60% Remedial Design Basis of Design Report

Appendix D
RAA Development and Dredge Prism Design Supporting Documents

1 Introduction

This appendix includes supporting figures and tables used during remedial action area (RAA) development and dredge prism design as part of Lower Duwamish Waterway (LDW) middle reach Preliminary (60%) Remedial Design. As stated in Section 5.5 of the BODR, remedial technologies are assigned to each RAA using the same procedure documented in Figure 19 and Revised Figure 20 of the *Record of Decision* (EPA 2014) and consider many factors including mudline elevation, remedial action level (RAL) exceedance factors, depth of contamination, and recovery category designation. Additional information regarding remedial technology assignments can be found in Section 3.4.2 and Appendix K of the *Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach* (Anchor QEA and Windward 2025). The various components of this appendix are as follows:

- Figure D1-1: RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Series Legend
  - Series legend for Figures D1-1a through D1-1o
- Figures D1-1a through D1-1o: RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data
  - These figures show various layers of significance that contribute to where the RAA boundaries were drawn based on requirements of the *Record of Decision* (EPA 2014). Information in these figures includes RAL exceedance area boundaries, design dataset sample locations and results, vertical cores profiles, intertidal/subtidal delineation, designation of LDW features of significance (e.g., RC 1 areas and shoal areas), and more.
- Figures D1-2a and D1-2b: Total Polychlorinated Biphenyl (PCB) Combined Surface and Subsurface Sediment Indicator Kriging Interpolation with RAA Boundaries
  - These figures show the RAA boundaries with respect to the PCB indicator kriging probability bands.
- Figures D1-3a and D1-3b: Thiessen Polygons at RAL Exceedance Areas 8 and 9
  - These figures show two areas (RAL exceedance areas 8 and 9) that are driven by non-PCB contaminants of concern to help identify extent of Thiessen polygons representing surface and subsurface exceedances.
- Table D1-1: Dredge Prism Development – Vertical Basis of Design
  - This table presents the elevation/depth of contamination for vertical data within each dredging RAA to indicate the basis of the resulting required dredge elevation/thickness.
- Table D1-2: Partial Dredge and Cap Development – Vertical Basis of Design
  - This table presents the elevation/depth of contamination for vertical data within each partial dredge and cap RAA to indicate the basis of the resulting required dredge elevation/thickness and cap placement.

Table D1-1
Dredge Prism Development – Vertical Basis of Design

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	Technology	Phase III Vertical Data Collection
1A	FNC (-15 ft MLLW)	Subsurface	1586 bounded at -21.2 ft MLLW	Dredge to EOC (-21.2 ft MLLW)	-21.5 ft MLLW, 1-ft overdredge	Dredge, RMC	One 0- to 60-cm sample within FNC (1728), one vertical extent core (1727)
2	FNC (-15 ft MLLW)	Subsurface	No vertical core; subsurface (0–60 cm) RAL interval exceedance (SC1577)	Dredge based on 0- to 60-cm RAL interval exceedance	2-ft-thick cut, 1-ft overdredge	Dredge, RMC	One 0- to 60-cm sample within FNC (1725), one vertical extent core (1724)
4	Subtidal	Subsurface	No vertical core; subsurface (0–60 cm) RAL interval exceedance (SC1573)	Dredge based on 0- to 60-cm RAL interval exceedance	2-ft-thick cut, 1-ft overdredge	Dredge, RMC	One vertical extent core (1722)
6	Intertidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1235); bounded by subsurface (0-45 cm) sample with no exceedances	Dredge based on surface-only exceedance and intertidal location	0.5-ft-thick cut, 0.5-ft overdredge	Dredge, backfill	One vertical extent core (1714)
7	Subtidal, FNC (-20 ft MLLW)	Subsurface	1563 bounded at -19 ft MLLW	Dredge to EOC (-19 ft MLLW)	-19 ft MLLW, 1-ft overdredge	Dredge, backfill/RMC	None planned
8A	Intertidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1564, SS1561); bounded by subsurface (0-45 cm) samples with no exceedances	Dredge based on surface-only exceedances and intertidal location	0.5-ft-thick cut, 0.5-ft overdredge	Dredge, backfill	None planned
8D	Subtidal	Subsurface	Surface (0–10 cm) RAL interval exceedance (SS1828); bounded by subsurface (0-60 cm) samples with no exceedances	Dredge to DOC (1-ft thickness)	1-ft-thick cut, 1-ft overdredge	Dredge, backfill/RMC	None planned
8E	Subtidal	Subsurface	1528 bounded at 4.5-ft depth	Dredge to DOC (4.5-ft thickness)	4.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
8F	Intertidal	Subsurface	1527 bounded at 5.4-ft depth	Dredge to DOC (5.5-ft thickness)	5.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
9B	Intertidal, subtidal	Subsurface	1555 unbounded at 2.9-ft depth (refusal)	Dredge to refusal (2.9-ft thickness); consider depth limitation because of utility crossing	3-ft-thick cut, 1-ft overdredge	Dredge, backfill	One vertical extent core (1717)
9C	Intertidal	Subsurface	1552 bounded at 2.5-ft depth	Dredge to DOC (2.5-ft thickness)	2.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
9E	Intertidal, subtidal	Surface	Surface (0-10 cm) RAL interval exceedance (numerous locations); bounded by subsurface (0-45 cm or 0-60 cm) samples with no exceedances	Dredge based on surface-only exceedances	1-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
9F	Intertidal	Surface, subsurface	1540 bounded at 3.9-ft depth 1543 bounded at 3.4-ft depth	Dredge to DOC (3.9-ft thickness)	4-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
9G	FNC (-20 ft MLLW)	Surface	Surface (0–10 cm) RAL interval exceedance (SS1230); bounded by adjacent subsurface (0–60 cm) sample with no exceedances	No vertical core within subarea; elevation based on adjacent core 1558	-24 ft MLLW, 1-ft overdredge	Dredge, RMC	One vertical extent core (1715)
9H	Subtidal	Surface, subsurface	1544 bounded at 6.9-ft depth	Dredge to DOC (6.9-ft thickness)	7-ft-thick cut, 1-ft overdredge	Dredge, RMC	None planned
9I	Intertidal, subtidal	Surface, subsurface	1519 bounded at 2.5-ft depth 1522 bounded at 2.5-ft depth 1536 bounded at 2-ft depth	Dredge to DOC (2.5-ft thickness)	2.5-ft-thick cut, 1-ft overdredge	Dredge, backfill/RMC	Three 0- to 45-cm samples (1702, 1703, and 1704)
9K	FNC (-20 ft MLLW)	Subsurface	1558 unbounded at -24 ft MLLW	Dredge elevation limited because of utility offset	-22 ft MLLW, 1-ft overdredge	AST, dredge	One vertical extent core (1716)
11	FNC (-20 ft MLLW)	Surface, subsurface	1503 bounded at -28.1 ft MLLW 1510 bounded at -28.9 ft MLLW 1511 bounded at -26.9 ft MLLW	Dredge to EOC (-28.9 ft MLLW)	-29 ft MLLW, 1-ft overdredge	Dredge, RMC	None planned
12	Intertidal, subtidal	Subsurface	Subsurface (0–45 cm) RAL interval exceedance; unbounded at 1.5 ft (IT1508) (refusal)	Dredge based on 0- to 45-cm RAL interval exceedance	1.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	One vertical extent core (1699)

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	Technology	Phase III Vertical Data Collection
14B	FNC (-20 ft MLLW)	Subsurface	1482 bounded at -23 ft MLLW 1488 bounded at -24 ft MLLW 1183 bounded at -20 ft MLLW	Dredge to EOC (-24 ft MLLW)	-24 ft MLLW, 1-ft overdredge	Dredge, RMC	One vertical extent core (1696)
15A	Subtidal	Subsurface	1490 bounded at -21.7 ft MLLW	Dredge to EOC (-21.7 ft MLLW)	-22 ft MLLW, 1-ft overdredge	Dredge, RMC	None planned
16	Subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1179); bounded by subsurface (0–60 cm) sample with no exceedances	Dredge based on surface-only exceedance	1-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
17	Intertidal, subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (LDW18-5thAveS) 1486 bounded at 1.5-ft depth	Dredge based on surface-only exceedance	1-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
18	FNC (-20 ft MLLW)	Surface	Surface (0–10 cm) RAL interval exceedance (SS1170); bounded by subsurface (0–60 cm) sample with no exceedances	Dredge based on surface-only exceedance	1-ft-thick cut, 1-ft overdredge	Dredge, RMC	None planned
19	Subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1171); bounded by subsurface (0–60 cm) sample with no exceedances (SC1171)	Dredge based on surface-only exceedance	1-ft-thick cut, 1-ft overdredge	Dredge, RMC	None planned
21A	Intertidal	Surface, subsurface	1456 subsurface (0–45 cm) RAL interval exceedance (no vertical collected because of refusal) 1457 unbounded at 4-ft depth (refusal)	Dredge to refusal (4-ft thickness)	4-ft-thick cut, 1-ft overdredge	Dredge, backfill	One vertical extent core (1686)
21C	Intertidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1142); bounded by subsurface (0–45 cm) sample with no exceedances (IT1142) 1448 bounded throughout (no interval > surface RAL)	Dredge based on surface-only exceedances and intertidal location	0.5-ft-thick cut, 0.5-ft overdredge	Dredge, backfill	None planned
24B	Intertidal	Surface Surface, subsurface	1609 0- to 45-cm interval > surface RAL (refusal) *FS2154-A-SE DOC deeper than 1.6 ft depth (bounded at approximately 3.3 ft depth)*	Dredge to DOC (1.6-ft thickness)	2-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
24C	Intertidal	Surface, subsurface	1607 bounded at -1.3 ft MLLW (refusal) 1606 bounded at 2.8 ft MLLW *FS2154-B-SE bounded at approximately 0 ft MLLW* *FS2154-C-SE bounded at approximately 2 ft MLLW* 1605 bounded at 1.2 ft MLLW 1604 unbounded at 2.1 ft MLLW (refusal) 1603 unbounded at 0.5 ft MLLW (refusal) *FS2154-D-SE bounded at approximately -1 ft MLLW* 1610 unbounded at 2.3 ft MLLW (refusal) *FS2154-F-SE bounded at approximately -1 ft MLLW* *FS2154-G-SE bounded at approximately 0 ft MLLW* 1601 bounded at -1.8 ft MLLW 1602 unbounded at 1.4 ft MLLW (refusal) 1600 bounded at 0.6 ft MLLW *FS2154-H-SE unbounded at approximately -2 ft MLLW*	Dredge to EOC (-1.8 ft MLLW) Note that cores are ordered from the inner part of the inlet toward the neck of the inlet.	-2 ft MLLW, 1-ft overdredge	Dredge, backfill	Evaluation of existing hard substrate layer thickness; vertical cores will be collected if feasible (1678, 1679, 1680, 1681, 1682, and 1683)

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	Technology	Phase III Vertical Data Collection
24D	Intertidal	Surface, subsurface	1612 bounded at 0.4 ft MLLW (refusal) 1611 unbounded at 0.4 ft MLLW (refusal) *FS2154-I-SE bounded at approximately -3 ft MLLW* 1599 bounded at -2 ft MLLW 1598 unbounded at 4 ft MLLW (refusal) *FS2154-J-SE bounded at approximately -3 ft MLLW* 1597 bounded at +4.4 ft MLLW 1596 unbounded at -1.9 ft MLLW (refusal)	Dredge to EOC (-3 ft MLLW) Note that cores are ordered from the inner part of the inlet toward the neck of the inlet.	-3 feet MLLW, 1-ft overdredge	Dredge, backfill	Evaluation of layer thickness; cores will be collected if feasible (1684 and 1685)
24E	Intertidal	Surface, subsurface	1595 bounded at 3.3-ft depth	Dredge to DOC (3.3-ft thickness)	3.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
24F	Intertidal	Surface, subsurface	1593 bounded at 1.5-ft depth *FS2154-L-SE bounded at approximately -0.5 ft MLLW (2.8-ft depth)*	Dredge to DOC (1.5-ft thickness)	1.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
24G	Intertidal	Surface, subsurface	*FS2154-K-SE bounded at approximately 4.4-ft depth* 1594 bounded at 1.5-ft depth	Dredge to DOC (4.4-ft thickness)	4.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
24H	Intertidal	Surface	*FS2154-M-SE bounded at approximately 1.2-ft depth* LDW-SC40 bounded at 1.3 ft	Dredge to DOC (1.3-ft thickness)	1.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
24J	Intertidal, subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1127); bounded by subsurface (0-45 cm) sample with no exceedance (IT1127)	Dredge based on surface-only exceedance	1-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
27A	Intertidal, subtidal	Surface, subsurface	1411 bounded at 2.5-ft depth 1413 bounded at 2.5-ft depth 1418 bounded at 2.5-ft depth	Dredge to DOC (2.5-ft thickness)	2.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
27C	Intertidal	Subsurface	1404 bounded at 3.4-ft depth	Dredge to DOC (3.4-ft thickness)	3.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
29	Intertidal, subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1077); bounded by subsurface (0–60 cm) sample with no exceedances (SC1077)	Dredge based on surface-only exceedance and intertidal location	0.5-ft-thick cut, 0.5-ft overdredge	Dredge, backfill	None planned
34A	Subtidal	Subsurface	1312 unbounded at -15.3 ft MLLW (refusal)	Dredge to refusal (-15.3 ft MLLW)	-15.5 ft MLLW, 1-ft overdredge	Dredge, backfill/RMC	Three vertical extent cores (1652, 1653, and 1654)
34B	Subtidal	Subsurface	1310 bounded at 2-ft depth	Dredge to DOC (2-ft thickness)	2-ft-thick cut, 1-ft overdredge	Dredge, RMC	None planned
35A	Intertidal, subtidal	Surface	Surface (0–10 cm) RAL interval exceedance (SS1034); bounded by subsurface (0–45 cm) sample with no exceedances (IT1034) Surface (0–10 cm) RAL interval exceedance (SS1317); bounded by subsurface (0–45 cm) sample with no exceedances (IT1317) 1318 has no intervals above surface RAL	Dredge based on surface-only exceedance and intertidal location	0.5-ft-thick cut, 0.5-ft overdredge	Dredge, backfill	None planned
36	Subtidal	Subsurface	1321 bounded at 2-ft depth	Dredge to DOC (2-ft thickness)	2-ft-thick cut, 1-ft overdredge	Dredge, RMC	None planned
SMA 10a	Intertidal	Surface	*SD-510 bounded at 6-ft depth*	Dredge to DOC (6-ft thickness)	6-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
SMA 10b	Intertidal	Subsurface	598 bounded at 2.5-ft depth	Dredge to DOC (2.5-ft thickness)	2.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
SMA 10c	Intertidal	Surface, subsurface	597 bounded at 3.5-ft depth	Dredge to DOC (3.5-ft thickness)	3.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned
SMA 10d	Intertidal, subtidal	Surface	*SD-508 bounded at 4-ft depth* *SC51 bounded at 3.8-ft depth* 592 bounded at 2.5-ft depth	Dredge to DOC (4-ft thickness)	4-ft-thick cut, 1-ft overdredge	Dredge, backfill	None planned

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	Technology	Phase III Vertical Data Collection
SMA 10e	Intertidal, subtidal	Surface	*SD-506 bounded at 4-ft depth*	Dredge to DOC (6-ft thickness)	6-ft-thick cut, 1-ft overdredge	Dredge, backfill	Two vertical extent cores (855 and 856)
			SD-507 unbounded at –22.8 ft MLLW				
			587 bounded at 6-ft depth				
			588 bounded at 5.5-ft depth				
SMA 10f	Intertidal, subtidal	Surface	*SD-504 bounded at 4-ft depth*	Dredge to DOC (12.5-ft thickness)	12.5-ft-thick cut, 1-ft overdredge	Dredge, backfill	Three vertical extent cores (852, 853, and 854)
			585 unbounded at 6.5-ft depth (resampled using core 790)				
			789 bounded at 12.5-ft depth				
			790 bounded at 12.5-ft depth				
SMA 10g	Intertidal, subtidal	Surface	582 unbounded at 6.5-ft depth	Dredge to DOC (8-ft thickness)	8-ft-thick cut, 1-ft overdredge	Dredge, backfill	One vertical extent core (851)
			788 bounded at 8-ft depth				

Notes:
Gray italic text identifies non-Lower Duwamish Waterway Group cores for which there is a higher level of uncertainty associated with the depth of contamination (e.g., due to low core recoveries).

1. Elevations within the parentheses identify the FNC authorized depth.
2. Elevations are based on RTK-DGPS field measurements, as discussed in Section 4.2 of the *Basis of Design Report*.
3. When defined, dredge thicknesses to accommodate caps include an intermediate allowance for placement tolerances. Those will be refined during Pre-Final (90%) Remedial Design.

AST: area-specific technology
cm: centimeter
DOC: depth of contamination
EOC: elevation of contamination
FNC: federal navigation channel
ft: foot
MLLW: mean lower low water
RAA: remedial action area
RAL: remedial action level
RMC: residuals management cover
RTK-DGPS: real-time kinematic differential global positioning system
SMA: sediment management area

Table D1-2
Partial Dredge and Cap Development – Vertical Basis of Design

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Need for Cap Placement	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	>1 Foot Remaining Analysis	Technology	Phase III Vertical Data Collection
1B	FNC (-15 ft MLLW)	Subsurface	1582 unbounded at -26.3 ft MLLW	Unbounded greater than 9 ft below authorized depth	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -19 ft MLLW)	-24 ft MLLW, 1-ft overdredge	EOC of -26.3 ft is >1 ft below -24 ft	PD&C	One 0- to 60-cm sample within FNC (1726)
5B	Intertidal, subtidal	Subsurface	1560 unbounded at 5.4-ft depth	Unbounded due to refusal	Dredge to accommodate placement of a 3-ft modified engineered cap	3-ft-thick cut, 1-ft overdredge	DOC of 5.4 ft is >1 ft below 3 ft	PD&C	One 0- to 60-cm sample collected as part of vertical core (1719)
8B	Intertidal, subtidal	Subsurface	1562 unbounded at 6-ft depth	Unbounded due to refusal	Dredge to accommodate placement of a 4.5-ft modified engineered cap	4.5-ft-thick cut, 1-ft overdredge	DOC of 6 ft is >1 ft below 4.5 ft	PD&C	One 0- to 60-cm sample and one 0- to 45-cm sample collected as part of vertical cores (1711 and 1712)
9A	Intertidal	Subsurface	1556 unbounded at 4.5-ft depth	Unbounded due to refusal	Dredge to accommodate placement of a 4.5-ft modified engineered cap	4.5-ft-thick cut, 1-ft overdredge	N/A (refusal)	PD&C	One 0- to 45-cm sample collected as part of vertical core (1718)
9D	Intertidal	Surface, subsurface	1551 unbounded at 4.3-ft depth	Unbounded due to refusal	Dredge to accommodate placement of a 4-ft modified engineered cap	4-ft-thick cut, 1-ft overdredge	N/A (refusal)	PD&C	None
9J	FNC (-20 ft MLLW)	Subsurface	1520 unbounded at -24 ft MLLW	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -24 ft MLLW)	-29 ft MLLW, 1-ft overdredge	EOC of -31.8 ft is >1 ft below -29 ft	PD&C	One vertical extent core (1709)
			1529 bounded at -24.5 ft MLLW						
			1531 unbounded at -22.6 ft MLLW (refusal)						
			1534 bounded at -27.8 ft MLLW						
			1535 bounded at -29.8 ft MLLW						
			1542 unbounded at -31.8 MLLW						
14A	FNC (-20 ft MLLW)	Subsurface	1501 unbounded at -24 ft MLLW	Deeper samples not collected; therefore, cap placement assumed	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -24 ft MLLW)	-29 ft MLLW, 1-ft overdredge	N/A (unbounded)	PD&C	One vertical extent core (1697)
			1502 unbounded at -24 ft MLLW						
15B	Subtidal	Subsurface	1493 unbounded at -26.7 ft MLLW	Unbounded greater than 9 ft below authorized depth	Dredge to accommodate placement of a 5-ft standard engineered cap	-26 ft MLLW, 1-ft overdredge	N/A (unbounded)	PD&C	One vertical extent core (1695)
20B	Intertidal, subtidal	Surface, subsurface	1154 surface (0–10 cm) RAL interval exceedance (SS1154); bounded by subsurface (0–45 cm) sample with no exceedances (IT1154)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 3-ft modified engineered cap	3-foot thick cut, 1-ft overdredge	DOC of 7.7 ft is >1 ft below 3 ft	PD&C	One 0- to 45-cm sample collected as part of vertical core (1689)
			LDW-SS2027-A surface (0–10 cm) RAL interval exceedance						
			1468 unbounded at 7-ft depth						
			1469 surface (0–10 cm) RAL interval exceedance (SS1469); bounded by subsurface (0–45 cm) sample with no exceedances (IT1469)						
			1470 unbounded at 7.7-ft depth						

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Need for Cap Placement	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	>1 Foot Remaining Analysis	Technology	Phase III Vertical Data Collection
22	FNC (-20 ft MLLW)	Subsurface	1406 unbounded at -31 ft MLLW 1409 unbounded at -29.9 ft MLLW 1416 unbounded at -29.9 ft MLLW 1421 unbounded at -31.8 ft MLLW 1431 unbounded at -32.2 ft MLLW 1439 unbounded at -31.7 ft MLLW 1451 unbounded at -31.8 ft MLLW 1460 unbounded at -29.9 ft MLLW	All cores unbounded greater than 9 ft below authorized depth	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -24 ft MLLW)	-29 ft MLLW, 1-ft overdredge	EOC of -31 ft is >1 ft below -29 ft	PD&C	None
23A	Subtidal	Subsurface	1424 unbounded at -24.6 ft MLLW (refusal) 1425 unbounded at -19.9 ft MLLW 1432 unbounded at -27 ft MLLW 1433 bounded at -11.7 ft MLLW 1441 unbounded at -26.9 ft MLLW 1442 unbounded at 16.1 ft MLLW (refusal) 1452 bounded at -21.3 ft MLLW 1453 unbounded at -24.7 MLLW	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap	-20 ft MLLW, 1-ft overdredge	EOC of -26.9 ft is >1 ft below -20 ft	PD&C	None
24I	Intertidal	Subsurface	1428 unbounded at 7.8-ft depth	Unbounded in intertidal with contaminated interval >1 ft below depth needed for cap	Dredge to accommodate placement of a 4-ft modified engineered cap	4-ft-thick cut, 1-ft overdredge	DOC of 7.8 ft is >1 ft below 4 ft	PD&C	None
30B	FNC (-20 ft MLLW)	Surface, subsurface	1382 unbounded at -34.3 ft MLLW 1383 unbounded at -34.5 ft MLLW 1384 unbounded at -31.2 ft MLLW 1385 unbounded at -33.4 ft MLLW 1387 unbounded at -31.1 ft MLLW	All cores unbounded greater than 9 ft below authorized depth	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -24 ft MLLW)	-29 ft MLLW, 1-ft overdredge; 5-ft offset from bridge	EOC of -34.5 ft is >1 ft below -29 ft	PD&C	None
30C	FNC (-30 ft MLLW)[4]	Surface, subsurface	1346 bounded at -36.9 ft MLLW 1347 unbounded at -36.4 ft MLLW (refusal)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -30 ft MLLW))	-35 ft MLLW, 1-ft overdredge; 5-ft offset from bridge; utility crossing	EOC of -36.4 ft is >1 ft below -35 ft	PD&C	Two vertical extent cores (1666 and 1667)
30D	FNC (-30 ft MLLW)[4]	Subsurface	1343 bounded at -36.9 ft MLLW (refusal) 1344 unbounded at -38.9 ft MLLW	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -30 ft MLLW))	-35 ft MLLW, 1-ft overdredge	EOC of -38.9 ft is >1 ft below -35 ft	PD&C	None
30E	FNC (-30 ft MLLW)[4]	Subsurface	1339 bounded at -36.4 ft MLLW 1341 unbounded -37.9 ft MLLW (refusal)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -30 ft MLLW)	-35 ft MLLW, 1-ft overdredge	EOC of -37.9 ft is >1 ft below -35 ft	PD&C	One vertical extent core (1661)

RAA Subarea	Area Type[1]	RAL Exceedance Type	Elevation or Depth of Contamination Based on Vertical Core Data Within RAA	Basis of Need for Cap Placement	Basis of Dredge Elevation/Thickness[2,3]	Required Dredge Elevation/Thickness	>1 Foot Remaining Analysis	Technology	Phase III Vertical Data Collection
30F	FNC (-30 ft MLLW)[4]	Subsurface	1340 unbounded at -38.9 ft MLLW	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -30 ft MLLW)	-35 ft MLLW, 1-ft overdredge	EOC of -37.9 ft is >1 ft below -35 ft	PD&C	None
30G	FNC (-30 ft MLLW)	Subsurface	1327 unbounded at -41.8 ft MLLW 1328 unbounded at -41.8 ft MLLW 1335 unbounded at -41.8 ft MLLW 1336 unbounded at -36.2 ft MLLW (refusal)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -34 ft MLLW)	-39 ft MLLW, 1-ft overdredge	EOC of -41.8 ft is >1 ft below -39 ft	PD&C	One vertical extent core (1656)
30H	FNC (-30 ft MLLW)	Subsurface	1324 unbounded at -39.9 ft MLLW 1325 unbounded at -41.8 ft MLLW	All cores unbounded greater than 9 ft below authorized depth	Dredge to accommodate placement of a 5-ft standard engineered cap (top of cap must be below -34 ft MLLW)	-39 ft MLLW, 1-ft overdredge	EOC of -41.8 ft is >1 ft below -39 ft	PD&C	One vertical extent core (1655)
31B	Intertidal	Subsurface	1369 unbounded at 3.3-ft depth 1370 unbounded at 1.5-ft depth (refusal) 1371 unbounded at -29.3 ft MLLW (refusal) 1372 unbounded at -21.8 ft MLLW 1373 bounded at 2.5-ft depth (native material) 1376 unbounded at 2.0-ft depth (refusal)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap; 3H:1V slope cut starting at edge of RAA 30D	3H:1V side slope cut, beginning 15 ft inside the FNC boundary (to avoid impacts to upland utility infrastructure)	EOC of -21.8 ft is >1 ft below the side slope elevation (approximately -17 ft)	PD&C	Two vertical extent cores (1662 and 1663)
31C	Intertidal, subtidal	Subsurface	<u>Cores in high-elevation intertidal</u>: 1359, 1361, 1362, 1364, and 1368 unbounded at between 2.0- and 3.1-ft depth (refusal for all cores) <u>Cores in lower elevation intertidal</u>: 1351, 1352, 1355, 1358, 1360, 1363, and 1367 unbounded at between 5.3- and 6.7-ft depth, corresponding to -9.2 to -10.7 ft MLLW (refusal for all cores) <u>Cores in shallow subtidal</u>: 1350 unbounded at -17 ft MLLW (refusal) 1354 bounded at -17 ft MLLW 1357 unbounded at -16.8 ft MLLW (refusal) 1366 unbounded at -11.8 ft MLLW (refusal) <u>Cores in deep elevation subtidal (along FNC)</u>: 1353 unbounded at -31.4 ft MLLW (refusal) 1356 unbounded at -32.1 ft MLLW (refusal); note that intervals above -18.6 ft MLLW are below RALs 1365 unbounded at -22.8 ft MLLW (refusal)	Variable depth of contamination with deepest contaminated interval >1 ft below elevation needed for cap placement	Dredge to accommodate placement of a 5-ft standard engineered cap; 3H:1V slope cut starting at edge of RAA 30E	3H:1V side slope cut, beginning 15 ft inside the FNC boundary	EOC of -17 ft is >1 ft below the side slope elevation (approximately -15 ft)	PD&C	One vertical extent core (1659)
31D	Intertidal	Subsurface	1374 unbounded at 4.5-ft depth (refusal)	Unbounded due to refusal	Dredge to accommodate placement of a 3-ft modified engineered cap	3-ft-thick cut, 1-ft overdredge	DOC of 4.5 ft is >1 ft below 3 ft	PD&C	None

Notes:

1. Elevations within the parentheses identify the FNC authorized depth.
2. Elevations are based on RTK-DGPS field measurements, as discussed in Section 4.2 of the *Basis of Design Report*.

3. When defined, dredge thicknesses to accommodate caps include an intermediate allowance for placement tolerances. Those will be refined during Pre-Final (90%) Remedial Design.
4. Refer to Section 5.1.2 of the *Basis of Design Report* regarding dredging constraints within the FNC north of the First Avenue South Bridge.

cm: centimeter
DOC: depth of contamination
EOC: elevation of contamination
FNC: federal navigation channel
ft: foot
H:V: horizontal to vertical (ratio)
MLLW: mean lower low water
N/A: not applicable
RAA: remedial action area
RAL: remedial action level
RTK-DGPS: real-time kinematic differential global positioning system
PD&C: partial dredge and cap

2 References

Anchor QEA and Windward (Windward Environmental LLC), 2025. *Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach*. Final. Submitted to EPA September 30, 2025.

EPA (U.S. Environmental Protection Agency), 2014. *Record of Decision*. Lower Duwamish Waterway Superfund Site. U.S. Environmental Protection Agency Region 10. November 2014.

Figures

Proposed Phase III QAPP locations

- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval)
- Precipitate layer core

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

- Exceeds RAL
- Does not exceed RAL

Other sampling locations

- Vertical extent (non-RAL interval)
- Surface (0-10 cm), archive
- Intertidal (0-45 cm) archive
- Subtidal (0-60 cm) archive
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- Shoaling core
- Core without appropriate RAL interval
- Surface (0-10 cm) bioassay passed
- Subtidal (0-60 cm) bioassay passed
- Sample above MHHW not included in the interpolation dataset
- Upland soil sample

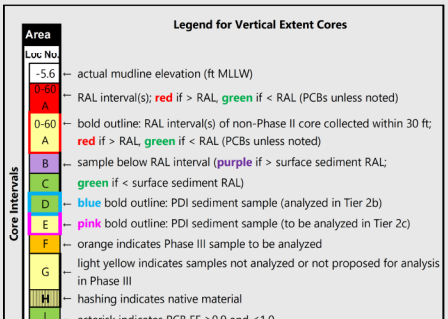
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs

Outfall classification

- CSO[b]
- CSO/storm drain[b]
- CSO/EOF[b]
- EOF/storm drain[b]
- Private storm drain[b]
- Public storm drain[b]
- Reservoir overflow[b]
- Stream, channel, or ditch[b]
- Abandoned/inactive outfall[b]
- Removed outfall[b]
- Pipe of unresolved origin and/or use[b]
- Not an outfall[b]

- Recovery Category 1
- Historical USACE overdredge extent
- Beach play area
- Georgetown WWTS diffuser pipe
- Utility corridor
- Bridge
- Dock/pier
- Marina
- Sand cover placement
- Boundary area thin-layer placement
- Talon Shoreline Stabilization Project
- Boyer maintenance dredging (2012)
- Intertidal area
- Potential vessel scour area
- Shoal area
- Below the navigation depth in the FNC and below potential vessel scour depth outside the FNC
- Not covered by bathymetric survey
- Bridge footing
- LDW Superfund Boundary (MHHW)[c]
- Early Action Area
- King Co tax parcel
- Federal Navigation Channel authorized depth boundary
- Federal Navigation Channel
- River mile

Legend for Vertical Extent Cores



- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

location ID year
LDW23-SS1003 (2023) RAL exceedance factor
0-10 cm: Phenol: 2.0
depth interval chemical

Exceedance boxes include RAL exceedances and near-exceedances for all COCs and intervals collected at that location.

[a] For 60% RD, daylight boundaries are not shown for dredge areas that are based on thickness cuts.
[b] Outfalls are based on the Ecology 2020 survey, as updated by LDWG as of February 20, 2024; the revised outfall layer is pending approval by LDWG, EPA, and Ecology.
[c] The 2010 MHHW boundary has been updated based on 2021 LiDAR data collected by King County.

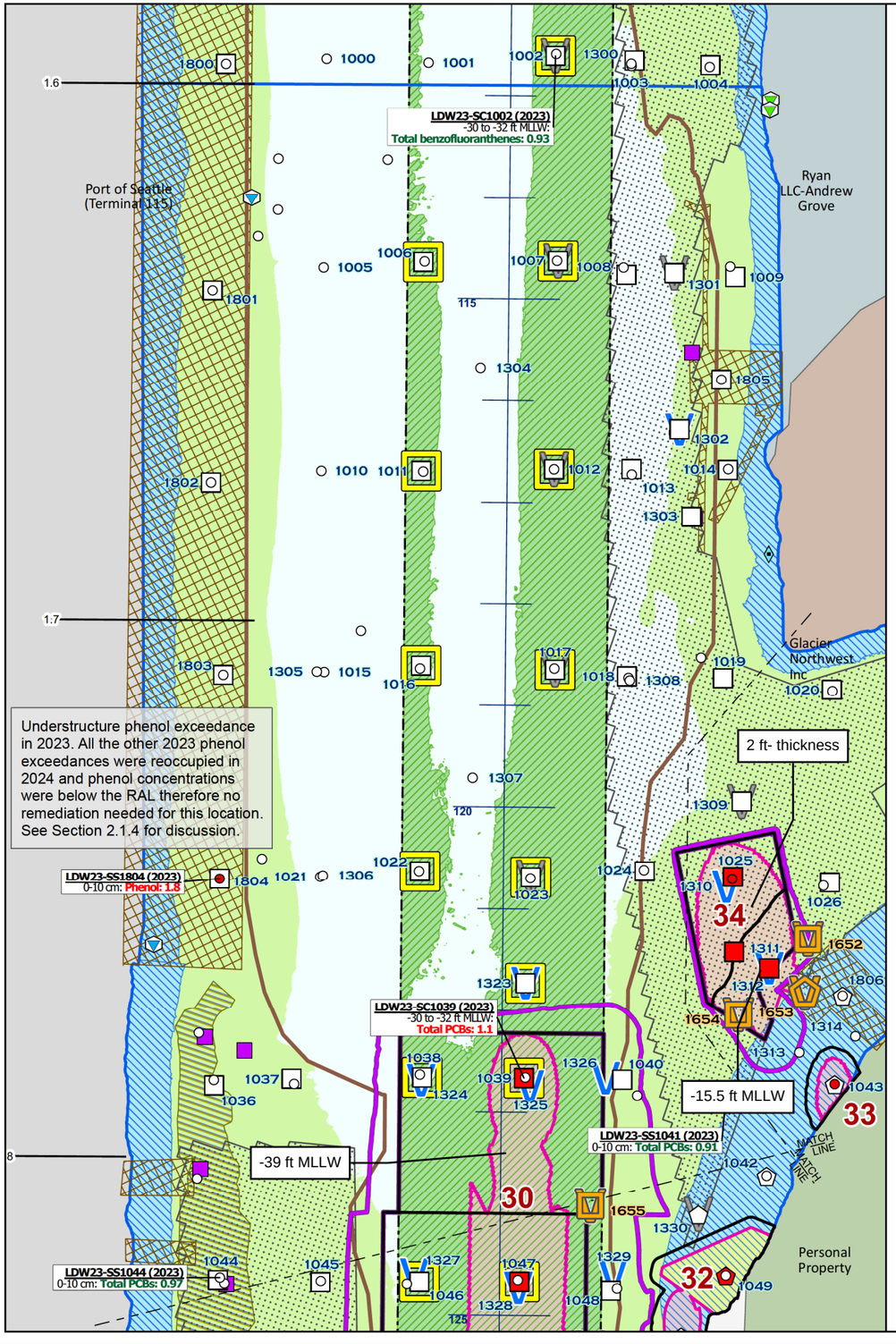
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Figure D1-1. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Series Legend

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

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RM 1.6 to RM 1.75 - FNC

Location	1002	1006	1007	1011	1012	1016	1017	1022	1023
Mudline	-26.9	-29.3	-27.8	-29.3	-28.3	-29.8	-28.5	-29.4	-28.8
Core Target:	-34 ft	-34 ft	-34 ft	-34 ft	-34 ft	-34 ft	-34 ft	-34 ft	-34 ft
-27 to -28 ft	sh. A								
-28 to -29 ft	sh. B		sh. A		sh. A		sh. A		sh. A
-29 to -30 ft		sh.		sh. o.d.		sh. o.d		sh. o.d	
-30 to -31 ft	o.d. C	A	o.d. B	A	o.d. B	A	o.d. B	A	o.d. B
-31 to -32 ft	C	B	C	B	C	B	C	B	C
-32 to -33 ft									
-33 to -34 ft									

RM 1.6 E

Location	1301	1302
Mudline	-23.2	-23.0
Core Target	-40 ft	-40 ft
Older Loc.	-	-
-23 to -24 ft	0-60 A	0-60 A *
-24 to -25 ft	B	B
-25 to -26 ft	C	C
-26 to -27 ft	D	D
-27 to -28 ft	E	E
-29 to -30 ft	F	F
-30 to -31 ft	G	G
-31 to -32 ft	H	H
-32 to -33 ft	I	I
-33 to -34 ft	J	J
-34 to -35 ft	K	K
-35 to -36 ft	L	L
-36 to -37 ft	ref.	M
-37 to -38 ft		N
-38 to -39 ft		O
-39 to -40 ft		ref.

Area 30 N - FNC

Location	1323	1324	1325	1326
Mudline	-29.2	-29.3	-26.0	-23.2
Core Target	-41 ft	-41 ft	-41 ft	20 ft
Older Loc.	-	1038	1039	1040
-23 to -24 ft				0-60 A
-24 to -25 ft				B
-25 to -26 ft			sh. A	C
-26 to -27 ft				D
-27 to -28 ft			sh. B	E
-29 to -30 ft	sh. o.d.	sh. o.d.		F
-30 to -31 ft	A	A	o.d. C	G *
-31 to -32 ft				H
-32 to -33 ft	B	B *	D	I
-33 to -34 ft	C	C	E	J
-34 to -35 ft	D	D	F	K
-35 to -36 ft	E	E	G	L
-36 to -37 ft	F	F	H	M
-37 to -38 ft	G	G	I	N
-38 to -39 ft	H	H	J	O
-39 to -40 ft	I	I	K	P
40 to 41 ft	J	J	L	Q
-41 to -42 ft	K	K	M	R
-42 to -43 ft			N	

PD&C

Proposed Phase III QAPP locations

- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

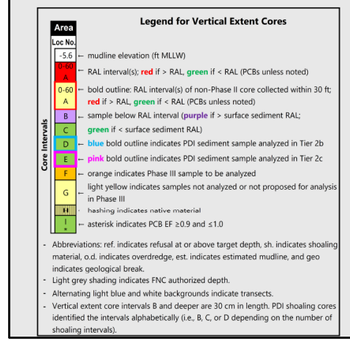
- Exceeds RAL
- Does not exceed RAL

Other sampling locations

- Core without appropriate RAL interval
- Shoaling core

Other sampling locations

- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



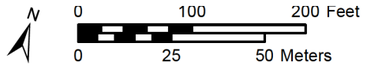


Figure D1-1a. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 1.6 to RM 1.8

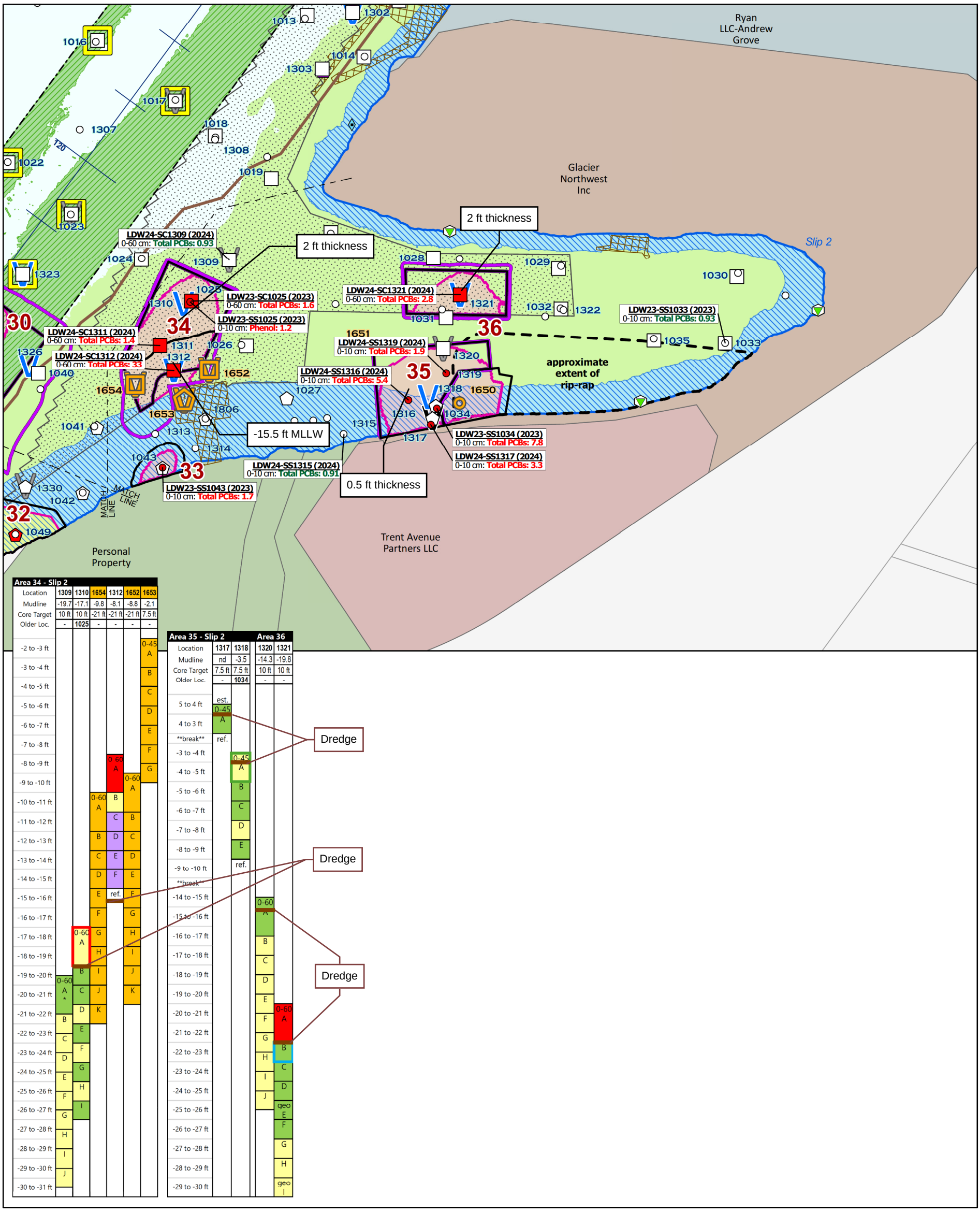
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Proposed Phase III QAPP locations

- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

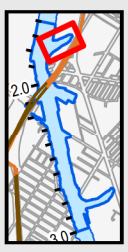
Subtidal (0-60 cm) core location

- Exceeds RAL
- Does not exceed RAL

Other sampling locations

- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- Core without appropriate RAL interval
- Shoaling core

- 60% RD RAA toe of cut/ placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



Legend for Vertical Extent Cores

Area / Loc No.

- -5.6 ← mudline elevation (ft MLLW)
- 0-60 A ← RAL interval(s); red if > RAL, green if < RAL (PCBs unless noted)
- 0-60 A ← bold outline: RAL interval(s) of non-Phase II core collected within 30 ft; red if > RAL, green if < RAL (PCBs unless noted)
- B ← sample below RAL interval (purple if > surface sediment RAL; green if < surface sediment RAL)
- C ← blue bold outline indicates PDI sediment sample analyzed in Tier 2b
- D ← pink bold outline indicates PDI sediment sample analyzed in Tier 2c
- E ← orange indicates Phase III sample to be analyzed
- F ← light yellow indicates samples not analyzed or not proposed for analysis in Phase III
- G ← hashing indicates native material
- H ← asterisk indicates PCB EF ≥0.9 and ≤1.0
- I

Core Intervals

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

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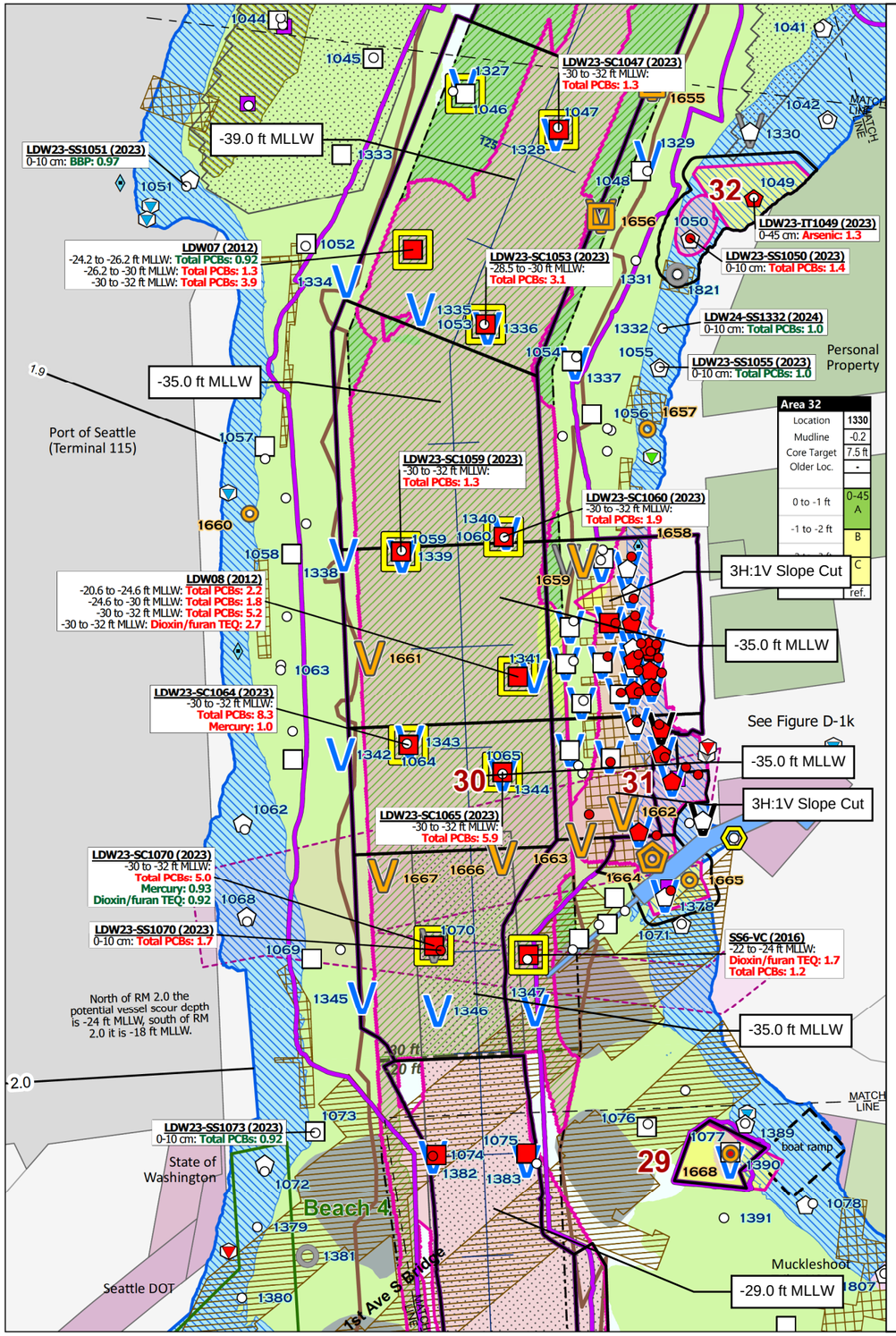
0 100 200 Feet
0 25 50 Meters

Figure D1-1b. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Slip 2

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF
DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

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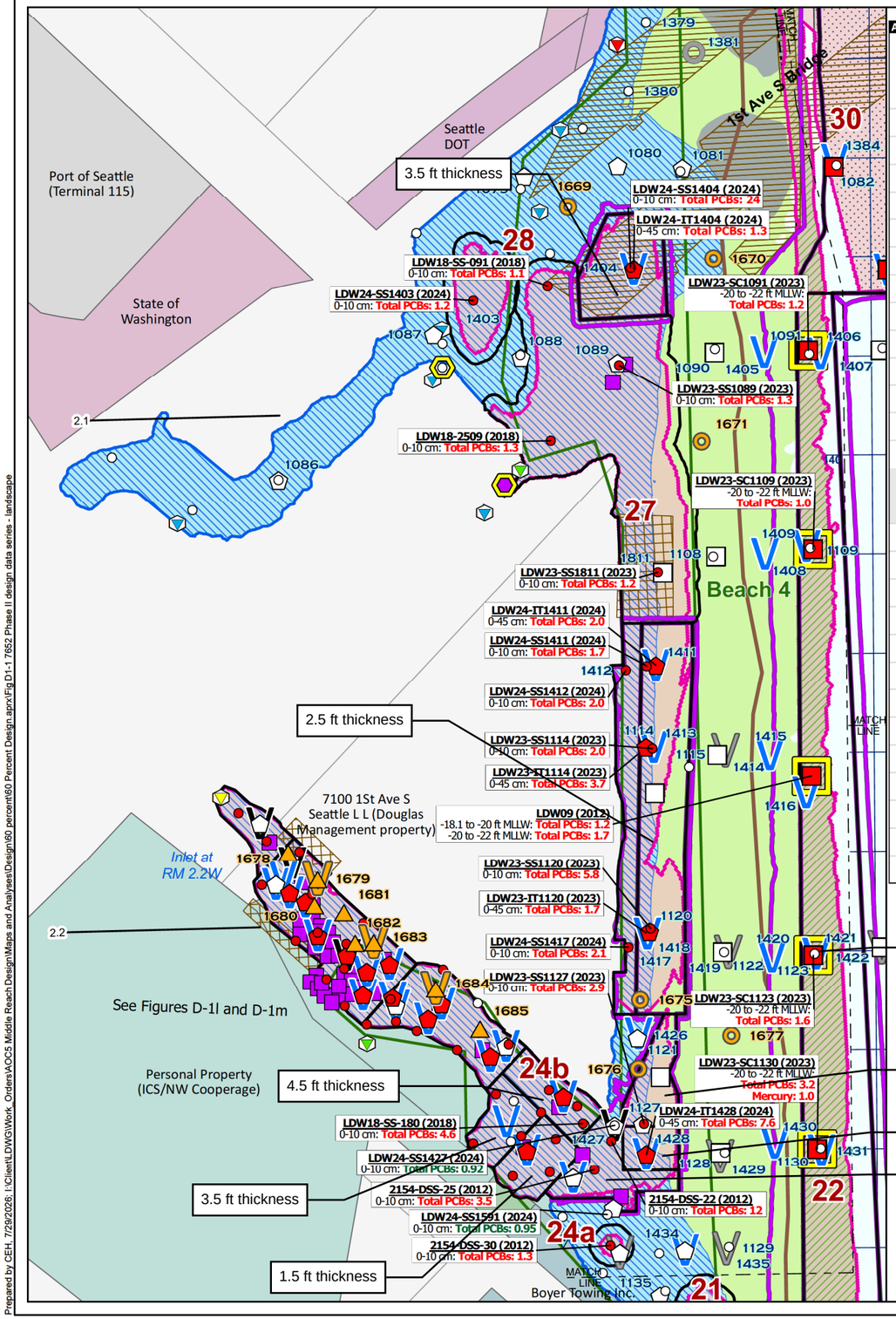


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Figure D1-1c. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 1.8 to RM 2.0

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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Proposed Phase III QAPP locations

- Surface (0-10 cm)
- Vertical extent (non-RAL interval)
- Precipitate layer core

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

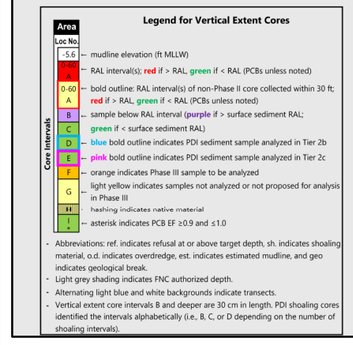
- Exceeds RAL
- Does not exceed RAL

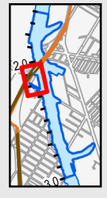
Other sampling locations

- Core without appropriate RAL interval
- Shoaling core
- Sample above MHHW not included in the interpolation dataset

Other sampling locations

- Vertical extent (non-RAL interval)
- Surface (0-10 cm), archive
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area





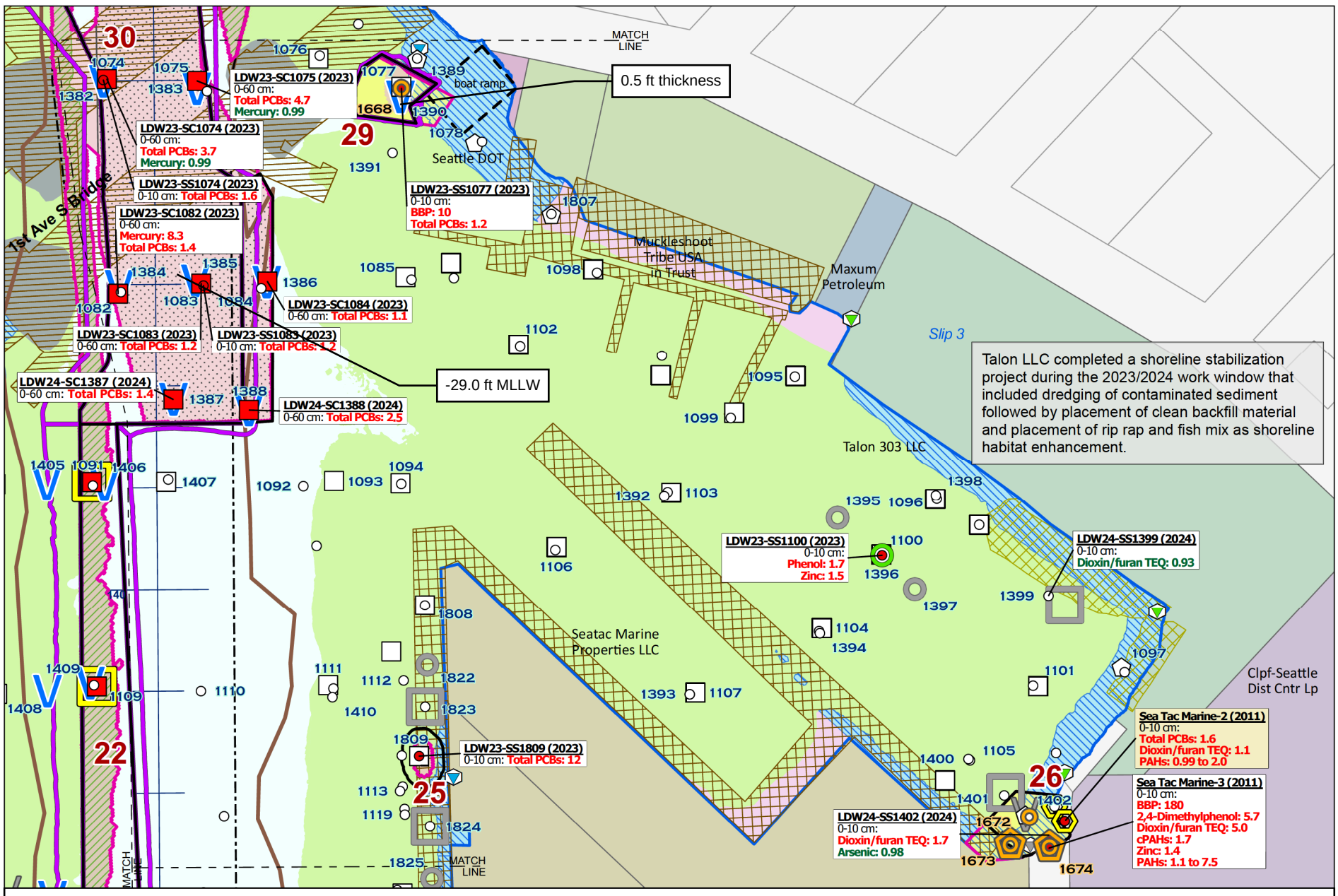
0 100 200 Feet
0 25 50 Meters

Figure D1-1d. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.0 to RM 2.25 West

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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Area 30 S - FNC and Sideslopes

Location	1382	1383	1384	1385	1386	1387	1388
Mudline	-27.3	-28.5	-23.3	-28.5	-21.0	-28.1	-24.4
Core Target	-31 ft	-31 ft	-31 ft	-31 ft	10 ft	-31 ft	10 ft
Older Loc.	1074	1075	1082	1083	1084	-	-
-20 to -21 ft							
-21 to -22 ft					0-60 A		
-22 to -23 ft					B		
-23 to -24 ft			0-60 A		C		
-24 to -25 ft			B		D		0-60 A Hg, PCBs
-25 to -26 ft			C		E		B
-26 to -27 ft			D		F Hg, PCBs		C
-27 to -28 ft	0-60 A		E		G Hg, PCBs	0-60 A	D
-28 to -29 ft	B	0-60 A	F	0-60 A	H Hg, PCBs	B	E Hg, PCBs
-29 to -30 ft	C	B	G	B	I	C	F
-30 to -31 ft	D	C	H	C	J	D	G
-31 to -32 ft	E	D		D	K	E	H
-32 to -33 ft	F	E D/F PCBs		E		F	
-33 to -34 ft				F		G	
-34 to -35 ft				G			
-35 to -36 ft				H			
-36 to -37 ft							
-37 to -38 ft							

Area 29

Location	1390
Mudline	-8.6
Core Target	10 ft
Older Loc.	1077
-8 to -9 ft	
-9 to -10 ft	0-60 A
-10 to -11 ft	B
-11 to -12 ft	C
-12 to -13 ft	geo D
-13 to -14 ft	E
-14 to -15 ft	F
-15 to -16 ft	G
-16 to -17 ft	H
-17 to -18 ft	I
-18 to -19 ft	J
-19 to -20 ft	

Area 26 - Slip 3

Location	1402
Mudline	-3.3
Core Target	7.5 ft
Older Loc.	-
-3 to -4 ft	
-4 to -5 ft	0-45 A
-5 to -6 ft	B
-6 to -7 ft	C
-7 to -8 ft	D
-8 to -9 ft	E
-9 to -10 ft	ref.

Dredge

PD&C

Proposed Phase III QAPP locations
- Surface (0-10 cm)
- Intertidal (0-45 cm)

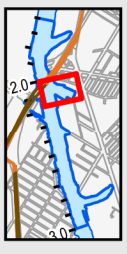
Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

Other sampling locations
- Vertical extent (non-RAL interval)
- Surface (0-10 cm), archive
- Subtidal (0-60 cm) archive
- Vertical extent (non-RAL interval) archive
- Core without appropriate RAL interval
- Shoaling core
- Sample above MHHW not included in the interpolation dataset

- 60% RD RAA toe of cut/ placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



Legend for Vertical Extent Cores

Area / Loc No.

Core Intervals	
-5.6	← mudline elevation (ft MLLW)
0-60 A	← RAL interval(s); red if > RAL, green if < RAL (PCBs unless noted)
0-60 A	← bold outline: RAL interval(s) of non-Phase II core collected within 30 ft; red if > RAL, green if < RAL (PCBs unless noted)
B	← sample below RAL interval (purple if > surface sediment RAL; green if < surface sediment RAL)
C	
D	← blue bold outline indicates PDI sediment sample analyzed in Tier 2b
E	← pink bold outline indicates PDI sediment sample analyzed in Tier 2c
F	← orange indicates Phase III sample to be analyzed
G	← light yellow indicates samples not analyzed or not proposed for analysis in Phase III
H	← hashing indicates native material
I *	← asterisk indicates PCB EF ≥0.9 and ≤1.0

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

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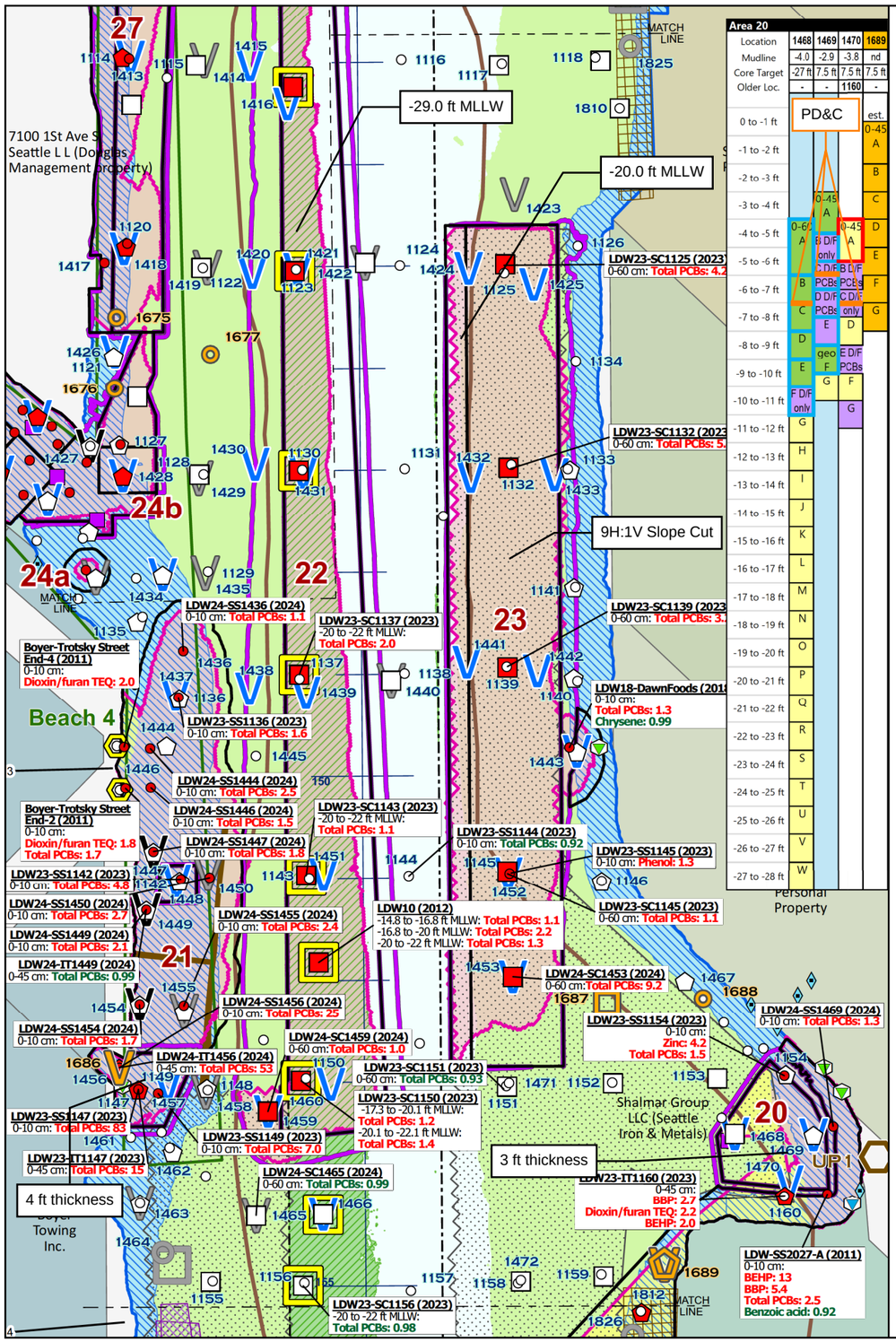
0 100 200 Feet
0 25 50 Meters

Figure D1-1e. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Slip 3

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF
DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

Prepared by CEH, 7/29/2026; I:\Client\LDWG\Work_Orders\AOC5 Middle Reach DesignMaps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig D1-1 7652 Phase II design data series - portrait



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Proposed Phase III QAPP locations

- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

- Exceeds RAL
- Does not exceed RAL

Other sampling locations

- Core without appropriate RAL interval
- Shoaling core
- Sample above MHHW not included in the interpolation dataset
- Upland soil sample

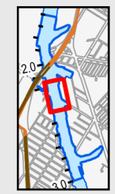
Other sampling locations

- Vertical extent (non-RAL interval)
- Surface (0-10 cm), archive
- Subtidal (0-60 cm) archive
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs

Legend for Vertical Extent Cores

Area / Loc No.	Core Intervals
-5.6	mudline elevation (ft MLLW)
RAL	RAL interval(s): red if > RAL, green if < RAL (PCBs unless noted)
0-60 A	bold outline: RAL interval(s) of non-Phase II core collected within 30 ft; red if > RAL, green if < RAL (PCBs unless noted)
B	sample below RAL interval (purple if > surface sediment RAL;
C	green if < surface sediment RAL)
D	blue bold outline indicates PDI sediment sample analyzed in Tier 2b
E	pink bold outline indicates PDI sediment sample analyzed in Tier 2c
F	orange indicates Phase III sample to be analyzed
G	light yellow indicates samples not analyzed or not proposed for analysis in Phase III
H	hashing indicates native material
*	asterisk indicates PCB EF ≥0.9 and ≤1.0

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

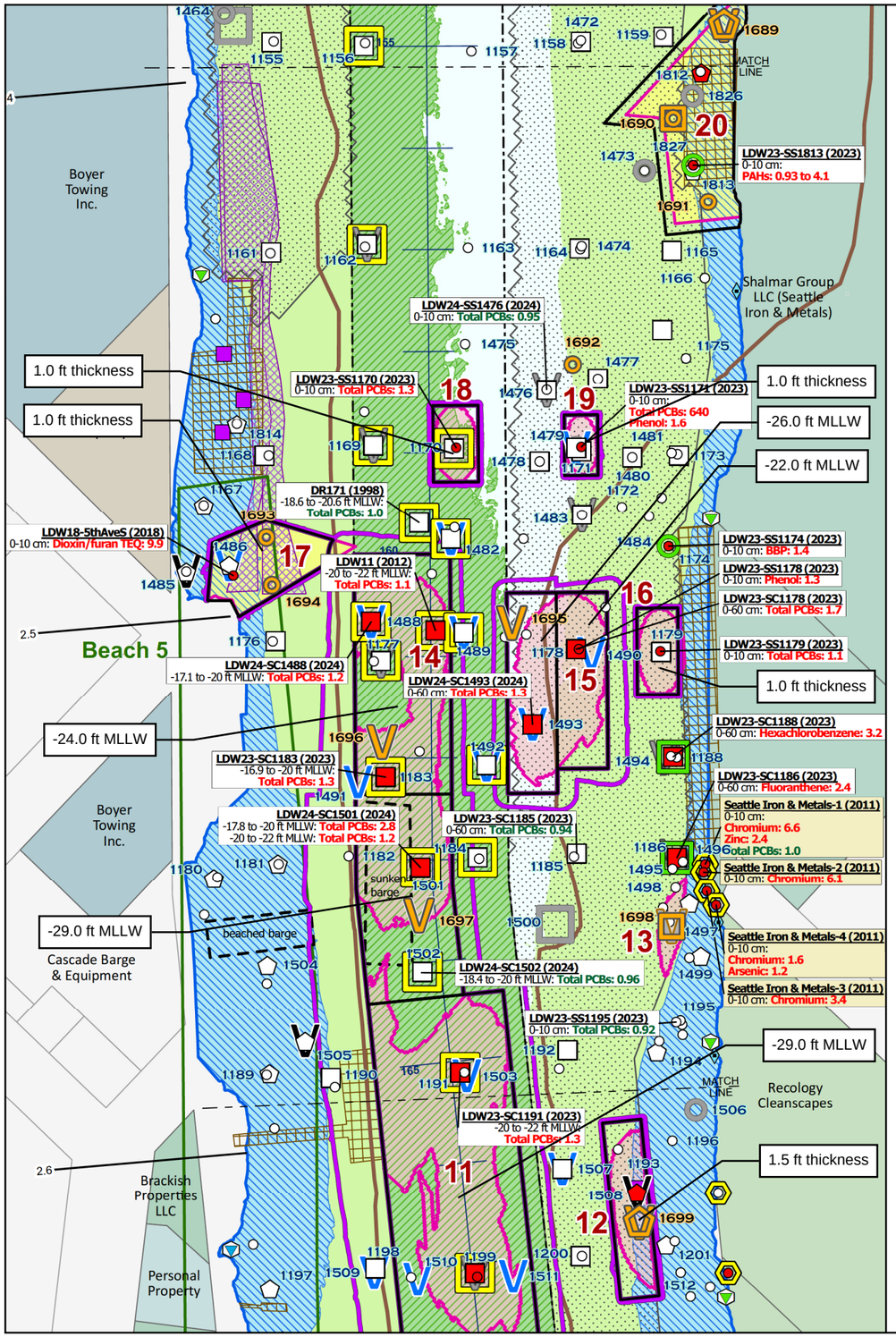


0 100 200 Feet
0 25 50 Meters

Figure D1-1f. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.2 to RM 2.4

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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City of Seattle / King County / The Boeing Company



Area 17		
Location	1485	1486
Mudline	nd	-1.1
Core Target	7.5 ft	7.5 ft
Older Loc.	-	-
	est.	
4 to 3 ft	0-45 A	
3 to 2 ft		ref.
2 to 1 ft		
1 to 0 ft		
0 to -1 ft		
-1 to -2 ft		0-45 A
-2 to -3 ft		B
-3 to -4 ft		C
-4 to -5 ft		D
-5 to -6 ft		ref.

Dredge

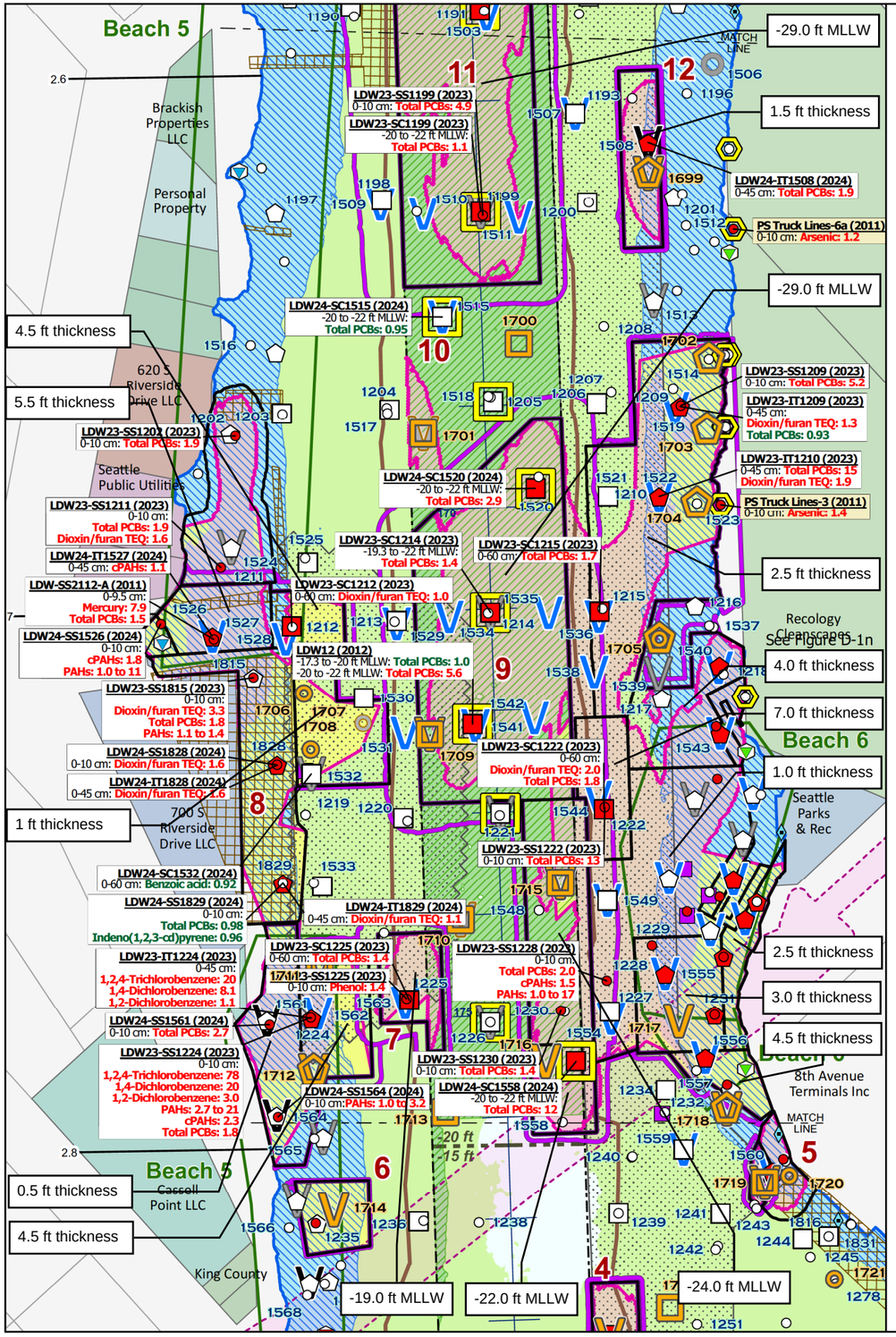
RM 2.5 E		
Location	1494	1495
Mudline	-9.1	-6.6
Core Target	-25 ft	10 ft
Older Loc.	1188	1186
-6 to -7 ft		0-60 A tox
-7 to -8 ft		B
-8 to -9 ft		C
-9 to -10 ft	0-60 A tox	D
-10 to -11 ft	B	E
-11 to -12 ft	C	ref.
-12 to -13 ft	D	
-13 to -14 ft	E	
-14 to -15 ft	F	
-15 to -16 ft	G	
-16 to -17 ft	H	
-17 to -18 ft	I	
-18 to -19 ft	ref.	

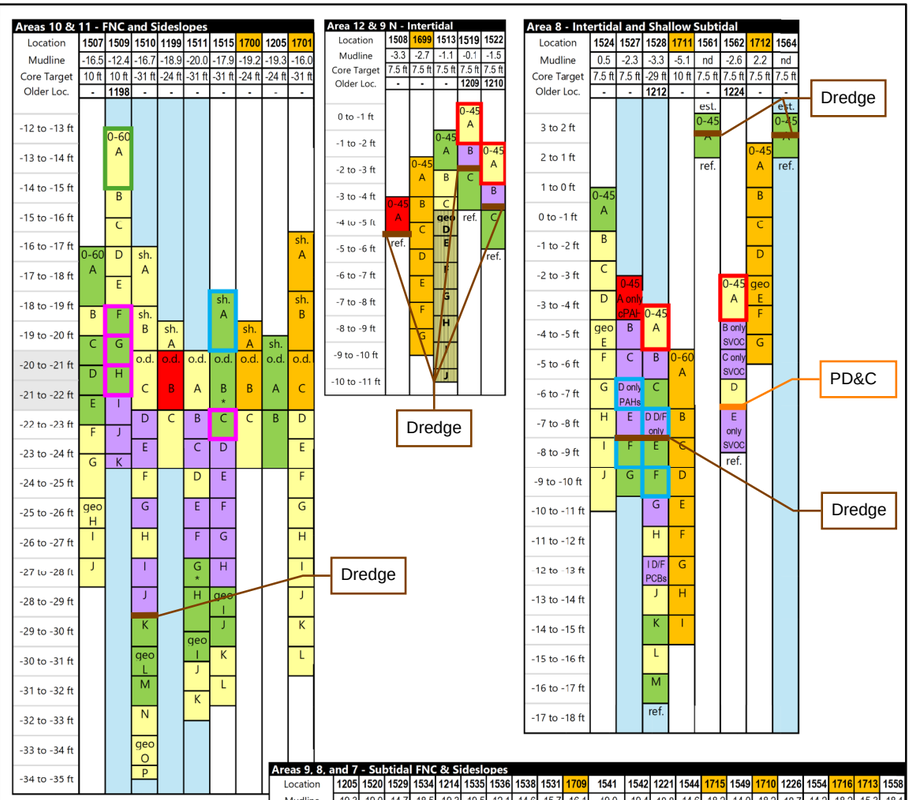
Note: dark green shading indicates subsurface bioassay passed

Areas 18 & 14 - FNC						
Location	1162	1169	1170	1177	1183	1184
Mudline	-18.4	-15.5	-19.8	-13.8	-10.7	-19.1
Core Target	-24 ft	-24 ft	-24 ft	-24 ft	-24 ft	-24 ft
-10 to -11 ft						
-11 to -12 ft					sh. A	
-12 to -13 ft						
-13 to -14 ft						sh. A
-14 to -15 ft					sh. B	
-15 to -16 ft		sh. A		sh. A		
-16 to -17 ft					sh. B	sh. B
-17 to -18 ft		sh. B				
-18 to -19 ft	sh. A			sh. B	sh. C	
-19 to -20 ft						sh. o.d
-20 to -21 ft	o.d. B	o.d. C	sh. o.d. A	o.d. C	o.d. D	A
-21 to -22 ft	C	D	B	D	E	B
-22 to -23 ft						
-23 to -24 ft						

Dredge

| Area 19 | | | | | |





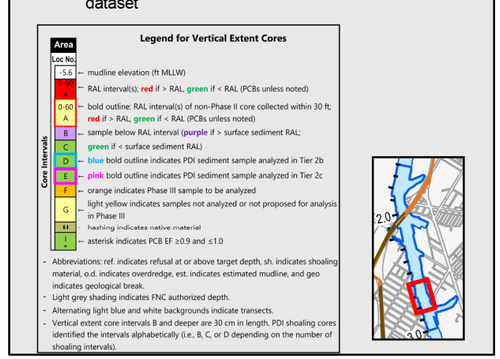
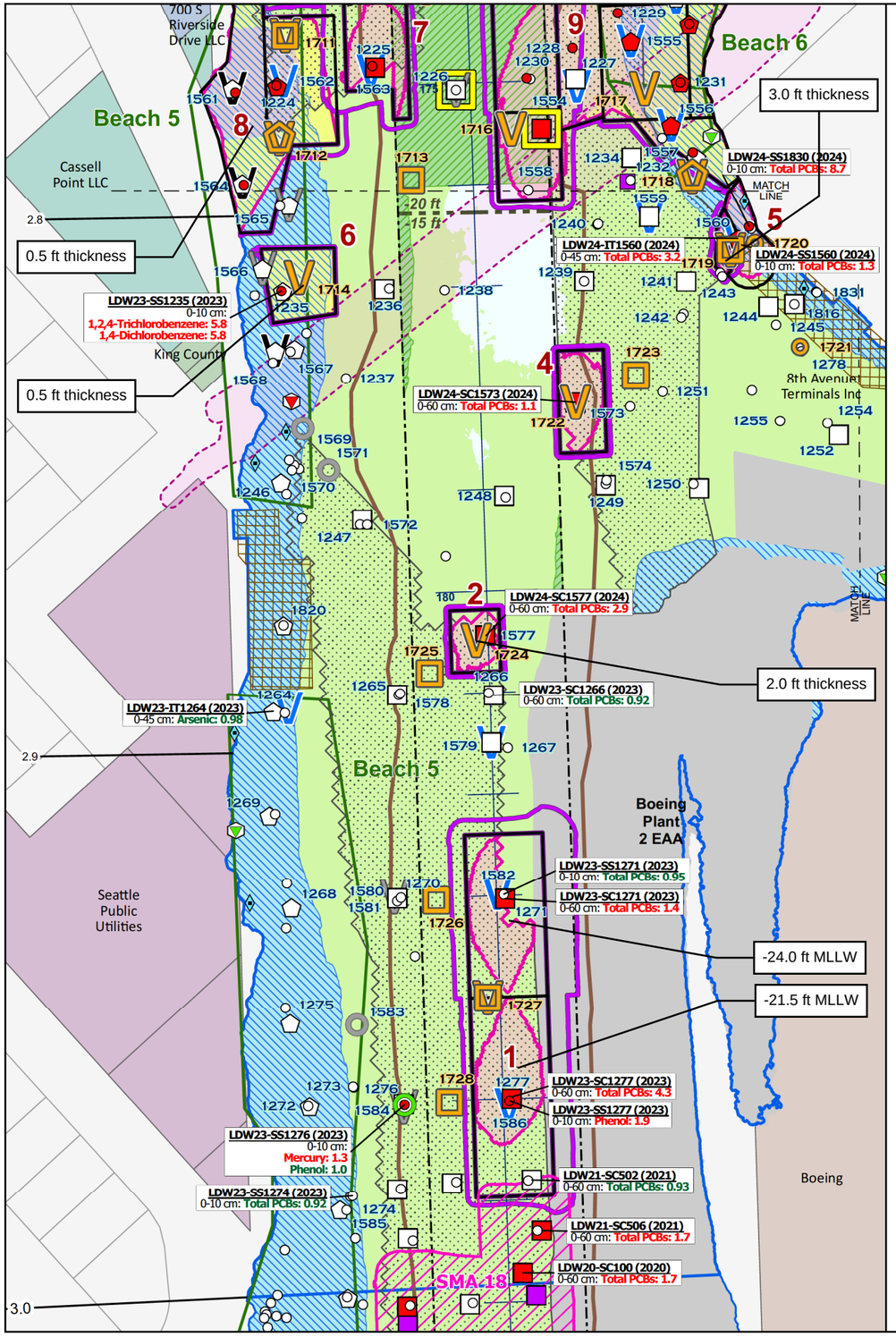


Figure D1-1h. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.6 to RM 2.8

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

ANCHOR QEA
BARR
Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

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Areas 6 & 8 S				
Location	1565	1566	1714	1568
Mudline	1.3	2.8	-0.2	nd
Core Target	7.5 ft	7.5 ft	7.5 ft	7.5 ft
Older Loc.	-	1235	-	-
3 to 2 ft		0-45 A		0-45 A est.
2 to 1 ft	0-45 A	B		ref.
1 to 0 ft		geo C		
0 to -1 ft	B	D	0-45 A	
-1 to -2 ft	geo C	E		
-2 to -3 ft	D	ref.	B	
-3 to -4 ft	E		C	
-4 to -5 ft	F		D	
-5 to -6 ft	G		E	
-6 to -7 ft			F	
-7 to -8 ft			G	

Area 4	Area 5			
Location	1722	1719	1559	1560
Mudline	-17.2	-7.0	-11.5	-3.9
Core Target	10 ft	10 ft	10 ft	7.5 ft
Older Loc.	1573	-	-	-
-4 to -5 ft				0-45 A
-5 to -6 ft				B
-6 to -7 ft				C
-7 to -8 ft		0-60 A		geo D
-8 to -9 ft		B		E
-9 to -10 ft		C		ref.
-10 to -11 ft		D	0-60 A *	
-11 to -12 ft		E	B	
-12 to -13 ft		F	C	
-13 to -14 ft		G	D	
-14 to -15 ft		H	E	
-15 to -16 ft		I	F	
-16 to -17 ft			geo G	
-17 to -18 ft	0-60 A		H	
-18 to -19 ft	B		I	
-19 to -20 ft	C		J	
-20 to -21 ft	D		K	
-21 to -22 ft	E			
-22 to -23 ft	F			
-23 to -24 ft	G			
-24 to -25 ft	H			
-25 to -26 ft	I			
-26 to -27 ft				

PD&C

Areas 1 & 2 - FNC							
Location	1724	1579	1581	1582	1727	1584	1586
Mudline	-17.4	-18.1	-14.5	-17.4	-17.2	-14.5	-18.2
Core Target	-26 ft	-26 ft	10 ft	-26 ft	-26 ft	10 ft	-26 ft
Older Loc.	1577	-	1270	1271	-	1276	1277
-14 to -15 ft			0-60 A			0-60 A	
-15 to -16 ft			B			B	
-16 to -17 ft			C		0-60 A	C	
-17 to -18 ft	0-60 A	0-60 A	D	0-60 A	B	D	0-60 A
-18 to -19 ft	B	B	E	B	C	E	B
-19 to -20 ft	C	C	F	C	D	F	C
-20 to -21 ft	D	D	G	D	E	G	D
-21 to -22 ft	E	F	H	E	F	geo H	geo E
-22 to -23 ft	F	F	I	F	G		F
-23 to -24 ft	G	G	J	G	H		G
-24 to -25 ft	H	H	K	H			H
-25 to -26 ft		I		I			
-26 to -27 ft							
-27 to -28 ft							

Dredge

PD&C

Proposed Phase III QAPP locations
- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval)

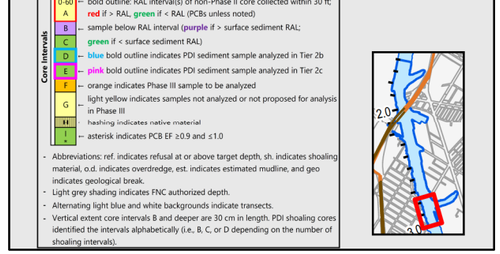
Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

Other sampling locations
- Core without appropriate RAL interval
- Shoaling core

Other sampling locations
- Vertical extent (non-RAL interval)
- Surface (0-10 cm), archive
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs
- Utility corridor
- Federal Navigation Channel authorized depth boundary



0 100 200 Feet
0 25 50 Meters

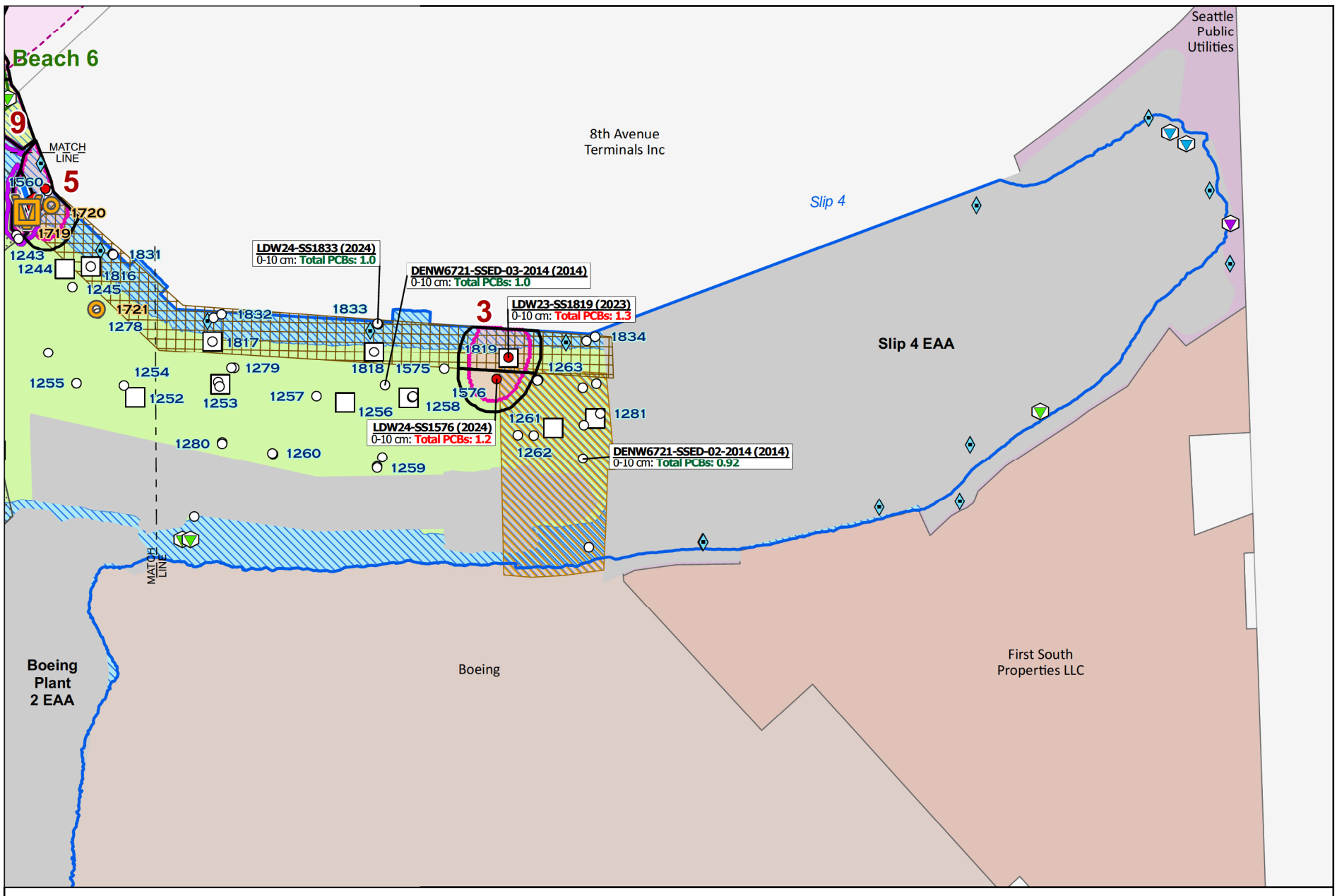
Figure D1-1i. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.8 to RM 3.0

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

ANCHOR QEA BARR

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

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Proposed Phase III QAPP locations

- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL

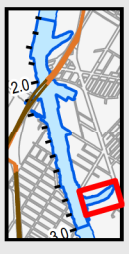
Subtidal (0-60 cm) core location

- Does not exceed RAL

Other sampling locations

- Vertical extent (non-RAL interval)
- Core without appropriate RAL interval

- 60% RD RAA toe of cut/ placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



Legend for Vertical Extent Cores

Area / Loc No. / Core Intervals

- -5.6 ← mudline elevation (ft MLLW)
- 0-60 A ← RAL interval(s); **red** if > RAL, **green** if < RAL (PCBs unless noted)
- 0-60 A ← bold outline: RAL interval(s) of non-Phase II core collected within 30 ft; **red** if > RAL, **green** if < RAL (PCBs unless noted)
- B ← sample below RAL interval (**purple** if > surface sediment RAL; **green** if < surface sediment RAL)
- C
- D ← **blue** bold outline indicates PDI sediment sample analyzed in Tier 2b
- E ← **pink** bold outline indicates PDI sediment sample analyzed in Tier 2c
- F ← orange indicates Phase III sample to be analyzed
- G ← light yellow indicates samples not analyzed or not proposed for analysis in Phase III
- H ← hashing indicates native material
- I * ← asterisk indicates PCB EF ≥0.9 and ≤1.0

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

ANCHOR QEA

BARR

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

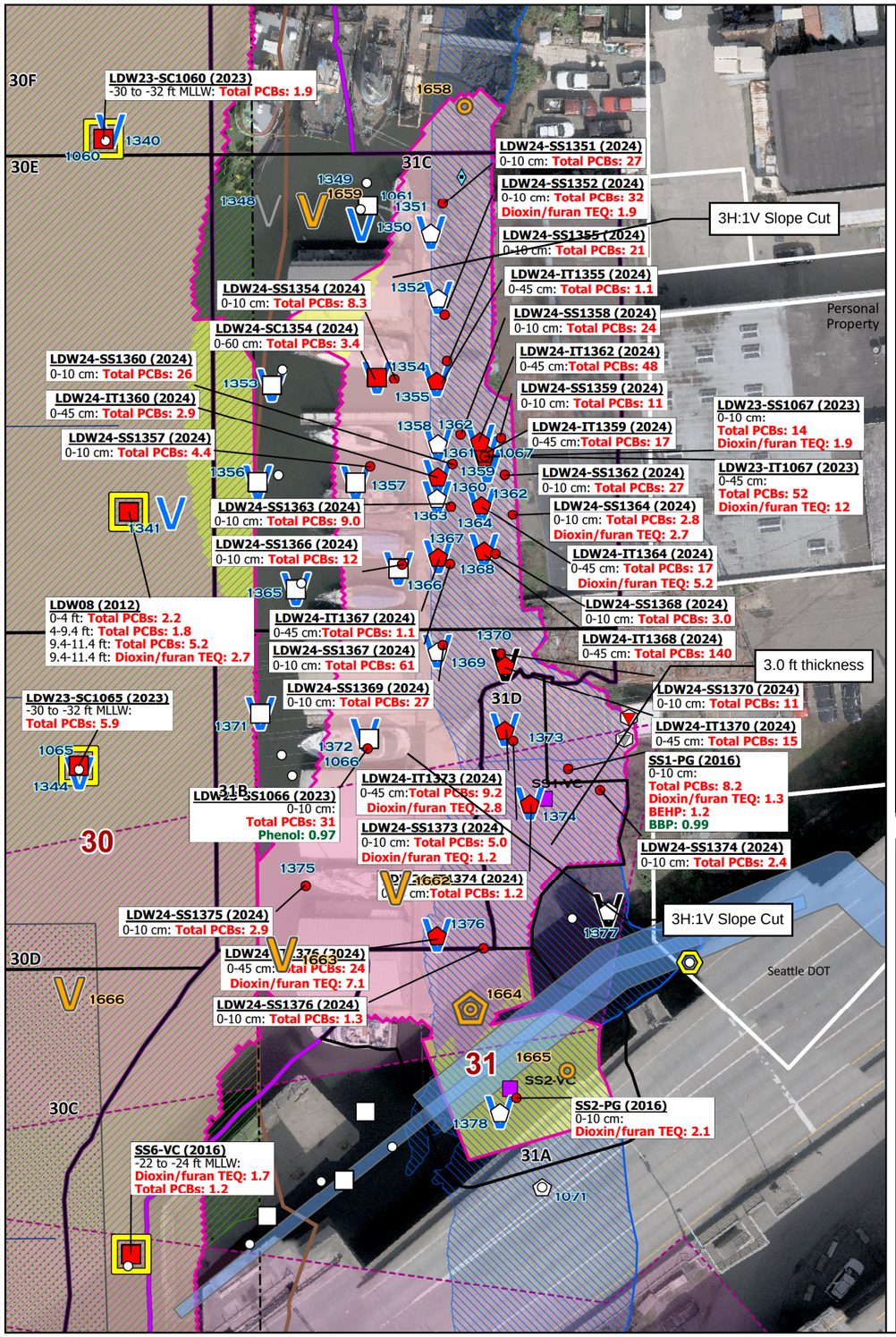
0 100 200 Feet
0 25 50 Meters

Figure D1-1j. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Slip 4

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF
DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

Prepared by CEH, 7/29/2026; I:\Client\LDWG\Work_Orders\AOC5 Middle Reach DesignMaps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig D1-1 7652 Phase II design data series - portrait



Area 30 - FNC

Location	1340	1341	1344	1666
Mudline	-20.5	-16.4	-22.5	-23.7
Core Target	-41 ft	-41 ft	-41 ft	-37 ft
Older Loc.	1060	LDW08	1065	-
-16 to -17 ft		sh. A		
-17 to -18 ft				
-18 to -19 ft				
-19 to -20 ft				
-20 to -21 ft	sh. A			
-21 to -22 ft		sh. B		
-22 to -23 ft			sh. A	
-23 to -24 ft				sh. A
-24 to -25 ft	sh. B			
-25 to -26 ft		sh. C		
-26 to -27 ft			sh. B	sh. B
-27 to -28 ft	sh. C			
-28 to -29 ft				
-29 to -30 ft				
-30 to -31 ft	o.d. D	o.d. D	o.d. C	o.d. C
-31 to -32 ft				
-32 to -33 ft	E	E D/F PCBs	D D/F PCBs	D
-33 to -34 ft	F	F D/F PCBs	E D/F PCBs	E
-34 to -35 ft	G	G	F	F
-35 to -36 ft	H	H	G D/F PCBs	G
-36 to -37 ft	I	I	H	H
-37 to -38 ft	J	J D/F PCBs	I	
-38 to -39 ft	K	K	J	
-39 to -40 ft	L	ref.	K	
-40 to -41 ft			L	
-41 to -42 ft			M	

Area 30 & 31 - Subtidal

Location	1348	1659	1350	1353	1354	1356	1357	1365	1366	1371	1372	1663	1662
Mudline	-14.4	nd	-9.1	-12.0	-7.7	-12.7	-8.9	-11.0	-5.6	-11.6	-8.0	-10.9	-6.4
Core Target	20 ft	19 ft	15 ft	20 ft	15 ft	20 ft	15 ft	20 ft	15 ft	20 ft	15 ft	-30 ft	19 ft
Older Loc.	-	-	1061	-	-	-	-	-	-	-	1066	-	-
-5 to -6 ft									0-60 A				0-60 A
-6 to -7 ft									B				B
-7 to -8 ft					0-60 A				C		0-60 A		C
-8 to -9 ft			0-60 A		B		0-60 A		D		B		D
-9 to -10 ft		est.	B	0-60 A	C		B	0-60 A	E		C	0-60 A	E
-10 to -11 ft	0-60 A	0-60 A	C	D	E	0-60 A	C	B	ref.	0-60 A	D	A	F
-11 to -12 ft	B	B	D	E	B	B	D	C		B	E	B	G
-12 to -13 ft	C	C	E	B	C	C	E	D		C	B	C	H
-13 to -14 ft	D	D	F	C	D	D	F	E		D	F	G	I
-14 to -15 ft	E	E	G	D	H	qeo F	G	F		E	G	D	J
-15 to -16 ft	F	F	H	E	I	G	H	G		F	H	E	K
-16 to -17 ft	G	G	I	F	J	D	qeo H	H		G	I	F	L
-17 to -18 ft	H	H	J	G	K	E	ref.	I		H	J	G	M
-18 to -19 ft	I	I	K	H	L	F		J		I	K	H	N
-19 to -20 ft	J	J	L	I	M	G		K		J	L	I	O
-20 to -21 ft	K	K	M	J	N	H		L		K	M	J	P
-21 to -22 ft	L	L	N	K	O	I		ref.		L	N	K	Q
-22 to -23 ft	M	M	O	L	P	J				M	O	L	R
-23 to -24 ft	N	N	P	M	Q	K				N	P	M	
-24 to -25 ft	O	O	Q	N	R	L				O	Q	N	
-25 to -26 ft	P	P	R	O	S	M				P	R	O	
-26 to -27 ft	Q	Q		P		N				Q		P	
-27 to -28 ft	R	R		Q		O				R		Q	
-28 to -29 ft		S		R		P						R	
-29 to -30 ft				S		Q							
-30 to -31 ft						R							
-31 to -32 ft						S							

Area 31 - Intertidal

Location	1351	1352	1355	1358	1359	1360	1362	1361	1363	1364	1367	1368	1369	1370	1373	1374	1376	1377	1378
Mudline	-4.0	-4.0	-3.9	-4.1	nd	-4.6	nd	nd	-3.9	nd	-3.9	nd	-3.4	nd	-2.3	-0.6	-3.0	nd	-0.6
Core Target	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft
Older Loc.	-	-	-	-	-	-	-	1067	-	-	-	-	-	-	-	-	-	-	-
3 to 2 ft					est.		est.	est.		est.		est.		est.				est.	
2 to 1 ft					0-45 A		0-45 A	0-45 A		0-45 A, D/F PCBs		0-45 A		0-45 A				0-45 A ref.	
1 to 0 ft					B		B	B D/F PCBs		B		B		ref.		0-45 A			0-45 A
0 to -1 ft					ref.		C	ref.		ref.		ref.			0-45 A, D/F PCBs	B	0-45 A, D/F PCBs		B
-1 to -2 ft							ref.								B	C	B D/F PCBs		ref.
-2 to -3 ft															C	D	ref.		
-3 to -4 ft													0-45 A		D	ref.			
-4 to -5 ft	0-45 A	0-45 A	0-45 A	0-45 A		0-45 A			0-45 A		0-45 A		B		E				
-5 to -6 ft	B	B	B	B		B			B		B		C		ref.				
6 to 7 ft	C	C	C	C		C			C		C		ref.						
-7 to -8 ft	D	D	D	D		D			D		D								
-8 to -9 ft	E	E	E	E		E			E		E								
-9 to -10 ft	F	F	ref.			ref.			ref.		ref.								
-10 to -11 ft	ref.	ref.		ref.															

Note: Location 1373 intervals C, D, and E were unable to be analyzed because they were were majority gravel.

PD&C
Dredge prism contact line with cores in RAA 31B and 31C varies based on slope cut; cut not indicated on core diagrams for these RAAs.

Proposed Phase III QAPP locations
- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

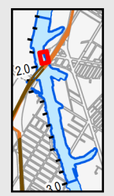
Other sampling locations
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- Core without appropriate RAL interval
- Shoaling core
- Sample above MHHW not included in the interpolation dataset
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs
- Georgetown WWTS diffuser pipe
- Utility corridor

Legend for Vertical Extent Cores

Area Loc No.	
-5.6	← actual mudline elevation (ft MLLW)
0-60 A	← RAL interval(s); red if > RAL, green if < RAL (PCBs unless noted)
0-60 A	← bold outline: RAL interval(s) of non-Phase II core collected within 30 ft; red if > RAL, green if < RAL (PCBs unless noted)
B	← sample below RAL interval (purple if > surface sediment RAL; green if < surface sediment RAL)
C	
D	← blue bold outline: PDI sediment sample (analyzed in Tier 2b)
E	← pink bold outline: PDI sediment sample (to be analyzed in Tier 2c)
F	← orange indicates Phase III sample to be analyzed
G	← light yellow indicates samples not analyzed or not proposed for analysis in Phase III
H	← hashing indicates native material
I *	← asterisk indicates PCB EF ≥0.9 and ≤1.0

Core Intervals

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).



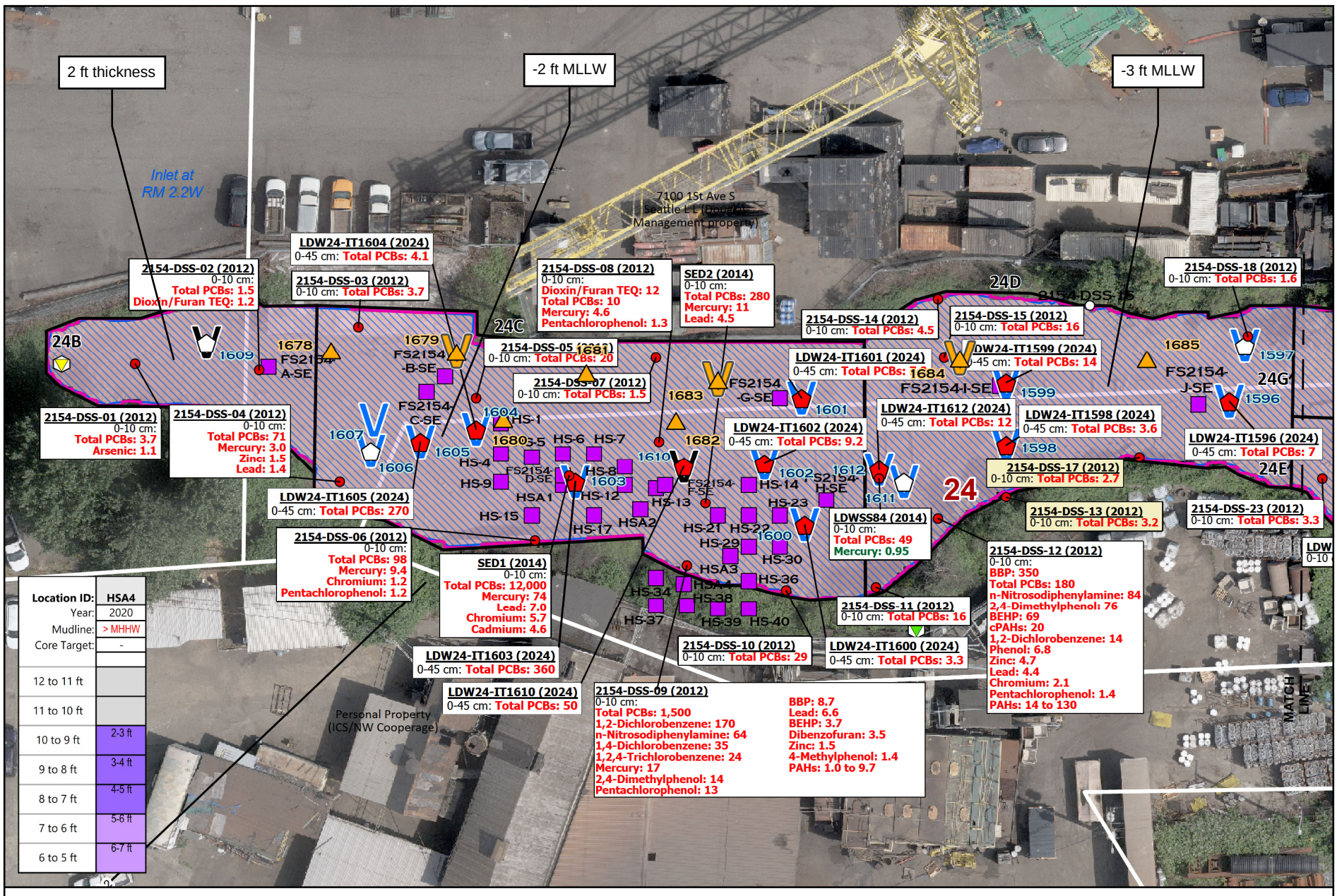
0 40 80 Feet
0 10 20 Meters

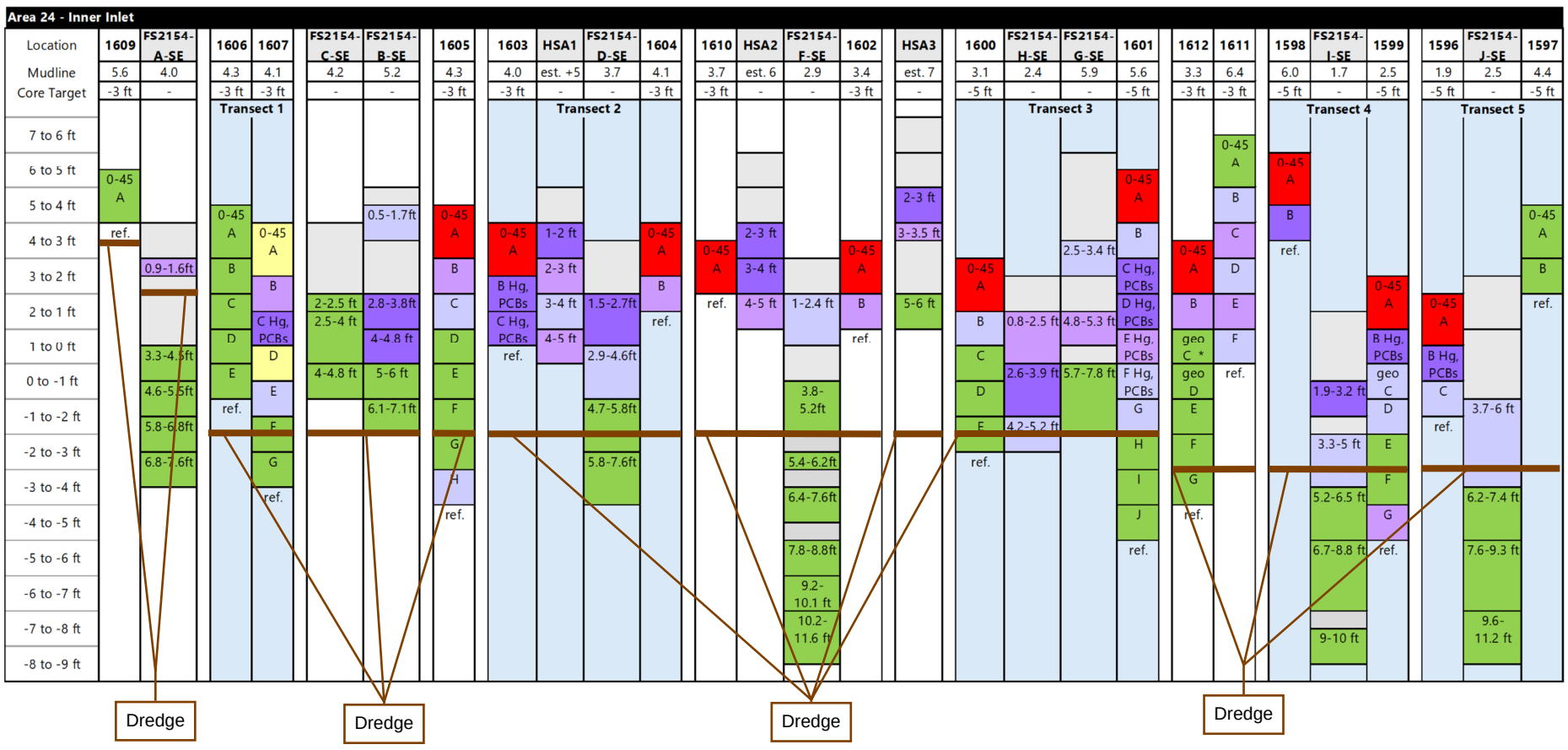
Figure D1-1k. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Duwamish Marine Center

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

ANCHOR QEA
BARR
Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

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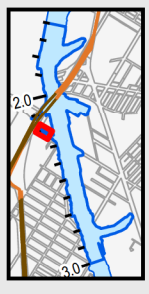
Proposed Phase III QAPP locations
- Vertical extent (non-RAL interval)
- Precipitate layer core

Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

Other samplling locations
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) not collected because of core refusal
- Core without appropriate RAL interval
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



Legend for Vertical Extent Cores

Area / Loc No.	
3.5	actual mudline elevation (ft MLLW)
0-60 A	RAL interval(s); **red** if > RAL, **green** if < RAL (PCBs unless noted)
B *	sample below RAL interval (**green** if > surface sediment RAL); asterisk indicates PCB EF ≥0.9 and ≤1.0
C	sample below RAL interval (**light purple** if maximum EF <10 relative to surface sediment RAL) (for PCBs unless noted)
D	sample below RAL interval (**purple** if maximum EF ≥10 relative to surface sediment RAL) (for PCBs unless noted)
E	sample below RAL interval (**dark purple** if maximum EF ≥100 relative to surface sediment RAL) (for PCBs unless noted)
F	light yellow indicates samples that were not analyzed

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Alternating light blue and white backgrounds indicate transects.
- PDI vertical extent core intervals B and deeper are 30 cm in length.

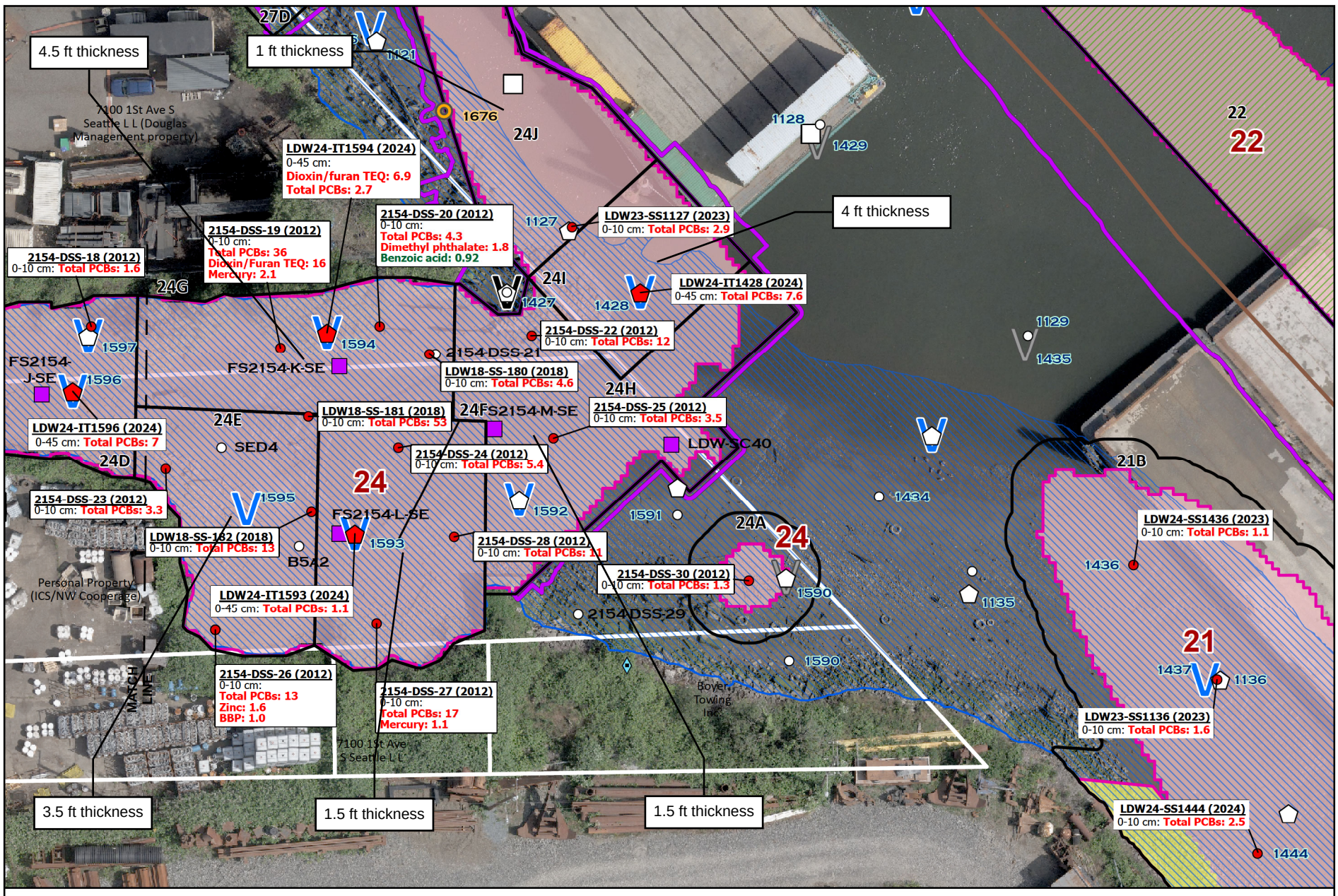
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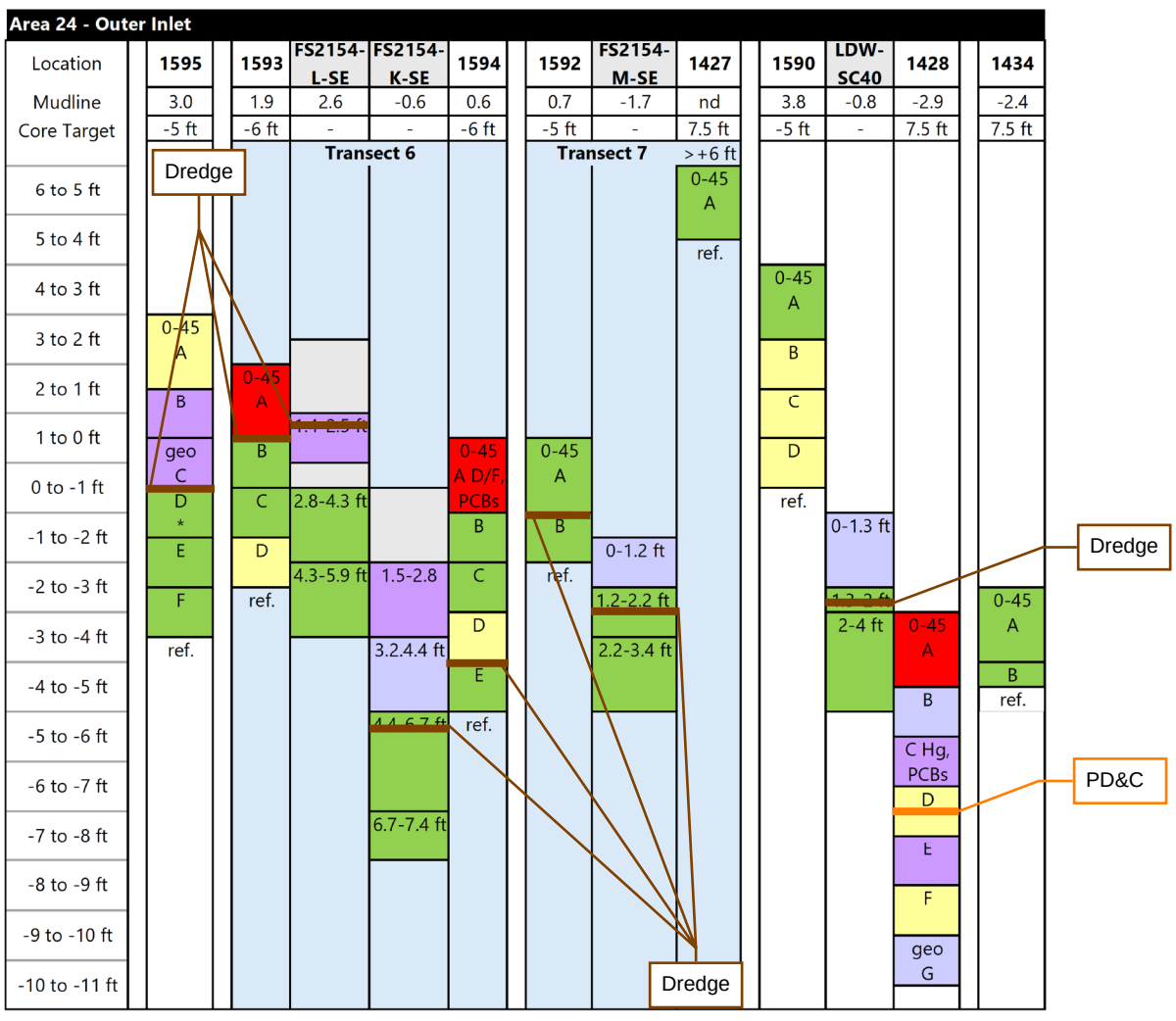
N
0 25 50 Feet
0 10 20 Meters

Figure D1-1I. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.2W Inner Inlet

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF
DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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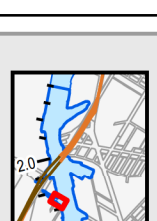
Proposed Phase III QAPP locations
- Surface (0-10 cm)

Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]

Other sampling locations
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- Core without appropriate RAL interval
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs



Legend for Vertical Extent Cores

Area / Loc No.	
3.5	actual mudline elevation (ft MLLW)
0-60 A	RAL interval(s); **red** if > RAL, **green** if < RAL (PCBs unless noted)
B *	sample below RAL interval (**green** if > surface sediment RAL); asterisk indicates PCB EF ≥0.9 and ≤1.0
C	sample below RAL interval (**light purple** if maximum EF <10 relative to surface sediment RAL) (for PCBs unless noted)
D	sample below RAL interval (**purple** if maximum EF ≥10 relative to surface sediment RAL) (for PCBs unless noted)
E	sample below RAL interval (**dark purple** if maximum EF ≥100 relative to surface sediment RAL) (for PCBs unless noted)
F	light yellow indicates samples that were not analyzed

- Abbreviations: ref. indicates refusal at or above target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.
- Alternating light blue and white backgrounds indicate transects.
- PDI vertical extent core intervals B and deeper are 30 cm in length.

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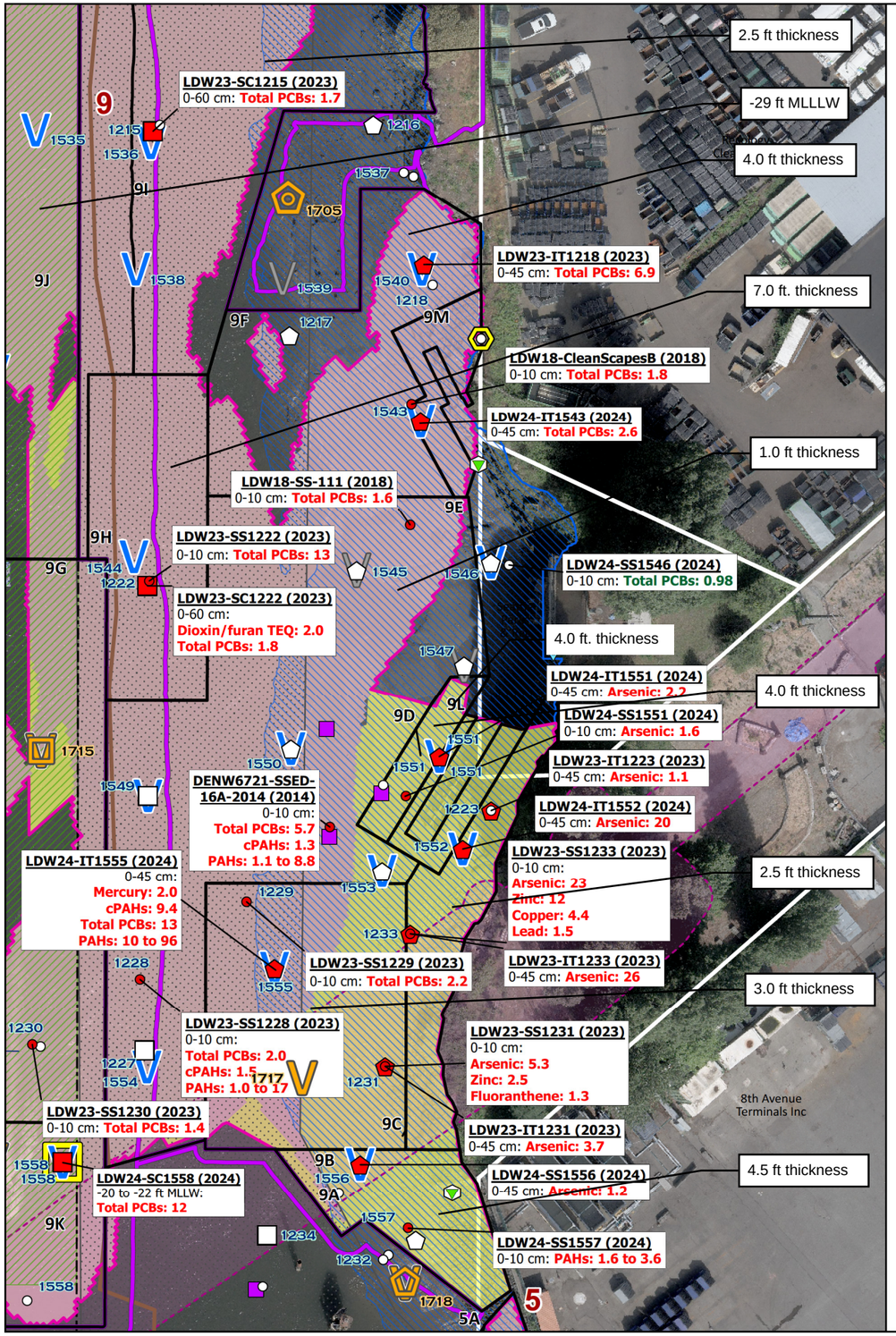
N
0 25 50 Feet
0 10 20 Meters

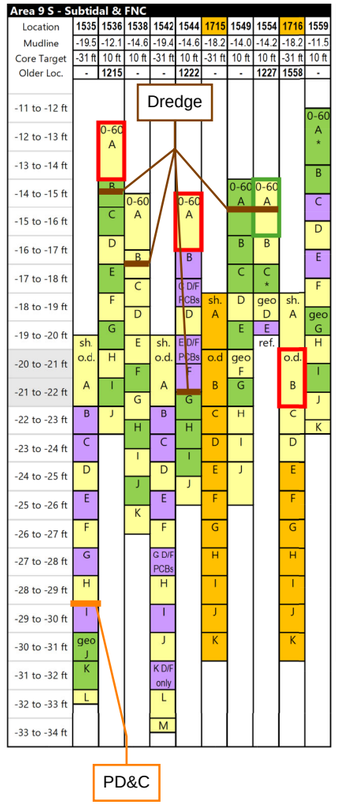
Figure D1-1m. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, RM 2.2W Outer Inlet

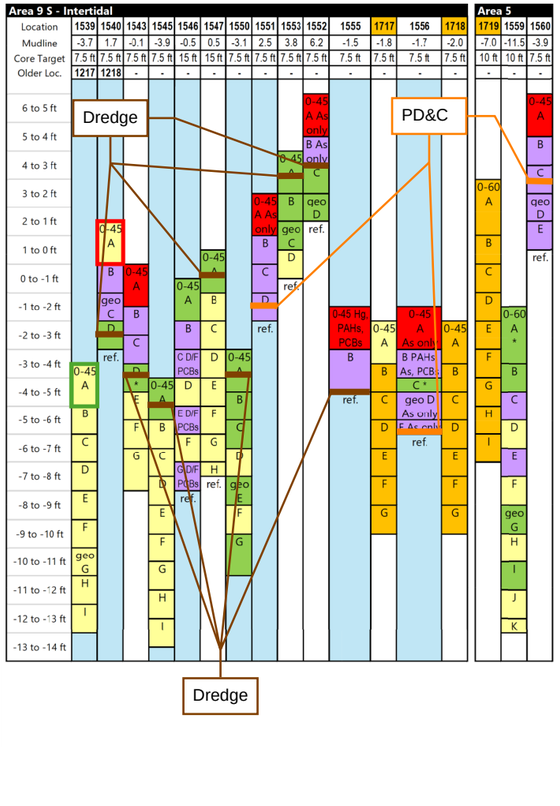
APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF
DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

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Proposed Phase III QAPP locations

- Surface (0-10 cm)
- Intertidal (0-45 cm)
- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

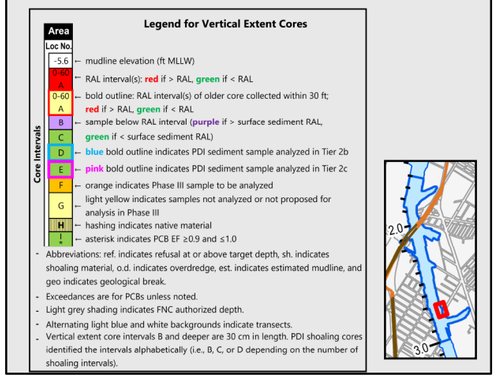
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

- Exceeds RAL
- Does not exceed RAL

Other sampling locations

- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Core without appropriate RAL interval
- Shoaling core
- Sample above MHHW not included in the interpolation dataset
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- 1 RAL exceedance area boundary
- Combined surface and subsurface sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs
- Utility corridor



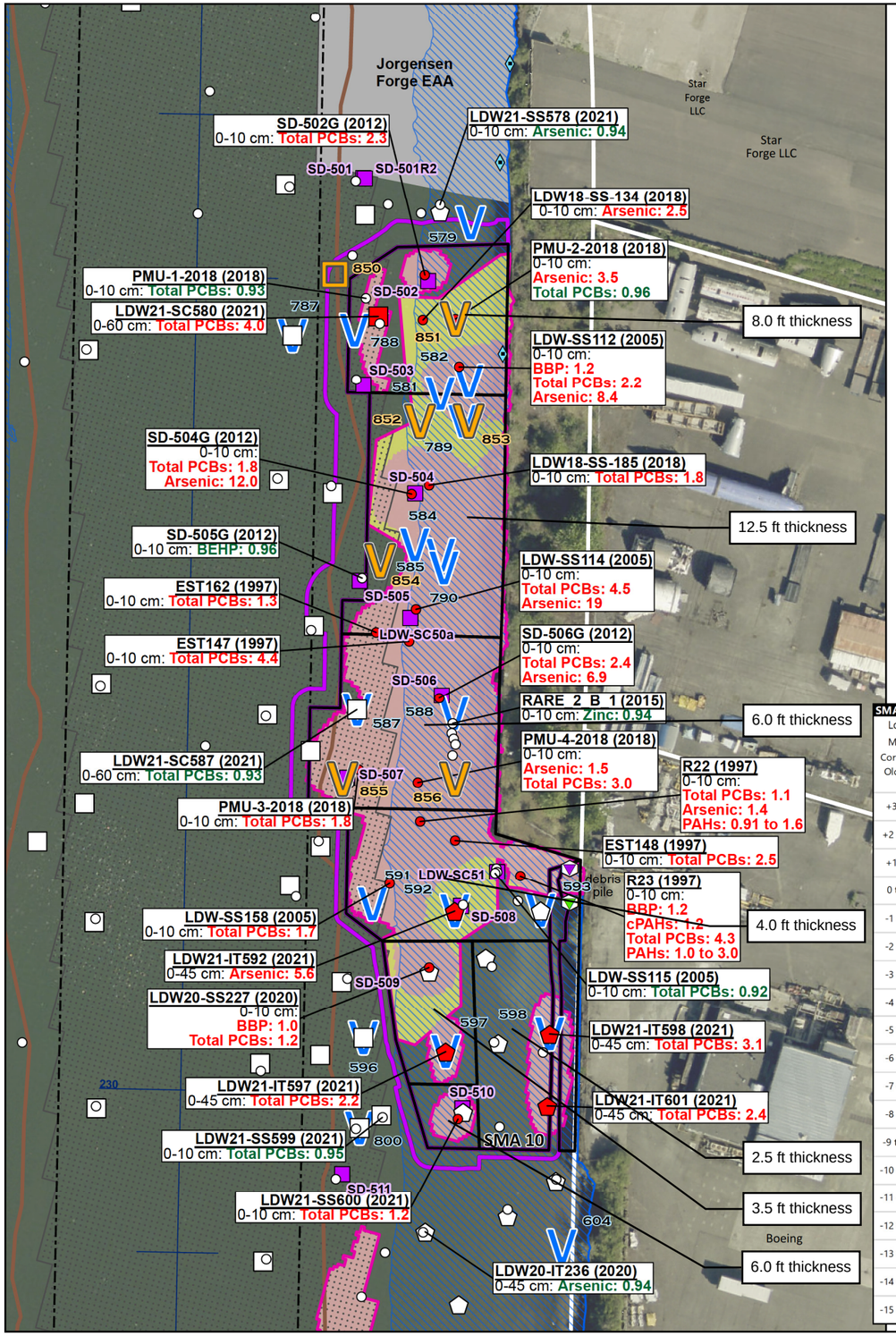
0 40 80 Feet
0 10 20 Meters

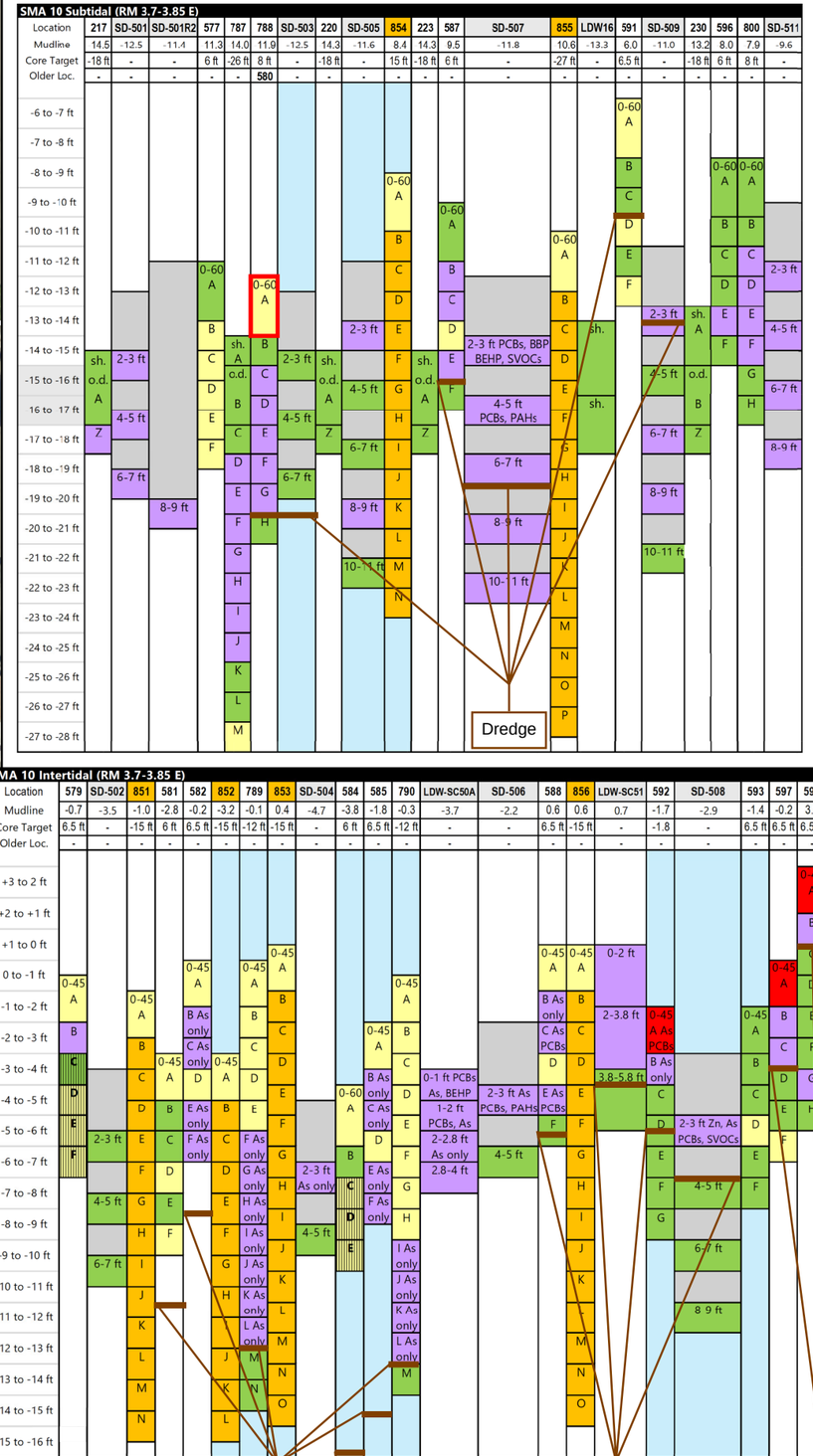
Figure D1-1n. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Gateway Park

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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Proposed Phase III QAPP locations

- Subtidal (0-60 cm)
- Vertical extent (non-RAL interval)

Surface (0-10 cm) sampling location

- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location

- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location

- Exceeds RAL
- Does not exceed RAL

Other sampling locations

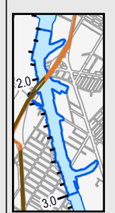
- Vertical extent (non-RAL interval)
- Core without appropriate RAL interval
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- RAL exceedance area boundary
- Sediment PCB indicator kriging RAL exceedance area
- Additional Thiessen polygon RAL exceedance area for other COCs

Legend for Vertical Extent Cores

Area / Loc No.

Core Intervals:
- -5.6 ← mudline elevation (ft MLLW)
- 0-60 A ← RAL interval(s): red if > RAL, green if < RAL
- 0-60 A ← bold outline: RAL interval(s) of older core collected within 30 ft;
- B ← non-RAL interval (purple if > surface sediment RAL, green if < surface sediment RAL)
- C ← green if < surface sediment RAL)
- F ← orange indicates Phase III sample to be analyzed
- J ← grey indicates no chemistry data available
- G ← light yellow indicates samples not analyzed or not proposed for analysis in Phase III
- H ← hashing indicates native material
- ! ← asterisk indicates PCB EF ≥0.9 and ≤1.0

- Abbreviations: sh. indicates shoaling material, o.d. indicates overdredge interval.
- Exceedances are for PCBs unless noted.
- Light grey shading indicates FNC authorized depth.
- Alternating light blue and white backgrounds indicate transects.
- Vertical extent core intervals B and deeper are 30 cm in length.



N

0 50 100 Feet

0 10 20 Meters

Figure D1-1o. RAA Boundaries, RAL Exceedance Areas, RAL Exceedance Locations, and Vertical Extent Data, Sediment Management Area 10

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

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PCB indicator kriging probability of RAL exceedance in combined surface and subsurface sediment

- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%
- 70% - 80%
- > 80%
- 50% probability of PCB RAL exceedance boundary
- 1 RAL exceedance area number
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- Recovery Category 1
- Intertidal area
- Shoal area
- LDW middle reach
- King Co tax parcel
- Federal Navigation Channel
- River mile

[a] For 60% RD, daylight boundaries are not shown for dredge areas that are based on thickness cuts.

W Marginal Way SW
Highland Park Way SW
S Michigan St
E Marginal Way S
4th Ave S
1st Ave S Bridge
Slip 2
Slip 3
Inlet at RM 2.2W
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
99
36
34
35
33
32
30
31
29
28
27
25
26
24b
24a
23
22
21
30H
30G
30F
30E
30D
30C
30B
30A
31C
31B
31A
31D
27C
27B
27D
24B
24C
24D
24G
24J
24E
24I
24H
24F
24A
23A
23B
21B
21C
36
34B
34A
35A
35B

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0 200 400 Feet
0 50 100 Meters

Figure D1-2a. Total PCB Combined Surface and Subsurface Sediment Indicator Kriging Interpolation with RAA Boundaries, RM 1.6 to RM 2.3

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

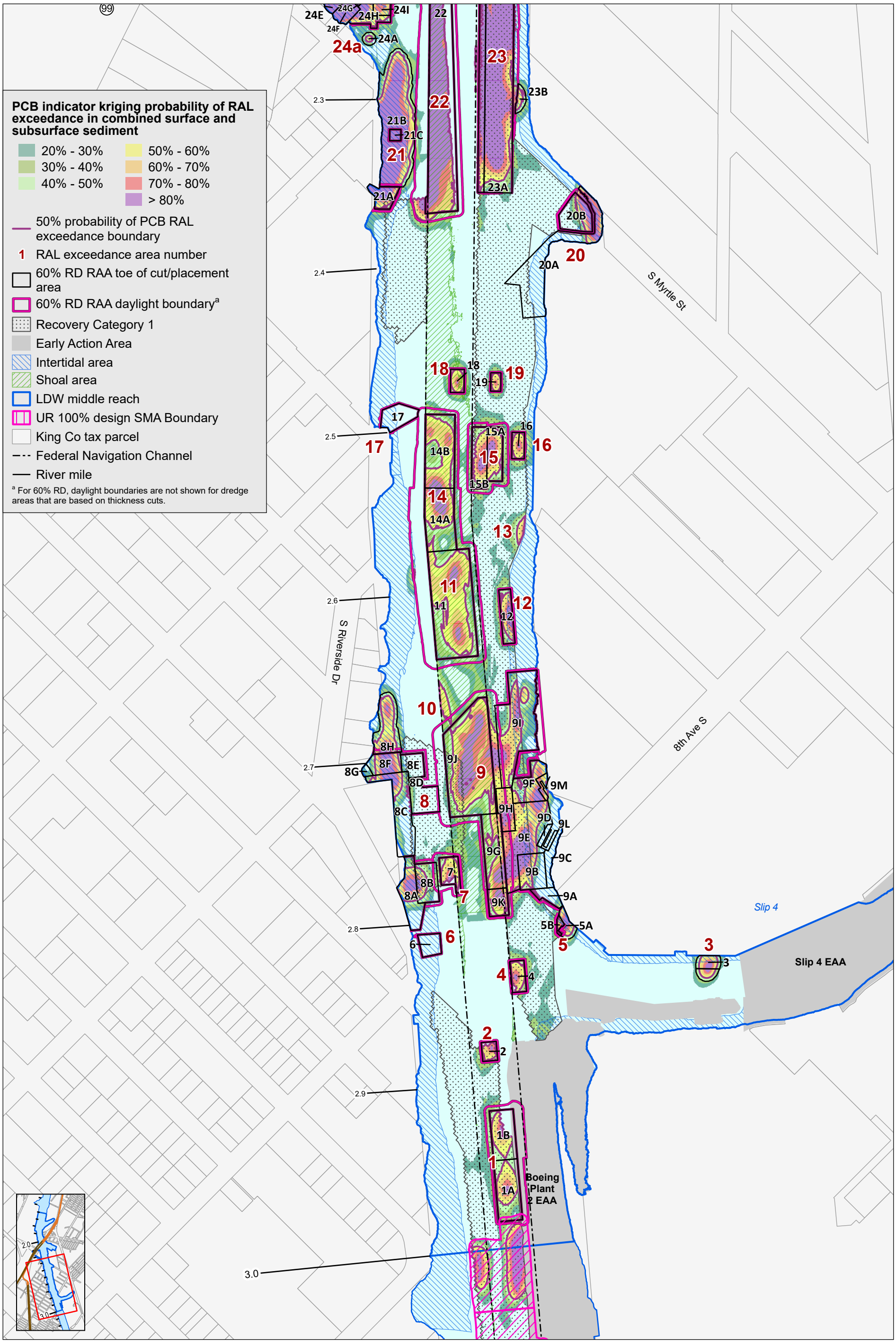
Prepared by CEH, 7/31/2026; I:\Client\LDWG\Work_Orders\AOC5 Middle Reach Design\Maps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig D1-2 7216 Combined PhII IK wRAAs

PCB indicator kriging probability of RAL exceedance in combined surface and subsurface sediment

- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%
- 70% - 80%
- > 80%

- 50% probability of PCB RAL exceedance boundary
- 1 RAL exceedance area number
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary[a]
- Recovery Category 1
- Early Action Area
- Intertidal area
- Shoal area
- LDW middle reach
- UR 100% design SMA Boundary
- King Co tax parcel
- Federal Navigation Channel
- River mile

[a] For 60% RD, daylight boundaries are not shown for dredge areas that are based on thickness cuts.



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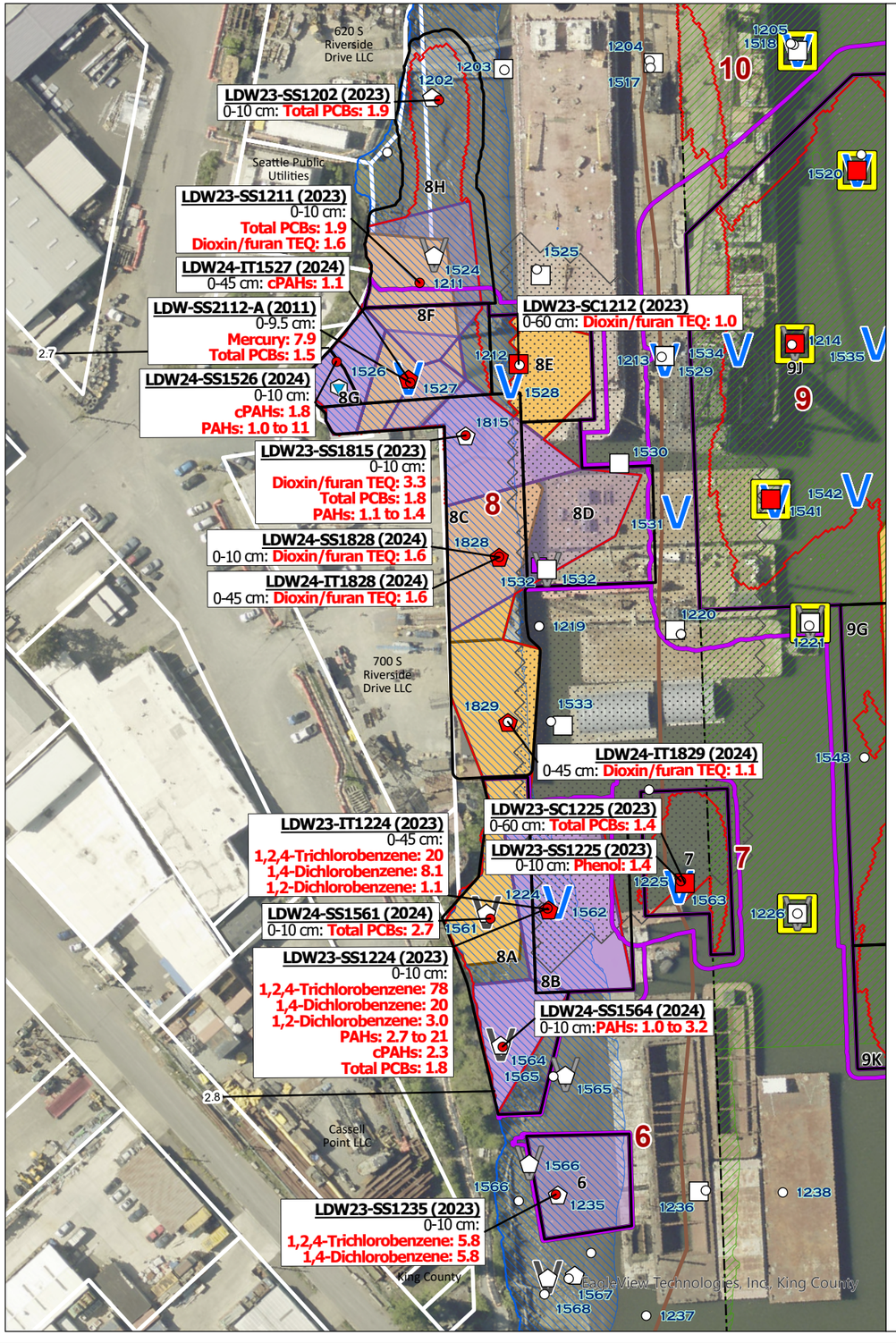
0 200 400 Feet
0 50 100 Meters

Figure D1-2b. Total PCB Combined Surface and Subsurface Sediment Indicator Kriging Interpolation with RAA Boundaries, RM 2.3 to RM 3.0

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

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Areas 6, 7, and 8 Intertidal and Subtidal

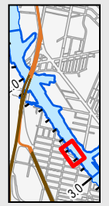
Location	1524	1527	1528	1532	1531	1561	1562	1563	1564	1565	1566	1568
Mudline	0.5	-2.3	-3.3	-5.5	-15.7	nd	-2.6	-12.1	nd	1.3	2.8	nd
Core Target	7.5 ft	7.5 ft	-29 ft	-29 ft	10 ft	7.5 ft	7.5 ft	10 ft	7.5 ft	7.5 ft	7.5 ft	7.5 ft
Event/Year	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2	PDI 2
Older Loc.	-	-	1212	-	-	-	1224	1225	-	-	1235	-
3 to 2 ft						est.			est.			est.
2 to 1 ft						0-45 A			0-45 A		0-45 A	0-45 A
1 to 0 ft						ref.			ref.	0-45 A	B	ref.
0 to -1 ft	0-45 A									B	geo C	
-1 to -2 ft	B									geo C	D	
-2 to -3 ft	C	0-45 A only cPAH					0-45 A			D	E	
-3 to -4 ft	D	B	0-45 A				B only SVOCs			E	ref.	
-4 to -5 ft	geo E	C	B	0-60 A			C only SVOCs			F		
-5 to -6 ft	F	D	C	B			D			G		
-6 to -7 ft	G	E	D	C			E only SVOCs					
-7 to -8 ft	H	F	E	D			ref.					
-8 to -9 ft	I	G	F	E								
-9 to -10 ft	J		G	F								
-10 to -11 ft			H	G								
-11 to -12 ft			I D/F. PCBs	H								
-12 to -13 ft			J	F				0-60 A				
-13 to -14 ft			K	G				B				
-14 to -15 ft			L	H				C				
-15 to -16 ft			M	I				D				
-14 to -15 ft			ref.	J	0-60 A			E				
-15 to -16 ft				K	B			F				
-16 to -17 ft				L	C			G				
-17 to -18 ft				M	D			H				
-18 to -19 ft				N	E			I				
-19 to -20 ft				O	F			J				
-20 to -21 ft				P	G							
-21 to -22 ft				Q	ref.	ref.						

Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

Other samplling locations
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Vertical extent (non-RAL interval) not collected because of core refusal
- Shoaling core
- Core without appropriate RAL interval
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary
- 1 RAL exceedance area boundary
- Surface Thiessen polygon RAL exceedance area
- Subsurface Thiessen polygon RAL exceedance area



Legend for Vertical Extent Cores

Area / Loc No.
- -5.6 — actual mudline elevation (ft MLLW)
- 0-60 A — RAL interval(s); red if > RAL, green if < RAL (PCBs unless noted)
- B — samples below RAL interval (purple if > surface sediment RAL; green if < surface sediment RAL)
- C — light yellow indicates samples that were not analyzed
- D — hashing indicates native material
- E — asterisk indicates PCB EF ≥0.9 and ≤1.0
- F * — bold outline indicates exceedance status of older sample collected within 30 ft. Red and green coloring follows that of solid colored intervals above.
- G

Core Intervals

Light grey shading indicates FNC authorized depth.
Abbreviations: ref. indicates refusal at or before target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.

Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

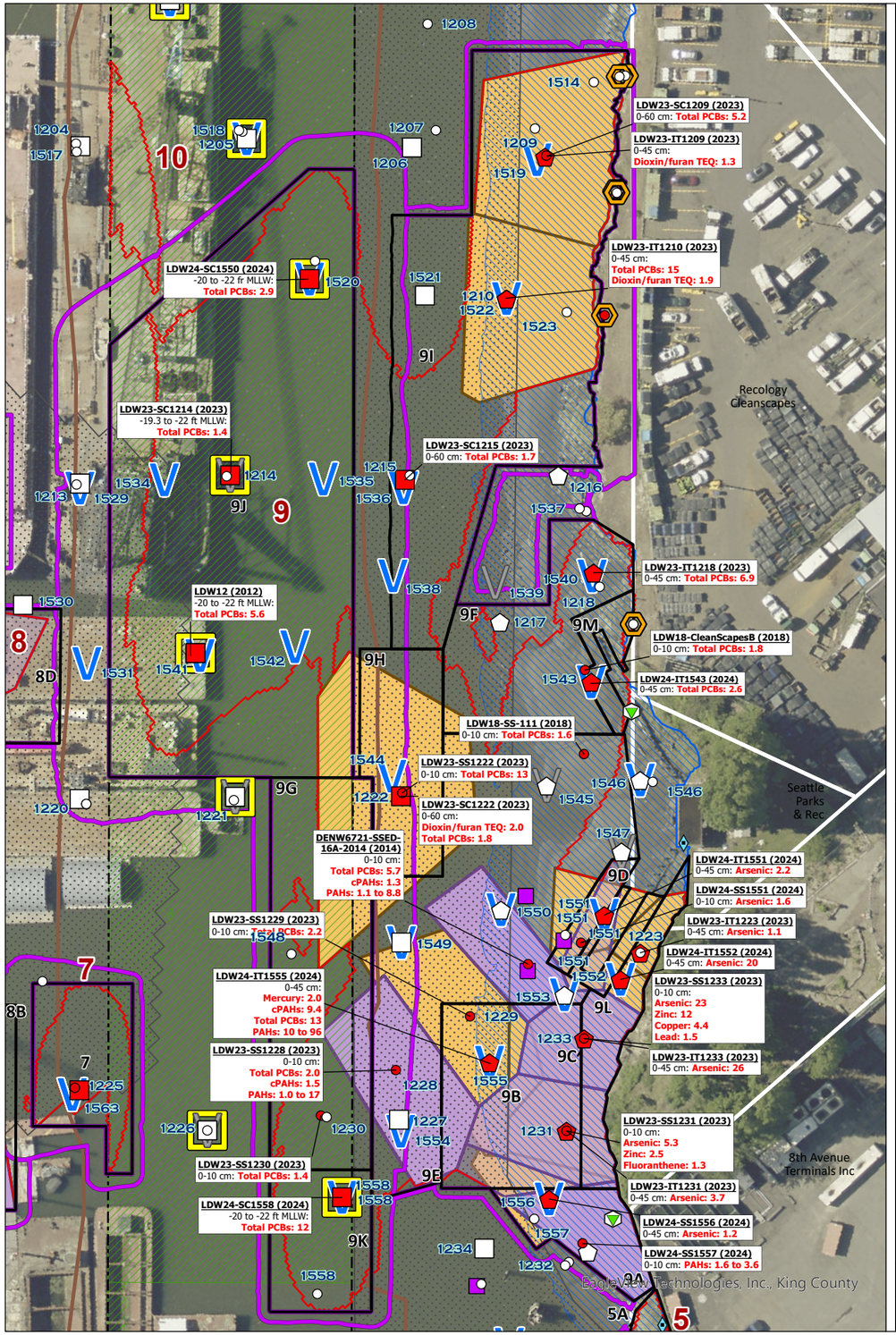
0 75 150 Feet
0 20 40 Meters

Figure D1-3a. Thiessen Polygons at RAL Exceedance Area 8

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

ANCHOR QEA
BARR
Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

Prepared by CEH, 7/29/2026; I:\Client\LDW\Work_Orders\AOC5 Middle Reach Design\Maps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig D1-3a 7708 Depth of contamination - PPM thiessens



Area 9 Subtidal S - FNC & Sidesloptes

Location	1520	1529	1534	1214	1535	1536	1531	1541	1542
Mudline	-19.0	-14.7	-18.5	-19.3	-19.5	-12.1	-15.7	-19.0	-19.4
Older Loc.	-	1213	-	-	-	1215	-	LDW12	-
-12 to -13 ft						0-60 A			
-13 to -14 ft						B			
-14 to -15 ft		0-60 A				C			
-15 to -16 ft		B				D	0-60 A		
-16 to -17 ft		C				E	B		
-17 to -18 ft		D	sh. A			F	C		
-18 to -19 ft	sh. A	E	o.d.	sh. o.d.	sh. o.d.	G	D	sh. A	sh. o.d.
-19 to -20 ft	o.d.	F	B	A	A	H	E	o.d.	A
-20 to -21 ft	B	G	C	B	B	I	F	B	B
-21 to -22 ft	C	H	D	C	C	J	G	C	C
-22 to -23 ft		I	E	D	D		ref.	D	D
-23 to -24 ft		J	F	E	E			E	E
-24 to -25 ft		K	qeo G	F	F			F	F
-25 to -26 ft			H	G	G			G	G D/F, PCBs
-26 to -27 ft			I	H	H			H	H
-27 to -28 ft			J	I	I			I	I
-28 to -29 ft			K	J	J			J	J
-29 to -30 ft			L	K	K			K	K D/F only
-30 to -31 ft			M	L	L			L	L
-31 to -32 ft				M	M			M	M
-32 to -33 ft								N	

Area 9 Intertidal North

Location	1519	1522	1539	1540	1543	1545	1546	1547	1550
Mudline	-0.1	-1.5	-3.7	1.7	-0.1	-3.9	-0.5	0.5	-3.1
Older Loc.	1209	1210	1217	1218	-	-	-	-	-
2 to 1 ft				0-45 A					
1 to 0 ft				B	0-45 A			0-45 A	
0 to -1 ft	0-45 A			geo C	B		0-45 A	B	
-1 to -2 ft	B	0-45 A		D	C		B	C	
-2 to -3 ft	C	B	0-45 A	ref.	D *	0-45 A	C D/F, PCBs	D	0-45 A
-3 to -4 ft	ref.	C	B		E	B	D	E	B
-4 to -5 ft		ref.	C		F	C	E D/F, PCBs	F	C
-5 to -6 ft			D		G	D	F	G	D
-6 to -7 ft			E			E	G D/F, PCBs	H	geo E
-7 to -8 ft			F			F	ref.	ref.	F
-8 to -9 ft			geo G			G			G
-9 to -10 ft			H			H			
-10 to -11 ft			I			I			
-11 to -12 ft									
-12 to -13 ft									
-13 to -14 ft									

Area 9 Subtidal N - FNC & Sidesloptes

Location	1538	1221	1544	1549	1554	1558
Mudline	-14.6	-18.8	-14.6	-14.0	-14.2	-18.1
Older Loc.	-	-	1222	-	1227	-
-14 to -15 ft	0-60 A		0-60 A	0-60 A	0-60 A	
-15 to -16 ft	B		B	B	B	
-16 to -17 ft	C		C D/F, PCBs	C	C *	
-17 to -18 ft	D	sh. A	D	D	geo D	sh. A
-18 to -19 ft	E	o.d.	E D/F, PCBs	geo F	E	o.d.
-19 to -20 ft	F	B	F	G	ref.	B
-20 to -21 ft	G	C	G	H		C
-21 to -22 ft	H		H	I		
-22 to -23 ft	I		I	J		
-23 to -24 ft	J		J			
-24 to -25 ft	K					

Area 9 Intertidal South

Location	1551	1553	1552	1555	1556
Mudline	2.5	3.8	6.2	-1.5	-1.7
Older Loc.	-	-	-	-	-
6 to 5 ft			0-45 A As only		
5 to 4 ft			B As only		
4 to 3 ft		0-45 A	C		
3 to 2 ft	0-45 A As only	B	geo D		
2 to 1 ft	B	geo C	ref.		
1 to 0 ft	C	D			
0 to -1 ft	D	ref.		0-45 Hg, PAHs, PCBs	0-45 A As only
-1 to -2 ft	ref.			B	B PAHs, As, PCBs
-2 to -3 ft				ref.	C *
-3 to -4 ft					qeo D As only
-4 to -5 ft					E As only
-5 to -6 ft					ref.
-6 to -7 ft					

Surface (0-10 cm) sampling location
- Exceeds RAL
- Does not exceed RAL

Intertidal (0-45 cm) core location
- Exceeds RAL
- Does not exceed RAL

Subtidal (0-60 cm) core location
- Exceeds RAL
- Does not exceed RAL

Other samplling locations
- Vertical extent (non-RAL interval)
- Vertical extent (non-RAL interval) archive
- Shoaling core
- Core without appropriate RAL interval
- Sample above MHHW not included in the interpolation dataset
- 60% RD RAA toe of cut/placement area
- 60% RD RAA daylight boundary
- 1 RAL exceedance area boundary
- Surface Thiessen polygon RAL exceedance area
- Subsurface Thiessen polygon RAL exceedance area



Legend for Vertical Extent Cores

Area / Loc No. / Core Intervals

- -5.6 — actual mudline elevation (ft MLLW)
- 0-60 A — RAL interval(s); red if > RAL, green if < RAL (PCBs unless noted)
- B — samples below RAL interval (purple if > surface sediment RAL;
- C — green if < surface sediment RAL)
- D — light yellow indicates samples that were not analyzed
- E — hashing indicates native material
- F * — asterisk indicates PCB EF ≥0.9 and ≤1.0
- G — bold outline indicates exceedance status of older sample collected within 30 ft. Red and green coloring follows that of solid colored intervals above.

Light grey shading indicates FNC authorized depth.
Abbreviations: ref. indicates refusal at or before target depth, sh. indicates shoaling material, o.d. indicates overdredge, est. indicates estimated mudline, and geo indicates geological break.

Vertical extent core intervals B and deeper are 30 cm in length. PDI shoaling cores identified the intervals alphabetically (i.e., B, C, or D depending on the number of shoaling intervals).

0 60 120 Feet
0 10 20 Meters

Figure D1-3b. Thiessen Polygons at RAL Exceedance Area 9

APPENDIX D - RAA DEVELOPMENT AND DREDGE PRISM DESIGN
INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH
JULY 31, 2026

ANCHOR QEA
BARR
Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

Prepared by CEH, 7/29/2026, I:\Client\LDW\GIWork_Orders\AOC5 Middle Reach Design\Maps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig D1-3b 7708 Depth of contamination - Beach 6 thiessens