60% Remedial Design Basis of Design Report

Appendix M
Chemical Fate and Transport Modeling to Support Buried Contamination Evaluation

TABLE OF CONTENTS

1 Introduction 1

2 Model Inputs and Approach 7

2.1 Model Inputs 7

2.2 Model Simulation Approach 12

3 Model Results 14

3.1 Intertidal Areas 14

3.2 Subtidal Areas 18

3.3 Shoaled Areas 22

4 Conclusions 24

5 References 25

TABLES

Table M1-1 Locations and COCs for Buried Contamination Evaluation 2

Table M2-1 Partition Coefficients Used in the Buried Contamination Evaluation 10

Table M2-2 Molecular Diffusivity Used in the Buried Contamination Evaluation 11

Table M3-1 Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Intertidal Areas 17

Table M3-2 Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Subtidal Areas 20

Table M3-3 Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Shoaled Areas 23

FIGURES

Figure M1-1 Core Locations Evaluated for Buried Contamination 4

Figure M3-1 Depth Profiles of Total PCBs for LDW24-IT1546 at Year 0 and Year 100 15

Figure M3-2 Depth Profiles of Fluoranthene for LDW24-IT1546 at Year 0 and Year 100 16

Figure M3-3 Depth Profiles of Total PCBs for SC-032 at Year 0 and Year 115 19

ATTACHMENTS

Attachment M.1 Core Profiles for Buried Contamination Evaluation

Attachment M.2 Model Inputs for Buried Contamination Evaluation

Attachment M.3 Model-Predicted COC Concentrations for Buried Contamination Evaluation

ABBREVIATIONS

--	not applicable
μg/kg	microgram per kilogram
BBP	butyl benzyl phthalate
BODR	*Basis of Design Report*
cm	centimeter
cm/yr	centimeter per year
cm^2/s	square centimeter per second
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
FNC	federal navigation channel
f_{OC}	fraction organic carbon
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HPCDD	heptachlorodibenzo-p-dioxin
HPCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
K_d	equilibrium partition coefficient
K_{OC}	organic carbon partition coefficient
K_{OW}	octanol-water partition coefficient
L/kg	liter per kilogram
LDW	Lower Duwamish Waterway
mg/kg	milligram per kilogram
ng/kg	nanogram per kilogram
OC	organic carbon
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	pre-design investigation
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
RAA	remedial action area
RAL	remedial action level
RC	recovery category
RD	remedial design
RM	river mile

SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TEQ	toxic equivalents
TOC	total organic carbon

1 Introduction

This appendix describes chemical transport modeling conducted to support the contaminated sediment remedial design (RD) for the middle reach of the Lower Duwamish Waterway (LDW). The purpose of this modeling was to evaluate the potential for dissolved-phase contaminants of concern (COCs) to pose a long-term contamination potential via transport to surface sediments in areas of contamination buried beneath cleaner sediment that does not require remedial action (i.e., surface sediment with concentrations less than remedial action levels [RALs]).

Buried contamination is defined as sediment having COC concentrations greater than the surface sediment RAL that is buried beneath 60 centimeters (cm; 2 feet) or more of sediment with concentrations that are less than RALs in subtidal areas or that is buried beneath 45 cm (1.5 feet) or more of sediment with concentrations that are less than surface RALs in intertidal areas. Therefore, these areas are located outside of RAL exceedance areas and do not coincide with the remedial action area (RAA) footprints.[1] A total of 13 sediment core locations, not within the middle reach RAAs, meet this definition of buried contamination. The core locations and the associated COCs with subsurface sediment concentrations that exceed the surface sediment RALs are provided in Table M1-1 and are shown in Figure M1-1.

[1] Buried contamination cores within the daylight side slopes that will be dredged as part of remedial action areas (RAAs) that include dredging were excluded from the evaluation. It is preliminarily assumed that any potential buried contamination will be addressed through the dredging of side slopes and subsequent placement of residuals management cover. This will be further evaluated in the 90% Remedial Design.

Table M1-1
Locations and COCs for Buried Contamination Evaluation

Core ID	Sample Year	RM	Area Type[a]	RC	COCs Exceeding Surface RAL	Depth Interval of Peak Concentration[b] (feet)	Location Notes
LDW24-SC1579[c]	2024	2.9	FNC	1	Total PCBs	6.9 to 7.9	Approximately 70 feet upstream of RAA 2
SC06	2004	2.8	Subtidal	2	Total PCBs	4 to 6	In Slip 4; near the early action area
LDW24-SC1559	2024	2.8	Subtidal	1	Total PCBs	9 to 10	Approximately 70 feet southwest of RAA 5B
DENW6721-SSED-SB-12A-2014	2014	2.8	Subtidal	1	Total PCBs	8 to 10	Approximately 20 feet upstream of RAA 9B
					Benzoic acid	2 to 4	
LDW24-IT1546	2024	2.7	Intertidal	2	Total PCBs	4.4 to 5.4	Approximately 20 feet northeast of RAA 9E
					Dioxin/Furan TEQ	6.4 to 7.5	
					Fluoranthene	2.5 to 3.4	
LDW24-SC1515	2024	2.6	FNC	3	Total PCBs	7.1 to 8.0	Approximately 30 feet upstream of RAA 11
LDW23-SC1156	2022	2.4	FNC	3	Total PCBs	4.7 to 6.6	Approximately 150 feet upstream of RAA 22
LDW24-IT1426	2024	2.2	Intertidal	3	Total PCBs	5.4 to 6.4	Approximately 20 feet west of RAAs 24J
LDW-SC37	2006	2.1	Subtidal	2	Copper	2 to 4	In Slip 3; approximately 50 feet west of RAA 26A
					Lead	2 to 4	
					Zinc	2 to 4	
					Benzo(a)pyrene	1 to 2	
					Fluoranthene	2 to 4	
					Phenanthrene	2 to 4	
					Total HPAHs	2 to 4	
					cPAHs	1 to 2	
					1,2,4-trichlorobenzene	2 to 4	
					1,2-dichlorobenzene	2 to 4	

Core ID	Sample Year	RM	Area Type[a]	RC	COCs Exceeding Surface RAL	Depth Interval of Peak Concentration[b] (feet)	Location Notes
SC-01	2010	1.8	Subtidal	1	Total PCBs	6 to 7	Approximately 180 feet west of RAA 30E
					Acenaphthene	6 to 7	
					Fluoranthene	6 to 7	
					BBP	4 to 5	
SC-02	2010	1.8	Subtidal	1	Total PCBs	4 to 5	Approximately 180 feet west of RAA 30E
					BBP	4 to 5	
SC-032	2010	1.8	Subtidal	1	Total PCBs	5 to 6	Approximately 220 feet west of RAA 30E
					Benzo(a)anthracene	4 to 5	
					Chrysene	4 to 5	
					Total HPAHs	4 to 5	
LDW24-SC1323	2024	1.8	FNC	3	Total PCBs	9.7 to 10.7	Approximately 50 feet downstream of RAA 30E

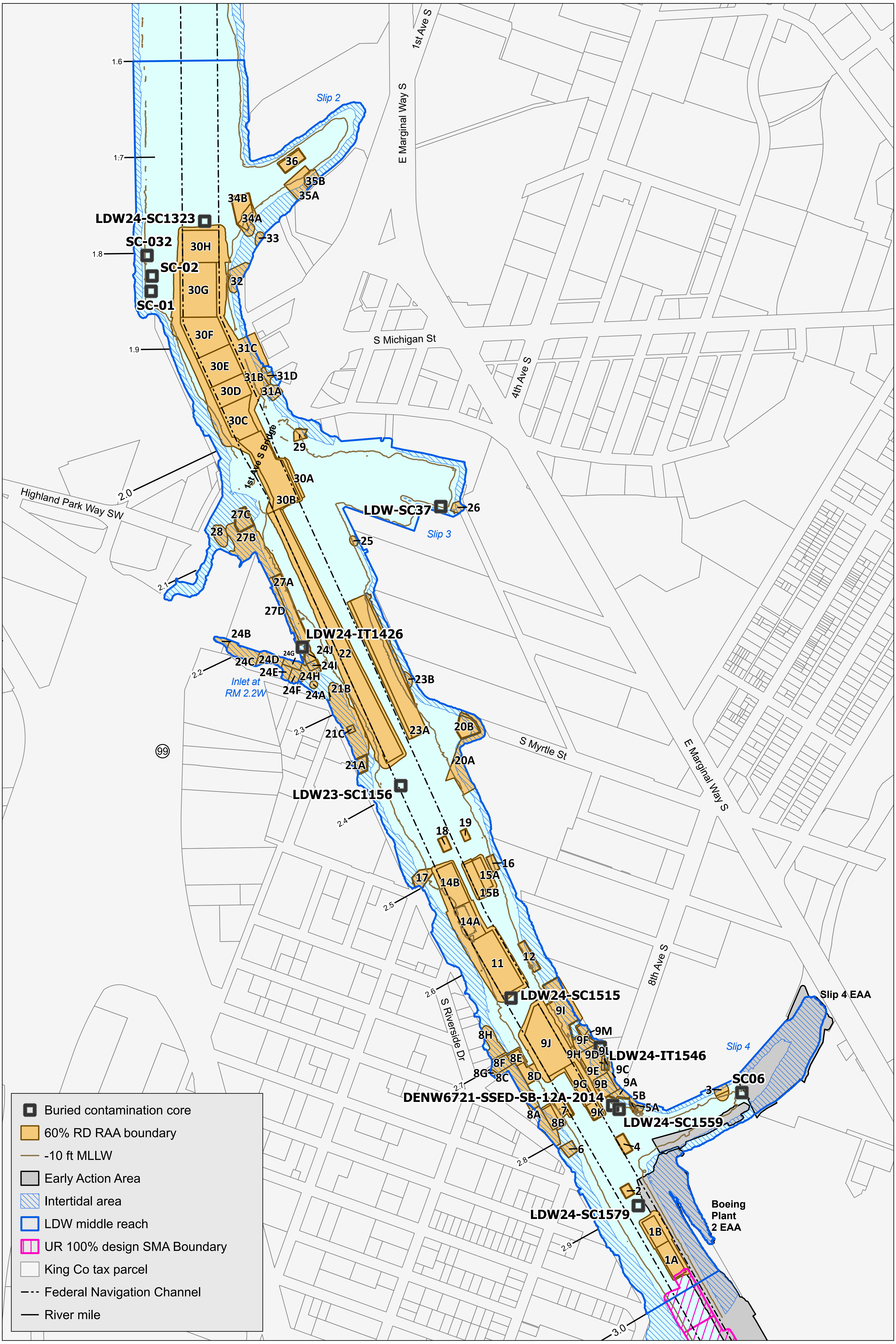
Notes:

a. The area type identifies the physical setting of the core location. For the buried contamination evaluation, cores were grouped according to the applicable RAL evaluation (i.e., intertidal, subtidal, or shoaled areas). Most FNC cores were evaluated using the shoaled area RALs, except for LDW24-SC1579, which was evaluated using the subtidal RALs.

b. The peak concentration was determined using OC-normalized concentration for all COCs except for copper, lead, zinc, and benzoic acid. The depth intervals were adjusted for the SC-01, SC-02, and SC-032 by adding 2 feet to the depth intervals measured in 2010 to account for the observation of 2 to 3 feet of deposited sediments on top of the sand cover during the Phase I PDI (see Section 2.1 for further descriptions). No adjustments were made for the other three historical cores collected between 2004 and 2014.

c. This core was added to the evaluation for the 60% RD because elevated PCBs were found in the additional depth intervals analyzed as part of the Phase II PDI Tier 2B/C analyses.

BBP: butyl benzyl phthalate
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
FNC: federal navigation channel
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
OC: organic carbon
PCB: polychlorinated biphenyl
PDI: pre-design investigation
RAA: remedial action area
RAL: remedial action level
RC: recovery category
RM: river mile
TEQ: toxic equivalents



ANCHOR QEA

BARR

Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

Figure M1-1. Core Locations Evaluated for Buried Contamination

APPENDIX M - GREEN REMEDIATION EVALUATION AND IMPLEMENTATION APPROACH
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 M1-1 7740 Cores Evaluated for Buried Contamination

Recovery category (RC), which is one factor that affects which RALs apply to an area, represents the projected potential for natural recovery within an area. Although natural recovery is anticipated to occur in areas designated as RC 2 and RC 3 due to the accumulation of deposited sediments, recovery may be limited in areas designated as RC 1. The RC for each sediment core location is provided in Table M1-1.

The objective of the present evaluation is to assess whether the transport of dissolved-phase contaminants from the buried sediment could cause surface sediment RAL exceedances in the future. A number of factors can affect the transport of contaminants within subsurface and surface sediment and influence the resulting concentrations over time in the surface sediment (i.e., top 10 cm). Several key factors that affect the potential for buried contamination to contaminate surface sediment over the long term due to dissolved-phase chemical migration through the sediments are as follows:

1. The magnitude of the buried contaminant concentrations
2. The depth below the surface at which such concentrations are present
3. The mobility of the contaminants

Higher COC concentrations present in buried sediments have a greater potential to result in an increase in concentrations in the surface sediment over the long term due to upward transport (i.e., driven by groundwater seepage) as compared with lower COC concentrations that are buried. Likewise, elevated COC concentrations present closer to the surface have a greater potential to result in an increase in concentrations in the surface sediment as compared to those same concentrations buried more deeply. Contaminant mobility also plays an important role in determining the extent of upward migration. Chemicals that sorb less strongly to sediment are generally more mobile in porewater and therefore have a greater potential for upward migration that could increase surface sediment concentrations. Conversely, chemicals that sorb more strongly are expected to exhibit limited dissolved-phase transport. In addition, higher groundwater seepage rates can increase the rate of contaminant migration toward the sediment surface via advective transport, whereas lower seepage rates generally reduce the potential for contaminant movement and subsequent accumulation in surface sediments.

The one-dimensional model of chemical transport within sediment caps, CapSim (version 4.2.3; Reible 2023),[2] was used for the evaluation. Although this model was initially developed to support design of sediment caps, it can also be used to simulate contaminant transport within uncapped sediments. This model simulates the time-variable fate and transport of chemicals (dissolved and sorbed phases) under the processes of advection, diffusion/dispersion, biodegradation, bioturbation/bioirrigation, and exchange with the overlying surface water within a vertical column of sediment and

[2] A newer version of CapSim (version 4.2.6) is available; however, the functionality of the model used in these evaluations has not changed in the newer version.

cap material (if present). Details on the model structure and underlying theory and equations are provided in Lampert and Reible (2009), Go et al. (2009), the U.S. Environmental Protection Agency/U.S. Army Corps of Engineers capping guidance (Appendix B of Palermo et al. 1998), and Shen et al. (2018).

2 Model Inputs and Approach

The section describes the model inputs and the simulation approach for the buried contamination evaluation. As described in Section 1, the CapSim model was used to simulate the transport of dissolved-phase COCs within the sediment. The purpose of the evaluation was to assess whether buried contamination is likely to migrate to the surface, resulting in exceedances of the RALs assigned to various depth intervals, as follows:

- 0 to 10 cm in both intertidal and subtidal areas
- 0 to 45 cm in intertidal areas
- 0 to 60 cm in subtidal areas
- 0 to 2 feet below the authorized navigation depth within the overdredge depth interval in federal navigation channel (FNC) shoaled areas

2.1 Model Inputs

The model uses several input parameters that describe chemical-specific properties, sediment properties, and chemical mass transfer rates. Chemical-specific properties (e.g., molecular diffusivity[3] and organic carbon [OC] partition coefficients), bioturbation properties (depth and biodiffusion coefficients), reaction rates, and sedimentation (conservatively ignored), are consistent with the values used for the cap design modeling described in *Basis of Design Report* (BODR) Appendix H. As described in BODR Appendix H, the groundwater seepage rate (Darcy flux) in the middle reach is estimated to average 400 centimeters per year (cm/yr) and range from 100 cm/yr in the center of the channel up to 800 cm/yr nearshore. Because there is some uncertainty in these estimated seepage rates given they were calculated from a regional groundwater modeling study and may not fully represent localized rates, and because the CapSim model is sensitive to seepage rates, a range of values was evaluated. For the four locations being evaluated for buried contamination within the FNC (i.e., LDW24-SC1579, LDW23-SC1156, LDW24-SC1515, and LDW24-SC1323), seepage rates of 100 cm/yr and 400 cm/yr were considered for this evaluation. For the remaining locations within the nearshore area or in the slips, seepage rates of 400 and 800 cm/yr were considered.

All core locations listed in Table M1-1 and the associated COCs were evaluated using CapSim. The thickness and properties (COC concentrations, fraction organic carbon [f_{OC}], dry bulk density, and porosity) of the model layers were specified to match those of the sampled core. The core profiles were developed based on sediment COC concentrations and total organic carbon (TOC) measured

[3] The model calculates an effective diffusion coefficient using a chemical-specific input value for the molecular diffusivity and an empirical equation based on the cap material porosity. The empirical relationship developed by Millington and Quirk (1961) is often used for coarse grained materials and the relationship described by Boudreau (1996) is used for finer grained sediments. Thus, sediment with porosity greater than 0.6 specified the relationship developed by Boudreau (1996) and porosity less than or equal to 0.6 used the relationship described by Millington and Quirk (1961).

throughout a sampled core. Dry bulk density and porosity were calculated from measured total solids content and an assumed particle density.

For cores in which sediment concentrations and properties were not analyzed for consecutive depth intervals, concentrations and properties were linearly interpolated using those from the depth intervals immediately above and below the missing depth interval(s).[4] Where surface sediment was not sampled at a core location, data from a nearby location (i.e., within 50 feet of the core being evaluated) were used to represent the COC concentrations and sediment properties (dry bulk density and porosity) in surface sediment at the given location, described as follows:

- DENW6721-SSED-SB-12A-2014: The upper 61 cm of sediment were not analyzed at this location; therefore, COC concentrations and sediment properties for this interval were specified using the 0- to 60-cm data from nearby core LDW23-SC1234 (i.e., slightly over 20 feet from the core being evaluated).
- LDW24-SC1515: The sediment properties in the upper 64 cm of sediment were not analyzed at this location. Because no nearby cores were available (the nearest location was 90 feet away), sediment properties for this interval were specified using data from the 64- to 125-cm interval of the same core.
- LDW24-IT1426: The upper 45 cm of sediment were not analyzed at this location; therefore, sediment concentrations and properties for this interval were specified using the 0- to 45-cm data from a nearby core LDW23-IT1121 (i.e., within 5 feet from the core being evaluated).
- LDW24-IT1546: The upper 45 cm of sediment COC concentrations are less than the 0- to 45-cm RAL but greater than the 0- to 10-cm RAL. A sample was not collected within the 0- to 10-cm depth interval for direct comparison to the 0- to 10-cm RAL, however. Therefore, 0- to 10-cm data from a nearby core LDW24-SS1546 (i.e., within 10 feet from the core being evaluated) were used to establish COC concentrations within the 0- to 10-cm depth interval at this location. The COC concentrations and sediment properties in 10- to 45-cm depth interval were subsequently adjusted (in conjunction with the 0- to 10-cm data) so that the depth-weighted average concentrations and sediment properties in the upper 45 cm of sediment were consistent with the measured values in the 0- to 45-cm sample at this location.
- SC06: The upper 61 cm of sediment COC concentrations are less than the 0- to 60-cm RAL but greater than the 0- to 10-cm RAL. A sample was not collected within the 0- to 10-cm depth interval for direct comparison to the 0- to 10- cm RAL, however. Therefore, 0- to 10-cm data from a nearby core LDW23-SS1281 (i.e., within 10 feet from the core being evaluated) were used to establish COC concentrations within the 0- to 10-cm depth interval at this location. The COC concentrations and sediment properties in 10- to 61-cm depth interval were subsequently adjusted (in conjunction with the 0- to 10-cm data) so that the depth-weighted

[4] One exception is for core LDW24-SC1579 - because sediment properties were not measured for depth intervals below 60 cm, sediment properties for those depth intervals were specified using data in the 0- to 60-cm interval of the same core.

average concentrations and sediment properties in the upper 61 cm of sediment were consistent with the measured values in the 0- to 61-cm sample at this location.

At locations SC-01, SC-02, and SC-032, a 1- to 1.5-foot sand cover was placed after sediment samples were collected in 2010; these post-dredge cores were collected following maintenance dredging at Terminal 115 (see Attachment I of the *Pre-Design Investigation Work Plan for the Lower Duwamish Waterway – Middle Reach* [Windward and Anchor QEA 2023]). Since then, 2 to 3 feet of sediments have deposited on top of the sand cover in these locations (Anchor QEA and Windward 2025). To be conservative, the model only represented 1 foot of sand cover in these locations and ignored the 2 to 3 feet of more recently deposited sediments on top of the cover. Because no data were collected from the sand cover, it was assumed that the sand cover had zero COC concentration at the time of placement. In addition, although the increase of bed thickness due to net deposition was not included in the model, it was assumed that in a dynamic system, TOC in the upper 10 cm of the cover (bioturbation zone) represents sand mixed with deposited sediment. The modeling at these three locations was conducted to simulate the transport of COCs into and through the sand cover over the long term.

The resulting core profiles used for the buried contamination evaluation are presented in Figures M.1.1 through M.1.12 in Attachment M.1, and a listing of model input parameters is provided in Tables M2.1 through M.2.12 in Attachment M.2. These inputs describe the characteristics of the sediment simulated with the model and include initial COC concentrations in porewater (calculated based on sediment concentrations using partitioning theory), porosity, dry bulk density, and f_{OC}. PCB concentrations measured using an Aroclor-based method were converted to equivalent estimated homolog concentrations,[5] consistent with the cap design modeling. The COC partition coefficients and molecular diffusivity values used in the buried contamination evaluation are identical to those in the engineered cap evaluation (see BODR Appendix H), except for the subset of COCs that were evaluated only in the buried contamination evaluation.[6] For completeness, the partition coefficients for all COCs included in the buried contamination evaluation are provided in Table M2-1. The molecular diffusivity values for these COCs are provided in Table M2-2. The remaining model input parameter values are the same as those used in the cap evaluation and are documented in BODR Appendix H.

[5] PCB concentrations were measured using an Aroclor-based method. To account for the range in mobility of the PCB congeners that make up an Aroclor, detected Aroclor PCB concentrations in sediment (mostly Aroclor-1248, -1254, and -1260, with occasionally Aroclor-1242) were converted to homolog concentrations based on the average fraction of each homolog group associated with each Aroclor developed from several published studies (Rushneck et al. 2004; Schulz-Bull et al. 1989; Frame et al. 1996; EPA 1995).

[6] These COCs are 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, benzoic acid, copper, and lead.

Table M2-1
Partition Coefficients Used in the Buried Contamination Evaluation

Chemical Name[1,2]	Log K_{OC} (log L/kg)	Chemical Name[2,3]	Log K_{OC} (log L/kg)	Chemical Name	Log K_d (log L/kg)
PCB-Mono	5.1	1,2,3,6,7,8-HxCDF	6.9	Copper	3.5
PCB-Di	5.4	1,2,3,7,8,9-HxCDF	6.9	Lead	4.6
PCB-Tri	5.8	2,3,4,6,7,8-HxCDF	6.9	Zinc	4.1
PCB-Tetra	6.1	1,2,3,4,6,7,8-HpCDF	7.3		
PCB-Penta	6.4	1,2,3,4,7,8,9-HpCDF	7.3		
PCB-Hexa	6.7	OCDF	7.7		
PCB-Hepta	7.0	Acenaphthene	3.9		
PCB-Octa	7.3	Benzo(a)anthracene	5.6		
PCB-Nona	7.5	Benzo(a)pyrene	6.0		
PCB-Deca	7.8	Benzo(g,h,i)perylene	6.4		
2,3,7,8-TCDD	6.4	Chrysene	5.6		
1,2,3,7,8-PeCDD	6.9	Dibenzo(a,h)anthracene	6.6		
1,2,3,4,7,8-HxCDD	7.3	Fluoranthene	5.0		
1,2,3,6,7,8-HxCDD	7.3	Indeno(1,2,3-cd)pyrene	6.6		
1,2,3,4,7,8,9-HxCDD	7.3	Phenanthrene	4.5		
1,2,3,4,6,7,8-HpCDD	7.9	Pyrene	4.8		
OCDD	8.2	Total benzofluoranthenes[4]	6.2		
2,3,7,8-TCDF	6.1	BBP	4.8		
1,2,3,7,8-PeCDF	6.5	1,2,4-trichlorobenzene	3.9		
2,3,4,7,8-PeCDF	6.5	1,2-dichlorobenzene	3.4		
1,2,3,4,7,8-HxCDF	6.9	Benzoic acid[5]	-0.26		

Notes:

1. Partition coefficients for PCB homologs were developed as part of the Pre-Design Studies (Windward 2020). Partition coefficients for the remaining COCs were based on literature as follows: PAH compounds (EPA 2003), dioxin/furan congeners (Aberg et al. 2008), metals (EPA 2005), benzoic acid (EPA 1996), and the remaining SVOCs (EPA 2008). For SVOCs, K_{oc} were calculated using the literature K_{ow} values and the relationship between K_{ow} and K_{oc} based on Di Toro (1985). PCB homologs were modeled separately to account for differences in transport properties and summed to calculate total PCB concentrations for comparison to the RAL.
2. Seventeen dioxin/furan congeners were modeled separately and then summed to calculate dioxin/furan TEQ for comparison to the RAL.
3. PAH compounds were modeled separately and then summed to calculate cPAHs and total HPAHs for comparison to the respective RALs.
4. K_{oc} for total benzofluoranthenes were estimated by averaging K_{oc} from benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene.
5. K_{oc} for benzoic acid was estimated as an ionizing organic chemical at pH of 7. See EPA 1996 for further details.

BBP: butyl benzyl phthalate
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran

K_d: equilibrium partition coefficient
K_{OC}: organic carbon partition coefficient
K_{OW}: octanol-water partition coefficient
L/kg: liter per kilogram
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
RAL: remedial action level
SVOC: semivolatile organic compound
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran
TEQ: toxic equivalents

Table M2-2
Molecular Diffusivity Used in the Buried Contamination Evaluation

Chemical Name	Diffusivity (cm^2/s)	Chemical Name	Diffusivity (10^{-6} cm^2/s)	Chemical Name	Diffusivity (cm^2/s)
PCB-Mono	6.5E-06	1,2,3,6,7,8-HxCDF	4.0E-06	Copper	4.2E-05
PCB-Di	5.8E-06	1,2,3,7,8,9-HxCDF	3.9E-06	Lead	2.4E-05
PCB-Tri	5.2E-06	2,3,4,6,7,8-HxCDF	4.0E-06	Zinc	3.60E-05
PCB-Tetra	4.8E-06	1,2,3,4,6,7,8-HpCDF	3.8E-06		
PCB-Penta	4.4E-06	1,2,3,4,7,8,9-HpCDF	3.8E-06		
PCB-Hexa	4.1E-06	OCDF	3.6E-06		
PCB-Hepta	3.9E-06	Acenaphthene	7.6E-06		
PCB-Octa	3.6E-06	Benzo(a)anthracene	5.7E-06		
PCB-Nona	3.5E-06	Benzo(a)pyrene	5.3E-06		
PCB-Deca	3.3E-06	Benzo(g,h,i)perylene	5.0E-06		
2,3,7,8-TCDD	4.5E-06	Chrysene	5.7E-06		
1,2,3,7,8-PeCDD	4.2E-06	Dibenzo(a,h)anthracene	5.0E-06		
1,2,3,4,7,8-HxCDD	3.9E-06	Fluoranthene	6.2E-06		
1,2,3,6,7,8-HxCDD	3.9E-06	Indeno(1,2,3-cd)pyrene	5.0E-06		
1,2,3,4,7,8,9-HxCDD	3.9E-06	Phenanthrene	6.8E-06		
1,2,3,4,6,7,8-HpCDD	3.7E-06	Pyrene	6.2E-06		
OCDD	3.5E-06	Total benzofluoranthenes[1]	5.3E-06		
2,3,7,8-TCDF	4.6E-06	BBP	4.6E-06		
1,2,3,7,8-PeCDF	4.3E-06	1,2,4-trichlorobenzene	6.7E-06		
2,3,4,7,8-PeCDF	4.3E-06	1,2-dichlorobenzene	7.8E-06		
1,2,3,4,7,8-HxCDF	4.0E-06	Benzoic acid	8.9E-06		

Notes:

1. Diffusivity for total benzofluoranthenes were estimated by averaging diffusivity values for benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene.

BBP: butyl benzyl phthalate
cm^2/s: square centimeter per second
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran

2.2 Model Simulation Approach

The purpose of this modeling was to evaluate whether buried contamination has the potential to contaminate surface sediments[7] to a concentration greater than the RAL in the future through dissolved-phase transport driven by groundwater seepage, diffusion/dispersion, and bioturbation. Conservatively, sedimentation was ignored in this evaluation, despite the fact that sedimentation in the river is ongoing, necessitating periodic maintenance dredging.

The model simulation was performed for 100 years,[8] which is consistent with the design life for the engineered cap (see BODR Appendix H). The model simulated the changes in COC concentration over time throughout the full thickness of the sediment bed (initial concentrations for each layer are shown in Figures M.1.1 through M.1.12 in Attachment M.1). Model-predicted concentrations over the entire 100-year simulation period were compared to the applicable RALs to evaluate whether buried contamination could result in RAL exceedances in the surface sediment at any point within the 100-year evaluation period. RALs were applied as follows:

- Intertidal areas: model-predicted concentrations in the top 10 cm and top 45 cm of the sediment were compared to the corresponding RALs.
- Subtidal areas outside shoaled areas: model-predicted concentrations in the top 10 cm and (if applicable) top 60 cm of the sediment were compared to the corresponding RALs. The exception was for historical core locations SC-01, SC-02, and SC-032, where sand cover was placed in 2010. The comparison for these locations was only conducted for the top 10 cm of the simulated sand cover material, because the focus was to assess the potential for elevated

[7] As described in Section 2, the surface sediment for the evaluation is defined as 0 to 10 cm, 0 to 45 cm, 0 to 60 cm, 0 to the navigation depth plus 2 feet, or a combination of the above intervals, depending on the location of the core (i.e., intertidal, subtidal, or shoaled area).

[8] For SC-01, SC-02, and SC-032, simulations were performed for 115 years. The additional 15 years was included because the placement of the sand cover in the area took place approximately 15 years ago.

COCs to migrate through the sand cover. The deposited sediments above the sand cover would meet both the top 10- and top 60-cm RAL if the COC concentrations within the top 10 cm of the sand cover are predicted to be below the RALs.

- Subtidal areas within shoaled areas: model-predicted concentrations at depths from the sediment surface to the authorized navigation depth and 2 feet below the navigation depth were compared to the RALs (consistent with the data segmentation used in the PDI).

As indicated in Section 1, sediment in RC 1 areas may have limited natural recovery potential; this is due to the potential for deeper scour in RC 1 compared with in RC 2 and RC 3 areas. A modeling study was conducted during the Feasibility Study to assess the scour potential in the LDW due to high-flow events and transiting and maneuvering ships (AECOM 2012). The high-flow-induced scour was predicted in limited areas within middle reach of the LDW, with the predicted scour depth in the range of 0 to 10 cm. The maneuvering propeller-induced scour depth was predicted to be approximately 25 cm in shallower water depths under conditions where ships are using 100% applied power. In addition, localized disturbances associated with anchor/chain drag have been observed in the middle reach. Chain drag will be considered as part of 90% design buried contamination evaluation in areas where this has been identified to be an ongoing activity. However, this disturbance is not expected to exceed the maximum propeller-induced scour depth evaluated in the Feasibility Study. Based on these results, the scour depth associated with high-flow events or vessel activities could range from 10 to approximately 25 cm.

These estimated scour values will be further evaluated during the Pre-Final (90%) RD as part of the additional modeling that will be used to design the cap erosion protection layer for engineered caps.

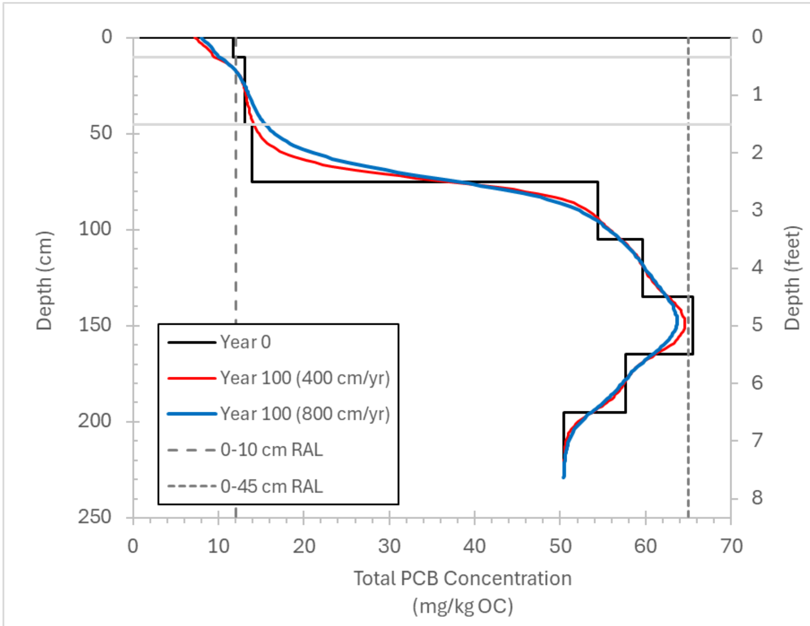
3 Model Results

Model-predicted sediment COC concentrations for cores within the intertidal, subarea, and shoaled areas are shown in Tables M3-1, M3-2, and M3-3, respectively, for both groundwater seepage rates evaluated, and results are discussed in the following subsections. Example depth profiles of model-predicted COC concentrations are shown in Figures M3-1 and M3-2 to illustrate the vertical migration associated with the buried contamination. Depth profiles of model-predicted COC concentrations for all core locations are provided in Attachment M3.

3.1 Intertidal Areas

For the intertidal areas, model results show that COC concentrations in the top 10 cm and top 45 cm of the sediment were predicted to be less than the respective RALs for more than 100 years for both core locations (Table M3-1). That is, COCs buried beneath 45 cm of cleaner sediment are not predicted to migrate to the surface sediment within 100 years at magnitudes that could cause RAL exceedances under groundwater seepage rates between 400 and 800 cm/yr. The model results for PCBs and fluoranthene at LDW24-IT1546, as shown in Figure M3-1, illustrate the predicted migration of COCs in the sediment. At Year 0, RAL exceedances of PCBs are buried beneath cleaner sediment with a peak PCB concentration of 66 milligrams per kilogram (mg/kg) OC (i.e., more than five times greater than the 0- to 10-cm RAL of 12 mg/kg OC) measured at the depth of 135 to 165 cm. The predicted PCB profiles at Year 100 show limited upward migration under the simulated range of seepage rates, with some smoothing of vertical concentration gradients due to the processes of diffusion and dispersion. Because PCBs partition relatively strongly to sediments, they do not migrate quickly through the sediments in dissolved phase. Therefore, PCBs that are buried beneath cleaner sediment are expected to remain buried at this location. It should also be noted that PCB concentrations at any depth are not expected to exceed the 0- to 45-cm RAL.

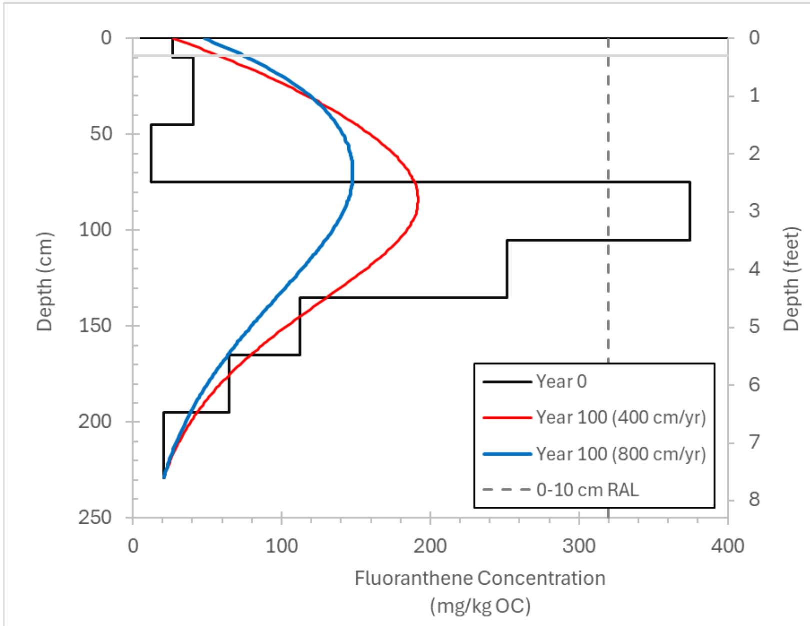
Figure M3-1
Depth Profiles of Total PCBs for LDW24-IT1546 at Year 0 and Year 100



Note:
The horizontal gray lines represent the sediment depths of 10 cm and 45 cm, which correspond to the depths over which the RALs apply (i.e., 0 to 10 cm and 0 to 45 cm).

Similarly, as shown in Figure M3-2, RAL exceedances of fluoranthene at Year 0 are buried beneath surface sediments at a depth of 75 to 105 cm, with a concentration of 370 mg/kg OC, which is 1.2 times greater than the 0- to 10-cm RAL of 320 mg/kg OC. Compared with PCBs, the model predicted a greater change in fluoranthene concentration profile over time, which is consistent with the fact that fluoranthene is more mobile than PCBs. The peak concentration is predicted to migrate further upward to some extent under the seepage rate of 800 cm/yr (and less so at 400 cm/yr), with greater effects from vertical mixing associated with diffusion and dispersion as compared to the predictions for PCBs. However, the predicted fluoranthene concentration in the upper 10 cm of sediment at Year 100 is much less than the RAL because of the relatively limited upward migration coupled with the attenuation from mixing and surface water exchange.

Figure M3-2
Depth Profiles of Fluoranthene for LDW24-IT1546 at Year 0 and Year 100



Note:
The horizontal gray line represents the sediment depth of 10 cm.

For LDW24-IT14261, concentrations in the top 45 cm sediment were based on the 0- to 45-cm data from LDW23-IT1121, as described in Section 2.1. Due to the low TOC of 0.37%, dry-weight PCB concentrations were compared to the dry-weight RAL. As shown in Table M3-1, the model-predicted dry-weight PCB concentration of 53 micrograms per kilogram (µg/kg) in the top 10 cm for both seepage rates evaluated is less than the dry-weight equivalent RAL of 130 µg/kg (when TOC is less than 0.5% or greater than 3.5%). Similarly, model-predicted, dry-weight PCB concentrations of 72 and 65 µg/kg in the top 45 cm for the seepage rates of 400 and 800 cm/yr, respectively, are less than the corresponding dry-weight equivalent RAL of 1,000 µg/kg. Therefore, PCBs that are buried beneath cleaner sediment are also expected to remain buried at this location.

Table M3-1
Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Intertidal Areas

Core Location	RC	COC	Unit	Top 10 cm RAL[1]	Predicted Average Concentrations in the Top 10 cm of Sediment at Year 100		Top 45 cm RAL[1]	Predicted Average Concentrations in the Top 45 cm of Sediment at Year 100	
					Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]		Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]
LDW24-IT1546	2	Total PCBs	mg/kg OC	12	8.6	9.2	65	12	12
		Dioxin/furan TEQ	ng/kg	25	5.2	5.1	28	4.8	4.9
		Fluoranthene	mg/kg OC	320	43	62	--	--	--
LDW24-IT1426[3]	3	Total PCBs	µg/kg	130	53	53	1,000	72	65

Notes:

1. OC-normalized RALs were used for the evaluation when TOC is within the range of 0.5% to 3.5%. Dry-weight equivalent RALs were used when TOC is either less than 0.5% or greater than 3.5%.
2. 400 cm/yr and 800 cm/yr were used for the lower bound and upper bound seepage rates, respectively.
3. As described in Section 2.1, data from the 0- to 45-cm segment in LDW23-IT1121 were used for the evaluation. Dry-weight equivalent RALs were used for PCBs due to low TOC (0.37%) measured in that segment.

--: not applicable
µg/kg: microgram per kilogram
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAL: remedial action level
RC: recovery category
TEQ: toxic equivalents
TOC: total organic carbon

3.2 Subtidal Areas

For the subtidal areas, model results show that COC concentrations in the top 10 cm and top 60 cm of the sediment are predicted to remain less than the respective RALs for more than 100 years in all seven subtidal cores for all applicable COCs. For the three historical locations SC-01, SC-02, and SC-032 where a sand cover was placed in 2010, the model simulation was performed for 115 years because the placement of the sand cover in the area took place approximately 15 years prior (see Section 2.2). The PCB concentrations with the top 10 cm of the cover are predicted to remain less than the RAL for 115 years. Figure M3-3 shows model-predicted PCB concentration profiles in SC-032. Limited PCB migration within the sand cover was predicted at the end of 115 years, with slightly higher PCB concentration near the bed surface under the 800 cm/yr seepage rate than the 400 cm/yr seepage rate. Overall, PCBs in the top 10 cm of the sand cover are predicted to remain less than the RAL under both seepage rates evaluated. Therefore, the buried PCBs are not expected to cause RAL exceedances in the depositing sediments on top of the sand cover. This model prediction is conservative because it ignores the sediment that has deposited on top of the cover; this additional sediment would provide additional attenuation, resulting in even lower concentrations at the surface.

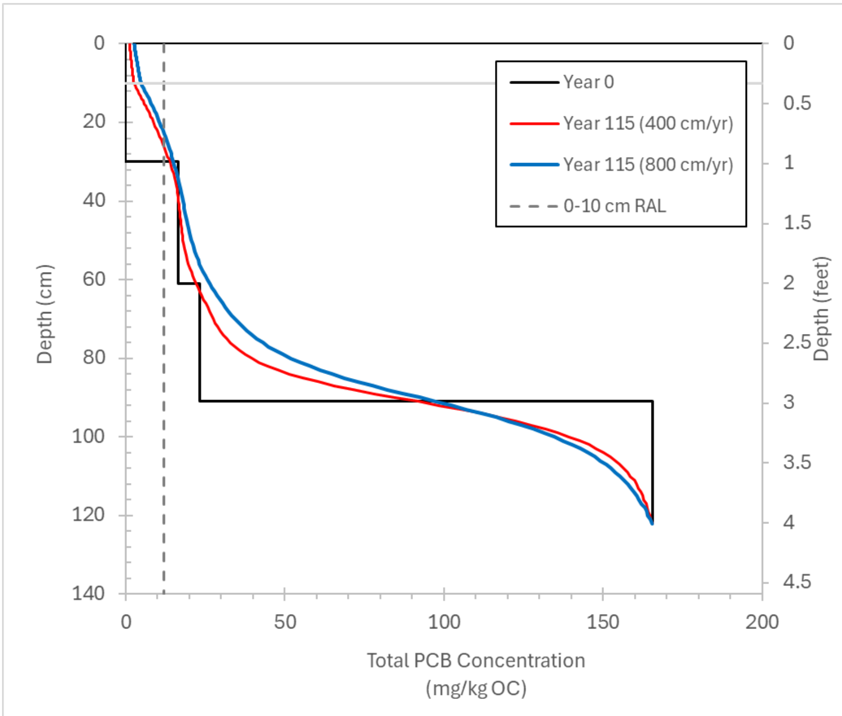
As discussed previously, sediments in RC 1 area have greater potential to scour; therefore, the model-predicted concentrations were further evaluated to account for the potential influence of scour. For the six sediment cores located in RC 1 area: LDW24-SC1579, LDW24-SC1559, DENW6721-SSED-SB-12A-2014, SC-01, SC-02, and SC-032, model-predicted concentration profiles at Year 100 were reviewed to determine whether concentrations below the sediment surface would remain below applicable RAL if surface sediment were temporarily removed as a result of the scour.

For LDW24-SC1579 and LDW24-SC1559, predicted PCB concentrations remain below the applicable RAL within the top 210 cm and 90 cm of sediment, respectively (Figure M.3.1a and M.3.3a, respectively), for both seepage rates evaluated. Thus, compliance with the top 10-cm and top 60-cm RALs would be maintained even under the expected potential scour depth (i.e., 25 cm).

For DENW6721-SSED-SB-12A-2014, PCBs and benzoic acid concentrations were predicted to remain below applicable RALs for limited scour depths (Figures M.3.4a and M.3.4b, respectively); however, there is potential for temporary furrows of deeper scour (approximately 25 cm deep) to occur that could expose material that exceeds the surface RAL. Such an extreme scour condition is considered unlikely at this location given the water depth of approximately 10 feet and would also expect to be temporary as ongoing sedimentation fills the furrows and the upper layers are redistributed by less concentrated forces from river flow and vessels wakes. Note that Long-Term Monitoring and Maintenance Plan will be implemented following remedial construction to provide ongoing monitoring throughout the LDW and identify changes in sediment conditions over time.

For SC-01, SC-02, and SC-032, the modeled scenario neglects the subsequent deposition of approximately 2 to 3 feet of sediment on top of the post dredging sand cover. Therefore, the potential for this area to be scoured such that sediment exceeding the surface RAL would be exposed is highly unlikely.

Figure M3-3
Depth Profiles of Total PCBs for SC-032 at Year 0 and Year 115



Notes:
The horizontal gray line represents the sediment depth of 10 cm.
The 0- to 60-cm RAL of 195 mg/kg OC was not evaluated for the locations with sand cover, as discussed in Section 2.2.
Note that the model neglects the deposition of approximately 2 to 3 feet of clean sediment that deposited over the post-dredge sand cover placed by the adjacent property owner. Thus, the actual PCB concentration profile represents deeper sediment than indicated in the plot.

Table M3-2
Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Subtidal Areas

Core Location	RC	COC	Unit	Top 10 cm RAL	Predicted Average Concentrations in Top 10 cm of Sediment at Year 100[1]		Top 60 cm RAL[3]	Predicted Average Concentration in the Top 60 cm of sediment at Year 100[1]	
					Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]		Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]
LDW24-SC1579	1	Total PCBs	mg/kg OC	12	6.4	6.8	12	9.1	9.1
SC06	2	Total PCBs	mg/kg OC	12	7.8	9.1	195	16	17
LDW24-SC1559	1	Total PCBs	mg/kg OC	12	4.0	4.2	12	5.3	5.4
DENW6721-SSED-SB-12A-2014	1	Total PCBs	mg/kg OC	12	5.8	6.1	12	8.9	9.5
		Benzoic acid	µg/kg	650	130	200	650	300	350
LDW-SC37	2	Copper	mg/kg	780	320	620	--	--	--
		Lead	mg/kg	900	79	90	--	--	--
		Zinc	mg/kg	820	190	340	--	--	--
		Benzo(a)pyrene	mg/kg OC	198	53	68	--	--	--
		Fluoranthene	mg/kg OC	320	90	140	--	--	--
		Phenanthrene	mg/kg OC	200	50	36	--	--	--
		Total HPAHs	mg/kg OC	1,920	530	670	--	--	--
		cPAHs	µg/kg	5,500	1,700	2,100	--	--	--
		1,2,4-trichlorobenzene	mg/kg OC	1.62	0.16	0.19	--	--	--
		1,2-dichlorobenzene	mg/kg OC	4.6	0.13	0.19	--	--	--

Core Location	RC	COC	Unit	Top 10 cm RAL	Predicted Average Concentrations in Top 10 cm of Sediment at Year 100[1]		Top 60 cm RAL[3]	Predicted Average Concentration in the Top 60 cm of sediment at Year 100[1]	
					Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]		Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[2]
SC-01	1	Total PCBs	mg/kg OC	12	1.5	2.9	--	--	--
		Acenaphthene	mg/kg OC	16	5.5	7.5	--	--	--
		Fluoranthene	mg/kg OC	160	6.7	23	--	--	--
		BBP	mg/kg OC	4.9	0.81	0.99	--	--	--
SC-02	1	Total PCBs	mg/kg OC	12	1.6	2.9	--	--	--
		BBP	mg/kg OC	4.9	0.72	0.78	--	--	--
SC-032	1	Total PCBs	mg/kg OC	12	1.9	3.7	--	--	--
		Benzo(a)anthracene	mg/kg OC	110	6.8	20	--	--	--
		Chrysene	mg/kg OC	110	6.8	21	--	--	--
		Total HPAHs	mg/kg OC	960	120	120	--	--	--

Notes:

1. Predicted sediment concentrations for SC-01, SC-02, and SC-032 were from the end of Year 115.
2. 400 cm/yr and 800 cm/yr were used for the lower bound and upper bound seepage rates, respectively, for all cores with the exception of LDW24-SC1579 where 100 cm/yr and 400 cm/yr were used for the lower bound and upper bound seepage rates, respectively.
3. The top 60-cm RALs were not applicable to SC-01, SC-02, and SC-032 because the focus was to assess the potential for elevated COCs to migrate through the sand cover (see Section 2.2). The top 60-cm RALs were not applicable for LDW-SC37 because the core is located in an RC-2 area where RAL was only established for PCBs.

--: not applicable
µg/kg: microgram per kilogram
BBP: butyl benzyl phthalate
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAL: remedial action level
RC: recovery category

3.3 Shoaled Areas

For the shoaled areas, model results show that PCB concentrations in both the shoaled material above the FNC navigation depth and the 2-foot overdredge depth are predicted to be less than the respective RALs for more than 100 years at all three locations (Table M3-3).

Table M3-3
Buried Contamination Model Results: Model-Predicted Concentrations at Year 100 for Cores in Shoaled Areas

Core Location	RC	COC	RAL (mg/kg OC)	Shoaled Sediment Above Authorized FNC Depth			Authorized FNC Depth to 2 feet Below Authorized FNC Depth		
				Depth Interval (feet)	Predicted Average Sediment Concentration at Year 100		Depth Interval (feet)	Predicted Average Sediment Concentration at Year 100	
					Lower Bound Seepage Rate[1]	Upper Bound Seepage Rate[1]		Lower Bound Seepage Rate[1]	Upper Bound Seepage Rate[1]
LDW24-SC1515	3	Total PCBs	12	0 to 2.1	4.9	5.2	2.1 to 4.1	10.7	10.1
LDW23-SC1156	3	Total PCBs	12	0 to 2.7	3.9	4.1	2.7 to 4.7	11	11
LDW24-SC1323	3	Total PCBs	12	0 to 0.8	7.9	7.9	0.8 to 2.8	10	10

Notes:

1. 100 cm/yr and 400 cm/yr were used for the lower bound and upper bound seepage rates, respectively.

cm/yr: centimeter per year
COC: contaminant of concern
FNC: federal navigation channel
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAL: remedial action level
RC: recovery category

4 Conclusions

Numerical modeling was conducted to evaluate transport potential of dissolved-phase COCs in areas of the middle reach of the LDW where contamination buried beneath cleaner sediment is present. The results showed that model-predicted COC concentrations within the surface of the sediment are expected to remain less than the respective RALs for more than 100 years, including in areas that may experience periodic scour and filling. For reference, the same buried contamination evaluation was conducted for the upper reach of the LDW (Anchor QEA and Windward 2024). The highest PCB concentration in the upper reach evaluation was nearly 700 mg/kg OC, which is four times higher than the highest PCB concentration (165 mg/kg OC) in the evaluation for the middle reach.

The results of these evaluations ignore the influence of future sedimentation. This is conservative because even at a modestly low rate, it can have a large impact on the future surface sediment concentrations. The evaluation will be further refined in the Pre-Final (90%) RD to incorporate any additional data collected during the Phase III PDI sampling.

5 References

Aberg, A., M. MacLeod, and K. Wiberg, 2008. "Physical-Chemical Property Data for Dibenzo-p-dioxin (DD), Dibenzofuran (DF), and Chlorinated DD/Fs: A Critical Review and Recommended Values." *Journal of Physical and Chemical Reference Data* 37(4). Available at: https://doi.org/10.1063/1.3005673.

AECOM, 2012. *Final Feasibility Study. Lower Duwamish Waterway Seattle, Washington. Appendix C Sediment Modeling Memoranda*. October 31, 2012.

Anchor QEA and Windward (Anchor QEA and Windward Environmental LLC), 2024. *Final (100%) Remedial Design Basis of Design Report for Lower Duwamish Waterway Upper Reach*. Submitted to EPA January 16, 2024.

Anchor QEA and Windward, 2025. *Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach*. Draft final. Submitted to EPA July 24, 2025.

Boudreau, B.P., 1996. "The Diffusive Tortuosity of Fine-Grained Unlithified Sediments." *Geochimica et Cosmochimica Acta* 60(16):3139–3142.

Di Toro, D.M., 1985. "A Particle Interaction Model of Reversible Organic Chemical Sorption." *Chemosphere* 14(10):1503–1538. Available at: https://doi.org/10.1016/0045-6535(85)90008-6.

EPA (U.S. Environmental Protection Agency), 1995. *Phase 2 Report – Review Copy. Further Site Characterization and Analysis. Database Report*. Hudson River PCBs Reassessment RI/FS. Prepared by TAMS Consultants, Inc., for EPA, Region 2, New York. October 1995.

EPA, 1996. *Soil Screening Guidance: Technical Background Document*. Second Edition. EPA-540-R-95-128. May 1996.

EPA, 2003. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures*. EPA-600-R-02-013. November 2003.

EPA, 2005. *Partition Coefficients for Metals in Surface Water, Soil, and Waste*. EPA-600-R-05-074. July 2005.

EPA, 2008. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics*. EPA-600-R-02-016. March 2008.

Frame, G.M., J.W. Cochran, and S.S. Bøwadt, 1996. "Complete PCB Congener Distributions for 17 Aroclor Mixtures Determined by 3 HRGC Systems Optimized for Comprehensive, Quantitative, Congener-Specific Analysis." *Journal of High Resolution Chromatography* 19(12):657–668.

Go, J., D.J. Lampert, J.A. Stegemann, and D.D. Reible, 2009. "Predicting Contaminant Fate and Transport in Sediment Caps: Mathematical Modeling Approaches." *Applied Geochemistry* 24(2009):1347–1353.

Lampert, D.J., and D. Reible, 2009. "An Analytical Modeling Approach for Evaluation of Capping of Contaminated Sediments." *Soil and Sediment Contamination: An International Journal* 18(4):470–488.

Millington, R.J., and J.P. Quirk, 1961. "Permeability of Porous Solids." *Transactions of the Faraday Society* 57:1200–1207.

Palermo, M., S. Maynord, J. Miller, and D. Reible, 1998. *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments.* EPA 905-B96-004, Chicago: Great Lakes National Program Office.

Reible, D., 2023. *CapSIM 4.2 Basic Users Manual*. Available at: https://www.depts.ttu.edu/ceweb/research/reiblesgroup/CapSim_4.2_Basic_User_Manual.pdf.

Rushneck D.R., A. Beliveau, B. Fowler, C. Hamilton, D. Hoover, K. Kaye, M. Berg, T. Smith, W.A. Telliard, H. Roman, E. Ruder, and L. Ryan, 2004. "Concentrations of Dioxin-Like PCB Congeners in Unweathered Aroclors by HRGC/HRMS Using EPA Method 1668A." *Chemosphere* 54:79–87.

Schulz-Bull, D., G. Petrick, and J.C. Duinker, 1989. "Complete Characterization of PCB Congeners in Commercial Aroclor and Clophen Mixtures by Multidimensional Gas Chromatography–Electron Capture Detection." *Environmental Science and Technology* 23(7):852–859.

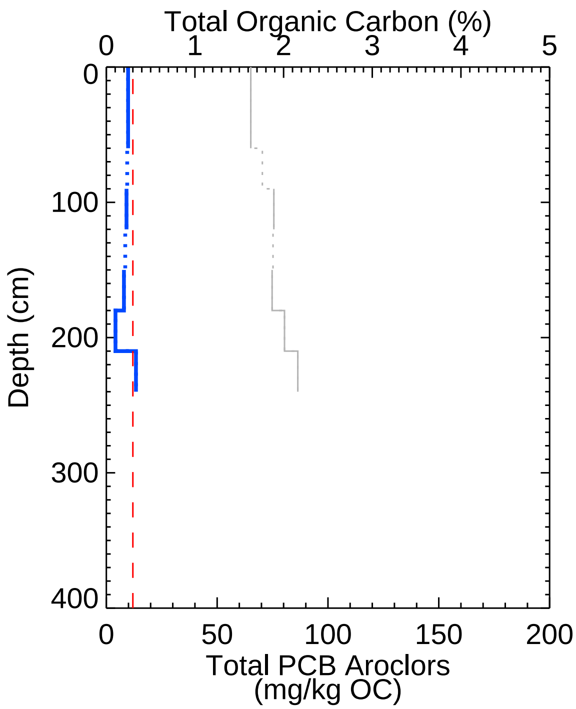
Shen, X., D. Lampert, S. Ogle, and D. Reible, 2018. "A Software Tool for Simulating Contaminant Transport and Remedial Effectiveness in Sediment Environments." *Environmental Modelling and Software* 109:104–113. DOI: 10.1016/j.envsoft.2018.08.014.

Windward, 2020. *Lower Duwamish Waterway Pre-Design Studies Data Evaluation Report (Task 6)*. Prepared for Lower Duwamish Waterway Group. June 26, 2020.

Windward and Anchor QEA, 2023. *Pre-Design Investigation Work Plan for the Lower Duwamish Waterway – Middle Reach*. Prepared for Lower Duwamish Waterway Group. February 14, 2023.

Appendix M – Chemical Fate and Transport Modeling to Support Buried Contamination Evaluation

Attachment M.1
Core Profiles for Buried Contamination Evaluation



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

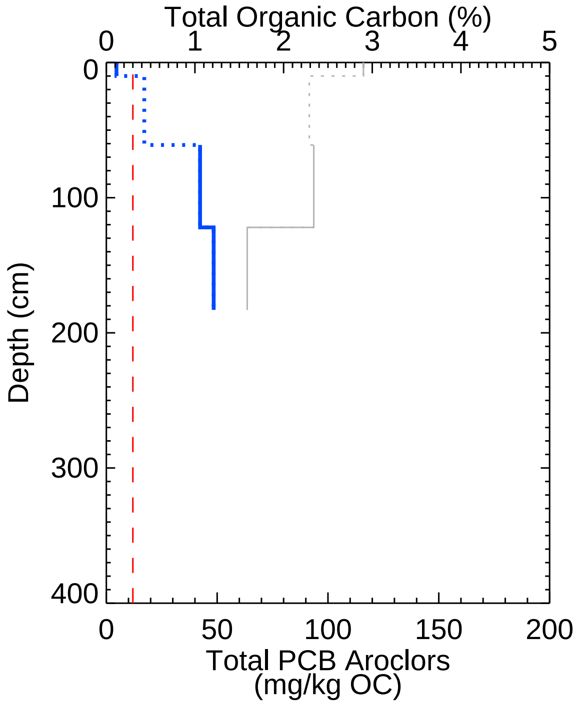
Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

ANCHOR QEA

Figure M.1.1

Core Profiles for Buried Contamination Evaluation for LDW24-SC1579

60% Remedial Design Basis of Design Report
LDW Middle Reach



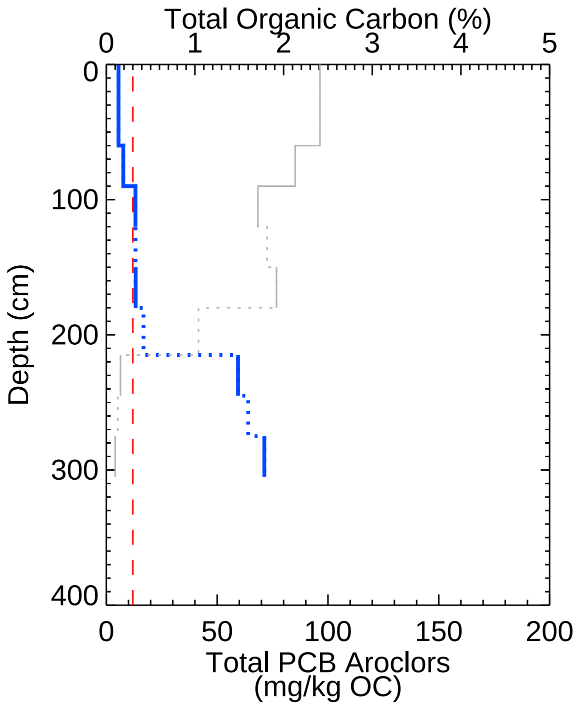
Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

Figure M.1.2

Core Profiles for Buried Contamination Evaluation for SC06



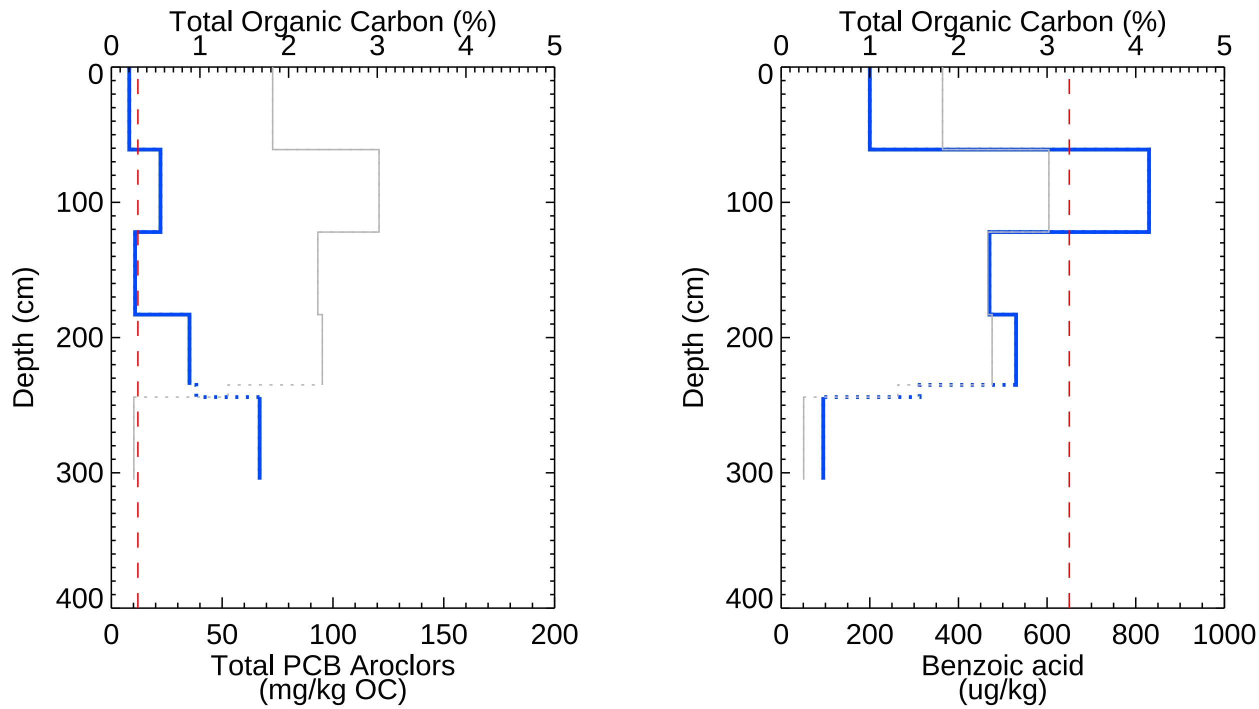
Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

Figure M.1.3

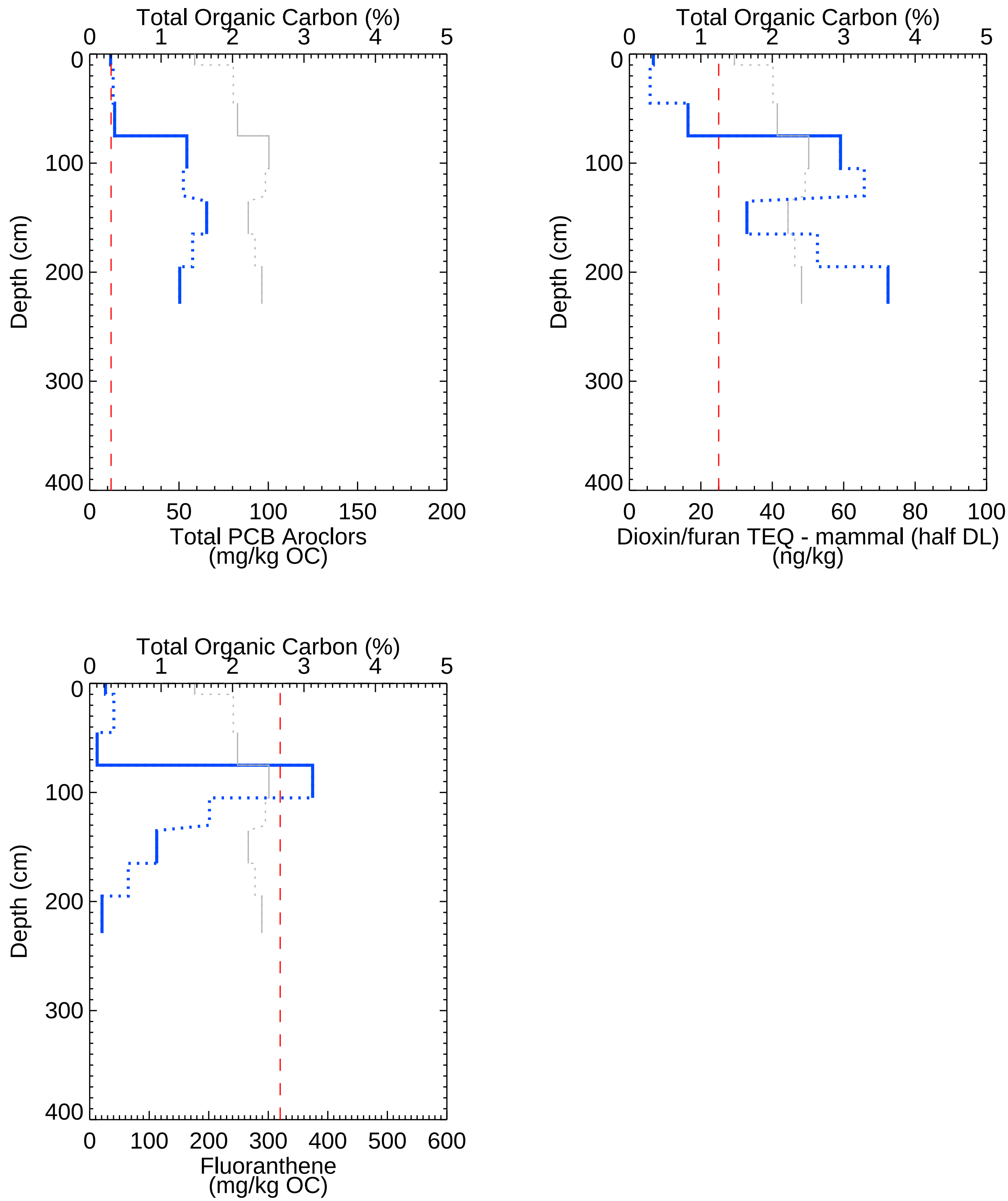
Core Profiles for Buried Contamination Evaluation for LDW24-SC1559



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

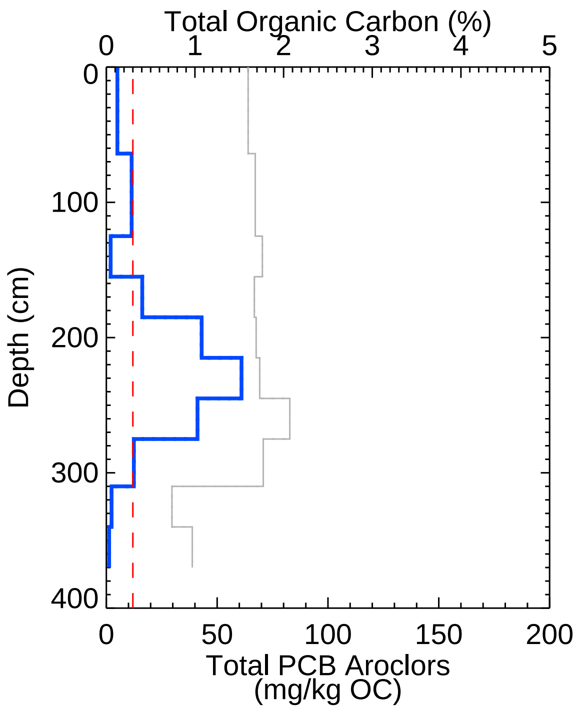
Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

ANCHOR QEA

Figure M.1.5

Core Profiles for Buried Contamination Evaluation for LDW24-IT1546

60% Remedial Design Basis of Design Report
LDW Middle Reach



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

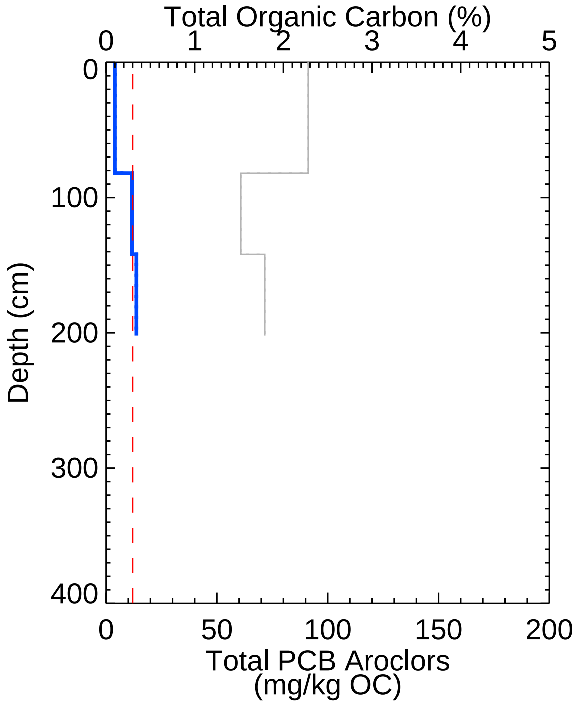
COC	
Total Organic Carbon	

ANCHOR QEA

Figure M.1.6

Core Profiles for Buried Contamination Evaluation for LDW24-SC1515

60% Remedial Design Basis of Design Report
LDW Middle Reach

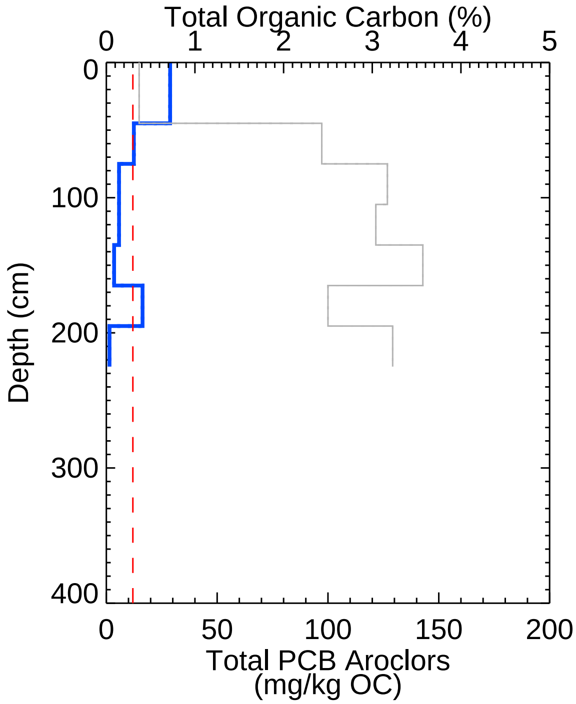


Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Figure M.1.7
Core Profiles for Buried Contamination Evaluation for LDW23-SC1156

60% Remedial Design Basis of Design Report
LDW Middle Reach



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

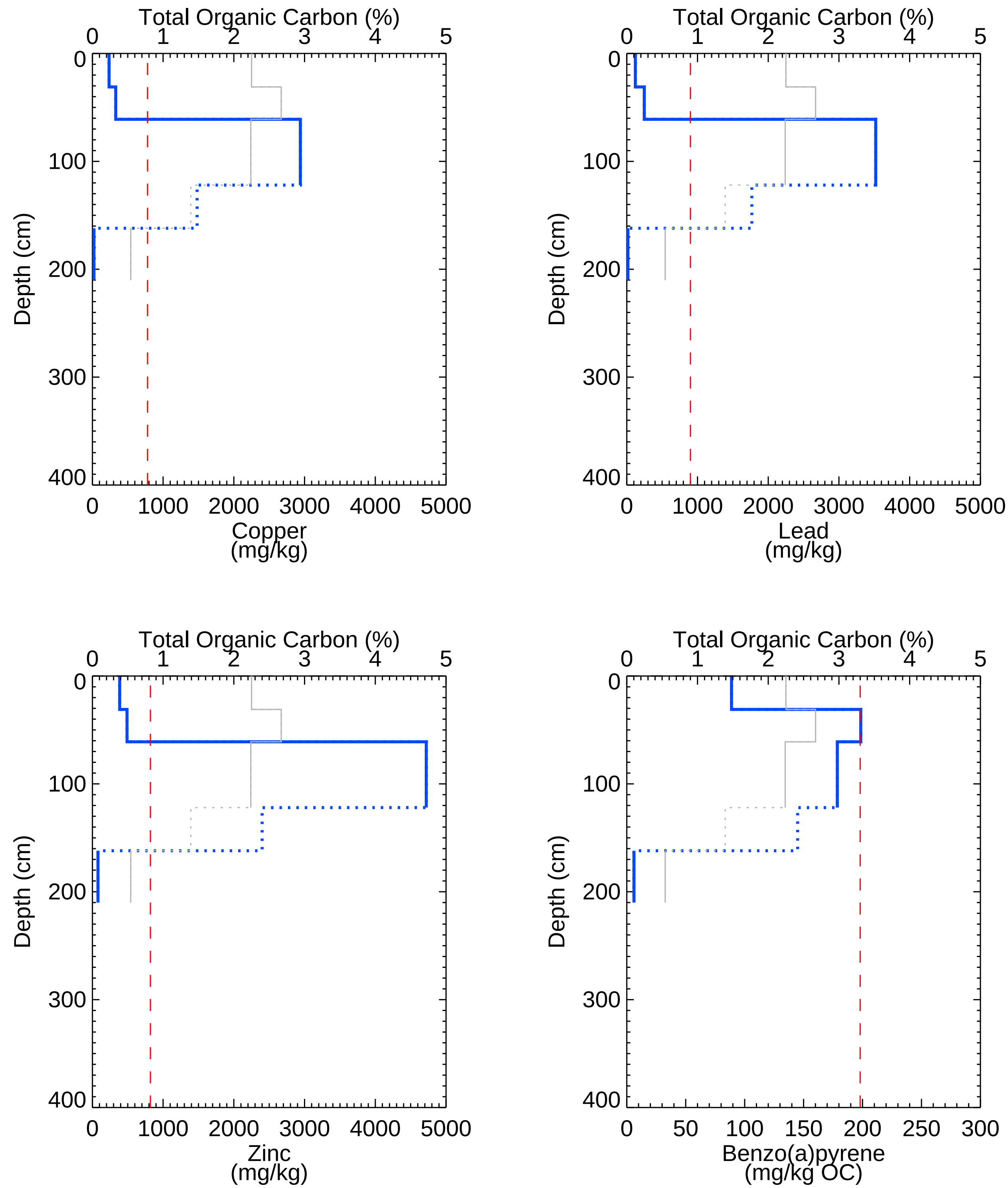
Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

ANCHOR QEA

Figure M.1.8a

Core Profiles for Buried Contamination Evaluation for LDW24-IT1426

60% Remedial Design Basis of Design Report
LDW Middle Reach



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

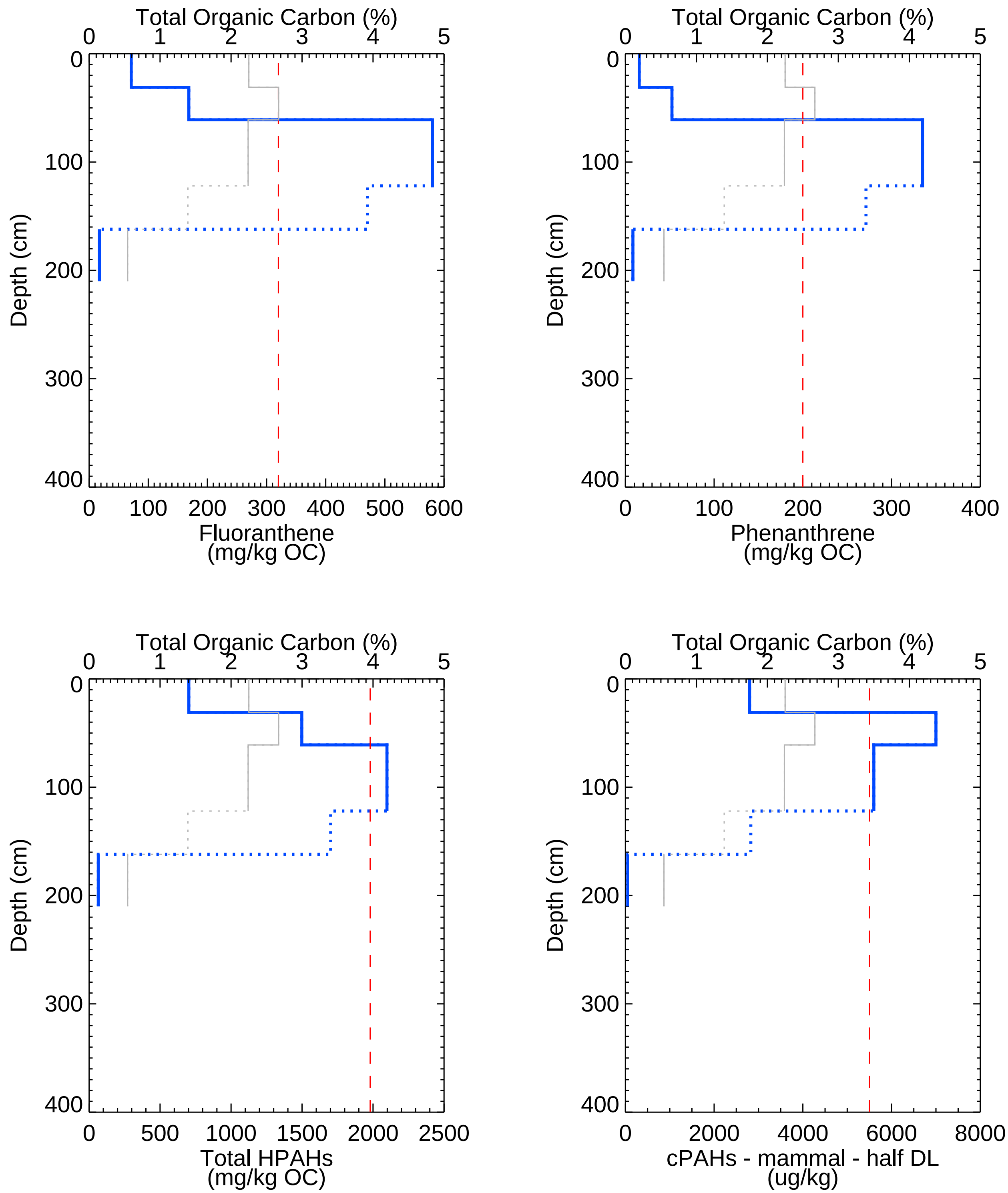
Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

ANCHOR QEA

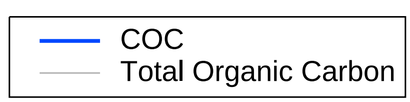
Figure M.1.9

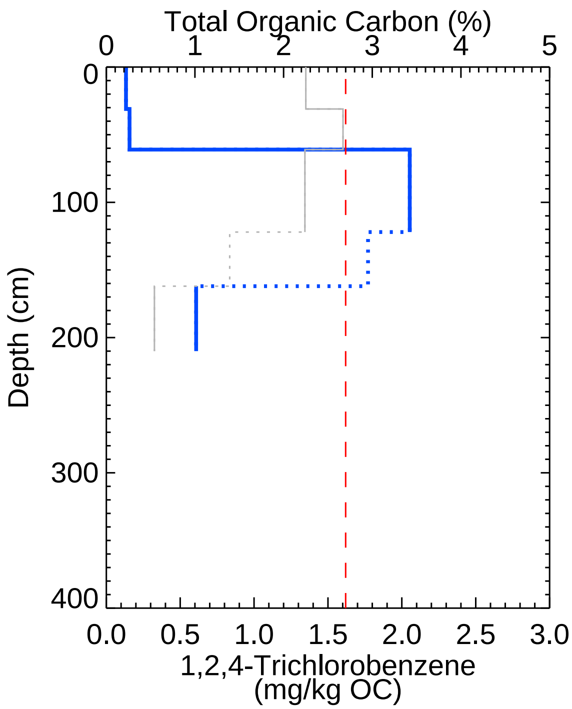
Core Profiles for Buried Contamination Evaluation for LDW-SC37

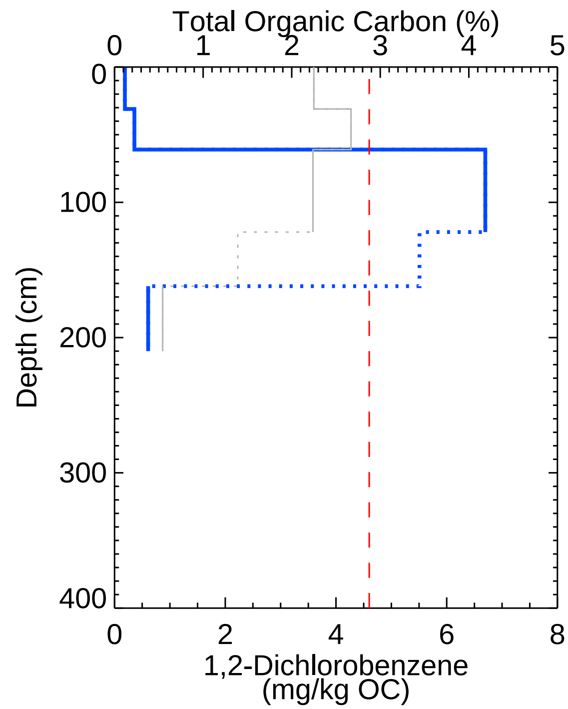
60% Remedial Design Basis of Design Report
LDW Middle Reach



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.







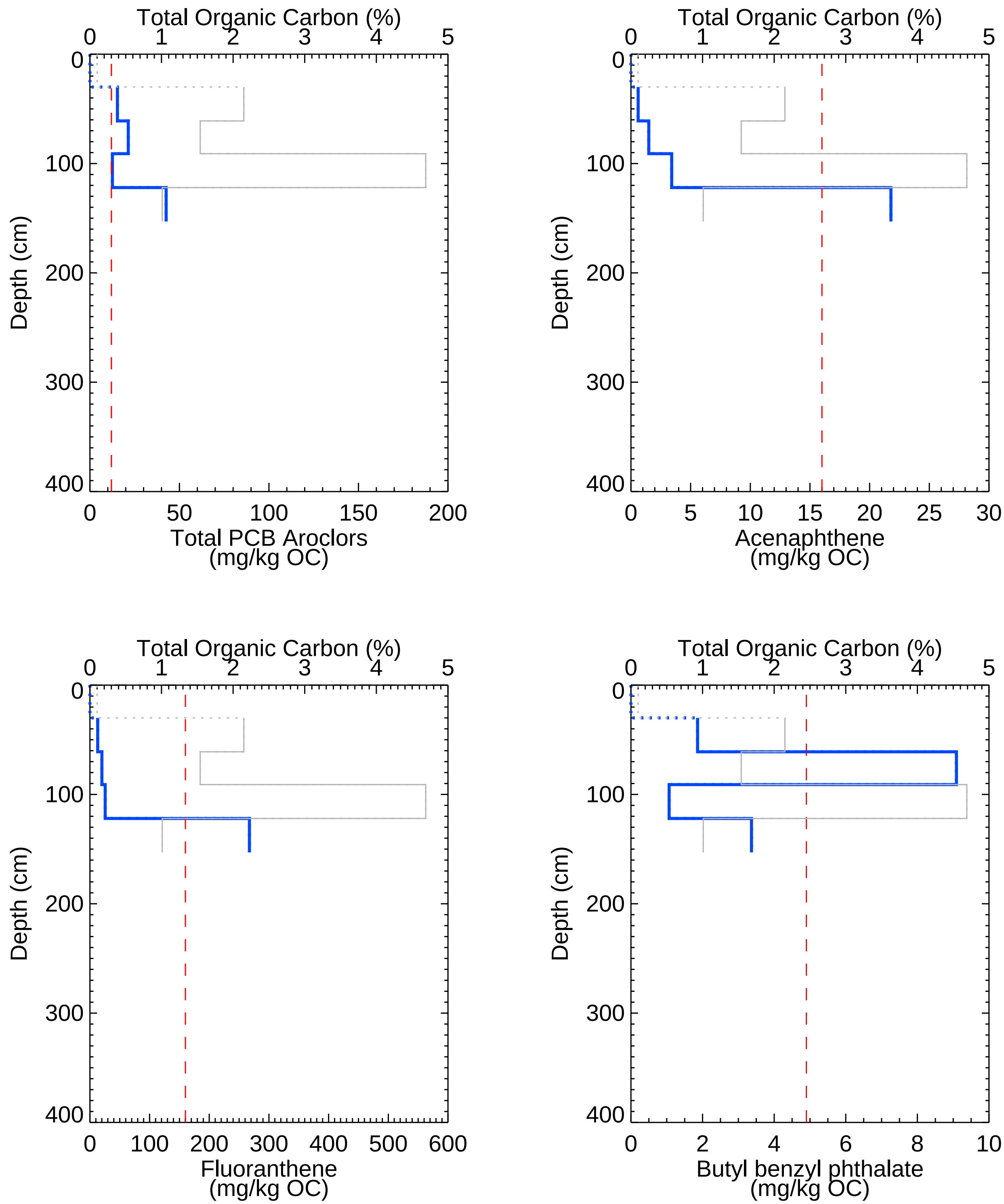
Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC	Total Organic Carbon

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

Figure M.1.9
Core Profiles for Buried Contamination Evaluation for LDW-SC37

60% Remedial Design Basis of Design Report
LDW Middle Reach



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

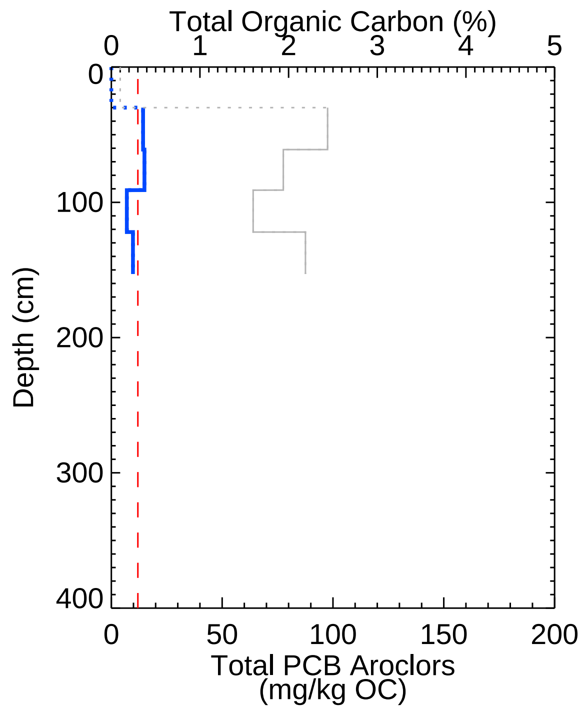
Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

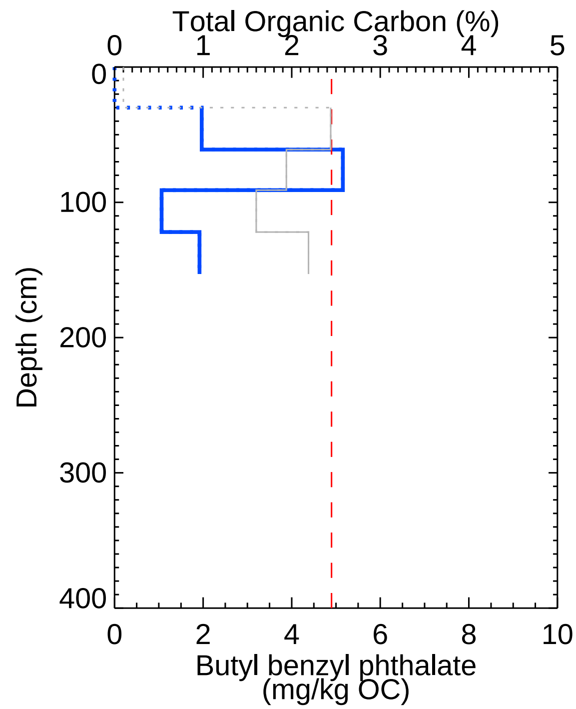
ANCHOR QEA

Figure M.1.10

Core Profiles for Buried Contamination Evaluation for SC-01

60% Remedial Design Basis of Design Report
LDW Middle Reach

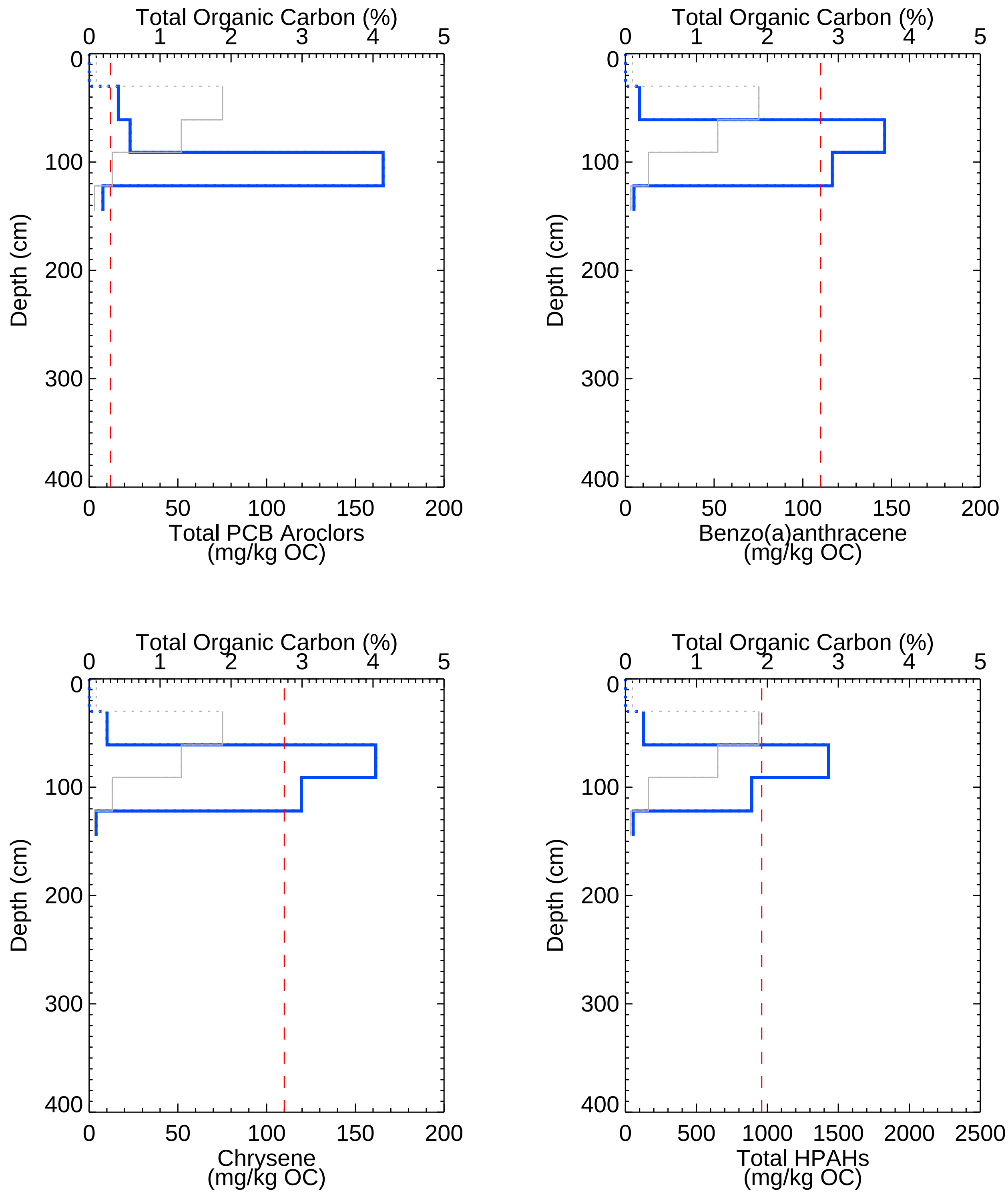




Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Figure M.1.11
Core Profiles for Buried Contamination Evaluation for SC-02

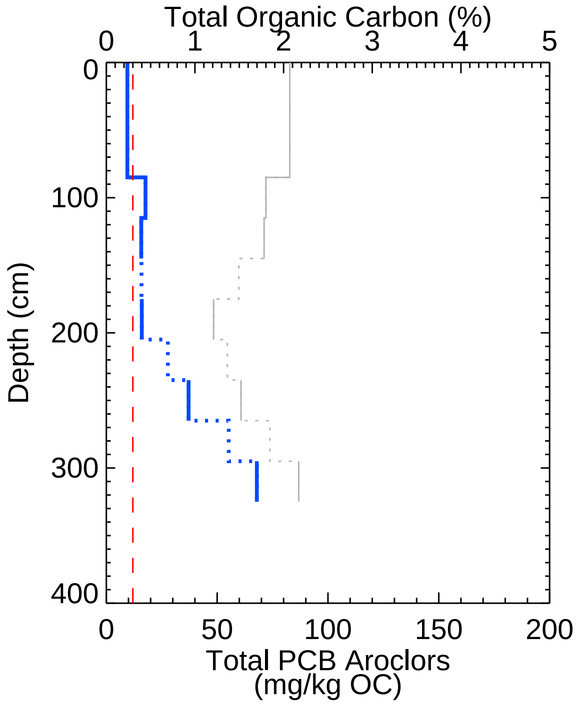


Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

Figure M.1.12

Core Profiles for Buried Contamination Evaluation for SC-032



Note:
Red dashed lines represent the 0 to 10 cm RAL, which is the most stringent RAL among other depth intervals.
Dotted lines represent interpolated concentration. Non-detects plotted at 1/2 QL.

COC
Total Organic Carbon

Publish Date: 05/27/2026 16:14 | User: wk
File Path: C:\Users\wku\OneDrive - ANCHOR QEA\Jobs\LDW\Documents\60% RD\Burried_Contamination\Figures\Figure_DepthProfile_Buried_Contamination_byCore.pro

ANCHOR QEA

Figure M.1.13
Core Profiles for Buried Contamination Evaluation for LDW24-SC1323

Appendix M – Chemical Fate and Transport Modeling to Support Buried Contamination Evaluation

Attachment M.2
Model Inputs for Buried Contamination Evaluation

Table M.2.1
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-SC1579

Group	Analyte	Unit	0 to 60 cm	60 to 90 cm	90 to 120 cm	120 to 150 cm	150 to 180 cm	180 to 210 cm	120 to 240 cm
PCBs	PCB-Mono	µg/L	1.2E-05	1.2E-05	1.2E-05	1.1E-05	9.9E-06	5.0E-06	1.6E-05
	PCB-Di	µg/L	1.6E-04	1.8E-04	2.0E-04	1.8E-04	1.6E-04	7.8E-05	2.6E-04
	PCB-Tri	µg/L	9.3E-04	1.1E-03	1.2E-03	1.1E-03	9.6E-04	4.7E-04	1.6E-03
	PCB-Tetra	µg/L	1.5E-03	1.7E-03	1.9E-03	1.7E-03	1.5E-03	7.7E-04	2.6E-03
	PCB-Penta	µg/L	1.1E-03	1.2E-03	1.2E-03	1.1E-03	1.0E-03	5.4E-04	1.8E-03
	PCB-Hexa	µg/L	5.3E-04	4.5E-04	3.8E-04	3.7E-04	3.6E-04	1.9E-04	5.9E-04
	PCB-Hepta	µg/L	1.5E-04	1.1E-04	8.0E-05	8.0E-05	8.0E-05	4.4E-05	1.2E-04
	PCB-Octa	µg/L	1.5E-05	1.1E-05	7.9E-06	8.0E-06	8.0E-06	4.4E-06	1.2E-05
	PCB-Nona	µg/L	9.2E-07	6.7E-07	4.7E-07	4.7E-07	4.7E-07	2.6E-07	7.1E-07
	PCB-Deca	µg/L	3.4E-08	2.5E-08	1.7E-08	1.7E-08	1.8E-08	9.6E-09	2.6E-08
Sediment Properties	Porosity[1]	--	0.67	0.67	0.67	0.67	0.67	0.67	0.67
	Dry Bulk Density[1]	g/cm^3	0.87	0.87	0.87	0.87	0.87	0.87	0.87
	f_{OC}	%	1.63	1.76	1.89	1.88	1.87	2.01	2.16

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.2
Buried Contamination Modeling Input Parameter Values for Core Location SC06

Group	Analyte	Unit	0 to 10 cm	10 to 61 cm	61 to 122 cm	122 to 183 cm
PCBs	PCB-Mono	µg/L	5.2E-06	1.8E-05	3.6E-05	2.6E-05
	PCB-Di	µg/L	7.5E-05	2.7E-04	5.2E-04	2.6E-04
	PCB-Tri	µg/L	4.4E-04	1.5E-03	2.8E-03	6.8E-04
	PCB-Tetra	µg/L	7.5E-04	2.9E-03	6.4E-03	5.1E-03
	PCB-Penta	µg/L	5.8E-04	2.6E-03	6.8E-03	8.6E-03
	PCB-Hexa	µg/L	2.3E-04	8.4E-04	2.2E-03	2.8E-03
	PCB-Hepta	µg/L	5.8E-05	1.6E-04	3.6E-04	4.6E-04
	PCB-Octa	µg/L	6.0E-06	1.6E-05	3.4E-05	4.2E-05
	PCB-Nona	µg/L	3.5E-07	9.1E-07	1.9E-06	2.4E-06
	PCB-Deca	µg/L	1.3E-08	3.3E-08	7.0E-08	8.5E-08
Sediment Properties	Porosity[1]	--	0.77	0.64	0.58	0.38
	Dry Bulk Density[1]	g/cm^3	0.60	0.94	1.08	1.62
	f_{OC}	%	2.9	2.29	2.34	1.59

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.3
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-SC1559

Group	Analyte	Unit	0 to 60 cm	60 to 90 cm	90 to 120 cm	120 to 150 cm	150 to 180 cm	180 to 215 cm	215 to 245 cm	245 to 275 cm	275 to 305 cm
PCBs	PCB-Mono	µg/L	6.6E-06	9.2E-06	1.6E-05	1.5E-05	1.5E-05	2.0E-05	8.3E-05	8.4E-05	8.6E-05
	PCB-Di	µg/L	9.7E-05	1.3E-04	2.4E-04	2.3E-04	2.2E-04	3.1E-04	1.4E-03	1.3E-03	1.3E-03
	PCB-Tri	µg/L	5.7E-04	7.9E-04	1.4E-03	1.3E-03	1.3E-03	1.8E-03	8.4E-03	8.2E-03	7.9E-03
	PCB-Tetra	µg/L	9.3E-04	1.3E-03	2.3E-03	2.2E-03	2.2E-03	3.0E-03	1.3E-02	1.3E-02	1.3E-02
	PCB-Penta	µg/L	6.6E-04	9.1E-04	1.6E-03	1.6E-03	1.7E-03	2.1E-03	7.1E-03	7.8E-03	9.0E-03
	PCB-Hexa	µg/L	2.8E-04	3.9E-04	6.4E-04	6.6E-04	6.8E-04	8.2E-04	2.5E-03	2.9E-03	3.4E-03
	PCB-Hepta	µg/L	7.3E-05	1.0E-04	1.6E-04	1.6E-04	1.7E-04	2.0E-04	6.1E-04	6.9E-04	8.3E-04
	PCB-Octa	µg/L	7.5E-06	1.1E-05	1.6E-05	1.7E-05	1.8E-05	2.1E-05	6.2E-05	7.1E-05	8.4E-05
	PCB-Nona	µg/L	4.5E-07	6.3E-07	9.5E-07	1.0E-06	1.0E-06	1.2E-06	3.7E-06	4.2E-06	5.0E-06
	PCB-Deca	µg/L	1.7E-08	2.3E-08	3.5E-08	3.7E-08	3.8E-08	4.6E-08	1.4E-07	1.5E-07	1.8E-07
Sediment Properties	Porosity[1]	--	0.73	0.71	0.64	0.66	0.68	0.53	0.33	0.32	0.31
	Dry Bulk Density[1]	g/cm^3	0.69	0.75	0.93	0.87	0.82	1.21	1.75	1.78	1.80
	f_{OC}	%	2.41	2.13	1.71	1.82	1.92	1.04	0.16	0.13	0.10

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable:
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.4
Buried Contamination Modeling Input Parameter Values for Core Location DENW6721-SSED-SB-12A-2014

Group	Analyte	Unit	0 to 61 cm	61 to 122 cm	122 to 183 cm	183 to 235 cm	235 to 244 cm	244 to 305 cm
PCBs	PCB-Mono	µg/L	9.1E-06	1.8E-05	1.1E-05	3.5E-05	3.5E-05	3.3E-05
	PCB-Di	µg/L	1.2E-04	2.7E-04	1.7E-04	4.3E-04	4.2E-04	3.7E-04
	PCB-Tri	µg/L	7.1E-04	1.4E-03	9.4E-04	2.3E-03	2.1E-03	1.0E-03
	PCB-Tetra	µg/L	1.2E-03	3.5E-03	1.8E-03	4.4E-03	4.8E-03	7.7E-03
	PCB-Penta	µg/L	9.6E-04	3.7E-03	1.6E-03	4.3E-03	5.2E-03	1.3E-02
	PCB-Hexa	µg/L	4.4E-04	1.1E-03	5.4E-04	2.1E-03	2.2E-03	3.8E-03
	PCB-Hepta	µg/L	1.2E-04	1.6E-04	1.1E-04	5.6E-04	5.6E-04	4.7E-04
	PCB-Octa	µg/L	1.2E-05	1.5E-05	1.1E-05	5.9E-05	5.7E-05	3.9E-05
	PCB-Nona	µg/L	7.4E-07	8.4E-07	6.2E-07	3.5E-06	3.3E-06	2.2E-06
	PCB-Deca	µg/L	2.7E-08	3.0E-08	2.3E-08	1.3E-07	1.2E-07	7.4E-08
SVOCs	Benzoic acid	µg/L	2.0E+04	5.0E+04	3.7E+04	4.1E+04	4.3E+04	6.8E+04
Sediment Properties	Porosity[1]	--	0.70	0.70	0.69	0.69	0.52	0.29
	Dry Bulk Density[1]	g/cm^3	0.77	0.79	0.81	0.82	1.24	1.85
	f_{OC}	%	1.82	3.02	2.33	2.38	1.32	0.25

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl
SVOC: semivolatile organic compound

Table M.2.5
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-IT1546

Group	Analyte	Unit	0 to 10 cm	10 to 45 cm	45 to 75 cm	75 to 105 cm	105 to 135 cm	135 to 165 cm	165 to 195 cm	195 to 229 cm
PCBs	PCB-Mono	µg/L	1.2E-05	1.4E-05	1.6E-05	6.2E-05	6.8E-05	7.5E-05	6.9E-05	6.4E-05
	PCB-Di	µg/L	1.8E-04	2.0E-04	2.2E-04	9.1E-04	1.0E-03	1.1E-03	1.1E-03	1.0E-03
	PCB-Tri	µg/L	9.9E-04	1.1E-03	1.3E-03	5.3E-03	6.0E-03	6.7E-03	6.4E-03	6.1E-03
	PCB-Tetra	µg/L	1.8E-03	2.0E-03	2.2E-03	9.1E-03	1.0E-02	1.2E-02	1.1E-02	9.6E-03
	PCB-Penta	µg/L	1.6E-03	1.6E-03	1.8E-03	7.0E-03	7.8E-03	8.7E-03	7.4E-03	6.2E-03
	PCB-Hexa	µg/L	6.1E-04	7.1E-04	7.2E-04	2.7E-03	2.9E-03	3.1E-03	2.7E-03	2.3E-03
	PCB-Hepta	µg/L	1.5E-04	1.9E-04	1.8E-04	6.6E-04	6.8E-04	7.1E-04	6.3E-04	5.7E-04
	PCB-Octa	µg/L	1.5E-05	1.9E-05	1.9E-05	6.7E-05	6.9E-05	7.1E-05	6.4E-05	5.8E-05
	PCB-Nona	µg/L	8.7E-07	1.1E-06	1.1E-06	3.9E-06	4.0E-06	4.2E-06	3.8E-06	3.4E-06
	PCB-Deca	µg/L	3.2E-08	4.2E-08	4.1E-08	1.5E-07	1.5E-07	1.5E-07	1.4E-07	1.3E-07
Dioxins/ Furans	2,3,7,8-TCDD	µg/L	3.5E-09	1.7E-09	1.1E-08	1.6E-08	2.2E-08	3.0E-08	2.7E-08	2.5E-08
	1,2,3,7,8-PeCDD	µg/L	7.1E-09	6.6E-09	1.3E-08	2.4E-08	3.2E-08	4.1E-08	4.6E-08	5.1E-08
	1,2,3,4,7,8-HxCDD	µg/L	3.7E-09	3.6E-09	6.9E-09	1.3E-08	1.4E-08	1.5E-08	1.8E-08	2.1E-08
	1,2,3,6,7,8-HxCDD	µg/L	1.8E-08	1.4E-08	3.0E-08	7.5E-08	7.0E-08	6.5E-08	1.1E-07	1.6E-07
	1,2,3,7,8,9-HxCDD	µg/L	1.0E-08	7.9E-09	1.5E-08	3.3E-08	3.7E-08	4.2E-08	6.2E-08	8.1E-08
	1,2,3,4,6,7,8-HpCDD	µg/L	1.7E-07	1.2E-07	3.7E-07	1.5E-06	9.9E-07	4.3E-07	1.1E-06	1.7E-06
	OCDD	µg/L	8.5E-07	4.9E-07	1.4E-06	6.7E-06	4.3E-06	1.7E-06	3.9E-06	6.0E-06
	2,3,7,8-TCDF	µg/L	5.3E-08	3.7E-08	6.4E-08	1.1E-07	1.2E-07	1.3E-07	1.2E-07	1.0E-07
	1,2,3,7,8-PeCDF	µg/L	1.1E-08	2.0E-08	2.9E-08	6.1E-08	5.6E-08	5.0E-08	4.1E-08	3.3E-08
	2,3,4,7,8-PeCDF	µg/L	6.2E-08	1.2E-08	7.8E-08	1.4E-07	1.4E-07	1.4E-07	1.3E-07	1.2E-07
	1,2,3,4,7,8-HxCDF	µg/L	3.2E-08	2.1E-08	4.7E-08	9.2E-08	1.0E-07	1.2E-07	1.0E-07	8.7E-08
	1,2,3,6,7,8-HxCDF	µg/L	1.4E-08	6.9E-09	1.7E-08	3.5E-08	3.9E-08	4.5E-08	4.0E-08	3.7E-08
	1,2,3,7,8,9-HxCDF	µg/L	7.6E-09	4.4E-09	1.5E-08	3.5E-08	2.9E-08	2.2E-08	2.1E-08	2.0E-08
	2,3,4,6,7,8-HxCDF	µg/L	1.7E-08	2.3E-09	2.4E-08	5.0E-08	5.4E-08	5.9E-08	5.4E-08	4.9E-08

Group	Analyte	Unit	0 to 10 cm	10 to 45 cm	45 to 75 cm	75 to 105 cm	105 to 135 cm	135 to 165 cm	165 to 195 cm	195 to 229 cm
Dioxins/ Furans	1,2,3,4,6,7,8-HpCDF	µg/L	1.1E-07	6.6E-08	1.3E-07	2.9E-07	3.0E-07	3.1E-07	3.1E-07	3.1E-07
	1,2,3,4,7,8,9-HpCDF	µg/L	1.0E-08	5.1E-09	1.1E-08	2.3E-08	2.8E-08	3.5E-08	3.2E-08	2.9E-08
	OCDF	µg/L	1.1E-07	8.7E-08	1.1E-07	2.3E-07	2.4E-07	2.6E-07	2.4E-07	2.2E-07
PAHs	Fluoranthene	µg/L	2.7E-01	4.1E-01	1.3E-01	3.8E+00	2.5E+00	1.1E+00	6.5E-01	2.1E-01
Sediment Properties	Porosity[1]	--	0.65	0.73	0.72	0.70	0.71	0.72	0.72	0.72
	Dry Bulk Density[1]	g/cm^3	0.90	0.71	0.73	0.78	0.76	0.73	0.74	0.74
	f_{OC}	%	1.47	2.01	2.07	2.51	2.37	2.22	2.32	2.41

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran

Table M.2.6
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-SC1515

Group	Analyte	Unit	0 to 64 cm	64 to 125 cm	125 to 155 cm	155 to 185 cm	185 to 215 cm	215 to 245 cm	245 to 275 cm	275 to 310 cm	310 to 340 cm	340 to 370 cm
PCBs	PCB-Mono	µg/L	6.2E-06	1.4E-05	2.5E-06	1.9E-05	5.3E-05	7.7E-05	5.3E-05	1.6E-05	3.2E-06	2.0E-06
	PCB-Di	µg/L	9.8E-05	2.0E-04	4.1E-05	2.9E-04	8.5E-04	1.3E-03	8.8E-04	2.7E-04	5.3E-05	3.5E-05
	PCB-Tri	µg/L	5.9E-04	1.2E-03	2.5E-04	1.7E-03	5.2E-03	7.9E-03	5.4E-03	1.7E-03	3.3E-04	2.3E-04
	PCB-Tetra	µg/L	9.6E-04	1.9E-03	4.0E-04	2.9E-03	8.5E-03	1.3E-02	8.7E-03	2.6E-03	5.0E-04	3.2E-04
	PCB-Penta	µg/L	6.5E-04	1.4E-03	2.5E-04	2.1E-03	5.7E-03	8.3E-03	5.6E-03	1.6E-03	3.0E-04	1.5E-04
	PCB-Hexa	µg/L	2.3E-04	5.8E-04	8.5E-05	7.8E-04	1.9E-03	2.5E-03	1.7E-03	5.1E-04	9.8E-05	4.4E-05
	PCB-Hepta	µg/L	5.1E-05	1.5E-04	1.9E-05	1.8E-04	4.0E-04	5.0E-04	3.3E-04	1.1E-04	2.2E-05	9.3E-06
	PCB-Octa	µg/L	5.1E-06	1.5E-05	1.9E-06	1.8E-05	4.0E-05	4.8E-05	3.2E-05	1.0E-05	2.2E-06	9.3E-07
	PCB-Nona	µg/L	3.0E-07	9.1E-07	1.1E-07	1.1E-06	2.3E-06	2.8E-06	1.9E-06	6.1E-07	1.3E-07	5.5E-08
	PCB-Deca	µg/L	1.1E-08	3.4E-08	4.1E-09	4.0E-08	8.7E-08	1.0E-07	6.8E-08	2.3E-08	4.8E-09	2.0E-09
Sediment Properties	Porosity[1]	--	0.64	0.64	0.63	0.62	0.64	0.63	0.64	0.67	0.48	0.48
	Dry Bulk Density[1]	g/cm^3	0.93	0.93	0.96	0.99	0.94	0.96	0.92	0.85	1.34	1.36
	f_{OC}	%	1.60	1.68	1.76	1.67	1.69	1.73	2.07	1.77	0.74	0.97

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.7
Buried Contamination Modeling Input Parameter Values for Core Location LDW23-SC1156

Group	Analyte	Unit	0 to 82 cm	82 to 142 cm	142 to 202 cm
PCBs	PCB-Mono	µg/L	4.6E-06	1.4E-05	1.8E-05
	PCB-Di	µg/L	6.6E-05	1.9E-04	2.9E-04
	PCB-Tri	µg/L	3.8E-04	1.1E-03	1.8E-03
	PCB-Tetra	µg/L	6.3E-04	1.9E-03	2.8E-03
	PCB-Penta	µg/L	4.7E-04	1.4E-03	1.7E-03
	PCB-Hexa	µg/L	2.0E-04	6.1E-04	6.0E-04
	PCB-Hepta	µg/L	5.5E-05	1.6E-04	1.4E-04
	PCB-Octa	µg/L	5.7E-06	1.7E-05	1.4E-05
	PCB-Nona	µg/L	3.4E-07	1.0E-06	8.1E-07
	PCB-Deca	µg/L	1.3E-08	3.7E-08	3.0E-08
Sediment Properties	Porosity[1]	--	0.63	0.63	0.66
	Dry Bulk Density[1]	g/cm^3	0.96	0.96	0.87
	f_{OC}	%	2.28	1.52	1.79

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.8
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-IT1426

Group	Analyte	Unit	0 to 45 cm	45 to 75 cm	75 to 105 cm	105 to 135 cm	135 to 165 cm	165 to 195 cm	195 to 225 cm
PCBs	PCB-Mono	µg/L	3.3E-05	1.4E-05	6.1E-06	6.4E-06	3.6E-06	1.7E-05	1.4E-06
	PCB-Di	µg/L	4.8E-04	1.8E-04	6.7E-05	8.5E-05	3.2E-05	1.8E-04	6.3E-06
	PCB-Tri	µg/L	2.8E-03	1.0E-03	3.5E-04	4.8E-04	1.4E-04	8.9E-04	1.1E-05
	PCB-Tetra	µg/L	4.8E-03	1.7E-03	6.1E-04	8.3E-04	2.7E-04	1.6E-03	3.3E-05
	PCB-Penta	µg/L	3.7E-03	1.4E-03	5.7E-04	6.8E-04	3.1E-04	1.6E-03	9.5E-05
	PCB-Hexa	µg/L	1.4E-03	7.1E-04	3.7E-04	3.2E-04	2.5E-04	1.1E-03	1.2E-04
	PCB-Hepta	µg/L	3.5E-04	2.1E-04	1.2E-04	8.9E-05	8.8E-05	3.5E-04	4.6E-05
	PCB-Octa	µg/L	3.6E-05	2.2E-05	1.3E-05	9.3E-06	9.5E-06	3.8E-05	5.0E-06
	PCB-Nona	µg/L	2.1E-06	1.3E-06	7.6E-07	5.5E-07	5.6E-07	2.3E-06	3.0E-07
	PCB-Deca	µg/L	7.8E-08	4.9E-08	2.8E-08	2.0E-08	2.1E-08	8.4E-08	1.1E-08
Sediment Properties	Porosity[1]	--	0.48	0.68	0.69	0.64	0.66	0.66	0.66
	Dry Bulk Density[1]	g/cm^3	1.36	0.84	0.82	0.93	0.89	0.89	0.89
	f_{OC}	%	0.37	2.43	3.17	3.04	3.57	2.50	3.23

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.9
Buried Contamination Modeling Input Parameter Values for Core Location LDW-SC37

Group	Analyte	Unit	0 to 31 cm	31 to 61 cm	61 to 122 cm	122 to 162 cm	162 to 210 cm
Metal	Copper	µg/L	7.5E+01	1.0E+02	9.3E+02	4.7E+02	6.7E+00
	Lead	µg/L	3.0E+00	6.2E+00	8.8E+01	4.4E+01	4.0E-01
	Zinc	µg/L	3.1E+01	3.9E+01	3.7E+02	1.9E+02	6.2E+00
PAHs	Benzo(a)anthracene	µg/L	1.3E-01	3.1E-01	5.3E-01	4.3E-01	1.9E-02
	Benzo(a)pyrene	µg/L	8.8E-02	2.0E-01	1.8E-01	1.4E-01	6.0E-03
	Benzo(g,h,i)perylene	µg/L	9.4E-03	1.5E-02	1.5E-02	1.2E-02	2.4E-03
	Chrysene	µg/L	1.7E-01	4.4E-01	5.4E-01	4.4E-01	1.8E-02
	Dibenzo(a,h)anthracene	µg/L	1.9E-03	3.4E-03	3.0E-03	2.6E-03	6.5E-04
	Fluoranthene	µg/L	7.1E-01	1.7E+00	5.8E+00	4.7E+00	1.7E-01
	Indeno(1,2,3-cd)pyrene	µg/L	8.2E-03	1.4E-02	1.3E-02	1.1E-02	1.5E-03
	Phenanthrene	µg/L	5.0E-01	1.7E+00	1.1E+01	8.7E+00	2.7E-01
	Pyrene	µg/L	1.9E+00	5.0E+00	5.8E+00	4.7E+00	3.5E-01
	Total benzofluoranthenes	µg/L	1.5E-01	2.5E-01	2.7E-01	2.2E-01	4.1E-03
SVOCs	1,2,4-Trichlorobenzene	µg/L	1.5E-02	1.8E-02	2.4E-01	2.0E-01	7.0E-02
	1,2-Dichlorobenzene	µg/L	8.0E-02	1.5E-01	2.9E+00	2.3E+00	2.6E-01
Sediment Properties	Porosity[1]	--	0.69	0.64	0.64	0.48	0.41
	Dry Bulk Density[1]	g/cm^3	0.84	0.93	0.97	1.36	1.55
	f_{OC}	%	2.25	2.67	2.24	1.39	0.54

Notes:
1. Porosity and dry bulk density were estimated using measured total solids.

--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PAH: polycyclic aromatic hydrocarbon
SVOC: semivolatile organic compound

Table M.2.10
Buried Contamination Modeling Input Parameter Values for Core Location SC-01

Group	Analyte	Unit	0 to 30 cm	30 to 61 cm	61 to 91 cm	91 to 122 cm	122 to 153 cm
PCBs	PCB-Mono	µg/L	0.0E+00	1.2E-04	2.7E-04	1.8E-04	5.9E-04
	PCB-Di	µg/L	0.0E+00	1.4E-03	3.2E-03	2.1E-03	7.0E-03
	PCB-Tri	µg/L	0.0E+00	1.7E-03	3.9E-03	2.6E-03	8.5E-03
	PCB-Tetra	µg/L	0.0E+00	1.3E-03	2.6E-03	1.7E-03	5.8E-03
	PCB-Penta	µg/L	0.0E+00	1.5E-03	2.4E-03	1.4E-03	5.2E-03
	PCB-Hexa	µg/L	0.0E+00	9.6E-04	1.1E-03	5.9E-04	1.9E-03
	PCB-Hepta	µg/L	0.0E+00	3.0E-04	2.9E-04	1.4E-04	4.0E-04
	PCB-Octa	µg/L	0.0E+00	3.2E-05	2.9E-05	1.4E-05	4.0E-05
	PCB-Nona	µg/L	0.0E+00	1.9E-06	1.7E-06	8.3E-07	2.3E-06
	PCB-Deca	µg/L	0.0E+00	7.0E-08	6.4E-08	3.0E-08	8.4E-08
PAHs	Acenaphthene	µg/L	0.0E+00	6.9E-02	1.7E-01	3.9E-01	2.5E+00
	Fluoranthene	µg/L	0.0E+00	1.3E-01	2.0E-01	2.6E-01	2.7E+00
Phthalates	BBP	µg/L	0.0E+00	3.2E-02	1.6E-01	1.9E-02	5.9E-02
Sediment Properties	Porosity[1]	--	0.40	0.70	0.63	0.59	0.47
	Dry Bulk Density[1]	g/cm^3	1.56	0.78	0.97	1.06	1.38
	f_{OC}	%	0.10	2.15	1.54	4.69	1.01

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
BBP: butyl benzyl phthalate
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl

Table M.2.11
Buried Contamination Modeling Input Parameter Values for Core Location SC-02

Group	Analyte	Unit	0 to 30 cm	30 to 61 cm	61 to 91 cm	91 to 122 cm	122 to 153 cm
PCBs	PCB-Mono	µg/L	0.0E+00	1.6E-04	1.6E-04	7.3E-05	1.3E-04
	PCB-Di	µg/L	0.0E+00	1.9E-03	1.9E-03	8.6E-04	1.5E-03
	PCB-Tri	µg/L	0.0E+00	2.3E-03	2.3E-03	1.0E-03	1.8E-03
	PCB-Tetra	µg/L	0.0E+00	1.7E-03	1.8E-03	8.0E-04	1.2E-03
	PCB-Penta	µg/L	0.0E+00	1.6E-03	1.8E-03	8.2E-04	1.1E-03
	PCB-Hexa	µg/L	0.0E+00	7.5E-04	8.0E-04	3.7E-04	4.9E-04
	PCB-Hepta	µg/L	0.0E+00	2.0E-04	2.0E-04	9.6E-05	1.3E-04
	PCB-Octa	µg/L	0.0E+00	2.0E-05	2.0E-05	9.8E-06	1.3E-05
	PCB-Nona	µg/L	0.0E+00	1.2E-06	1.2E-06	5.8E-07	7.9E-07
	PCB-Deca	µg/L	0.0E+00	4.4E-08	4.3E-08	2.1E-08	2.9E-08
Phthalates	BBP	µg/L	0.0E+00	3.4E-02	9.0E-02	1.8E-02	3.3E-02
Sediment Properties	Porosity[1]	--	0.40	0.70	0.62	0.63	0.64
	Dry Bulk Density[1]	g/cm^3	1.56	0.78	0.98	0.95	0.95
	f_{OC}	%	0.10	2.44	1.94	1.60	2.19

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.

--: not applicable
µg/L: microgram per liter
BBP: butyl benzyl phthalate
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PCB: polychlorinated biphenyl

Table M.2.12
Buried Contamination Modeling Input Parameter Values for Core Location SC-032

Group	Analyte	Unit	0 to 30 cm	30 to 61 cm	61 to 91 cm	91 to 122 cm	122 to 145 cm
PCBs	PCB-Mono	µg/L	0.0E+00	2.3E-04	3.4E-04	2.3E-03	--
	PCB-Di	µg/L	0.0E+00	2.7E-03	4.1E-03	2.7E-02	--
	PCB-Tri	µg/L	0.0E+00	3.2E-03	4.9E-03	3.3E-02	--
	PCB-Tetra	µg/L	0.0E+00	2.1E-03	3.1E-03	2.3E-02	--
	PCB-Penta	µg/L	0.0E+00	1.8E-03	2.6E-03	2.0E-02	--
	PCB-Hexa	µg/L	0.0E+00	8.1E-04	1.1E-03	7.7E-03	--
	PCB-Hepta	µg/L	0.0E+00	2.0E-04	2.6E-04	1.7E-03	--
	PCB-Octa	µg/L	0.0E+00	2.1E-05	2.6E-05	1.7E-04	--
	PCB-Nona	µg/L	0.0E+00	1.2E-06	1.5E-06	9.8E-06	--
	PCB-Deca	µg/L	0.0E+00	4.5E-08	5.6E-08	3.6E-07	--
PAHs	Benzo(a)anthracene	µg/L	0.0E+00	2.1E-02	3.9E-01	3.1E-01	1.3E-02
	Benzo(a)pyrene	µg/L	0.0E+00	1.1E-02	7.6E-02	4.0E-02	2.7E-03
	Benzo(g,h,i)perylene	µg/L	0.0E+00	1.7E-03	5.9E-03	3.6E-03	9.4E-04
	Chrysene	µg/L	0.0E+00	2.4E-02	3.9E-01	2.9E-01	9.4E-03
	Dibenzo(a,h)anthracene	µg/L	0.0E+00	4.6E-04	2.1E-03	9.3E-04	4.9E-04
	Fluoranthene	µg/L	0.0E+00	1.8E-01	1.2E+00	1.4E+00	5.7E-02
	Indeno(1,2,3-cd)pyrene	µg/L	0.0E+00	1.6E-03	6.6E-03	3.0E-03	4.8E-04
	Pyrene	µg/L	0.0E+00	6.5E-01	1.0E+01	5.3E+00	4.3E-01
	Total benzofluoranthenes	µg/L	0.0E+00	1.6E-02	1.2E-01	6.3E-02	3.1E-03
Sediment Properties	Porosity[1]	--	0.40	0.63	0.53	0.20	0.27
	Dry Bulk Density[1]	g/cm^3	1.56	0.96	1.22	2.07	1.91
	f_{OC}	%	0.10	1.88	1.30	0.33	0.08

Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
The evaluation only simulated the top 122 cm of PCBs because PCBs were not detected beyond 122 cm.

1. Porosity and dry bulk density were estimated using measured total solids.

--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: gram per cubic centimeter
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl

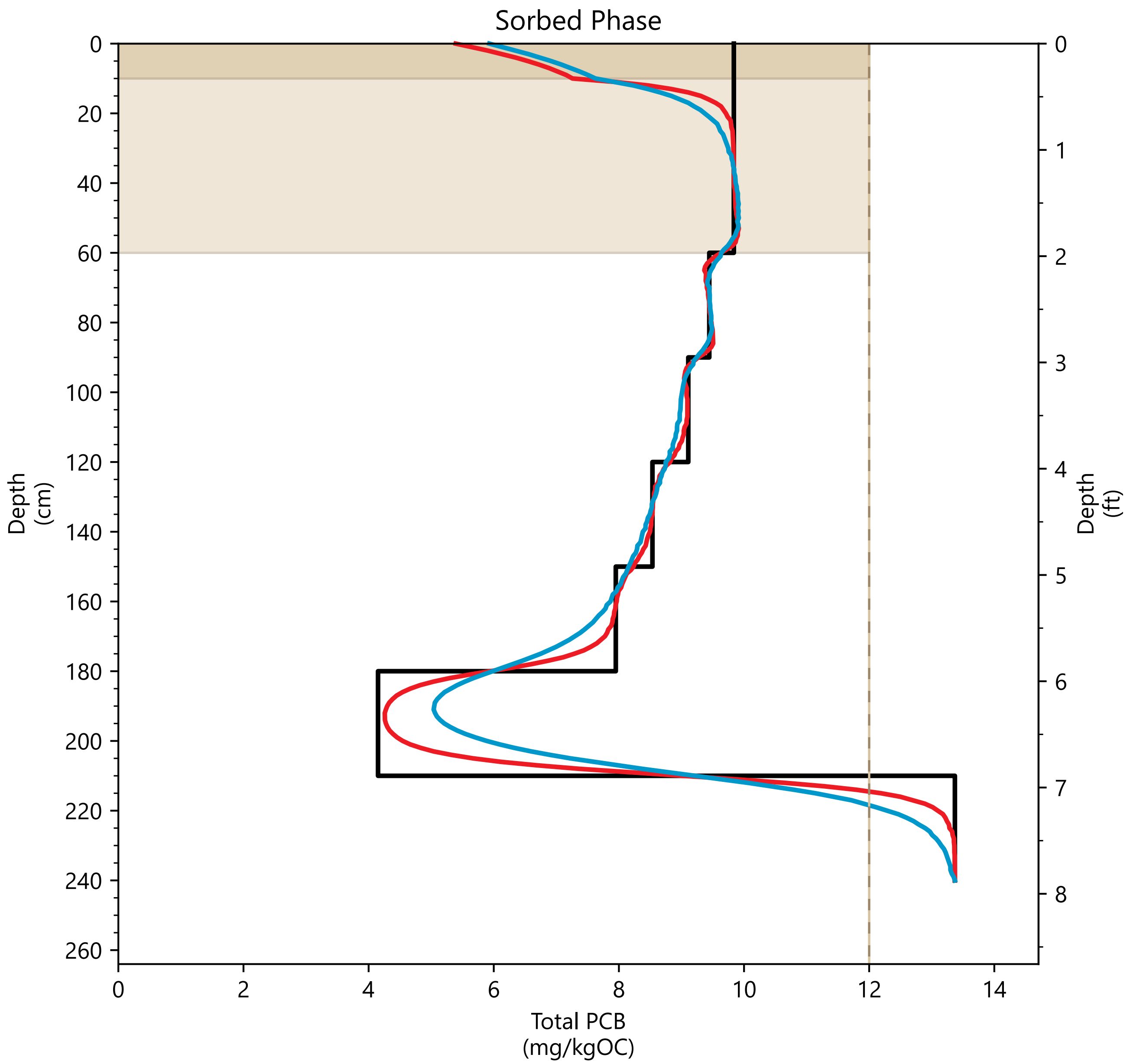
Table M.2.13
Buried Contamination Modeling Input Parameter Values for Core Location LDW24-SC1323

Group	Analyte	Unit	0 to 85 cm	85 to 115 cm	115 to 145 cm	145 to 175 cm	175 to 205 cm	205 to 235 cm	235 to 265 cm	265 to 295 cm	295 to 325 cm
PCBs	PCB-Mono	µg/L	1.1E-05	2.0E-05	1.8E-05	1.7E-05	1.7E-05	4.1E-05	6.0E-05	7.4E-05	8.3E-05
	PCB-Di	µg/L	1.7E-04	2.8E-04	2.5E-04	2.5E-04	2.5E-04	7.0E-04	1.1E-03	1.2E-03	1.4E-03
	PCB-Tri	µg/L	9.9E-04	1.6E-03	1.4E-03	1.4E-03	1.4E-03	4.5E-03	6.9E-03	7.8E-03	8.4E-03
	PCB-Tetra	µg/L	1.7E-03	2.8E-03	2.5E-03	2.5E-03	2.6E-03	6.5E-03	9.5E-03	1.2E-02	1.4E-02
	PCB-Penta	µg/L	1.2E-03	2.3E-03	2.0E-03	2.1E-03	2.1E-03	3.3E-03	4.2E-03	7.3E-03	9.4E-03
	PCB-Hexa	µg/L	4.6E-04	9.1E-04	8.2E-04	8.2E-04	8.1E-04	1.1E-03	1.3E-03	2.2E-03	2.9E-03
	PCB-Hepta	µg/L	1.1E-04	2.2E-04	2.1E-04	2.0E-04	1.9E-04	2.4E-04	2.9E-04	4.4E-04	5.5E-04
	PCB-Octa	µg/L	1.1E-05	2.3E-05	2.1E-05	2.0E-05	1.9E-05	2.5E-05	2.9E-05	4.3E-05	5.3E-05
	PCB-Nona	µg/L	6.3E-07	1.4E-06	1.3E-06	1.2E-06	1.1E-06	1.5E-06	1.7E-06	2.5E-06	3.1E-06
	PCB-Deca	µg/L	2.3E-08	5.0E-08	4.6E-08	4.4E-08	4.1E-08	5.5E-08	6.5E-08	9.4E-08	1.1E-07
Sediment Properties	Porosity[1]	--	0.70	0.67	0.65	0.65	0.66	0.63	0.61	0.63	0.64
	Dry Bulk Density[1]	g/cm^3	0.79	0.85	0.92	0.91	0.89	0.95	1.02	0.97	0.92
	f_{OC}	%	2.07	1.80	1.78	1.50	1.21	1.37	1.52	1.85	2.17

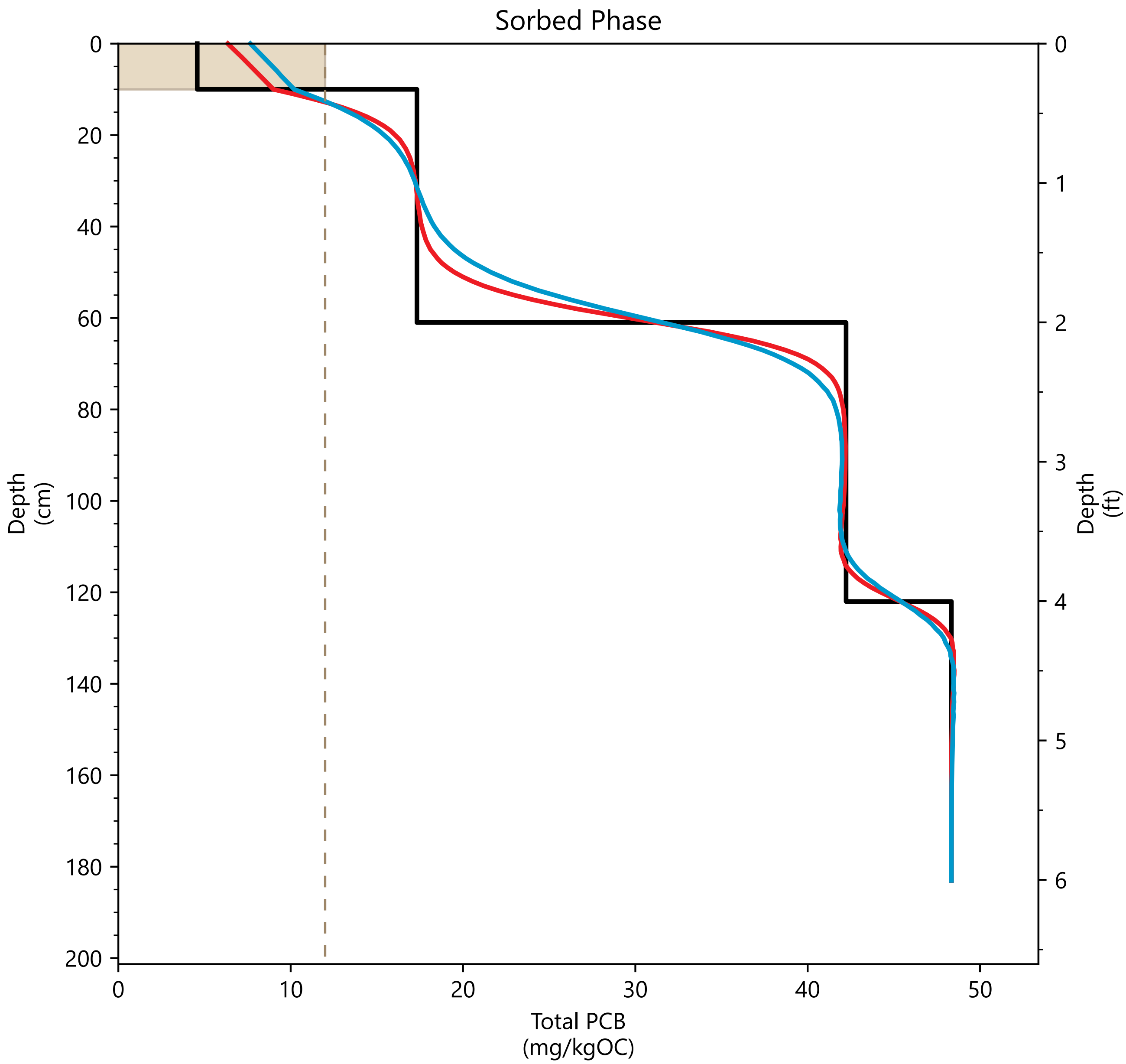
Notes:
PCB congener concentrations were calculated from the measured Aroclor PCB concentrations in sediment based on the composition of an Aroclor. See Section 2.1 for further detail.
1. Porosity and dry bulk density were estimated using measured total solids.
--: not applicable
µg/L: microgram per liter
cm: centimeter
f_{OC}: fraction organic carbon
g/cm^3: grams per cubic centimeter
PCB: polychlorinated biphenyl

Appendix M – Chemical Fate and Transport Modeling to Support Buried Contamination Evaluation

Attachment M.3
Model-Predicted COC Concentrations for Buried Contamination Evaluation



The shaded areas represent the 10 cm and 60 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 60 cm).



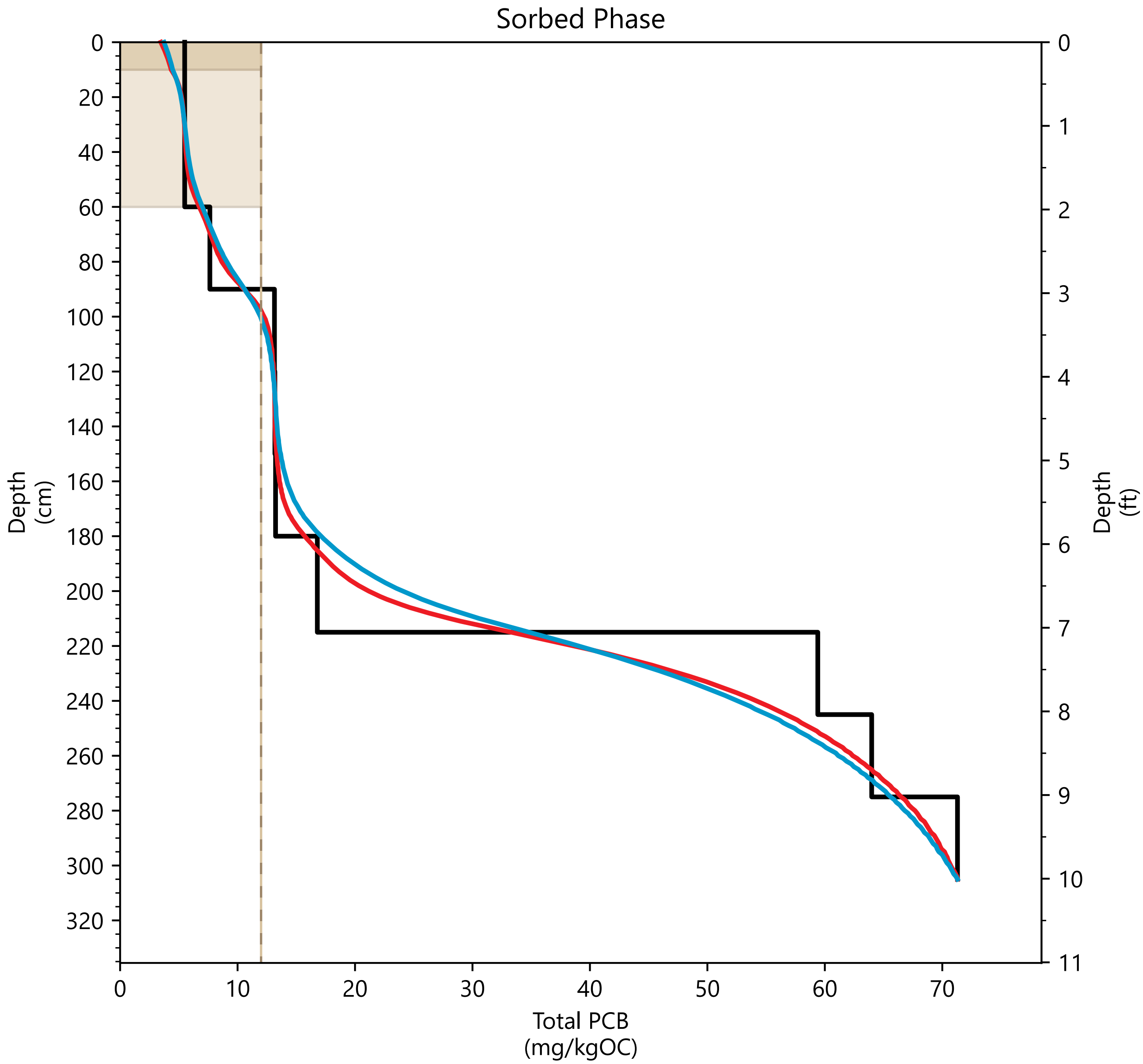
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

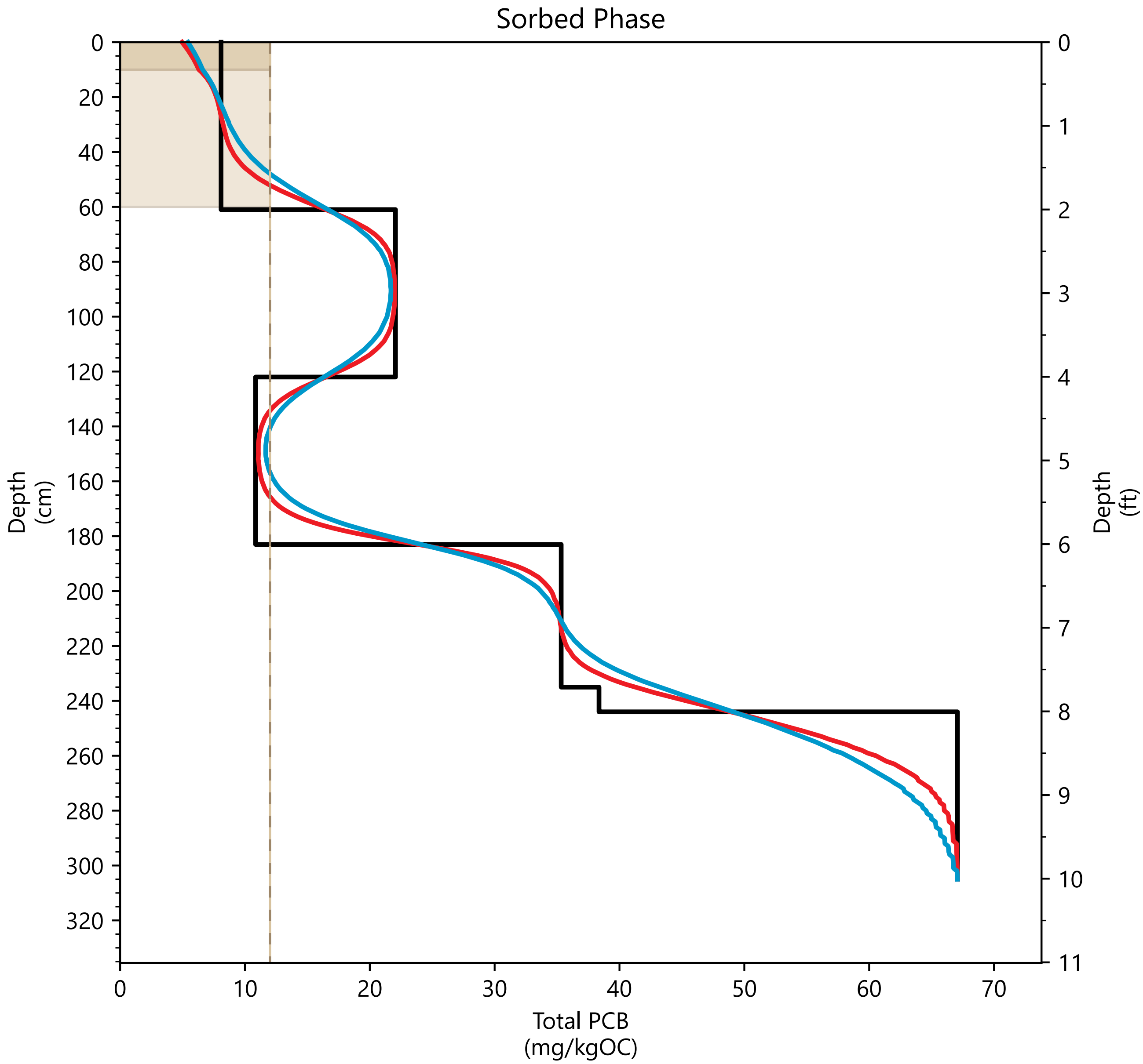
Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.2a
Core Profiles of Total PCB for SC06

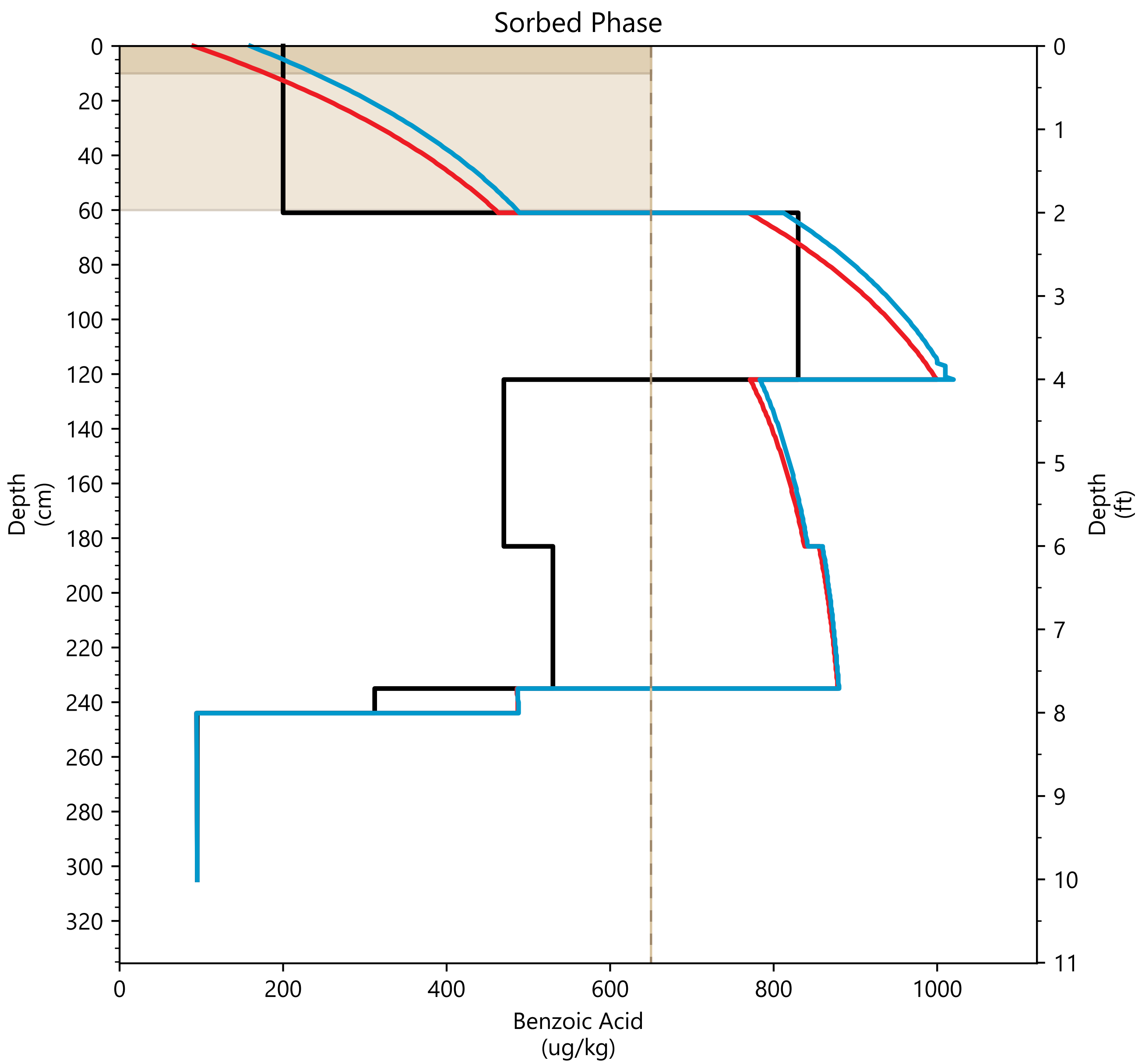


The shaded areas represent the 10 cm and 60 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 60 cm).



The shaded areas represent the 10 cm and 60 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 60 cm).

Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

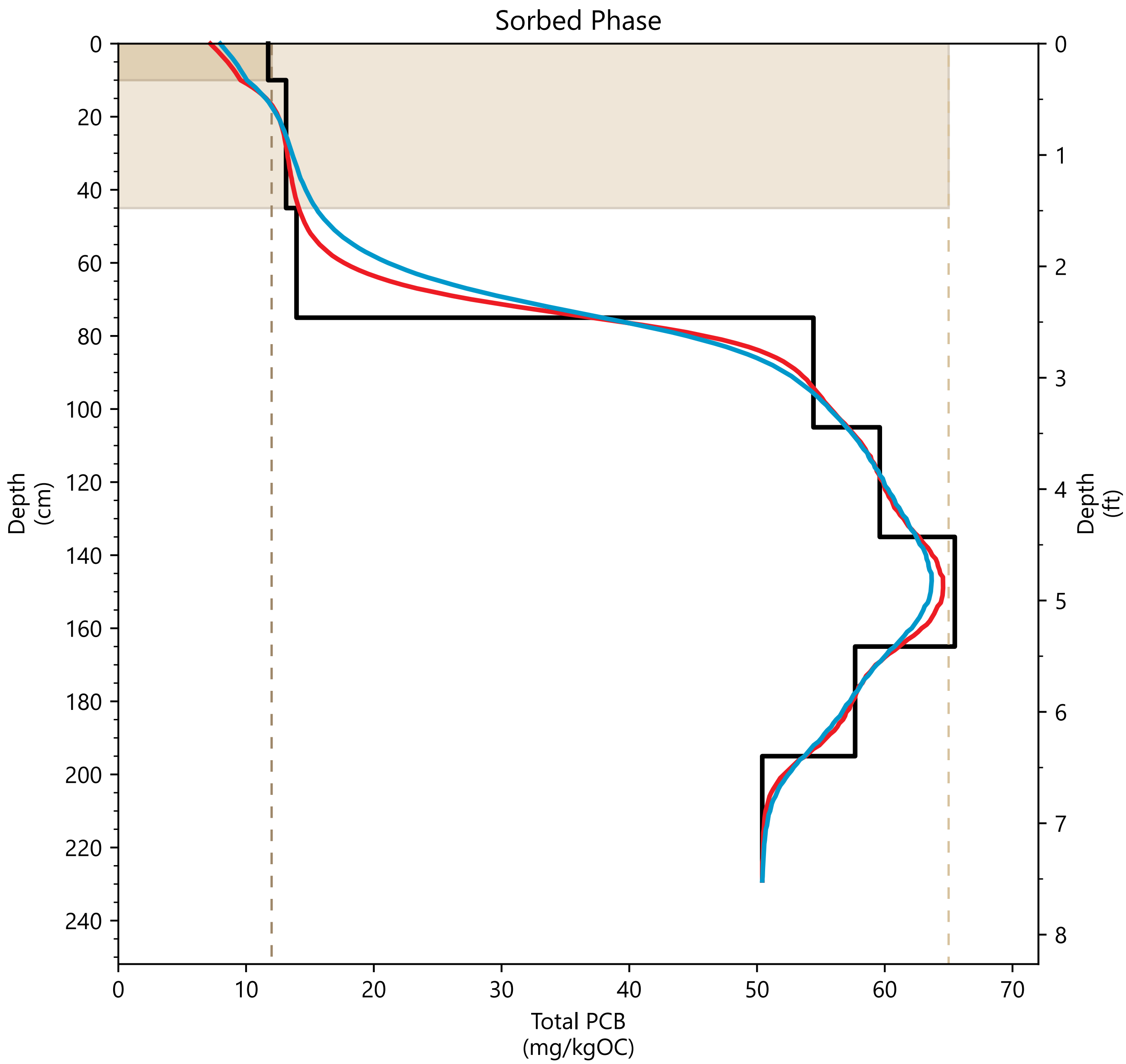


The shaded areas represent the 10 cm and 60 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 60 cm).

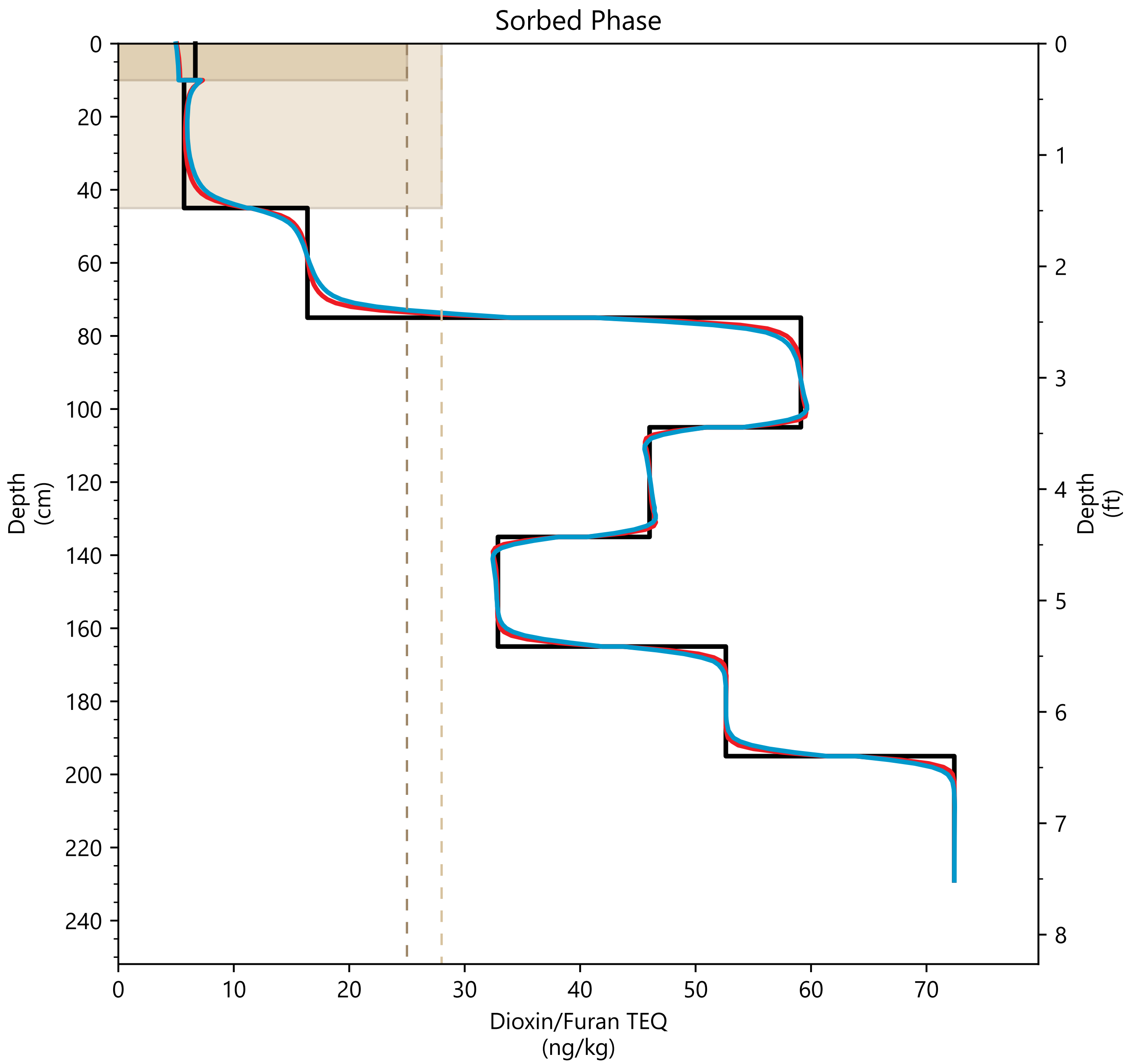
Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL
0-60cm RAL

ANCHOR QEA

Figure M.3.4b
Core Profiles of Benzoic Acid for DENW6721-SSED-SB-12A-2014



The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).

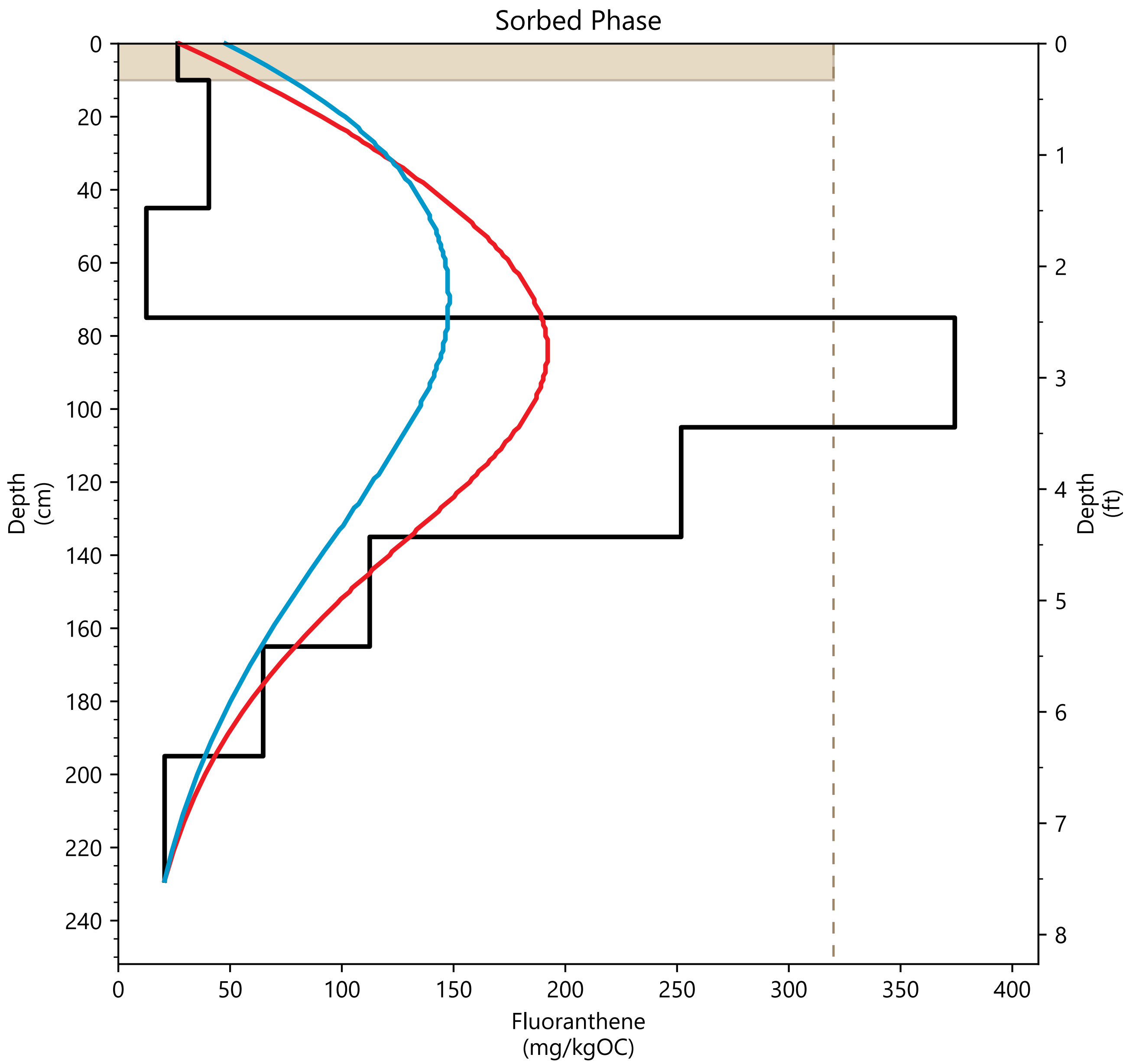


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies
(i.e., 0 to 10 cm and 0 to 45 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL
0-45cm RAL

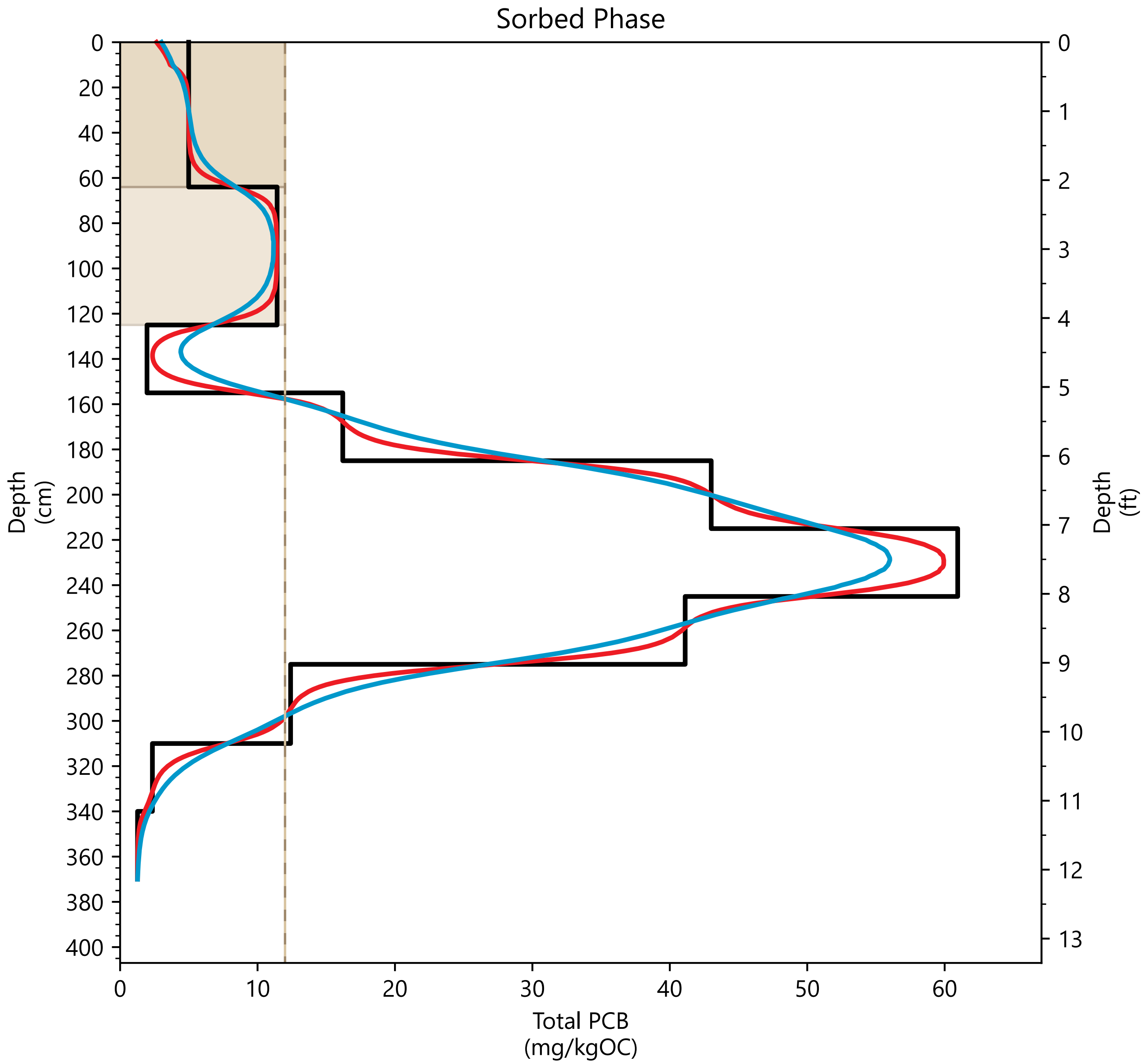
Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

Figure M.3.5b
Core Profiles of Dioxin/Furan TEQ for LDW24-IT1546



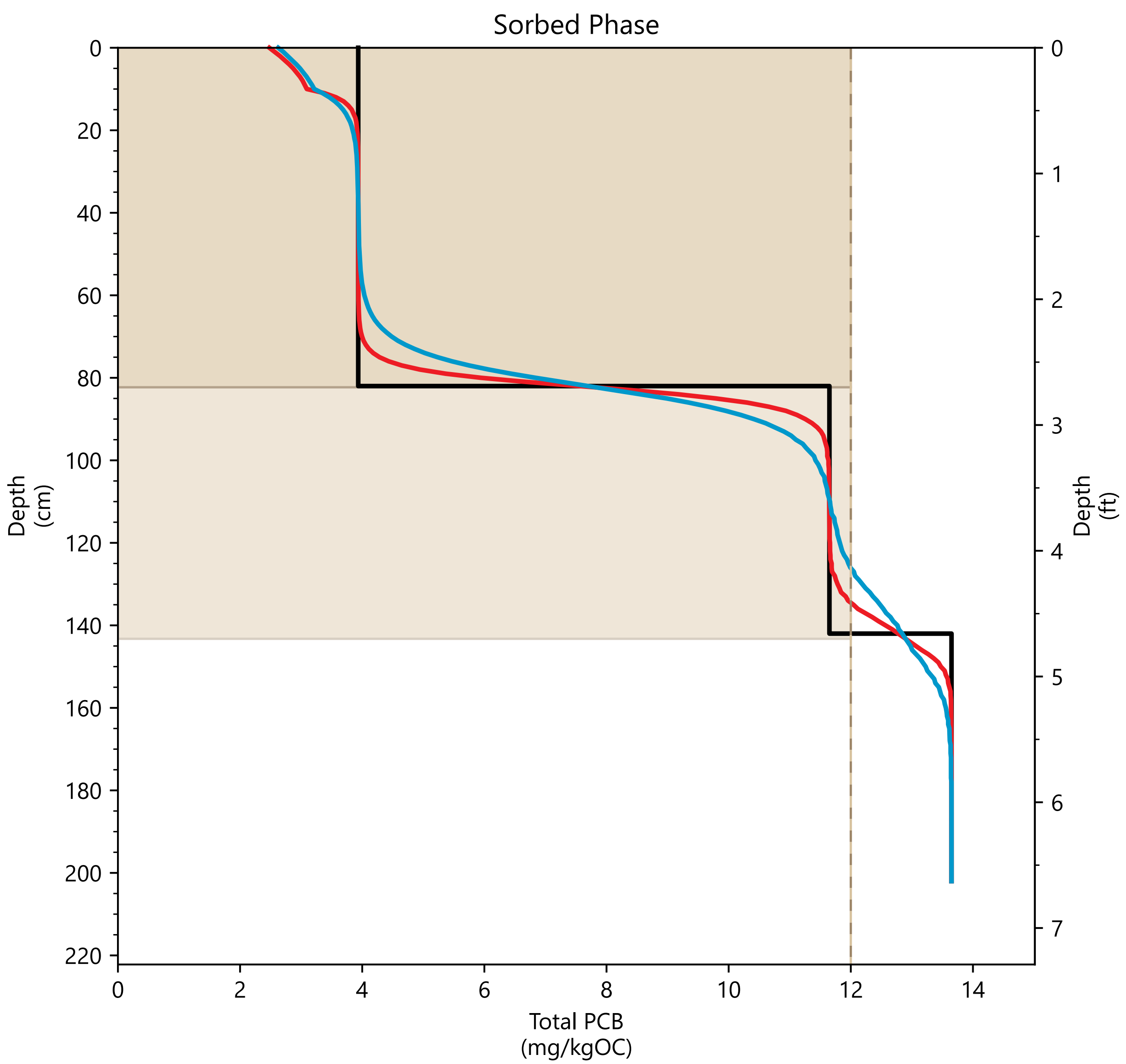
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

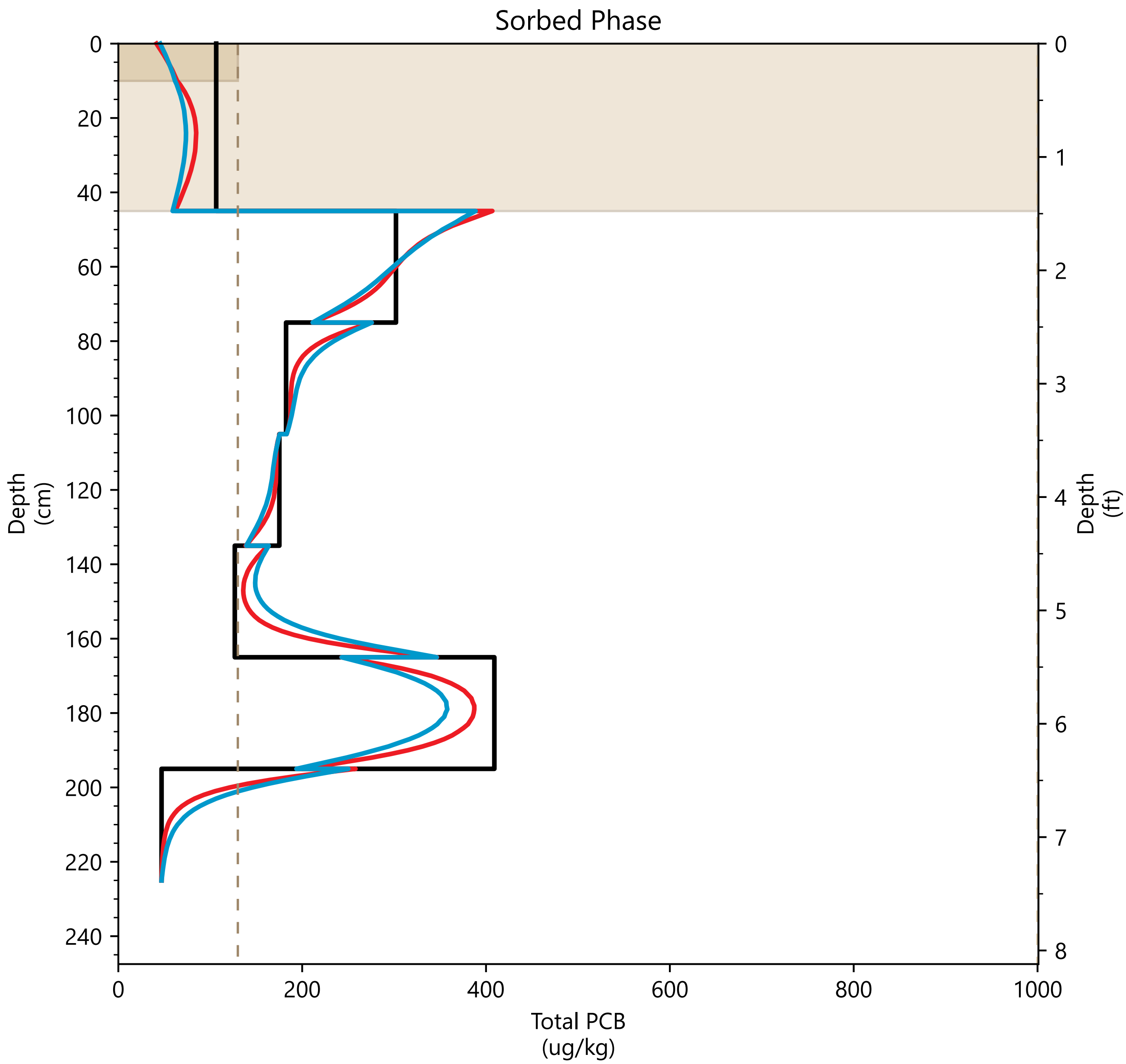


The shaded areas represent the RALs for the sediment depth above the FNC and 2 feet below the FNC in shoaled areas.

Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py



The shaded areas represent the RALs for the sediment depth above the FNC and 2 feet below the FNC in shoaled areas.



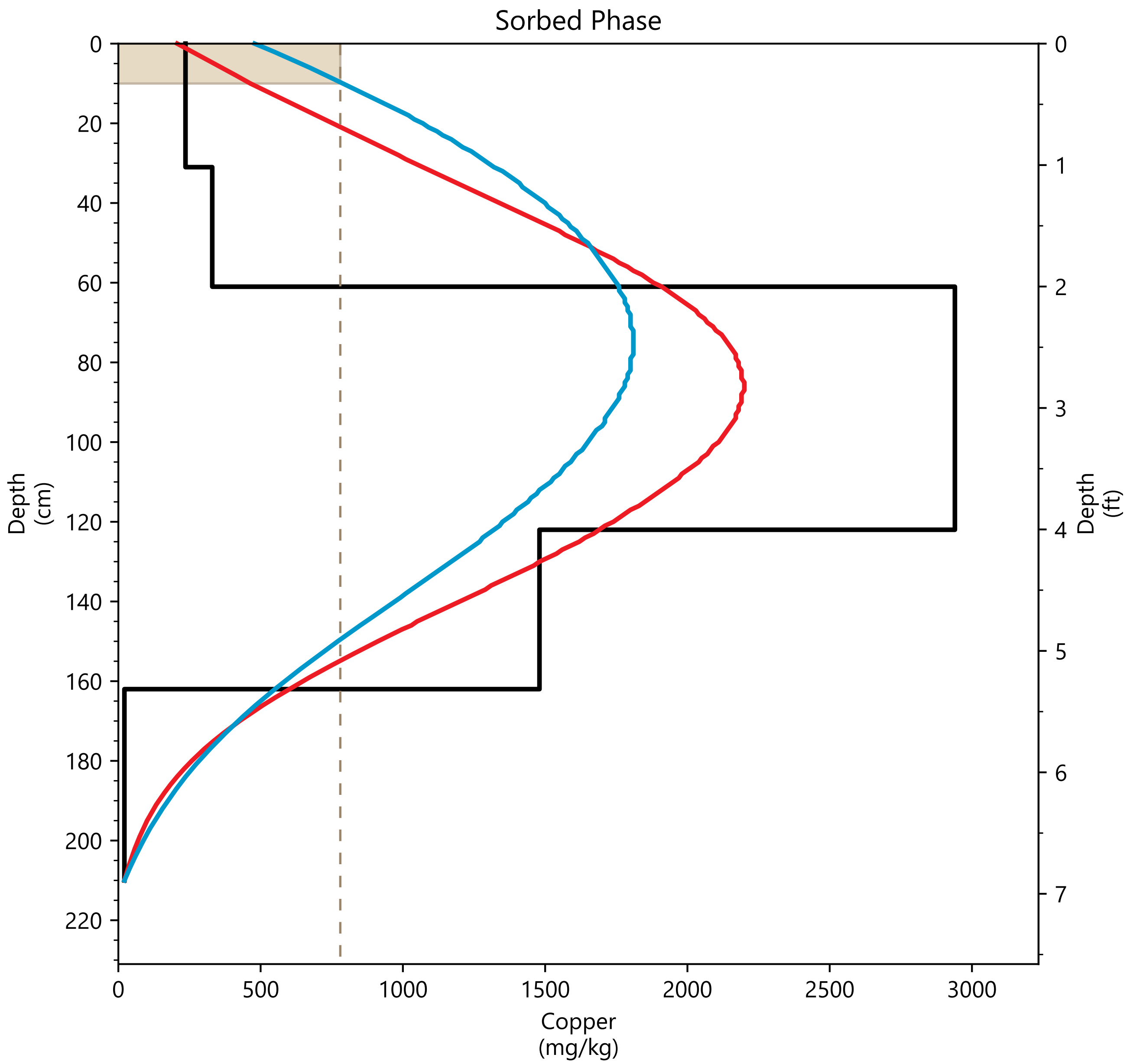
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Due to low TOC content in the surface sediment, dry-weight PCB concentrations were compared to the dry-weight RAL.

- Year 0
- Year 100 (400 cm/yr)
- Year 100 (800 cm/yr)
- 0-10cm RAL
- 0-45cm RAL

Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

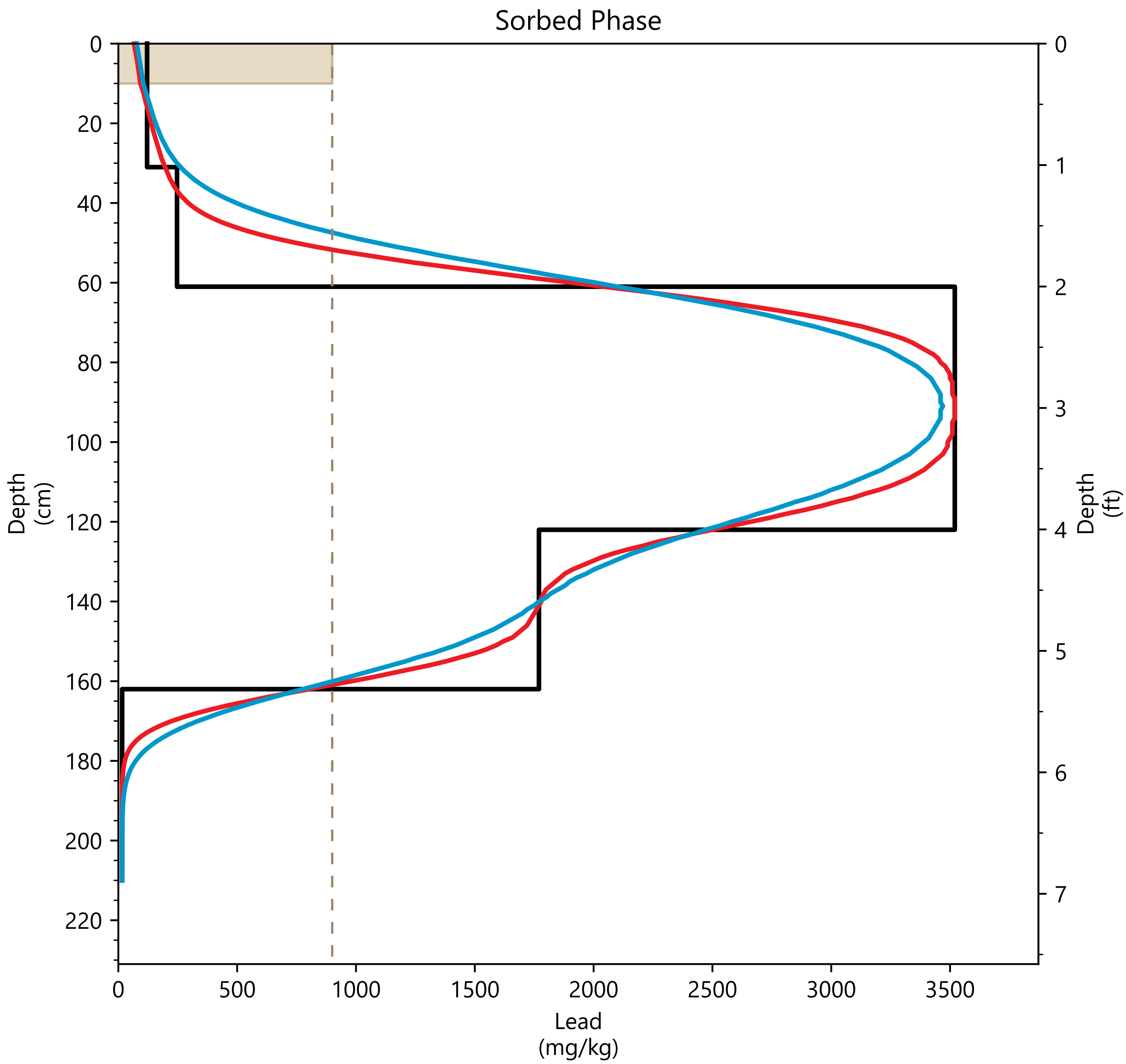
Figure M.3.8a
Core Profiles of Total PCB for LDW24-IT1426



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

Publish Date: 06/25/2026 10:58 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

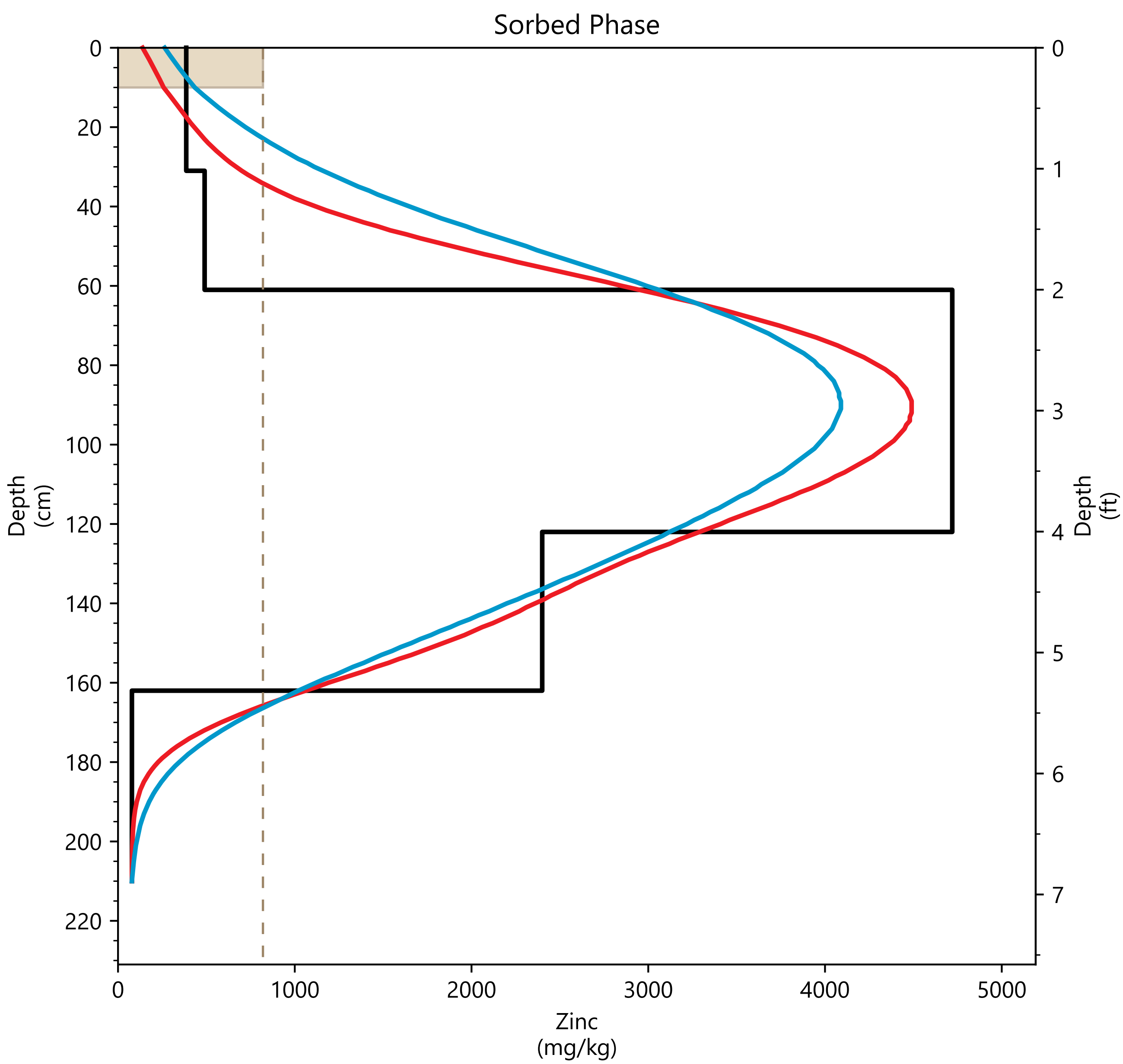


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

Publish Date: 06/25/2026 10:59 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

Figure M.3.9b
Core Profiles of Lead for LDW-SC37



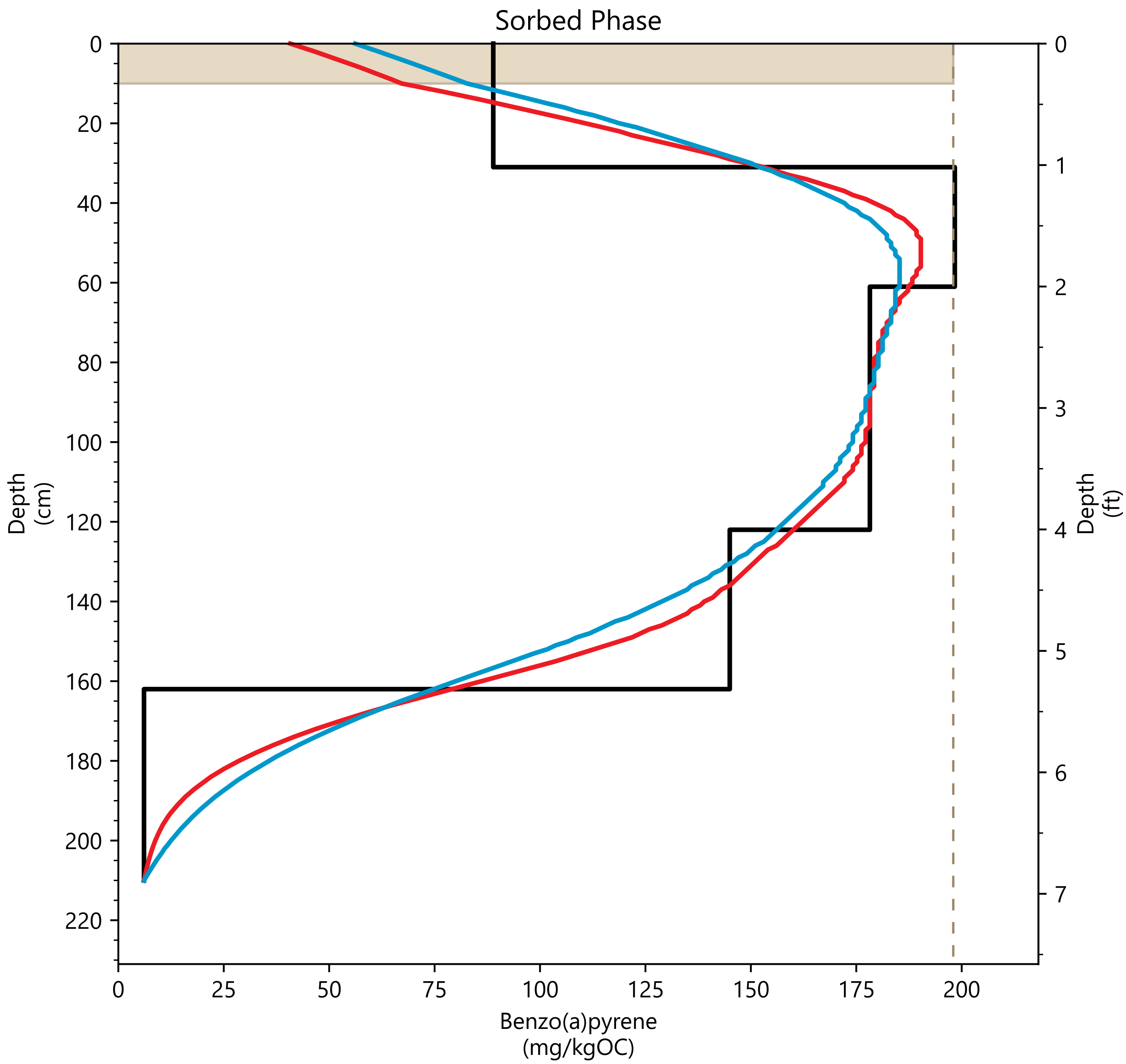
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

- Year 0
- Year 100 (400 cm/yr)
- Year 100 (800 cm/yr)
- 0-10cm RAL

Publish Date: 06/25/2026 10:59 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

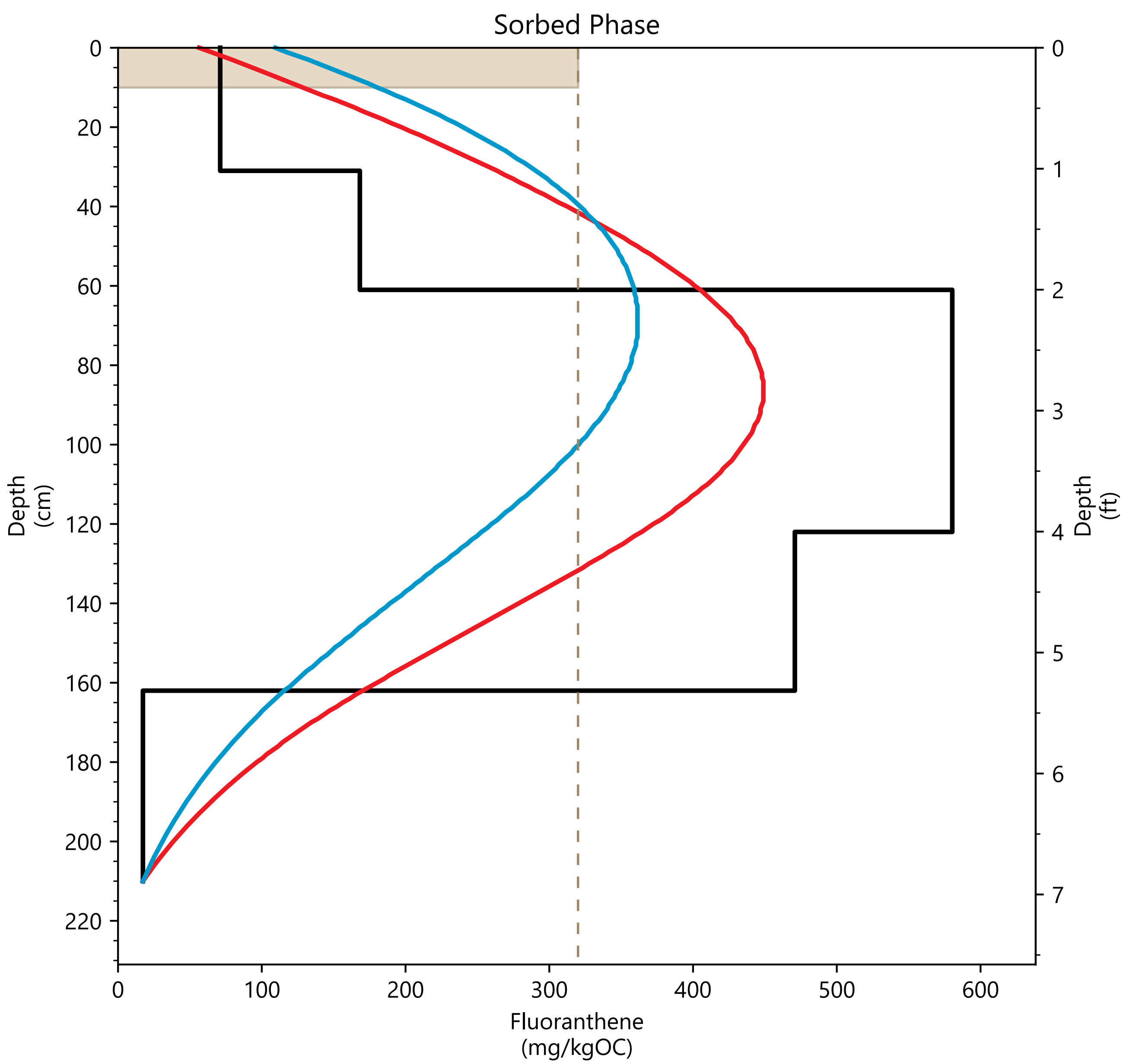
ANCHOR QEA

Figure M.3.9c
Core Profiles of Zinc for LDW-SC37
60% Remedial Design Basis of Design Report
LDW Middle Reach



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Figure M.3.9d
Core Profiles of Benzo(a)pyrene for LDW-SC37
60% Remedial Design Basis of Design Report
LDW Middle Reach



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

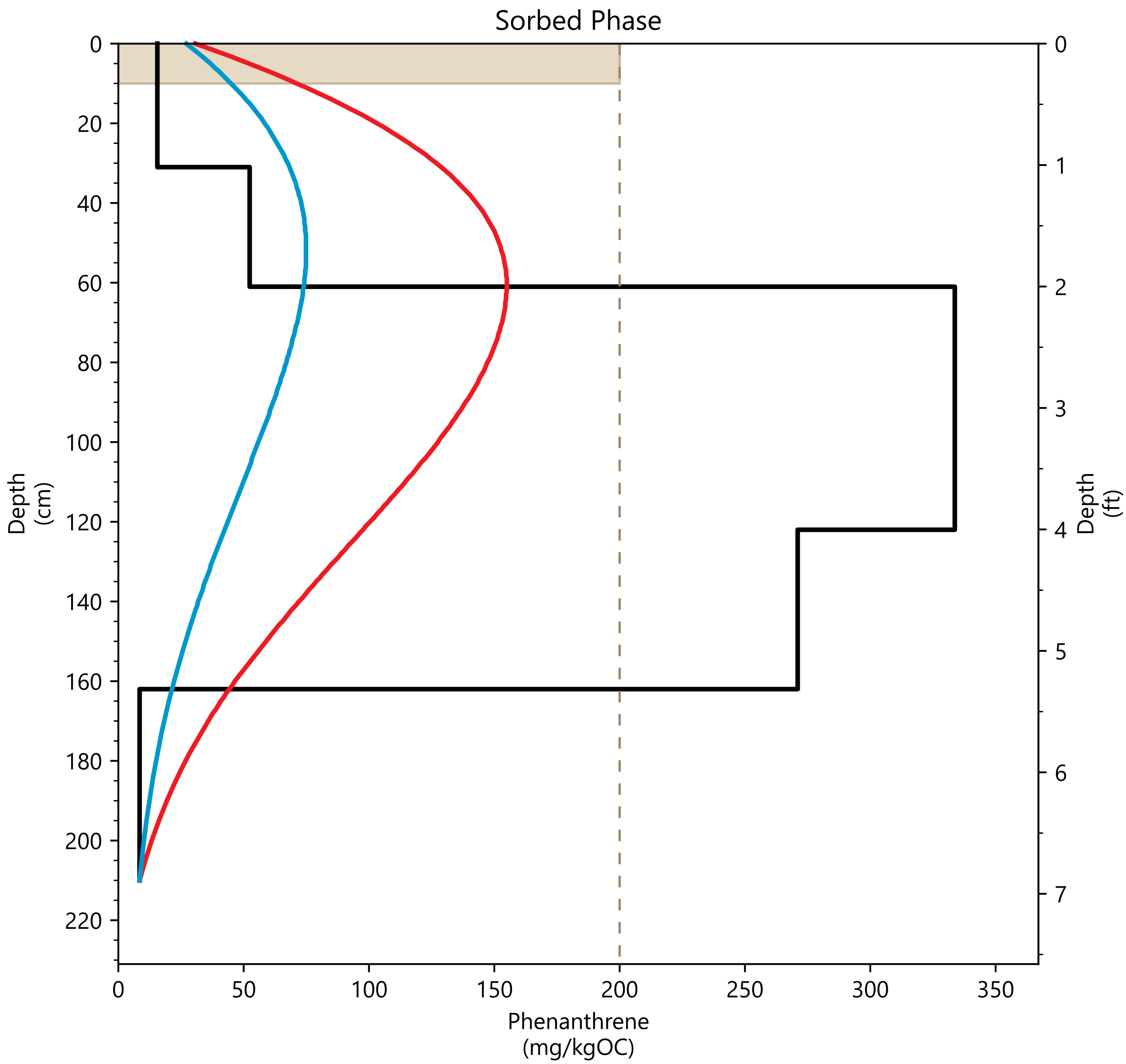
- Year 0
- Year 100 (400 cm/yr)
- Year 100 (800 cm/yr)
- 0-10cm RAL

Publish Date: 06/25/2026 10:59 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

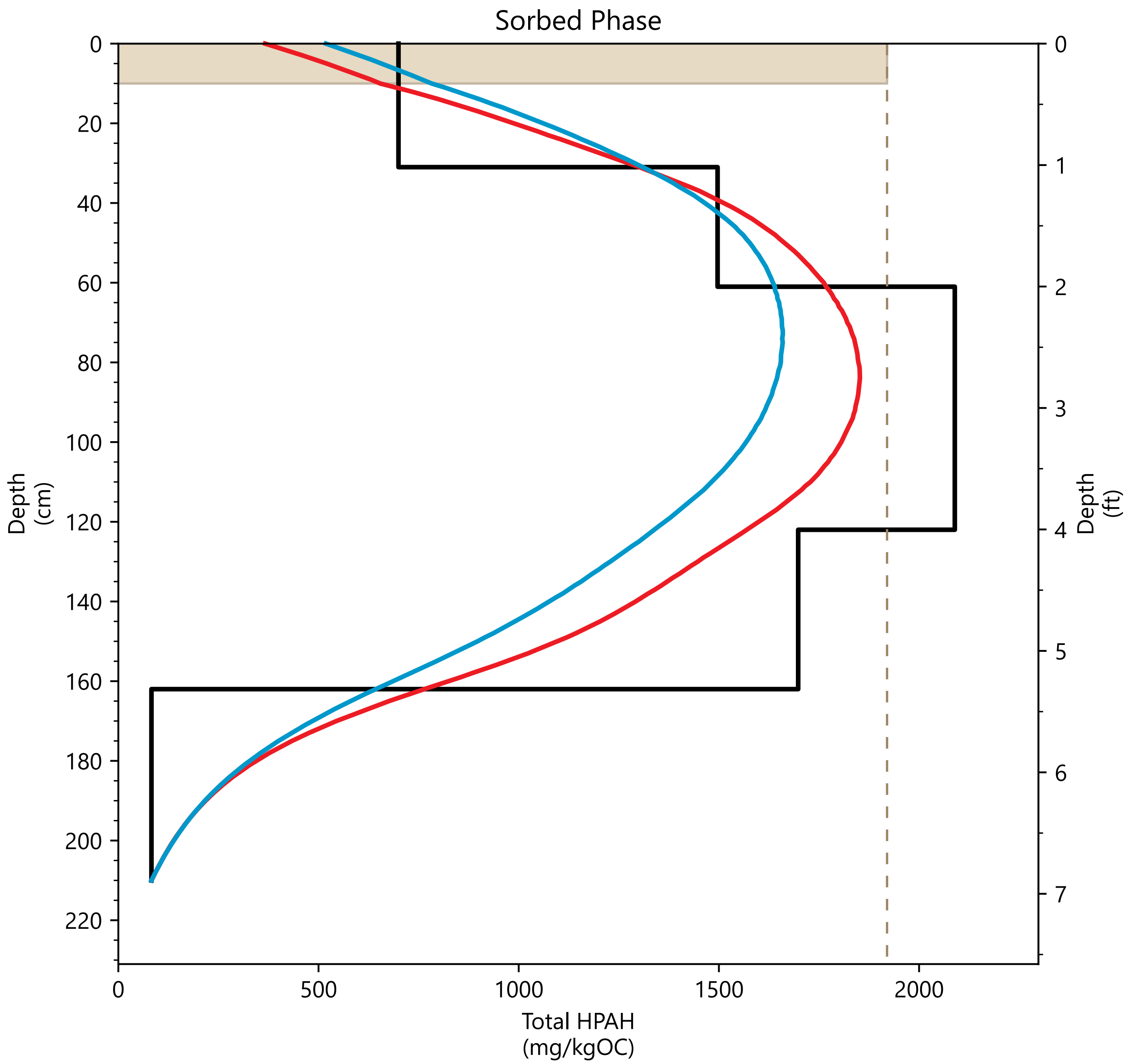
ANCHOR QEA

Figure M.3.9e
Core Profiles of Fluoranthene for LDW-SC37

60% Remedial Design Basis of Design Report
LDW Middle Reach

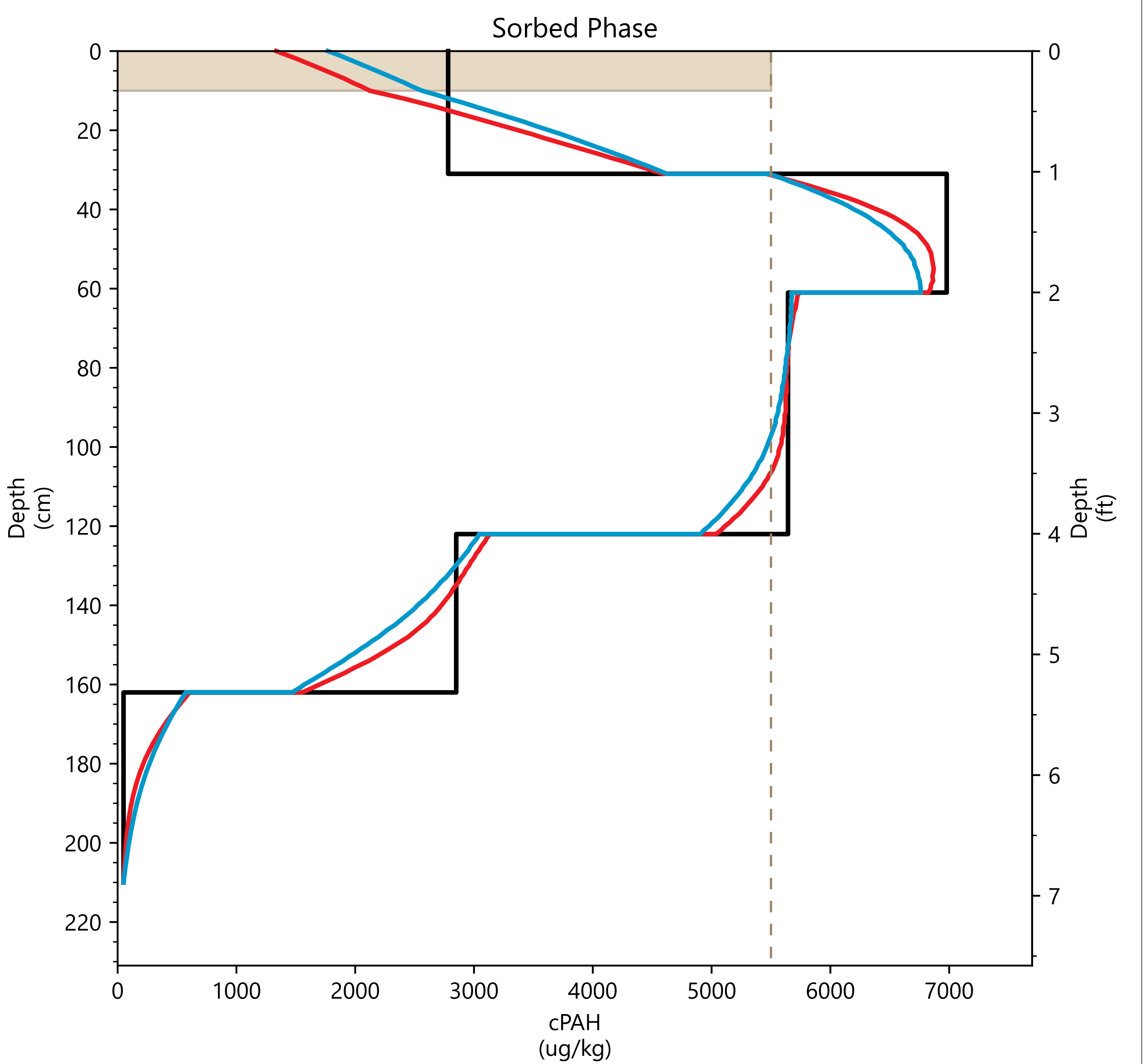


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

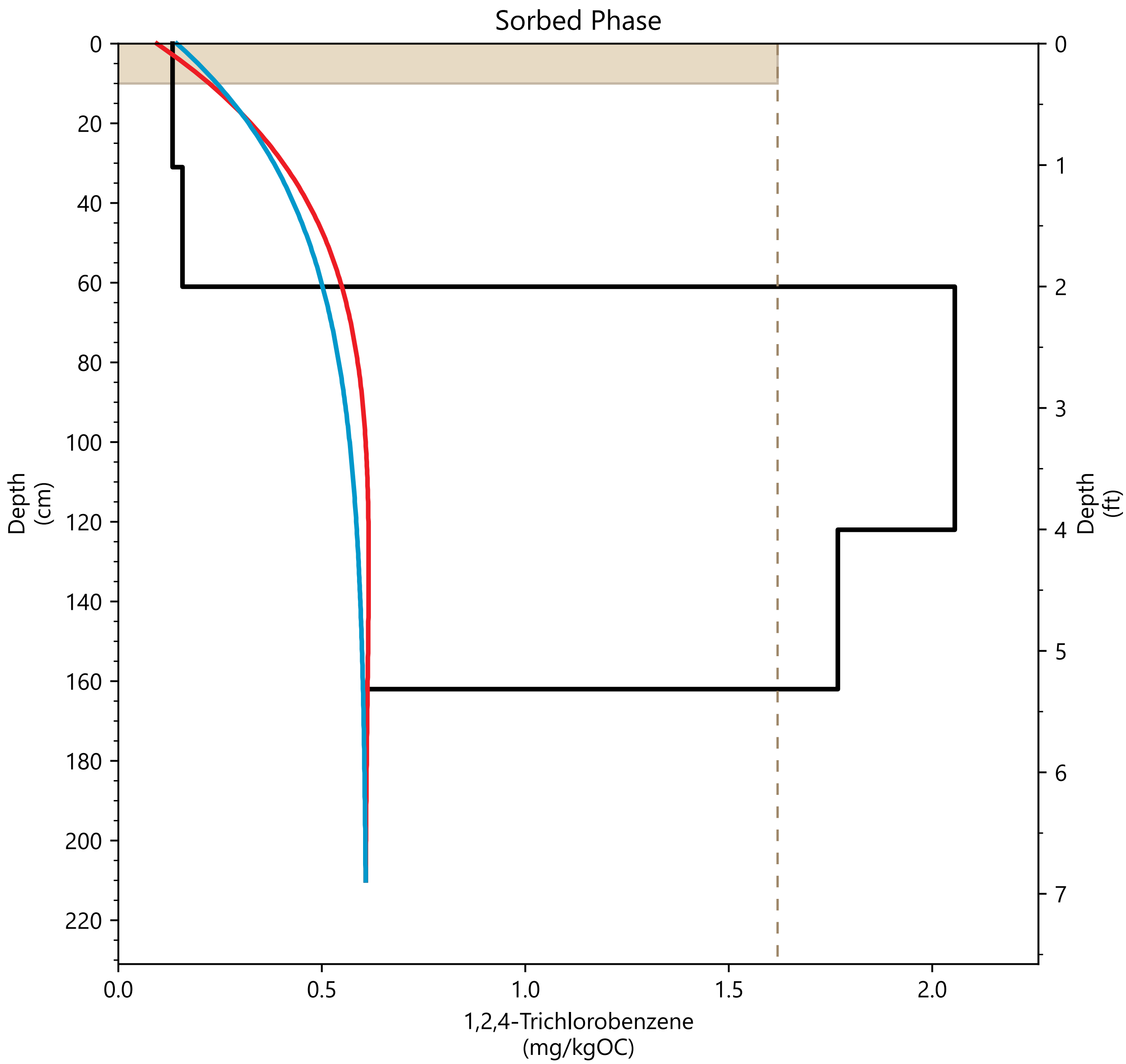


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Publish Date: 06/25/2026 10:59 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py



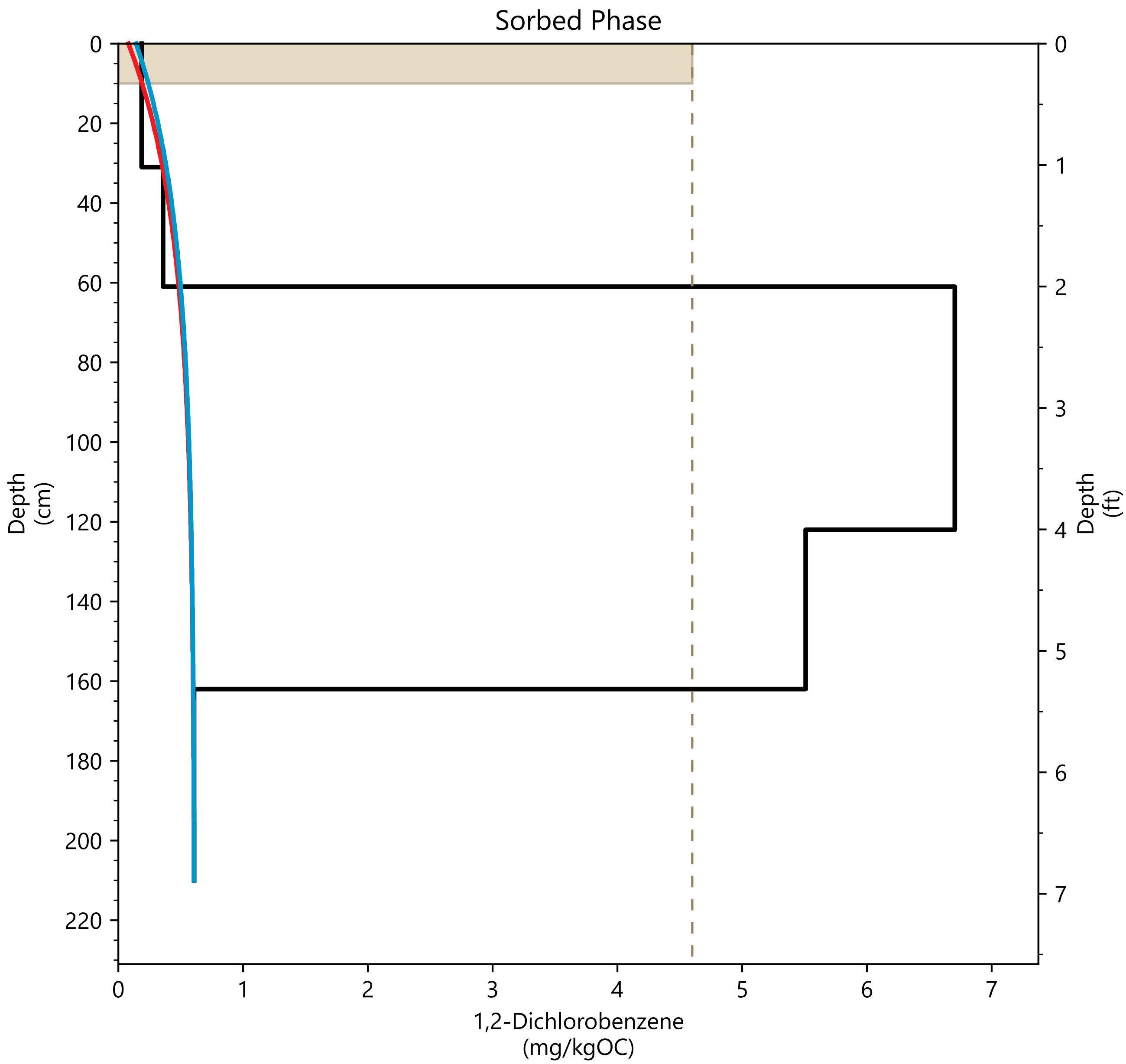
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

ANCHOR QEA

Figure M.3.9i
Core Profiles of 1,2,4-Trichlorobenzene for LDW-SC37



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

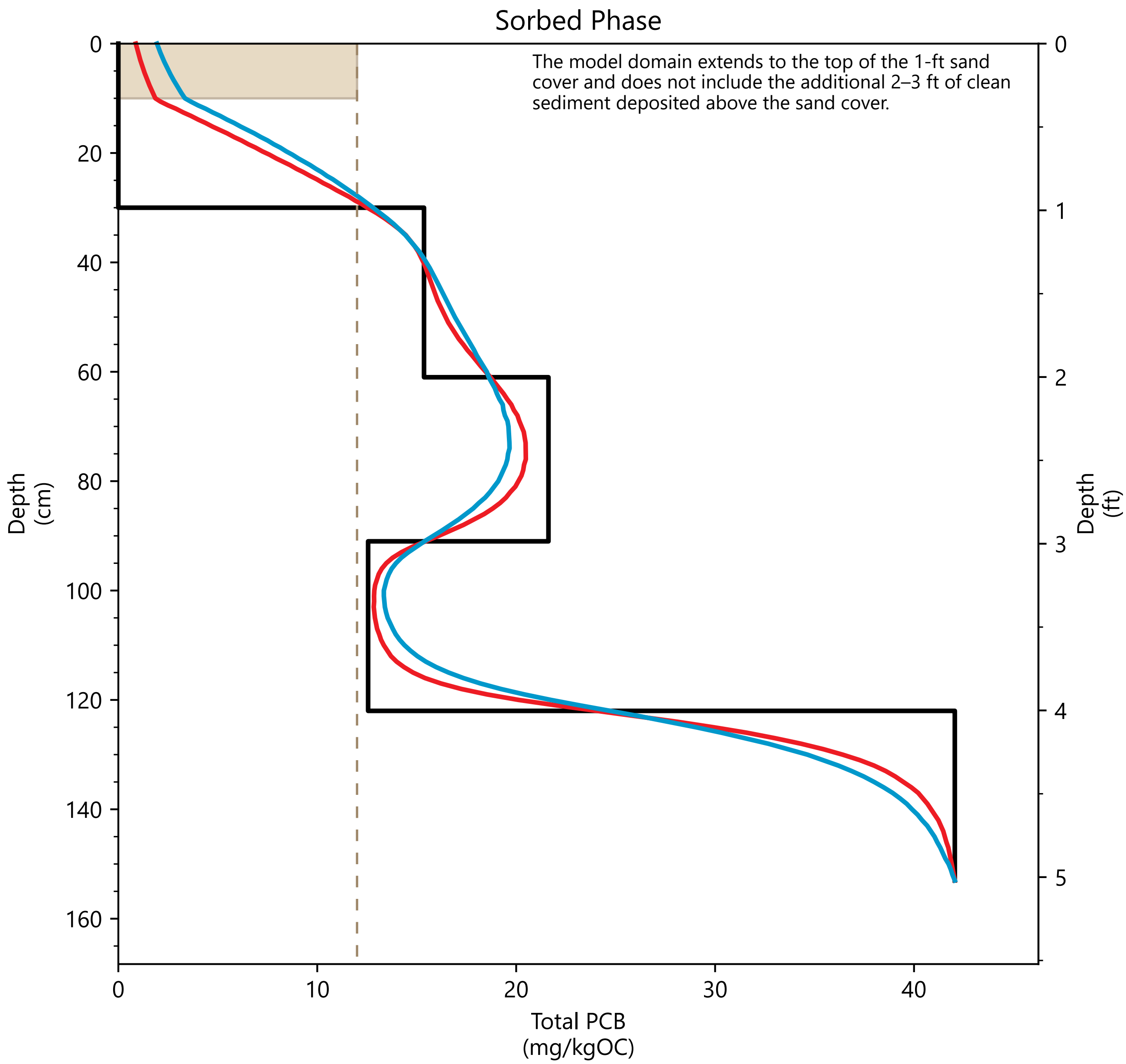
Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

Publish Date: 06/25/2026 10:59 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.9j
Core Profiles of 1,2-Dichlorobenzene for LDW-SC37

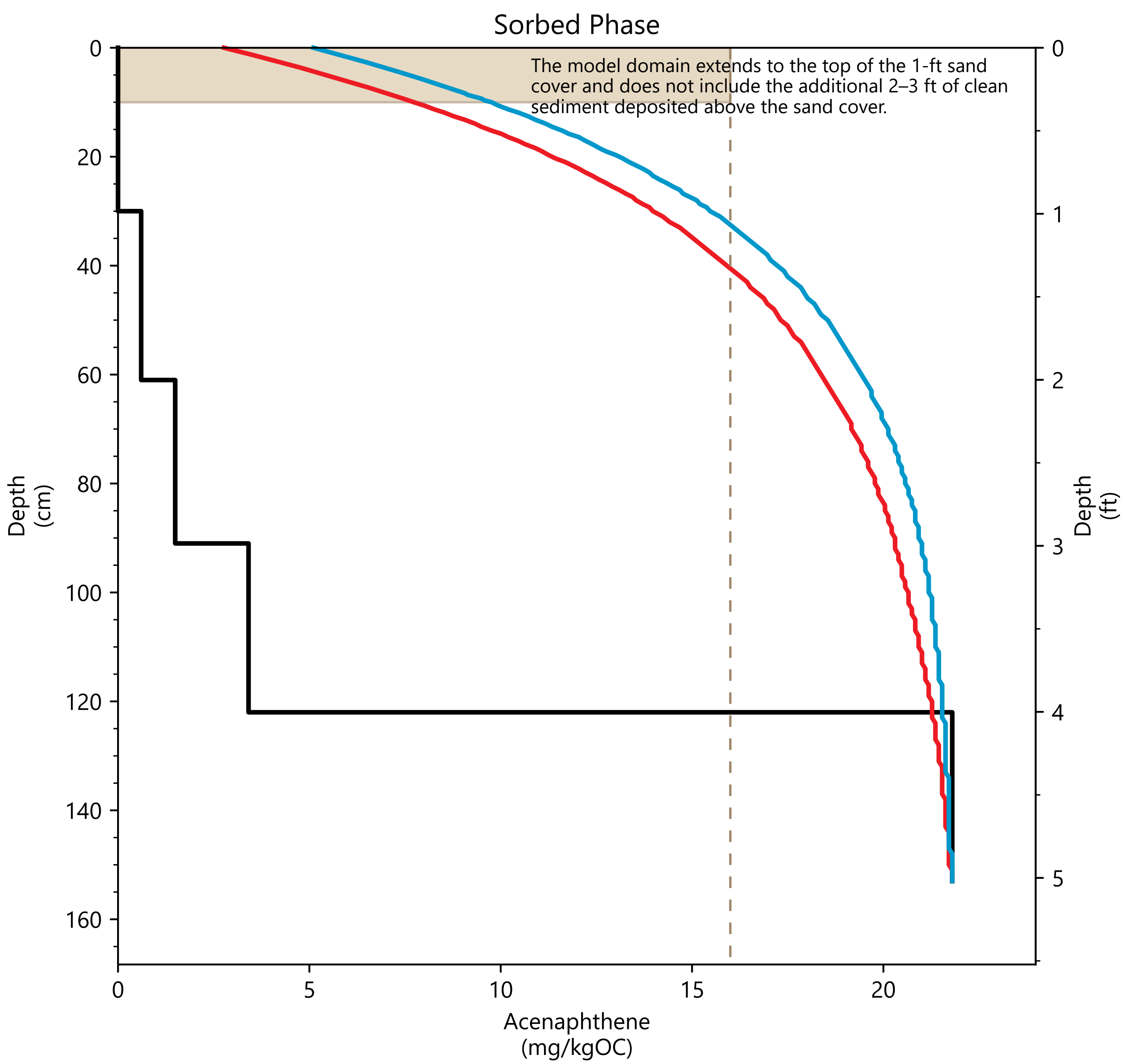
60% Remedial Design Basis of Design Report
LDW Middle Reach



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

- Year 0
- Year 100 (400 cm/yr)
- Year 100 (800 cm/yr)
- 0-10cm RAL

Publish Date: 06/25/2026 11:18 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

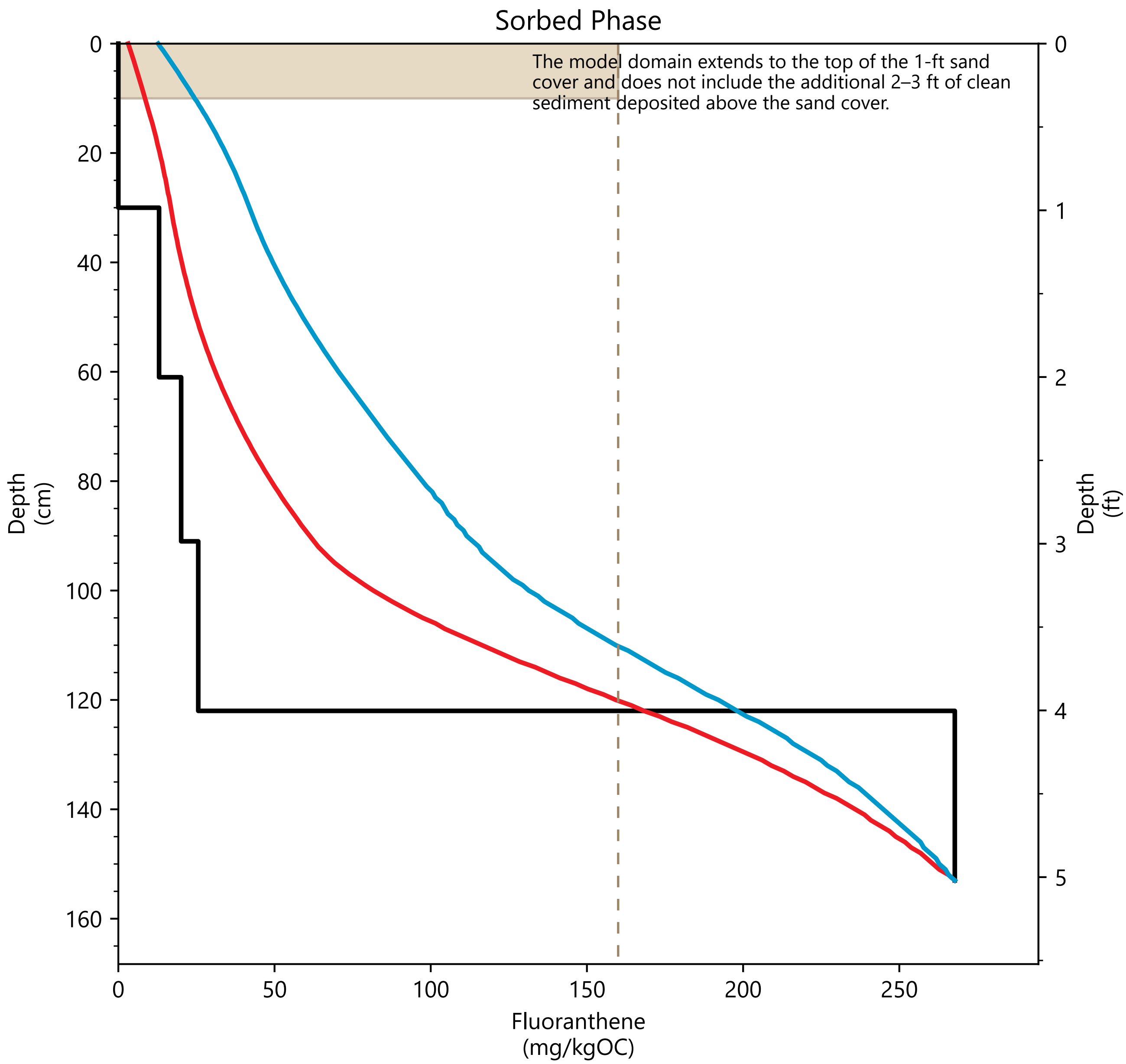


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Publish Date: 06/25/2026 11:18 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.10b
Core Profiles of Acenaphthene for SC-01

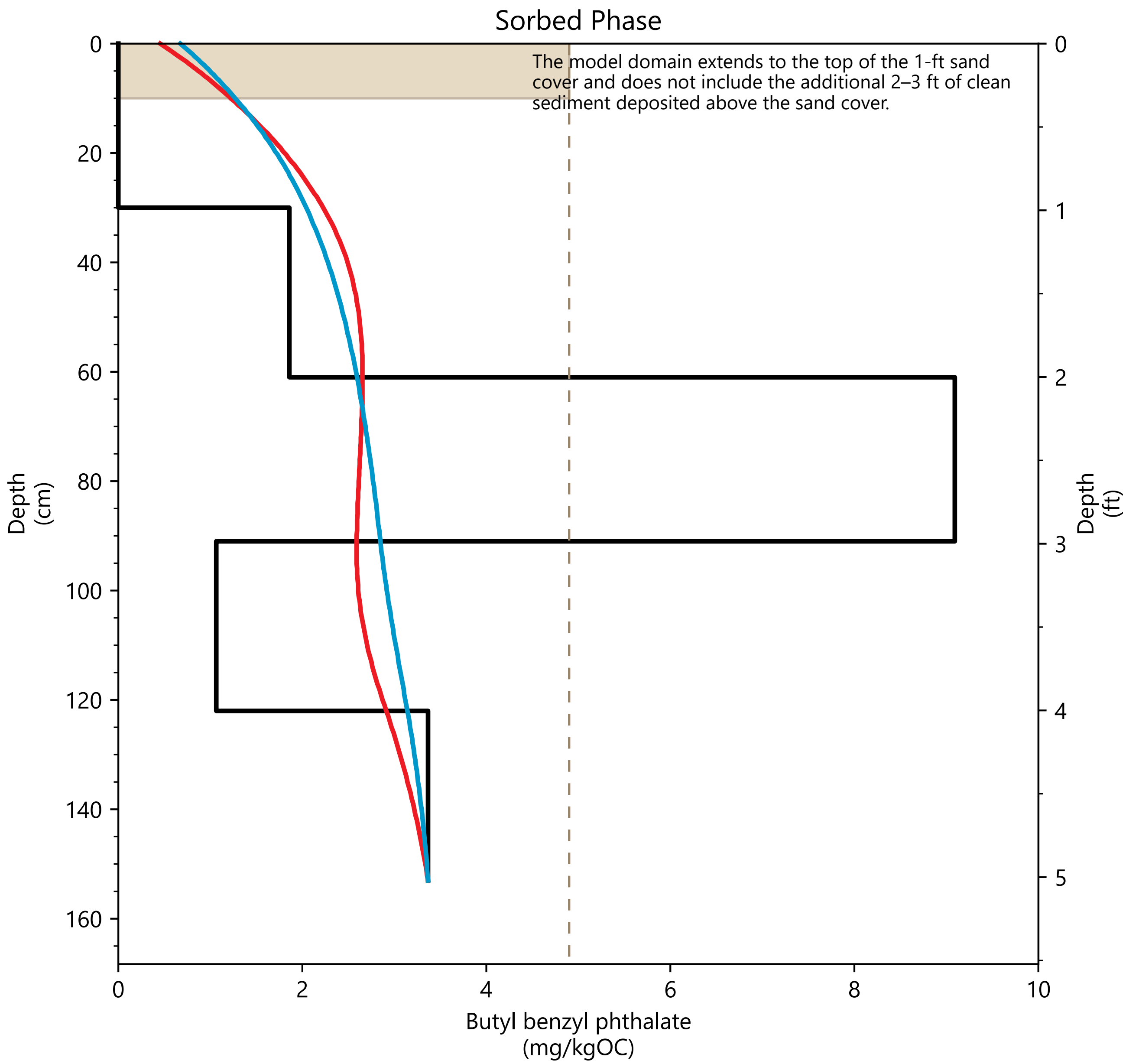


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

Publish Date: 06/25/2026 11:18 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

Figure M.3.10c
Core Profiles of Fluoranthene for SC-01

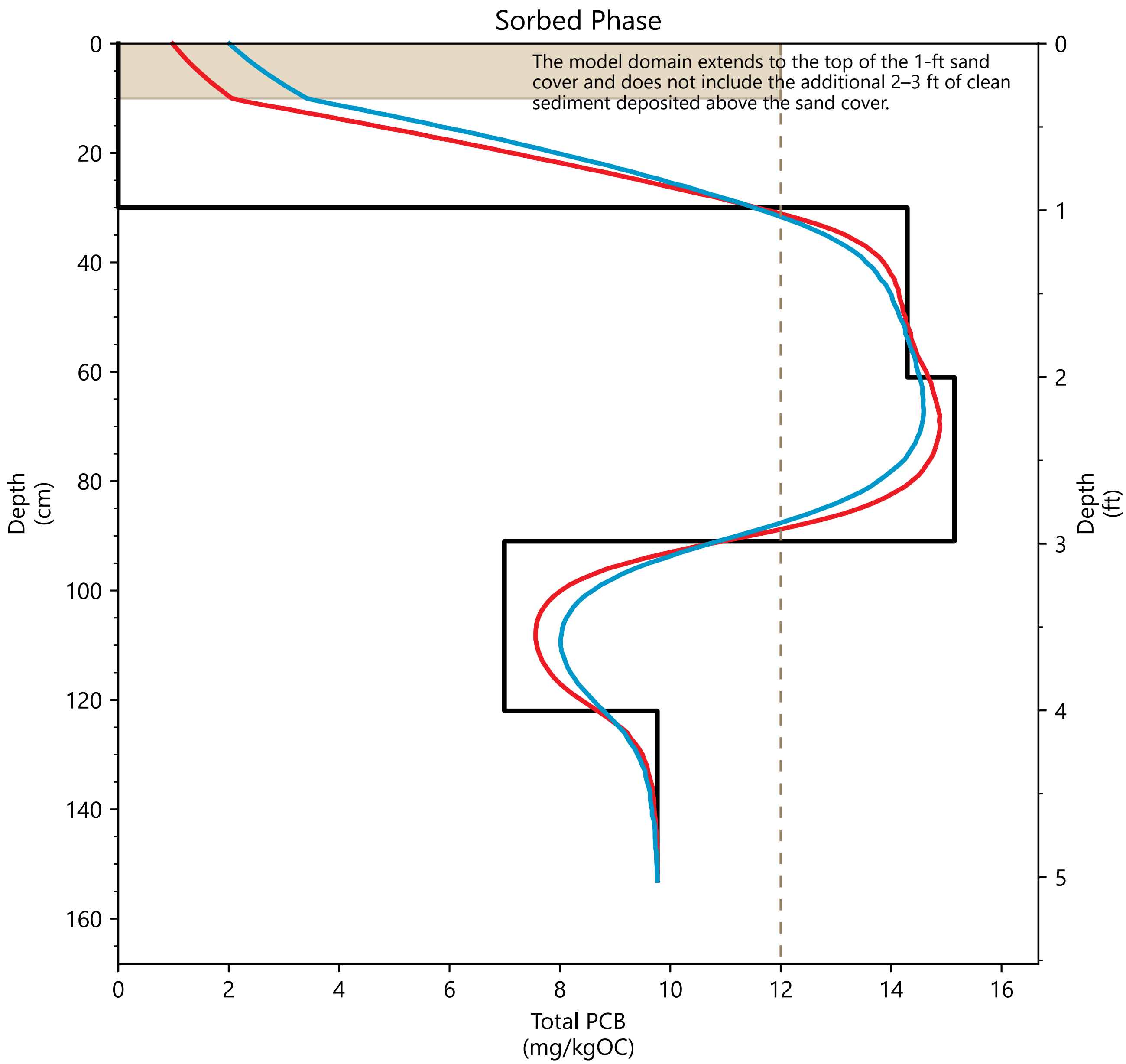


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

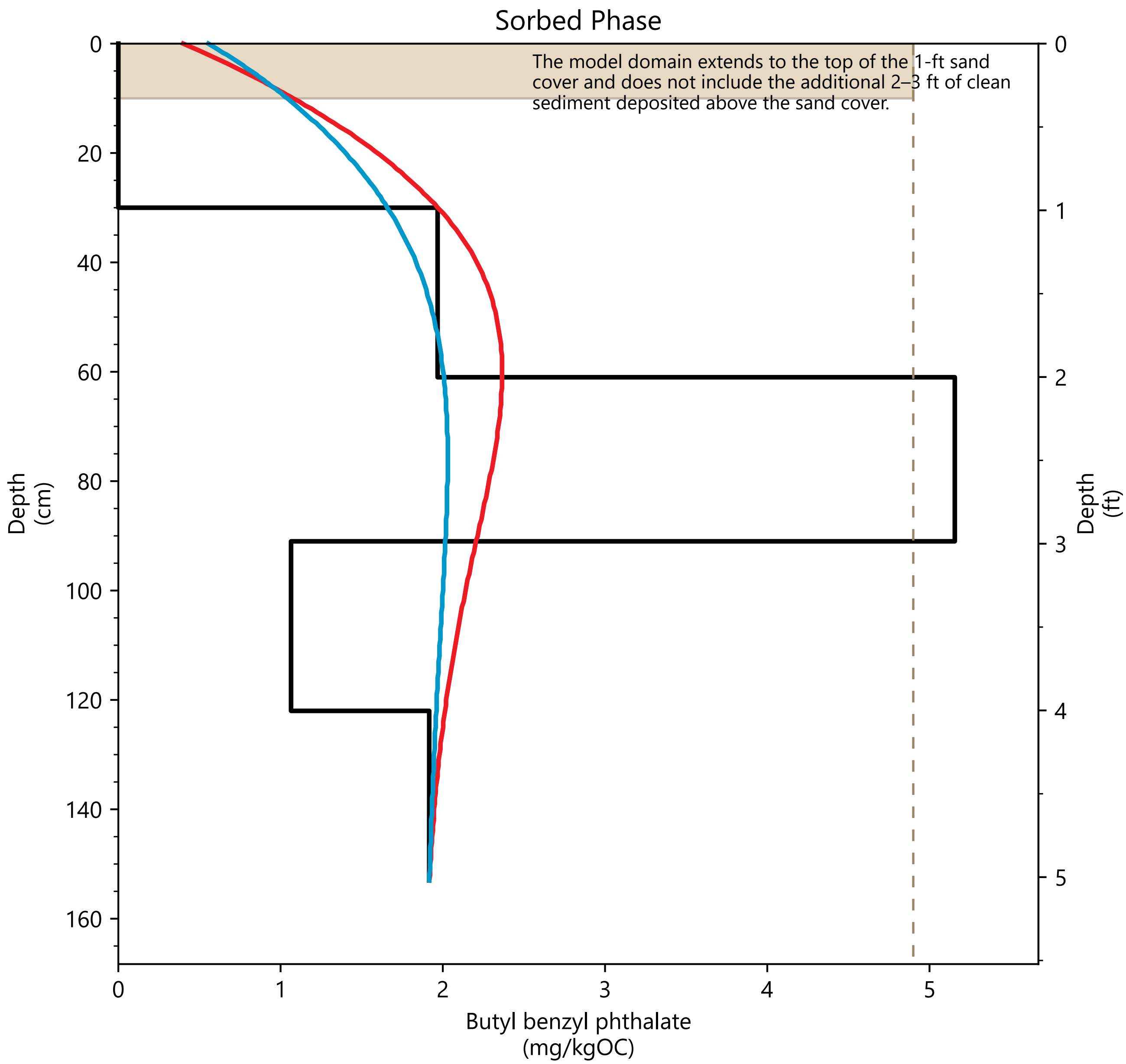
Publish Date: 06/25/2026 11:18 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

Figure M.3.10d
Core Profiles of Butyl benzyl phthalate for SC-01



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Figure M.3.11a
Core Profiles of Total PCB for SC-02



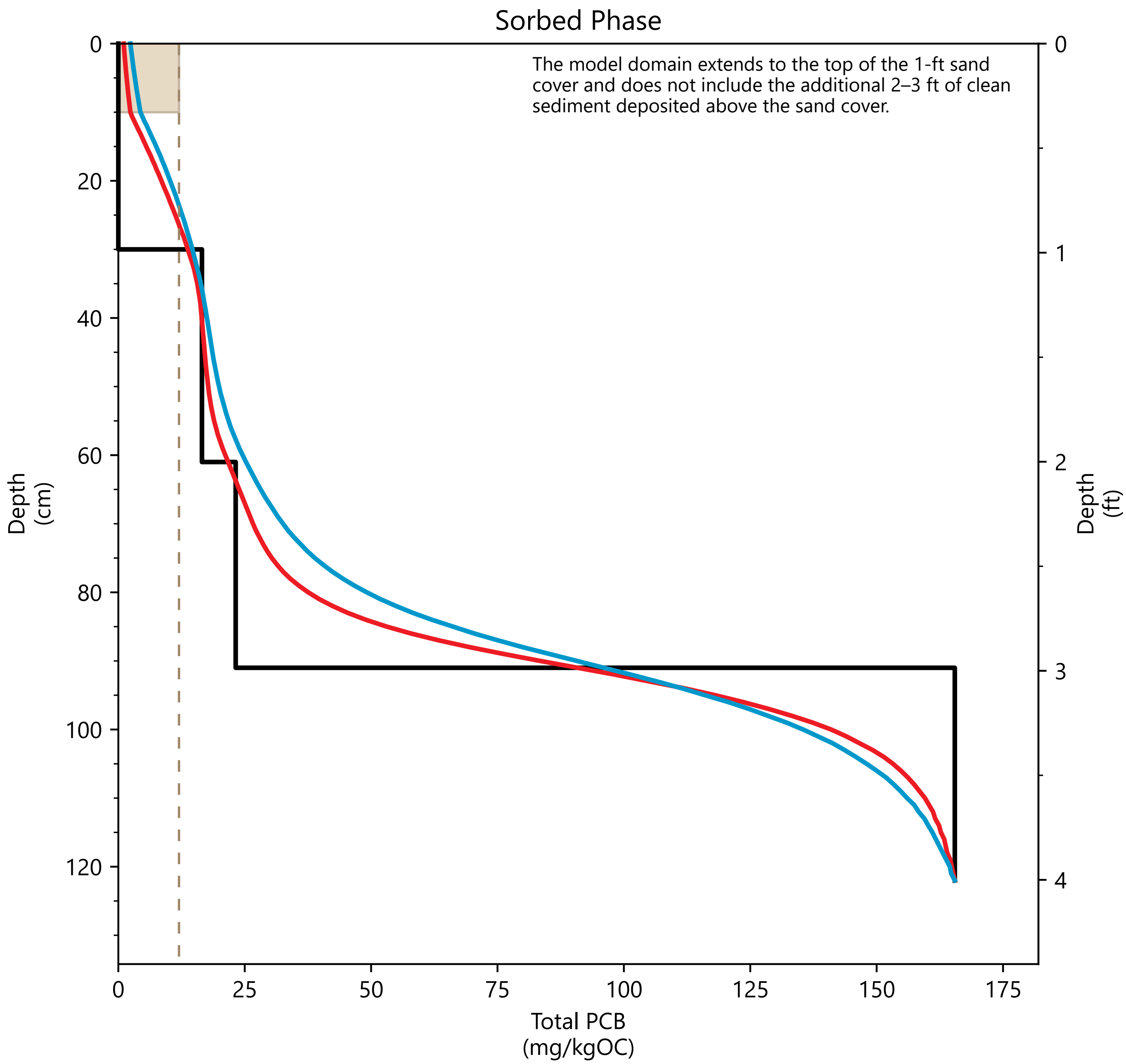
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Year 0
Year 100 (400 cm/yr)
Year 100 (800 cm/yr)
0-10cm RAL

Publish Date: 06/25/2026 11:19 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.11b
Core Profiles of Butyl benzyl phthalate for SC-02
60% Remedial Design Basis of Design Report
LDW Middle Reach

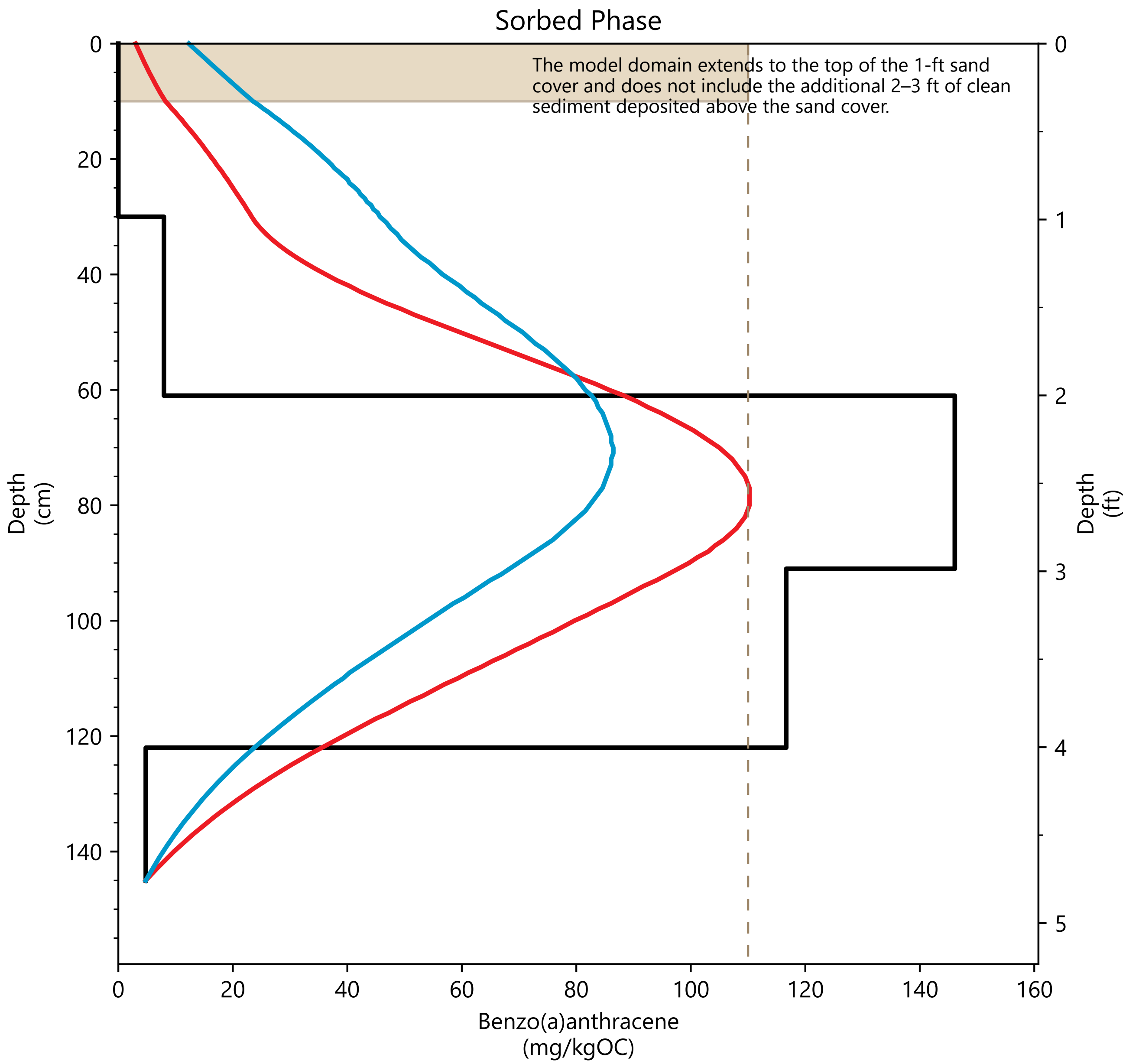


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Publish Date: 06/25/2026 11:19 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

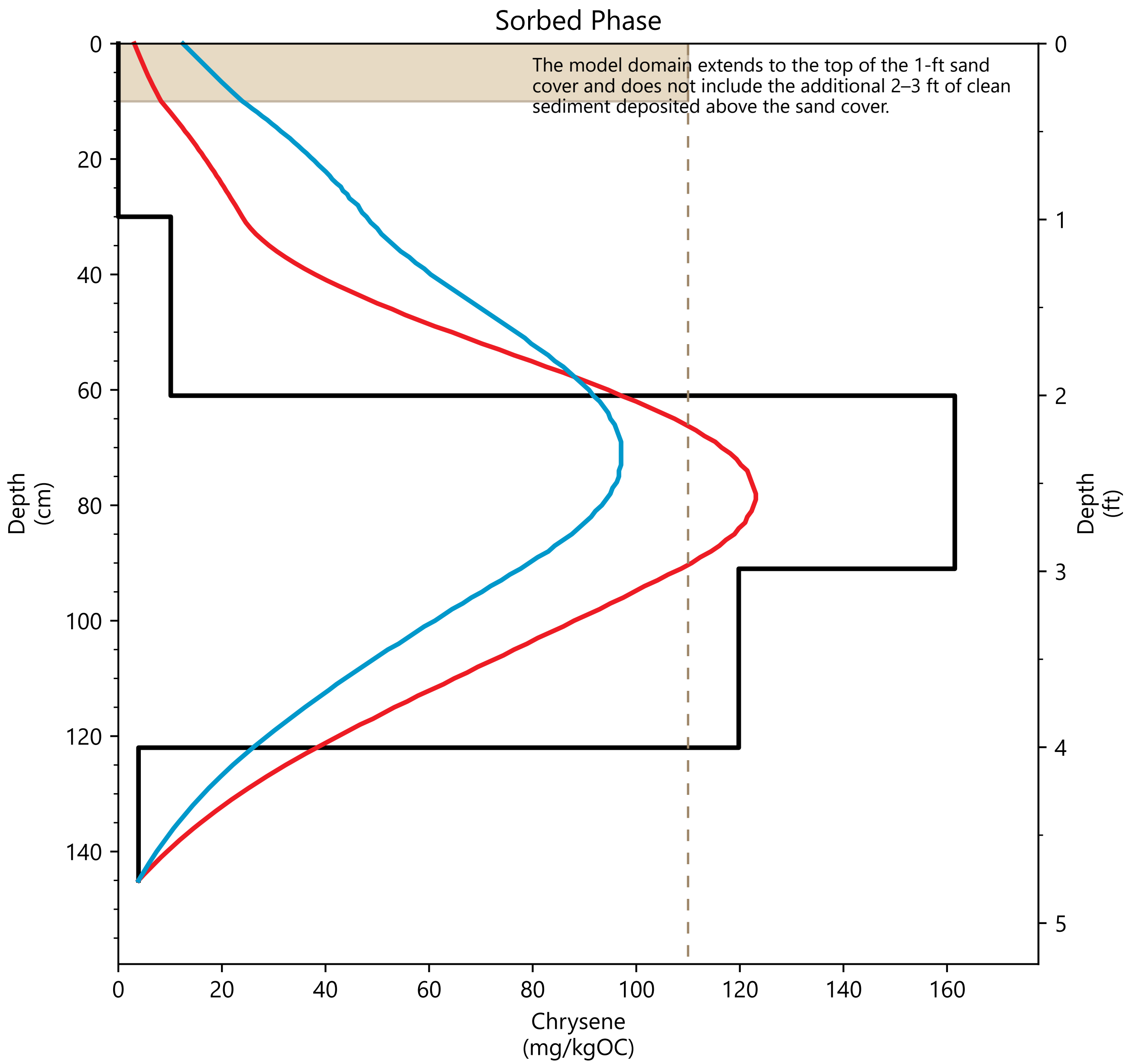
Figure M.3.12a
Core Profiles of Total PCB for SC-032



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

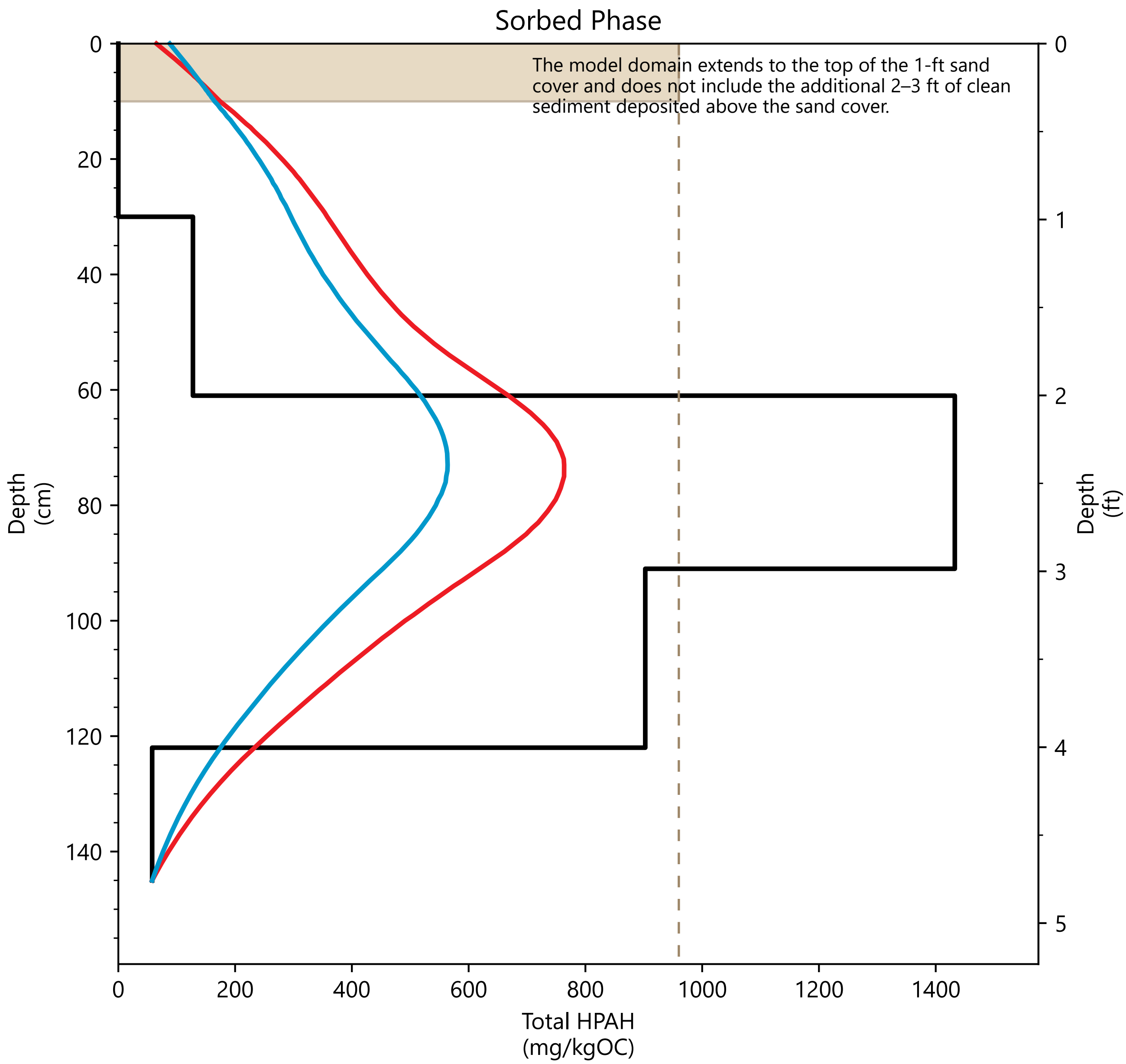
Publish Date: 06/25/2026 11:19 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

Figure M.3.12b
Core Profiles of Benzo(a)anthracene for SC-032



The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Figure M.3.12c
Core Profiles of Chrysene for SC-032
60% Remedial Design Basis of Design Report
LDW Middle Reach

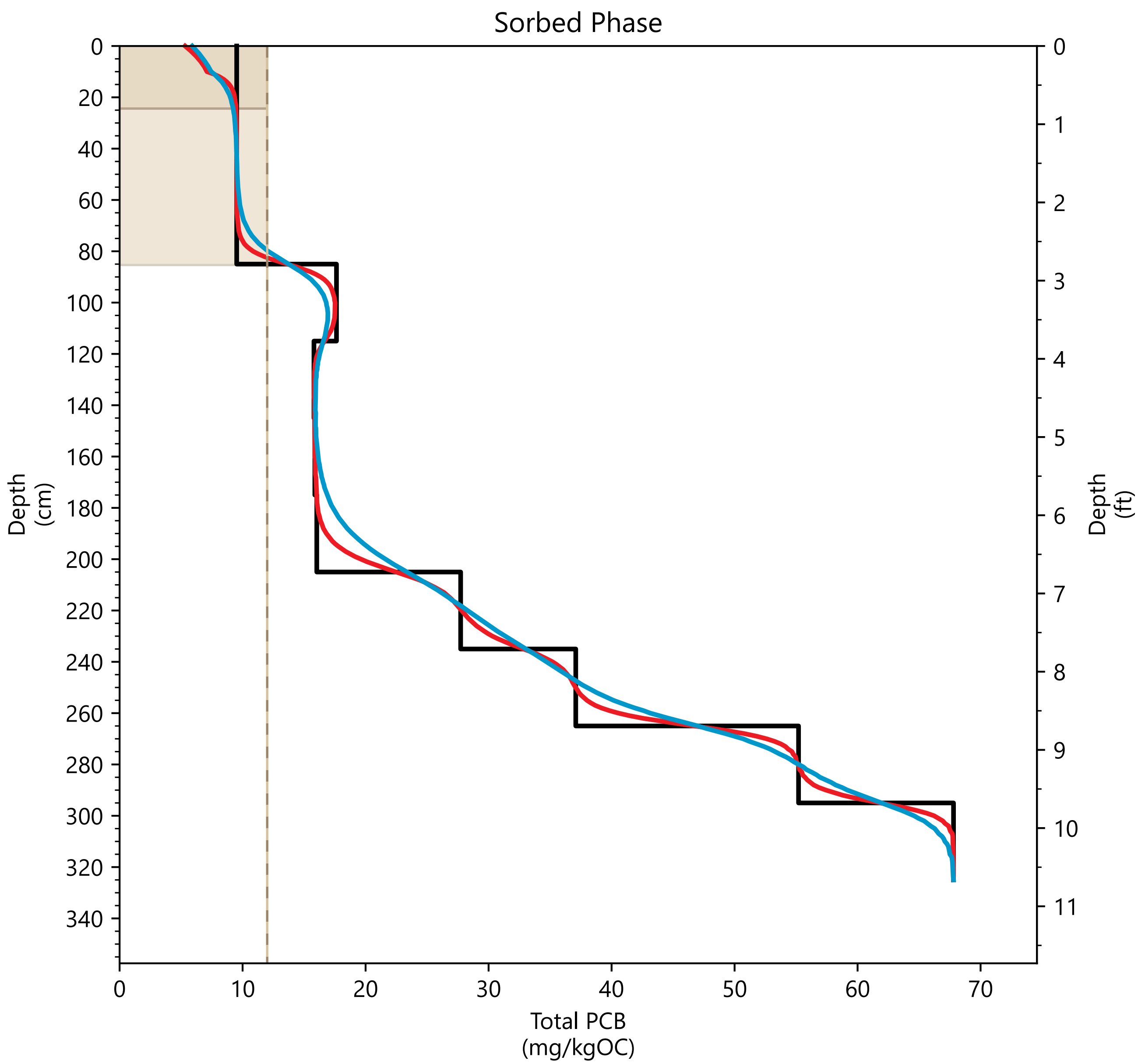


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).

Publish Date: 06/25/2026 11:19 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.12d
Core Profiles of Total HPAH for SC-032



The shaded areas represent the RALs for the sediment depth above the FNC and 2 feet below the FNC in shoaled areas.

- Year 0
- Year 100 (100 cm/yr)
- Year 100 (400 cm/yr)
- 0.0-0.8 ft RAL
- 0.8-2.8 ft RAL

Publish Date: 06/25/2026 11:00 AM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

ANCHOR QEA

Figure M.3.13a
Core Profiles of Total PCB for LDW24-SC1323