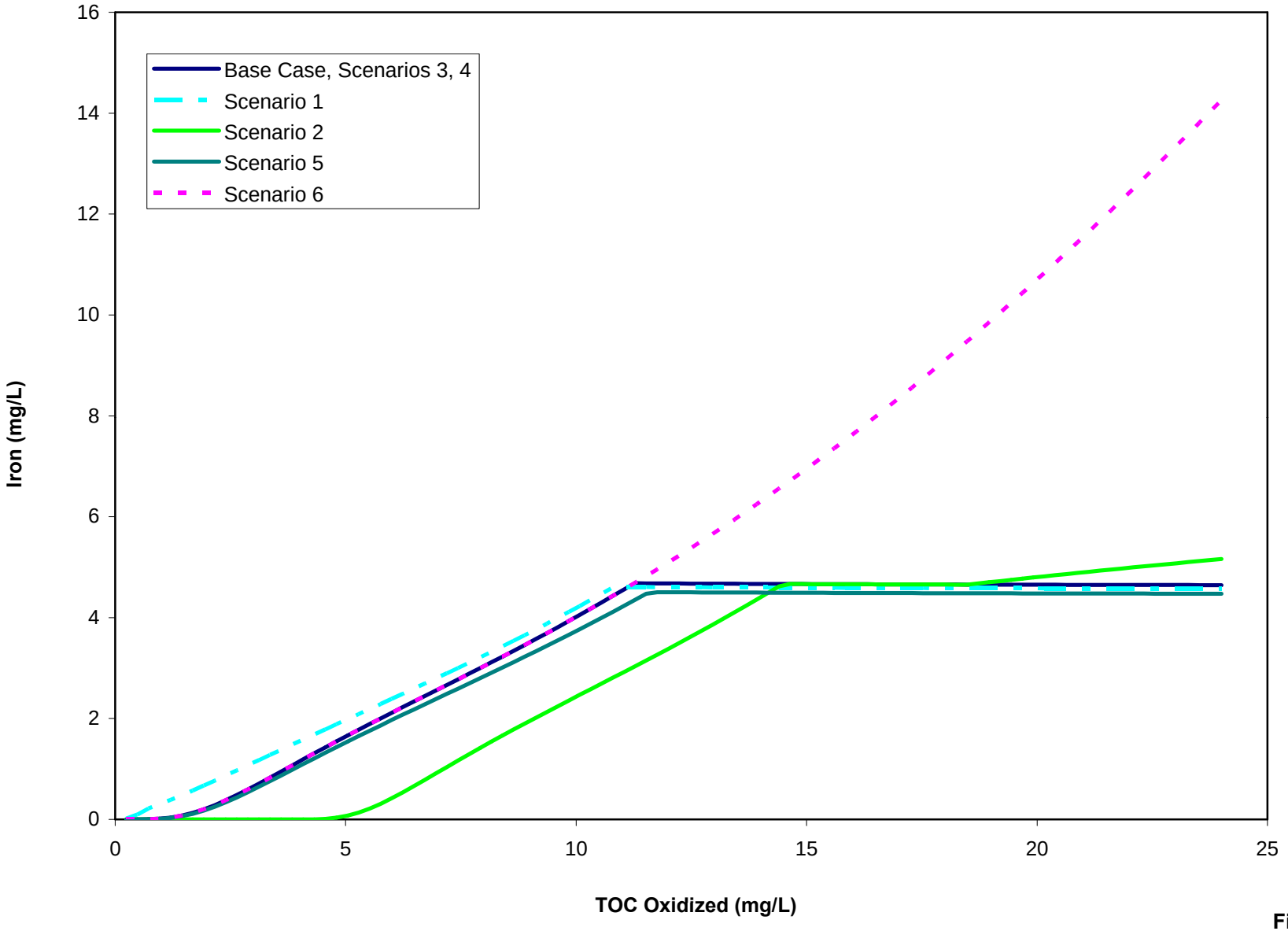


Figure C4.3-24
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for Iron

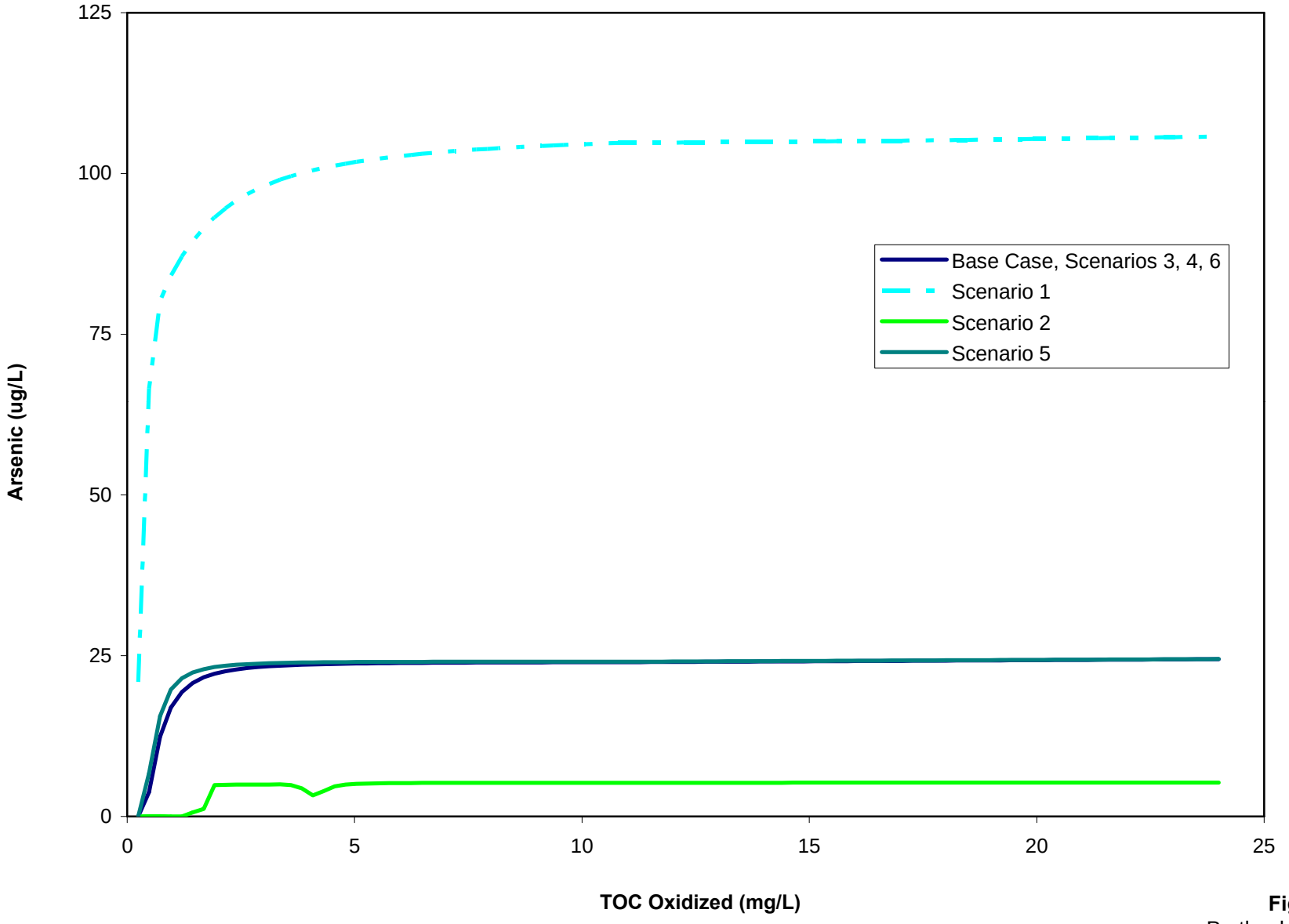


Figure C4.3-25
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for Arsenic

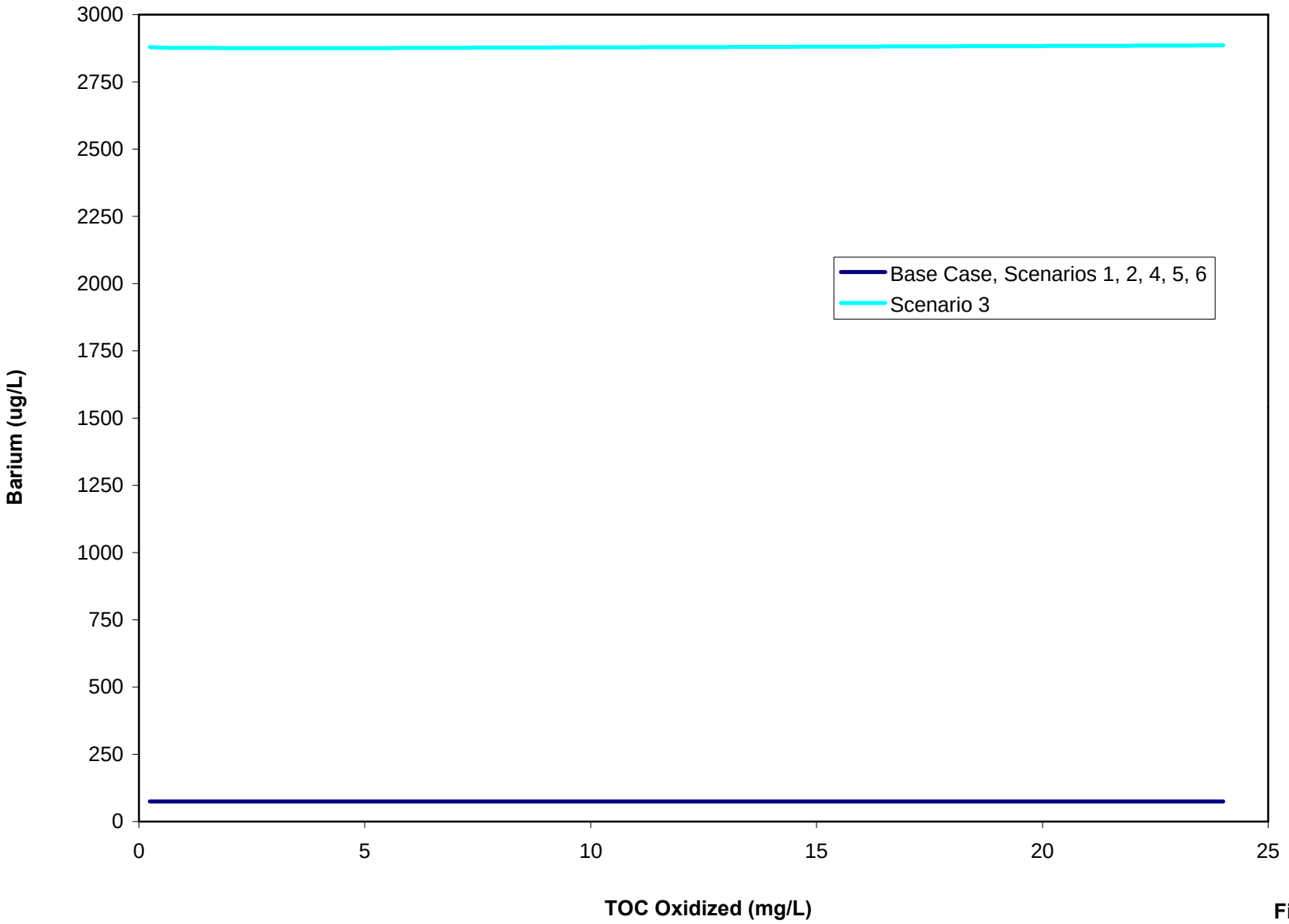


Figure C4.3-26
Portland Harbor RI/FS
Remedial Investigation Report
Geochemical Modeling Results for Barium