60% Remedial Design Basis of Design Report

Appendix H
Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

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ABBREVIATIONS

µg/kg	microgram per kilogram
µg/L	microgram per liter
AC	activated carbon
AST	area-specific technology
BBP	butyl benzyl phthalate
BODR	*Basis of Design Report*
cfs	cubic foot per second
cm	centimeter
cm/hr	centimeter per hour
cm/yr	centimeter per year
cm^2/s	square centimeter per second
cm^2/yr	square centimeter per year
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant differences
f_{OC}	fraction organic carbon
FNC	federal navigation channel
g/cm^3	gram per cubic centimeter
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
Kbl	boundary layer mass transfer coefficient
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
MLLW	mean lower low water
N/A	not applicable
ng/kg	nanogram per kilogram
OC	organic carbon
OCDD	octachlorodibenzo-p-dioxin

OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PD&C	partial dredge and cap
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
ROD	*Record of Decision*
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TEQ	toxic equivalents
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers

1 Introduction

This appendix documents chemical isolation modeling conducted to design engineered capping and covers to address contaminants of concern (COCs) above remedial action levels (RALs) in the sediment of the middle reach of Lower Duwamish Waterway (LDW).

Two types of engineered caps will be placed in the middle reach of LDW—a standard cap and a modified cap in habitat areas. The remedial design (RD) for a standard cap consists of a chemical isolation layer overlain by a 6-inch-minimum-thickness filter layer and a 1-foot-minimum-thickness erosion protection (i.e., armor) layer. Standard caps are proposed in 16 remedial action areas (RAAs): RAAs 1B, 9J, 14A, 15B, 22, 23A, 30A, 30B, 30C, 30D, 30E, 30F, 30G, 30H, 31B, and 31C.[1] The modified cap in habitat areas consists of a chemical isolation layer overlain by a 0.5-foot-minimum-thickness armor layer and a 1.5-foot-minimum-thickness habitat layer. The modified caps are proposed in eight RAAs: RAAs 5B, 8B, 9A, 9D, 20B, 24I, 26, and 31D.[2] More detailed descriptions on the design of the engineered caps can be found in Section 9.3 of the Intermediate (60%) RD *Basis of Design Report* (BODR). Additionally, as described in Section 9.6 of the main report, area-specific technologies (ASTs) are required for areas with restrictions that prevent standard application of remedial technologies to an RAA. RAA 9K is located within the federal navigation channel (FNC) and includes a utility crossing that prevents dredging to a depth that would allow placement of a standard cap and meet the *Record of Decision* (ROD; EPA 2014) requirement of top of cap elevation being 4 feet below the FNC authorized depth. Instead of a standard cap, an AST (i.e., utility crossing cover) will be placed after partial dredging of this RAA. The evaluation of AST for this RAA with a utility crossing was performed using the same framework as for the standard caps and is documented herein.

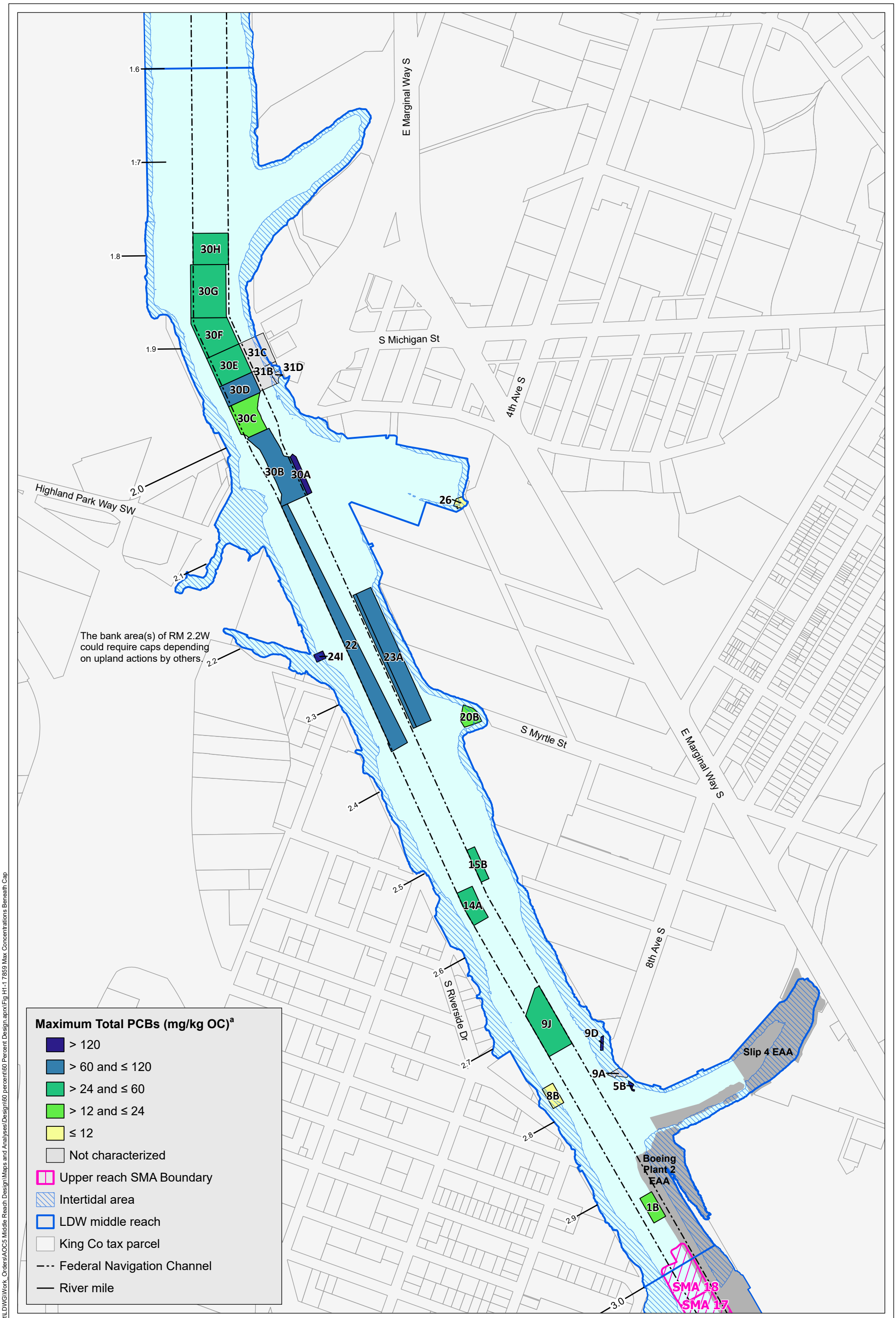
A map of the RAAs proposed for capping and AST can be found in Figures 5-2a and 5-2b of the BODR.

There are a total of 42 COCs for the LDW: 4 COCs based on risk to human health, 40 COCs based on risk to benthic invertebrates, and 1 COC for wildlife (i.e., river otters). COCs that exceeded remedial action levels (RALs) set forth in the ROD (EPA 2014) and explanation of significant differences (ESD; EPA 2021)[3] in sediments that will remain beneath the proposed engineered cap or AST in at least one of the RAAs include the following: polychlorinated biphenyls (PCBs); dioxins/furans; carcinogenic polycyclic aromatic hydrocarbons (cPAHs); mercury, zinc, butyl benzyl phthalate (BBP); 1,2,4-trichlorobenzene; 1,4-dichlorobenzene; 2,4-dimethylphenol; total high-molecular-weight

[1] RAAs 31B and 31C were not included in the standard cap evaluation for the Intermediate (60%) RD, as discussed later in Section 1. These RAAs will be evaluated in the Pre-Final (90%) RD.
[2] RAAs 9A and 31D were not included in the modified cap evaluation for the Intermediate (60%) RD, as described later in Section 1. These RAAs will be evaluated in the Pre-Final (90%) RD. Based on the results of the Phase III investigation, it is also possible that caps may be required in RAAs 9B and 9C.
[3] RAL exceedances were determined based on the 2014 ROD for all COCs, with the exception of carcinogenic polycyclic aromatic hydrocarbons (cPAHs), which is based on the 2021 ESD.

polycyclic aromatic hydrocarbons (HPAHs); and 11 individual polycyclic aromatic hydrocarbons (PAHs).

Chemical transport modeling was therefore conducted to identify the thickness and composition (e.g., amendment needs) for the chemical isolation component of an engineered cap that will meet RALs for a long period of time (defined as 100 years). In the RAA where a utility crossing AST is used (i.e., partial dredging and cover), the evaluation was conducted to predict the concentrations that may be expected at the top of the cover over the 100-year time frame. The modeling analyses described in this appendix were performed in accordance with guidance on cap design set forth by the U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (Palermo et al. 1998) and the Interstate Technology and Regulatory Council (2014, 2023). RAAs that were evaluated for engineered caps and the utility crossing AST are listed in Tables H1-1 and H1-2, respectively. These tables include the COC(s) evaluated due to RAL exceedances measured in sediments that will remain (i.e., following removal where applicable) beneath the sediment engineered cap in each RAA. In addition, the area type (i.e., intertidal, subtidal, or shoaled area) and recovery category (RC) for each RAA are provided in Tables H1-1 and H1-2 because the information is relevant for the selection of applicable RALs for the evaluation. The depth interval of COC concentrations to be evaluated also varies by RC (further discussed in Section 2.2). Figures H1-1a and H1-1b show the maximum sediment concentration beneath the engineered cap within each RAA for total PCBs and dioxins/furans, respectively, which are the COCs having the most frequent RAL exceedances in the middle reach. Other COCs present below caps are summarized in Table H1-1.



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Figure H1-1a. Maximum Sediment Concentrations for Total PCBs Beneath the Proposed Engineered Cap

APPENDIX H – ENGINEERED CAP CHEMICAL ISOLATION DESIGN ANALYSIS AND AREA-SPECIFIC TECHNOLOGY EVALUATION INTERMEDIATE (60%) REMEDIAL DESIGN BASIS OF DESIGN REPORT FOR THE LDW MIDDLE REACH

JULY 31, 2026

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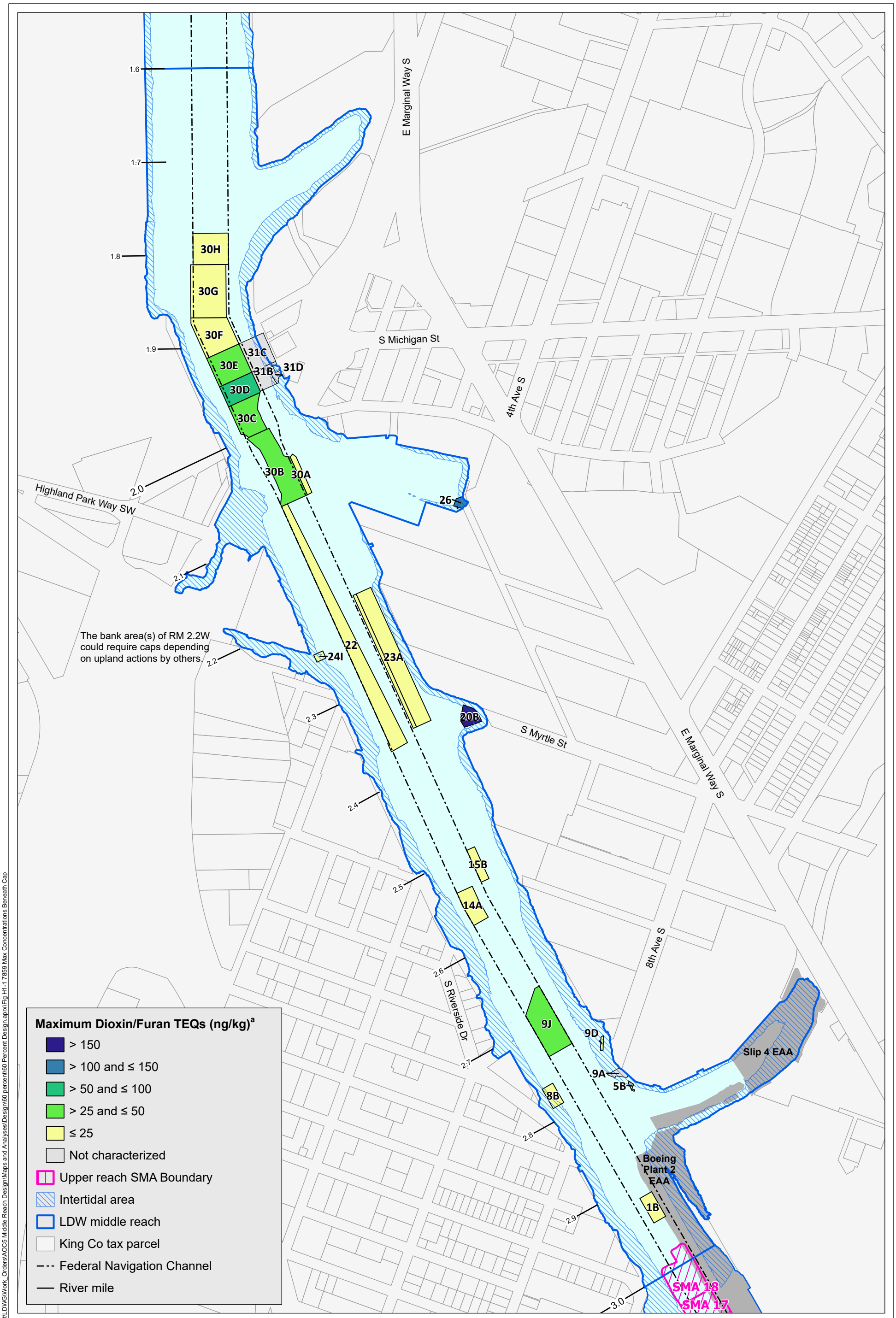

1.6
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2.2
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2.4
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2.7
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30H
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30E
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30C
30B
30A
31C
31B
31D
26
22
24I
23A
20B
15B
14A
9J
9D
9A
5B
8B
1B
SMA 18
SMA 17
Slip 4 EAA
Boeing Plant 2 EAA
E Marginal Way S
S Michigan St
4th Ave S
Highland Park Way SW
S Myrtle St
8th Ave S
S Riverside Dr
The bank area(s) of RM 2.2W could require caps depending on upland actions by others.
Maximum Dioxin/Furan TEQs (ng/kg)[a]
> 150
> 100 and ≤ 150
> 50 and ≤ 100
> 25 and ≤ 50
≤ 25
Not characterized
Upper reach SMA Boundary
Intertidal area
LDW middle reach
King Co tax parcel
Federal Navigation Channel
River mile
N
0 250 500 Feet
0 100 200 Meters
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Figure H1-1b. Maximum Sediment Concentrations for Dioxin/Furan TEQs Beneath the Proposed Engineered Cap
Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation 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\AOCs Middle Reach Design\Maps and Analyses\Design\60 percent\60 Percent Design.aprx\Fig H1-1 7859 Max Concentrations Beneath Cap

Table H1-1
List of RAAs, Cap Type, and COCs Included in the Engineered Cap Evaluation

RAA[1]	RM[2]	Area Type[3]	RC	Selected Remedial Technology	Dredge Depth (feet) or Elevation (feet MLLW)[4]	Engineered Cap Type	COC(s) with RAL Exceedances Below the Cap.[5]
1B	2.9	FNC	1	PD&C	-24 feet MLLW	Standard cap	Total PCBs
5B	2.8	Intertidal	2	PD&C	3 feet	Modified cap	Total PCBs (
8B	2.8	Intertidal	1	PD&C	4.5 feet	Modified cap	1,2,4-trichlorobenzene, 1,4-dichlorobenzene
9D	2.8	Intertidal	2	PD&C	4 feet	Modified cap	Total PCBs
9J	2.7	FNC	3	PD&C	-29 feet MLLW	Standard cap	Total PCBs, dioxin/furan TEQ
14A	2.5	FNC	3	PD&C	-29 feet MLLW	Standard cap	Total PCBs
15B	2.5	Subtidal	1	PD&C	-26 feet MLLW	Standard cap	Total PCBs
20B[6]	2.4	Intertidal	1	PD&C	3 feet	Modified cap	Total PCBs, dioxin/furan TEQ
22	2.2	FNC	3	PD&C	-29 feet MLLW	Standard cap	Total PCBs
23A	2.3	Subtidal	1	PD&C	-20 feet MLLW	Standard cap	Total PCBs
24I	2.2	Intertidal	2	PD&C	4 feet	Modified cap	Total PCBs
26	2.1	Intertidal	2	Cap only	none	Modified cap	cPAHs, dioxin/furan TEQ, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, total benzofluoranthenes, total HPAHs, BBP, 2,4-dimethylphenol
30A	2.1	Subtidal	1	Cap only	none	Standard cap	Total PCBs, mercury
30B	2.0	FNC	1	PD&C	-29 feet MLLW	Standard cap	Total PCBs, dioxin/furan TEQ
30C	2.0	FNC	1	PD&C	-35 feet MLLW	Standard cap	Total PCBs, dioxin/furan TEQ
30D	2.0	FNC	3	PD&C	-35 feet MLLW	Standard cap	Total PCBs, dioxin/furan TEQ

RAA[1]	RM[2]	Area Type[3]	RC	Selected Remedial Technology	Dredge Depth (feet) or Elevation (feet MLLW)[4]	Engineered Cap Type	COC(s) with RAL Exceedances Below the Cap[5]
30E	1.9	FNC	3	PD&C	-35 feet MLLW	Standard cap	Total PCBs, dioxin/furan TEQ
30F	1.9	FNC	3	PD&C	-35 feet MLLW	Standard cap	Total PCBs
30G	1.8	FNC	3	PD&C	-39 feet MLLW	Standard cap	Total PCBs
30H	1.8	FNC	3	PD&C	-39 feet MLLW	Standard cap	Total PCBs

Notes:

1. RAAs 9A, 31B, 31C, and 31D were not evaluated as part of Intermediate (60%) RD; they will be evaluated during Pre-Final (90%) RD.
2. RMs approximated to represent the centroid of the RAA.
3. If an RAA overlapped with both intertidal and subtidal areas, it was specified as intertidal and evaluated under a higher range of seepage rates to be conservative (see Section 3.3).
4. Refer to BODR Section 5.1.2, Bullet No. 4, for a discussion regarding the modified dredge depths in RAAs 30c through 30F.
5. The final list of COCs will be revised based on the results of the Phase III PDI.
6. RAAs 20B and 20C were consolidated into RAA 20B. The cap evaluation for RAA 20C in the Preliminary (30%) RD was carried forward for RAA 20B because it captured the sample with the highest COC concentration within the consolidated RAA.

BBP: butyl benzyl phthalate
BODR: *Basis of Design Report*
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
FNC: federal navigation channel
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
MLLW: mean lower low water
PCB: polychlorinated biphenyl
PD&C: partial dredge and cap
PDI: pre-design investigation
RAA: remedial action area
RAL: remedial action level
RC: recovery category
RD: remedial design
RM: river mile
TEQ: toxic equivalents

Table H1-2
List of RAAs, Placement Thickness, and COCs Included in the Utility Crossing AST Evaluation

RAA	RM[1]	Area Type	RC	Dredge Elevation (feet MLLW)	Placement (Thickness)	COC(s) with RAL Exceedances Below the AST Cover
9K	2.8	FNC Shoal	3	-22	AST Cover (2 feet)	Total PCBs

Notes:
1. RMs approximated to represent the centroid of the RAA.

AST: area-specific technology
COC: contaminant of concern
FNC: federal navigation channel
MLLW: mean lower low water
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
RC: recovery category
RM: river mile

Modeling analyses were conducted for the RAAs listed in Tables H1-1 and H1-2 based on all available data, including those collected historically, and those collected during Phase I and Phase II Pre-Design Investigation (PDI) sampling. Additional sediment samples are currently being collected for RAAs proposed for modified caps as part of the Phase III PDI, so the model analyses were not updated for these RAAs. Updates to the modeling evaluations that incorporate the Phase III PDI data for these RAAs will be conducted during Pre-Final (90%) RD. In addition, modeling analyses were not updated for RAAs 9A, 31B, 31C, and 31D for the following reasons:

- The core associated with RAA 9A terminated by refusal prior to the target depth; therefore, no RAL exceedances were measured in samples at this location (Figures H1-1a and H1-1b). However, because nearby cores suggest that sediments exceeding the surface RAL may be present within RAA 9A, partial dredge and cap technology was applied to this area in Section 9.3.3. The chemical isolation layer thickness and composition in RAA 9A were based on the evaluation results from nearby RAA 5B given the proximity. RAA 9A will be reevaluated during Pre-Final (90%) RD using the additional data collected as part of the Phase III PDI.
- RAAs 31B, 31C, and 31D are located along the slide slopes of RAAs 30D and 30E. The depth of contamination within portions of RAAs 31B, 31C, and 31D is not fully characterized; thus, these RAAs were also excluded from the capping evaluation for the Intermediate (60%) RD. The cap designs for RAAs 31B and 31D were based on the modeling results from the adjacent RAA 30D, and the cap design for RAA 31C was based on the modeling results from the adjacent RAA 30E. The modeling analyses for these RAAs will be refined during Pre-Final (90%) RD using additional data collected as part of the Phase III PDI.

The following sections document the modeling conducted for the evaluation of the engineered caps and utility crossing AST. Section 2 describes the modeling approach for the evaluation. Section 3

describes the inputs used for the model simulations for both the engineered cap and utility crossing AST evaluations. Section 4 describes model simulation results for the given chemical isolation layer design and whether RAL exceedances are predicted to occur in the utility crossing AST covers at the end of 100 years. Section 5 describes model sensitivity analyses that were conducted to evaluate certain model inputs or assumptions.

2 Cap Modeling Approach

This section describes the modeling framework and approach used to design the engineered cap isolation layers and utility crossing cover (AST D) for this Intermediate (60%) RD. The modeling approach used in the middle reach of LDW is generally consistent with the EPA-approved modeling for the upper reach (Anchor QEA and Windward 2024).

2.1 Model Framework

The 1D model of chemical transport within sediment caps, CapSim (version 4.2.3; Reible 2023),[4] was used for this evaluation. 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 sediment cap. This model and its predecessor versions have been used to support the evaluation and design of sediment caps at numerous cleanup sites around the United States and internationally. Details on the model structure and underlying theory and equations are provided in Lampert and Reible (2009), Go et al. (2009), and Shen et al. (2018).

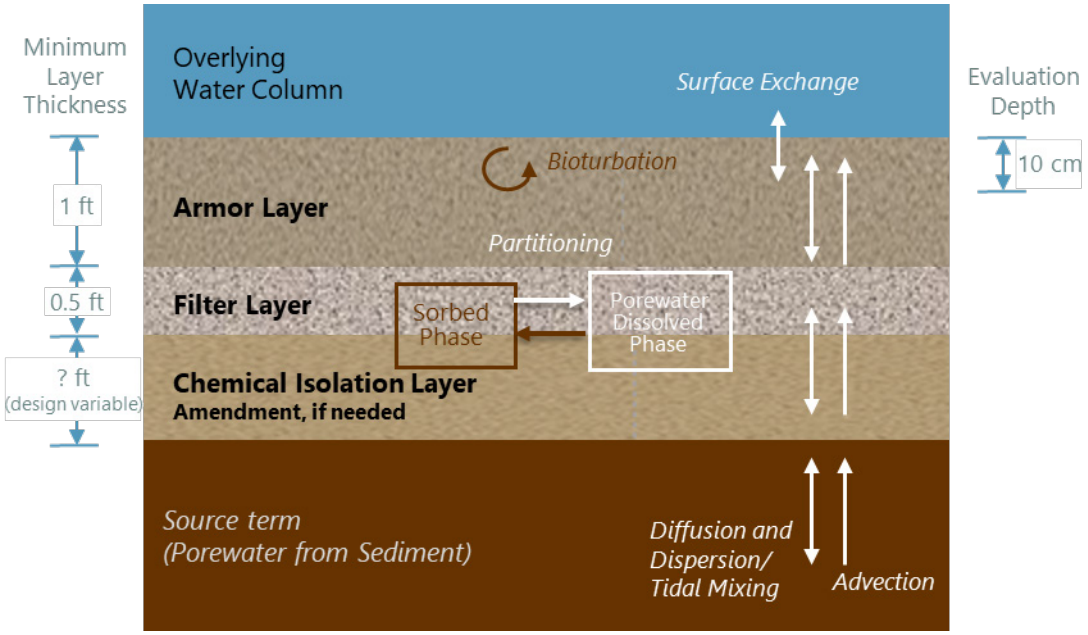
2.2 Simulation Approach

2.2.1 Engineered Caps

As shown in the schematic in Figure H2-1a, the model configuration (i.e., layers included in the simulation) for a standard cap consisted of a chemical isolation layer, overlain by a 0.5-foot-minimum-thickness filter layer and a 1-foot-minimum-thickness erosion protection (i.e., armor) layer. The armor layer was specified as a cobble and gravel layer, as discussed in Section 9.3 and Appendix I of the BODR. It was assumed that the interstitial spaces of the armor layer will become filled in from deposition of suspended river sediments having finer grain size.

[4] 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.

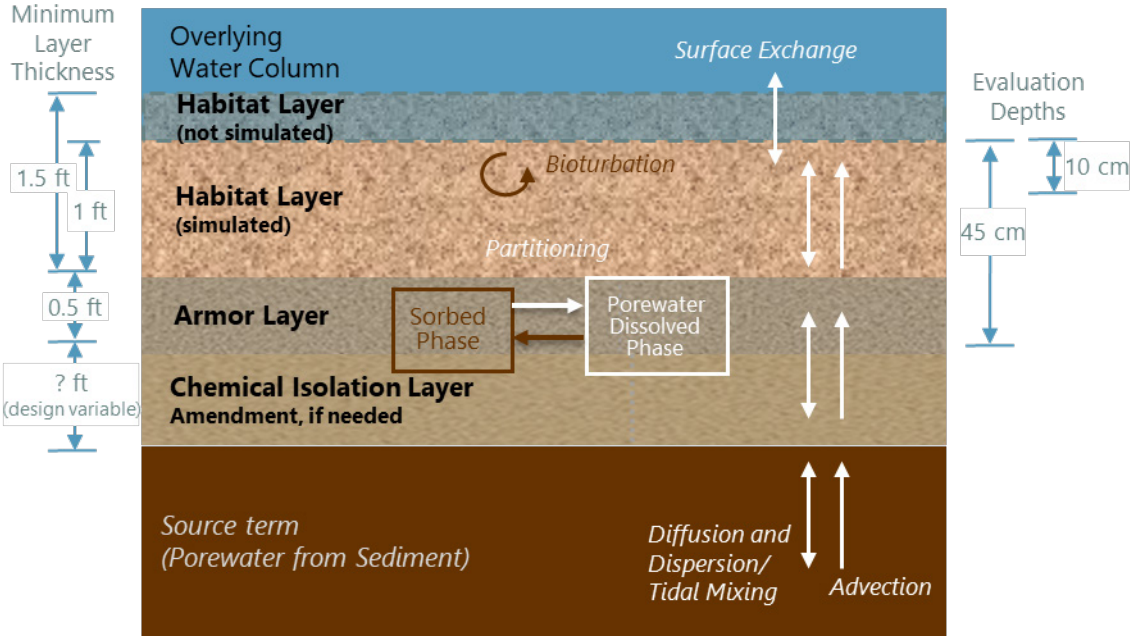
Figure H2-1a
Engineered Cap Layer Configuration and Processes Simulated in the Model – Standard Cap



Notes:
The modeling approach conservatively ignored net sedimentation (i.e., addition of material on top of the cap, which would add thickness to the model domain) but does assume that the cap surface will become infilled with depositing sediment. The model uses a porosity for the armor that assumes the infilling is complete at the beginning of the simulation, which is a reasonable assumption given the relatively short time it will take for infilling to occur compared with the long-term simulation period of 100 years.
Consolidation of underlying sediments was not simulated; consolidation was assumed to be negligible due to dredging before material placement. See Section 7 and Appendix F of the BODR for further details.
As described in Section 2.2, model predicted COC concentrations in the top 10 centimeters (cm) were evaluated against the applicable RALs.

The model configuration for a modified cap was somewhat different from that for a standard cap. As shown in Figure H2-1b, the modified cap consists of a chemical isolation layer overlain by a 0.5-foot-minimum-thickness armor layer and a 1.5-foot-minimum-thickness habitat layer in potential clamming areas. The habitat layer was preliminarily specified as sand and/or rounded gravel aggregate, as discussed in Section 9.5.1 of the BODR. Because the habitat layer was not designed to withstand the full range of potential shear forces that may occur in the area, it is possible that the habitat layer thickness may vary over time, with declines following high energy (erosion) events, followed by increases due to deposition during periods of lower energy. Therefore, only the lower 1 foot of the habitat layer thickness was represented in the model to be conservative.

Figure H2-1b
Engineered Cap Layer Configuration and Processes Simulated in the Model – Modified Cap



Notes:
The modeling approach conservatively ignored net sedimentation (i.e., addition of material on top of the cap, which would add thickness to the model domain) but does assume that the cap surface will become infilled with depositing sediment. The model uses a porosity for the armor that assumes the infilling is complete at the beginning of the simulation, which is a reasonable assumption given the relatively short time it will take for infilling to occur compared with the long-term simulation period of 100 years.
Consolidation of underlying sediments was not simulated; consolidation was assumed to be negligible due to dredging before material placement. See Section 7 and Appendix F of the BODR for further details.
As described in Section 2.2, model predicted COC concentrations in the top 10 cm and top 45 cm were evaluated against the applicable RALs.
A 1-foot habitat layer thickness was represented in the model to be conservative, whereas a minimum thickness of 1.5 feet of habitat layer was proposed in the Intermediate (60%) RD.

The cap evaluation was conducted for all RAAs listed in Table H1-1 that will receive a cap. The evaluation included all COCs with concentrations greater than their respective surface RAL in sediments that will remain following dredging. These COCs are listed in Table H1-1. For a given COC, the highest calculated porewater concentration below the cap based on sediment sampling data within an RAA was used as the contaminant source for the modeling to be conservative. PCBs were simulated as PCB homologs in the model to account for the differences in mobility among PCB congeners.[5] Similarly, the individual dioxin/furan congeners and PAH compounds were simulated individually and the respective results were used to calculate dioxin/furan toxic equivalents (TEQ), cPAHs, and total HPAHs by summation (with multiplication by toxicity factors as applicable for dioxin/furan TEQ and cPAHs).

Model simulations were conducted to identify the chemical isolation layer thickness and/or the amount of amendment required to maintain COC concentrations less than the corresponding RALs for a period of 100 years. Initial model simulations started with a chemical isolation layer thickness of 0.5 foot. Model-predicted COC concentrations in the surface of the cap (i.e., within the armor layer for the standard cap or habitat/armor layer for the modified cap, as shown in Figures H2-1a and H2-1b, respectively) were computed and compared with applicable RALs over the evaluation depth interval(s), as discussed subsequently. If a 0.5-foot chemical isolation layer was not sufficient to maintain predicted COC concentrations less than the applicable RALs, then the model simulations were conducted iteratively, to determine the required thickness or sorptive amendment dosage (represented in the model as total organic carbon [TOC]) necessary to achieve the applicable RALs. In this evaluation, TOC was used as a generic representative for carbon-based amendments that can sorb organic contaminants, such as activated carbon (AC). For PCBs and PAHs, AC has been shown to be at 10 to 100 times more sorptive than TOC (e.g., Jonker and Koelmans 2002; Hale and Werner 2010). Therefore, a TOC of 10% could be achieved by 0.1 to 1% AC. Conservatively, this evaluation assumed that AC is 10 times more sorptive than AC.[6]

Consistent with the approach used for the upper reach (Anchor QEA and Windward 2024) and the data evaluation conducted for the development of RAAs, RALs were applied as follows:

- Intertidal Areas: Model-predicted concentrations averaged over the top 10 centimeters (cm) and top 45 cm of the sediment were compared to the corresponding RALs. This was applied to RAAs 5B, 8B, 9D, 20B, 24I, and 26 (all receiving a modified cap). As set forth in the ROD, the 0- to 45-cm RALs in intertidal areas vary by RC, where RC 1 denotes areas with limited recovery and RC 2 denotes areas with less certainty of recovery.

[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 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] The treatability study being conducted as part of the Phase III PDI would be used to characterize site-specific sorption characteristics between volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) and AC.

- Subtidal Areas Outside the FNC: Model-predicted concentrations averaged over the top 10 cm of the sediment were compared to the corresponding RALs. This was applied to RAAs 15B, 23A, and 30A (all receiving a standard cap). The 0- to 60-cm RALs were not evaluated in these areas because the armored layer in these RAAs will protect against erosion/scour.
- Subtidal Areas Within the FNC: Model-predicted concentrations averaged over the top 10 cm of the sediment were compared to the corresponding RALs for the shoaled areas. This was applied to RAAs 1B, 9J, 14A, 22, 30B, 30C, 30D, 30E, 30F, 30G, and 30H (all receiving a standard cap). Given that the proposed dredging in these RAAs will remove sediments to 9 feet below the authorized navigation depth,[7] the post-remedial surface will be below the horizon of the 2-foot overdredge that the U.S. Army Corps of Engineers (USACE) uses to maintain the channel for navigation purposes. Thus, the evaluation was limited to the top 10 cm of the cap material.

Compliance with the RALs was determined based on comparing model-predicted concentrations averaged over the top 10 cm and/or the top 45 cm of the cap to the respective RALs. Model-predicted concentrations were averaged over the top 10 and 45 cm of the cap because the corresponding RALs were established based on the 0- to 10-cm and 0- to 45-cm sediment intervals to protect benthic exposure and human health from exposure during digging or other disturbances, respectively. Averaging predicted concentrations over this interval is therefore consistent with the basis used to derive these RALs and provides an appropriate measure for evaluating long-term cap effectiveness. Furthermore, the 0- to 10-cm interval represents the biologically active zone where most benthic organisms reside and feed, although the majority of benthic activity occurs within the top few centimeters of sediments (Clarke 2001; EPA 2015). As such, the use of a depth-average concentration over the biologically active zone provides a representative measure of benthic exposure because organisms are exposed to contaminants across the range of depths they inhabit and forage within, rather than a single discrete depth. In addition, concentrations within the upper few centimeters of the cap, where most benthic organisms are present, are usually lower than the concentration averaged over the full 10-cm interval due to surficial fate and transport processes that act on the sediment bed or cap surface. Indeed, detailed profiling of sediment PCB concentrations documented by Apell et al. (2018) show porewater concentration gradients within the top 10 cm of the bed, consistent with the surficial fate and transport processes represented by the CapSim model. Therefore, the 0- to 10-cm average concentration is considered an appropriate and conservative

[7] For RAA 1B, dredging will be conducted down to -24 feet mean lower low water (MLLW), whereas the authorized navigation depth is in that area is -15 feet MLLW. For RAAs 9J and 22, dredging will be conducted down to -29 feet (MLLW), whereas the authorized navigation depth in those areas is -20 feet MLLW. Similarly, dredging will be conducted down to -35 feet MLLW for RAAs 30B through 30F and -39 feet MLLW for RAAs 30G and 30H, whereas the authorized navigation depth in those areas is -30 feet MLLW.

metric for evaluating compliance with the benthic RALs, which were developed to achieve the benthic sediment cleanup objectives (SCOs).[8]

A listing of the RALs used in the engineered cap modeling evaluation is provided in Table H2-1. The depth intervals for the evaluation of the standard cap and modified cap are also shown in Figures H2-1a and H2-1b, respectively.

Table H2-1
RALs for Engineered Cap Evaluation

COC	Units	Intertidal Area (RC 1)		Intertidal Area (RC 2/3)		Subtidal/ FNC Area[1]
		0–10 cm	0–45 cm	0–10 cm	0–45 cm	0–10 cm
Total PCBs	mg/kg OC	12	12	12	65	12
cPAHs	µg/kg	5,500	5,900	5,500	5,900	5,500
Dioxin/furan TEQ	ng/kg	25	28	25	28	25
Mercury	mg/kg	0.41	0.41	0.82	--	0.41
Zinc	mg/kg	410	410	820	--	410
Anthracene	mg/kg OC	220	220	440	--	220
Benzo(a)anthracene	mg/kg OC	110	110	220	--	110
Benzo(a)pyrene	mg/kg OC	99	99	198	--	99
Benzo(g,h,i)perylene	mg/kg OC	31	31	62	--	31
Chrysene	mg/kg OC	110	110	220	--	110
Dibenzo(a,h)anthracene	mg/kg OC	12	12	24	--	12
Fluoranthene	mg/kg OC	160	160	320	--	160
Indeno(1,2,3-cd)pyrene	mg/kg OC	34	34	68	--	34
Phenanthrene	mg/kg OC	100	100	200	--	100
Pyrene	mg/kg OC	1,000	1,000	2,000	--	1,000
Total benzofluoranthenes	mg/kg OC	230	230	460	--	230
Total HPAHs	mg/kg OC	960	960	1,920	--	960
BBP	mg/kg OC	4.9	4.9	9.8	--	4.9
2,4-dimethylphenol	µg/kg	29	29	58	--	29
1,2,4-trichlorobenzene	mg/kg OC	0.81	0.81	0.81	--	0.81
1,4-dichlorobenzene	mg/kg OC	3.1	3.1	3.1	--	3.1

Notes:

1. RAAs within the subtidal areas are all in RC 1 and have the same 0- to 10-cm RAL as those within the FNC (which is independent of RC).

--: not applicable
µg/kg: microgram per kilogram
BBP: butyl benzyl phthalate

[8] The benthic SCOs are established to protect sediment-dwelling organisms. Depending on the applicable recovery category, benthic RALs are set equal to or two times the SCOs.

cm: centimeter
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
FNC: federal navigation channel
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
RC: recovery category
TEQ: toxic equivalents

2.2.2 Utility Crossing AST

As described in Section 1, the evaluation of the utility crossing AST was performed for RAA 9K, which is within the FNC. The dredge depth at the utility crossing is limited by a vertical offset from the assumed location of the utility. For RAA 9K, dredging will remove approximately 3.9 feet of sediment down to an elevation of -22 feet mean lower low water (MLLW), followed by a placement of a 2-foot-minimum thickness of AST cover specified as sandy gravel. The 2-foot AST cover will bring the bed elevation to -20 feet MLLW, which is at the authorized navigation depth in this area. Total PCB was the only COC that exceeded the RAL below the dredge horizon in this RAA.

The utility crossing AST evaluation used the highest COC concentration below the AST cover in RAA 9K based on sediment sampling data as the contaminant source for the modeling. The simulations were performed for 100 years to assess the predicted COC concentrations in the AST cover material relative to the respective RALs. The model-predicted concentrations in the top 10 cm of AST cover material were compared to the RALs, as summarized in Table H2-2.

Table H2-2
Summary of RALs for Utility Crossing AST Evaluation

RAA	COC	Units	Depth Interval	RAL
9K	Total PCBs	mg/kg OC	0 to 10 cm	12

Notes:
AST: area-specific technology
cm: centimeter
COC: contaminant of concern
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level

3 Model Inputs

The CapSim model uses several input parameters that describe chemical-specific properties, sediment cap material properties (or cover in the case of the utility crossing AST), and chemical mass transfer rates. These input parameters were developed based on site-specific data, information from literature, and experience with cap design at other similar sites, including the upper reach of the LDW final design. A list of model input parameters, values used for this modeling assessment, and source(s) from which they were derived is provided in Table H3-1. More details describing certain key model inputs are provided in Sections 3.1 through 3.3.

Table H3-1
Input Parameter Values for the Chemical Isolation Cap Model

Model Input Parameter	Value	Data Source
Chemical-Specific Properties		
COC porewater concentrations	Table H.1.1 (Attachment H.1)	Based on the maximum COC porewater concentration calculated from sediment sampling data for a given RAA. For organic chemicals, porewater concentrations were calculated based on bulk sediment COC and TOC concentrations and COC-specific organic carbon partition coefficients. For total PCBs, PCB homolog concentrations were estimated from individual PCB Aroclor concentrations based on composition reported in literature. For metals, porewater concentrations were calculated based on bulk sediment COC concentrations and equilibrium partition coefficients. The model conservatively assumes a fixed concentration at the bottom boundary of the model (i.e., infinite source). See Section 3.3 for more detail.
Organic carbon partition coefficients for organic chemicals, log K_{OC} (log L/kg)	Table H3-2	K_{OC} values for PCB homologs were developed as part of the Pre-Design Studies (Windward 2020). Sources of K_{OC} values for the remaining organic COCs were based on literature as follows: PAH compounds (EPA 2003), dioxin/furan congeners (Aberg et al. 2008), and VOCs and SVOCs (EPA 1996, 2008). See Section 3.1 for more detail.
Partition coefficients for metals, log K_d(log L/kg)	Table H3-2	K_d values based on literature (EPA 2005). See Section 3.1 for more detail.
Molecular diffusivity (10^{-6} cm^2/s)	Table H3-3	Based on literature-based relationships with molecular weight (organic chemicals; Schwarzenbach et al. 1993) and molar volume (metals; Hayduk and Laudie 1974). See Section 3.2 for more detail.
Chemical biodegradation rate (per year)	0	Assumed no biodegradation, which is conservative for some COCs that have been shown to degrade in sediment such as some of the PAHs, SVOCs, and VOCs evaluated herein.

Model Input Parameter	Value	Data Source
Standard Cap Armor Layer Properties (applicable to standard caps only)		
Thickness (cm)	30	Minimum armor layer thickness.
Total porosity	0.35	The armor layer material consists of angular rock armor (cobble/quarry spalls size; see Section 9.5 of the Intermediate [60%] RD BODR). The porosity represents a typical value for these materials, assuming the interstitial spaces in this matrix will become filled in from future fine-grained sediment deposition (e.g., Domenico and Schwartz 1990).
Dry bulk density (g/cm^3)	1.69	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.35 (see previous row).
Fraction OC of bioturbation zone (%)	1	Assumed 1% within the 10-cm bioturbation zone based on experience from other sites and the assumption that over time, the interstitial spaces of the armor stone will fill in and the f_{OC} will increase toward levels similar to (but less than) those of the current surface sediment, which averages 1.9%. f_{OC} of 1% was also the value used in the cap evaluation for the LDW upper reach final design.
Fraction OC of cap material below bioturbation zone (%)	0.1	Represents the sorptive capacity of the cap material within the 10- to 30-cm depth interval. A typical lower-bound estimate to represent quarry material, in which sorption to mineral fractions can also occur (Karickhoff 1984; EPA 2000), was used. This is conservative because the armor material may be filled in completely with depositional material having a higher fraction of OC.
Modified Cap Habitat Layer Properties (applicable to modified caps only)[a]		
Thickness (cm)	30	Conservatively simulated 30 cm of the 45 cm of habitat material that will be placed, assuming that some of the habitat material may be eroded away over time (recognizing that deposition following such erosion could likely occur).
Total porosity	0.35	The habitat layer material consists of sand and/or rounded gravel aggregate (see Section 9.5 of the Intermediate [60%] RD BODR). The porosity represents a typical value for these materials (e.g., Domenico and Schwartz 1990).
Dry bulk density (g/cm^3)	1.69	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.35 (see previous row).
Fraction OC of bioturbation zone (%)	1	Assumed 1% within the 10-cm bioturbation zone based on experience from other sites and the assumption that over time, depositional sediment will mix with the habitat layer material to some extent and the f_{OC} will increase toward levels similar to (but less than) those of the current surface sediment, which averages 1.9%.
Fraction OC of cap material below bioturbation zone (%)	0.1	Assumed 0.1% within the 10- to 30-cm depth interval of the habitat material (below the bioturbation zone), which is a lower-bound estimate typically used to represent quarry materials in which sorption to mineral fractions can also occur (Karickhoff 1984; EPA 2000).

Model Input Parameter	Value	Data Source
Standard Cap Filter Layer Properties (applicable to standard caps only)		
Thickness (cm)	15	Minimum thickness of 15 cm (0.5 foot).
Total porosity	0.35	Typical value for gravel (e.g., Domenico and Schwartz 1990).
Dry bulk density (g/cm^3)	1.69	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.35 for gravel.
Fraction OC of cap material (%)	0.1	A lower-bound estimate typically used to represent quarry sand in which sorption to mineral fractions can also occur (Karickhoff 1984; EPA 2000).
Modified Cap Armor Layer Properties (applicable to modified caps only)		
Thickness (cm)	15	Minimum thickness of 15 cm (0.5 foot).
Total porosity	0.35	Typical value for gravel (e.g., Domenico and Schwartz 1990).
Dry bulk density (g/cm^3)	1.69	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.35 for gravel.
Fraction OC of cap material (%)	0.1	A lower-bound estimate typically used to represent quarry sand in which sorption to mineral fractions can also occur (Karickhoff 1984; EPA 2000).
Chemical Isolation Layer Properties[a]		
Thickness (cm)	Design variable	Design variable. Started with a minimum thickness of 15 cm (0.5 foot) and increased as necessary to meet the applicable RALs.
Total porosity[b]	0.4 (standard cap) 0.35 (modified cap)	The chemical isolation layer material consists of gravelly sand (see Section 9.5 of the Intermediate [60%] RD BODR). The porosity represents typical values for gravelly sand (standard cap) and gravel (modified cap) based on Domenico and Schwartz 1990.
Dry bulk density (g/cm^3)[b]	1.56 (standard cap) 1.69 (modified cap)	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.4 for the standard cap and 0.35 for the modified cap (see previous row).
Fraction OC of chemical isolation cap material (%)	Design variable	Represents sorptive capacity of the cap material. Started with a nominal value of 0.1%. If an organic chemical RAL was predicted not to be met with sand alone, this value was increased as necessary to represent an OC amendment needed to meet the RALs.
AST Cover Layer Properties (applicable to utility crossing ASTs only)[a]		
Thickness (cm)	60	Minimum layer thickness
Total porosity	0.35	Typical value for sandy gravel.
Dry bulk density (g/cm^3)	1.69	Calculated based on typical particle density of 2.6 g/cm^3 and porosity of 0.35 (see previous row).
Fraction OC of bioturbation zone (%)	1	Assumed 1% within the 10-cm bioturbation zone of the cover material, based on experience from other sites and the assumption that over time, the f_{OC} will increase toward levels similar to (but less than) those of the current surface sediment due to mixing with depositional sediment.

Model Input Parameter	Value	Data Source
Fraction OC of cap material below bioturbation zone (%)	0.1	Assumed 0.1% within the 10- to 60-cm depth interval (below the bioturbation zone), which is a lower-bound estimate typically used to represent quarry materials in which sorption to mineral fractions can also occur (Karickhoff 1984; EPA 2000).
Mass Transport Properties		
Boundary layer mass transfer coefficient (cm/hr)	0.3	Midpoint of range of values compiled from laboratory and field site measurements reported in the literature (e.g., Thibodeaux et al. 2001; Martinez et al. 2010; Erickson et al. 2005) or calibrated as part of models (1D and system-wide) of sediment/water exchange at other sites (e.g., Anchor QEA and GZA 2015; Connolly et al. 2000; EPA 2006; LBG et al. 2014). The contaminants evaluated in these cited studies included dioxins/furans, metals, PCBs, PAHs, and SVOCs. The selected value is also within the range of estimations for several PCB congeners in the LDW (Apell et al. 2018). The value selected is less than the default value of 1 cm/hr in CapSim (Reible 2023). See Section 5.2 for further discussion and sensitivity analysis conducted to evaluate uncertainty in this value.
Groundwater seepage rate (cm/yr)	100, 400, and 800	Range of values estimated from MODFLOW model predictions developed by Fabritz et. al. (1998). Seepage rates of 400 and 800 cm/yr were used for RAAs in the intertidal and subtidal areas. Seepage rates of 100 and 400 cm/yr were used for RAAs in the middle of the channel, defined by the FNC. See Section 3.4 for detail.
Net sedimentation rate (cm/yr)	0	Conservatively assumed no future net sedimentation in the model, which would add material on top of the cap or cover, adding thickness to the model domain. Instead, the model assumes a porosity of material in the top of the cap that accounts for infilling (in the case of armor stone for the standard cap) at the beginning of the simulation, which is a reasonable assumption, given the relatively short time it will take for infilling to occur compared with the long-term simulation period of 100 years.
Dispersion length (cm)	12	Based on 20% of the model domain length (general cap thickness of 60 cm). See Section 3.5 for detail.
Bioturbation zone thickness (cm)	10	The RI (Windward 2010) concluded that 10 cm can be reasonably estimated as the depth of bioturbation in the LDW.
Particle biodiffusion coefficient (cm^2/yr)	1	Parameter represents bioturbation rate applied to the particulate phase; order of magnitude estimate represents midpoint between freshwater rivers and intertidal areas (Thibodeaux and Mackay 2011).
Porewater biodiffusion coefficient (cm^2/yr)	100	Parameter represents bioturbation rate applied to dissolved phase. Typical cap modeling approach is to use 100 times the particle biodiffusion coefficient (see previous row; Reible 2012).

Model Input Parameter	Value	Data Source
Consolidation (cm)	0	Consolidation is not expected to occur as dredging of sediments will occur prior to placing a cap or cover for most RAAs; therefore, no consolidation is expected. Also see Section 7 and Appendix F of the BODR for further details.

Note:
a. The porosity and bulk density values used in the cap modeling analysis may not fully represent the specific materials shown in "data source" column. The bulk density and porosity values will be refined in the cap model for the Pre-Final (90%) RD; however, the resulting changes are not expected to materially affect the predicted contaminant transport within the cap.
b. The placement of amendment may alter the bulk density and porosity in the chemical isolation layer. The magnitude of change in bulk density and porosity depends on multiple factors, such as the type of and quantity of amendment. This effect will be further assessed in the Pre-Final (90%) RD; however, the resulting changes are not expected to materially affect the predicted contaminant transport within the cap.

AST: area-specific technology
BODR: *Basis of Design Report*
cm: centimeter
cm/hr: centimeter per hour
cm/yr: centimeter per year
cm^2/s: square centimeter per second
cm^2/yr: square centimeter per year
COC: contaminant of concern
f_{OC}: fraction organic carbon
FNC: federal navigation channel
g/cm^3: gram per cubic centimeter
K_{OC}: organic carbon partition coefficient
K_d: equilibrium partition coefficient
L/kg: liter per kilogram
LDW: Lower Duwamish Waterway
OC: organic carbon
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
RD: remedial design
RI: remedial investigation
SVOC: semivolatile organic compound
TOC: total organic carbon

3.1 Partitioning Coefficients

Partitioning of chemicals between the dissolved and sorbed (i.e., cap or cover material) phases is described in the model by the chemical-specific equilibrium partition coefficient (K_d). This approach assumes sorption follows a linear isotherm and is not rate-limited and reversible. For organic compounds, including PCBs, dioxins/furans, PAHs, semivolatile organic compounds (SVOCs; i.e., BBP, 2,4-dimethylphenol), and volatile organic compounds (VOCs; i.e., 1,2,4-trichlorobenzene and 1,4-dichlorobenzene), the partition coefficient is calculated in the model based on the customary $K_d = f_{OC} * K_{OC}$ approach (e.g., Karickhoff 1984), where K_{OC} is the compound's OC partition coefficient and f_{OC} is the OC fraction of the solid phase (i.e., cap material).

The partition coefficients for all COCs used in the cap modeling are listed in Table H3-2; the approach used by chemical class was as follows:

- For PCBs, model simulations were performed at the homolog level to represent the range of chemical mobility associated with the congeners that make up the total Aroclors, as discussed previously. Log K_{OC} values for each PCB homolog group were calculated from the empirical relationship developed from the data collected as part of the pre-design studies (log K_{OC} = 0.77 × log K_{OW} + 1.5) using the K_{OW} values from Hawker and Connell (1988) (Windward 2020). Windward (2020) confirmed that effects from black carbon on partitioning within site

sediments were minimal; therefore, these site-specific partition coefficients were used to represent partitioning between porewater and sediments as well as cap and cover materials.

- For dioxins/furans, K_{OC} values were based on Aberg et al. (2008).
- For most VOCs and SVOCs (i.e., BBP, 1,2,4-trichlorobenzene, and 1,4-dichlorobenzene), K_{OC} values were calculated using the K_{OW} values from EPA 2008 and the relationship between K_{OW} and K_{OC} based on Di Toro (1985). For 2,4-dimethylphenol, the K_{OC} value was from EPA 1996.
- For PAHs and metals, K_{OC} and K_d values were based on literature values in EPA 2003 and EPA 2005, respectively.

Literature-based K_{OC} and K_d values for SVOCs, PAHs, dioxins/furans, and metals were also used to represent partitioning between porewater and sediments as well as cap and cover materials.

Table H3-2
Partition Coefficients Used in the Cap Model

Chemical Group	Chemical Name	Log K_{OC} (log L/kg)	Chemical Group	Chemical Name	Log K_{OC} (log L/kg)	Chemical Group	Chemical Name	Log K_d (log L/kg)
PCBs	PCB-Mono	5.1	Dioxins/ Furans	2,3,7,8-TCDD	6.4	Metals	Mercury	4.9
	PCB-Di	5.4		1,2,3,7,8-PeCDD	6.9		Zinc	4.1
	PCB-Tri	5.8		1,2,3,4,7,8-HxCDD	7.3			
	PCB-Tetra	6.1		1,2,3,6,7,8-HxCDD	7.3			
	PCB-Penta	6.4		1,2,3,4,7,8,9-HxCDD	7.3			
	PCB-Hexa	6.7		1,2,3,4,6,7,8-HpCDD	7.9			
	PCB-Hepta	7.0		OCDD	8.2			
	PCB-Octa	7.3		2,3,7,8-TCDF	6.1			
	PCB-Nona	7.5		1,2,3,7,8-PeCDF	6.5			
	PCB-Deca	7.8		2,3,4,7,8-PeCDF	6.5			
PAHs	Acenaphthene	3.9		1,2,3,4,7,8-HxCDF	6.9			
	Benzo(a)anthracene	5.6		1,2,3,6,7,8-HxCDF	6.9			
	Benzo(a)pyrene	6.0		1,2,3,7,8,9-HxCDF	6.9			
	Benzo(g,h,i)perylene	6.4		2,3,4,6,7,8-HxCDF	6.9			
	Chrysene	5.6		1,2,3,4,6,7,8-HpCDF	7.3			
	Dibenzo(a,h)anthracene	6.6		1,2,3,4,7,8,9-HpCDF	7.3			
	Fluoranthene	5.0		OCDF	7.7			
	Indeno(1,2,3-cd)pyrene	6.6	VOCs/SVOCs	BBP	4.8			
	Phenanthrene	4.5		2,4-dimethylphenol	2.3			
	Pyrene	4.8		1,2,4-trichlorobenzene	3.9			
	Total benzofluoranthenes[1]	6.2		1,4-dichlorobenzene	3.4			

Notes:
1. K_{OC} for total benzofluoranthenes were estimated by averaging K_{OC} from benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene.
BBP: butyl benzyl phthalate
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
K_d: partition coefficient
K_{OC}: organic carbon partition coefficient
L/kg: liter per kilogram
OCDD: octachlorodibenzo-p-dioxin
OCDF: octachlorodibenzofuran
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
SVOC: semivolatile organic compound
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran
VOC: volatile organic compound

3.2 Molecular Diffusivity Values

The model calculates an effective diffusion coefficient using a chemical-specific molecular diffusivity value and an empirical equation based on the cap material porosity using the approach developed by Millington and Quirk (1961) for coarse-grained materials. For organic compounds, molecular diffusivity values were calculated based on molecular weight using the correlation from Schwarzenbach et al. (1993). For metals, values were calculated based on Hayduk and Laudie (1974) as a function of molar volume. Molecular diffusivity values used in the model are listed in Table H3-3.

Table H3-3
Molecular Diffusivity Values Used in the Cap Model

Chemical Group	Chemical Name	Diffusivity (cm^2/s)
PCBs	PCB-Mono	6.5E-06
	PCB-Di	5.8E-06
	PCB-Tri	5.2E-06
	PCB-Tetra	4.8E-06
	PCB-Penta	4.4E-06
	PCB-Hexa	4.1E-06
	PCB-Hepta	3.9E-06
	PCB-Octa	3.6E-06
	PCB-Nona	3.5E-06
	PCB-Deca	3.3E-06
PAHs	Acenaphthene	7.6E-06
	Benzo(a)anthracene	5.7E-06
	Benzo(a)pyrene	5.3E-06
	Benzo(g,h,i)perylene	5.0E-06
	Chrysene	5.7E-06
	Dibenzo(a,h)anthracene	5.0E-06
	Fluoranthene	6.2E-06
	Indeno(1,2,3-cd)pyrene	5.0E-06
	Phenanthrene	6.8E-06
	Pyrene	6.2E-06
	Total benzofluoranthenes[1]	5.3E-06

Chemical Group	Chemical Name	Diffusivity (cm^2/s)
Dioxins/ Furans	2,3,7,8-TCDD	4.5E-06
	1,2,3,7,8-PeCDD	4.2E-06
	1,2,3,4,7,8-HxCDD	3.9E-06
	1,2,3,6,7,8-HxCDD	3.9E-06
	1,2,3,4,7,8,9-HxCDD	3.9E-06
	1,2,3,4,6,7,8-HpCDD	3.7E-06
	OCDD	3.5E-06
	2,3,7,8-TCDF	4.6E-06
	1,2,3,7,8-PeCDF	4.3E-06
	2,3,4,7,8-PeCDF	4.3E-06
	1,2,3,4,7,8-HxCDF	4.0E-06
	1,2,3,6,7,8-HxCDF	4.0E-06
	1,2,3,7,8,9-HxCDF	3.9E-06
	1,2,3,4,6,7,8-HpCDF	3.8E-06
	1,2,3,4,7,8,9-HpCDF	3.8E-06
	OCDF	3.6E-06
VOCs/SVOCs	BBP	4.6E-06
	2,4-dimethylphenol	8.9E-06
	1,2,4-trichlorobenzene	6.7E-06
	1,4-dichlorobenzene	7.8E-06
Metals	Mercury	2.8E-05
	Zinc	3.6E-05

Notes:

1. The diffusivity value is the same as that for benzo(b)fluoranthene, benzo(j)fluoranthene and benzo(k)fluoranthene, which constitute total benzofluoranthenes, because these compounds are structural isomers with the same molecular weight.

BBP: butyl benzyl phthalate
cm^2/s: square centimeter per second
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
OCDD: octachlorodibenzo-p-dioxin
OCDF: octachlorodibenzofuran
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
SVOC: semivolatile organic compound
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran
VOC: volatile organic compound

3.3 Porewater Concentrations

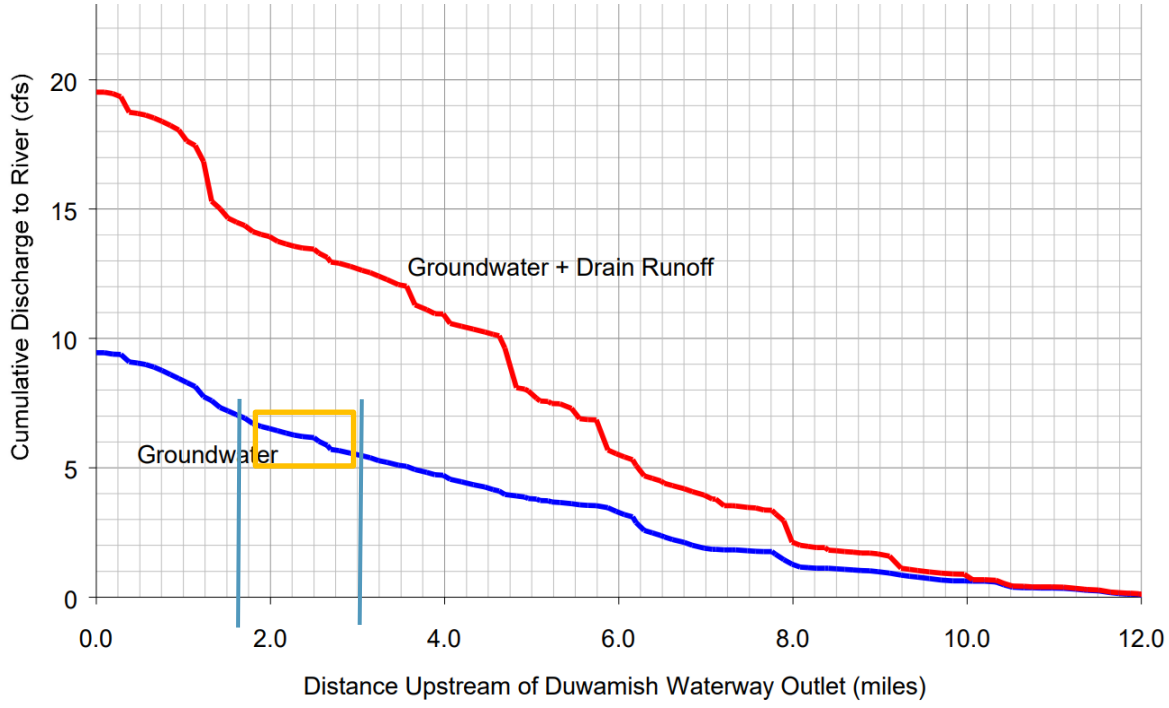
The porewater concentration input defines the source term in the CapSim model and corresponds to the contaminant concentrations present in the porewater immediately beneath the cap or cover. Porewater was not sampled in the RAAs that will have engineered caps or the utility crossing AST; therefore, COC concentrations in sediment porewater were calculated using measured sediment concentrations and TOC from the corresponding samples, in conjunction with the COC-specific equilibrium partitioning coefficients discussed in Section 3.1.

For each RAA that will include an engineered cap or utility crossing AST, porewater concentrations were calculated using the method described in the preceding paragraph for all samples collected from depths below the bottom elevation of the planned cap or utility crossing AST. Conservatively, for each COC (or individual chemical within a group in the case of COCs for which concentrations were summed to calculate a total), the sample that yielded the maximum calculated porewater concentration was used for the simulation of each RAA. The porewater concentrations used in the engineered cap and utility crossing AST evaluations, along with the sample IDs of the sediment samples used to estimate porewater concentrations, are provided in Tables H.1.1 and H.1.2 of Attachment H.1, respectively.

3.4 Groundwater Seepage

Direct measurements of groundwater seepage rates in the project area were not available. Therefore, seepage rates were estimated from the groundwater flow modeling study documented by Fabritz et. al. (1998). In this study, a 3D model of the Duwamish River Basin was developed using the U.S. Geological Survey MODFLOW framework. As part of that study, predicted cumulative discharge to LDW was presented as a function of location along 12 miles of river (see Figure H3-1, which is adapted from Figure 11 of Fabritz et al. [1998]). To estimate the seepage rate in the middle reach cap/cover RAAs, the change in cumulative discharge with distance in the project area, as shown in Figure H3-1, was reviewed. The increase in discharge with distance appears to differ somewhat among three sections of the river. Discharge is predicted to be the greatest from the river outlet to river mile (RM) 2.75, as illustrated by the steeper slope shown in Figure H3-1. Discharge is predicted to be lower moving upstream as the slope becomes flatter from RM 2.75 to approximately RM 5, and further decline from RM 6 to RM 9.5. The middle reach cap/cover RAAs are located between RMs 1.8 and 2.9 (identified by the yellow rectangle in Figure H3-1), which is nearly the entire extent of the middle reach (between RMs 1.6 and 3.0). Thus, the estimated groundwater seepage rate for the entire middle reach was used for the cap evaluation.

Figure H3-1
Cumulative Discharge to the Lower Duwamish Waterway Predicted by MODFLOW Model



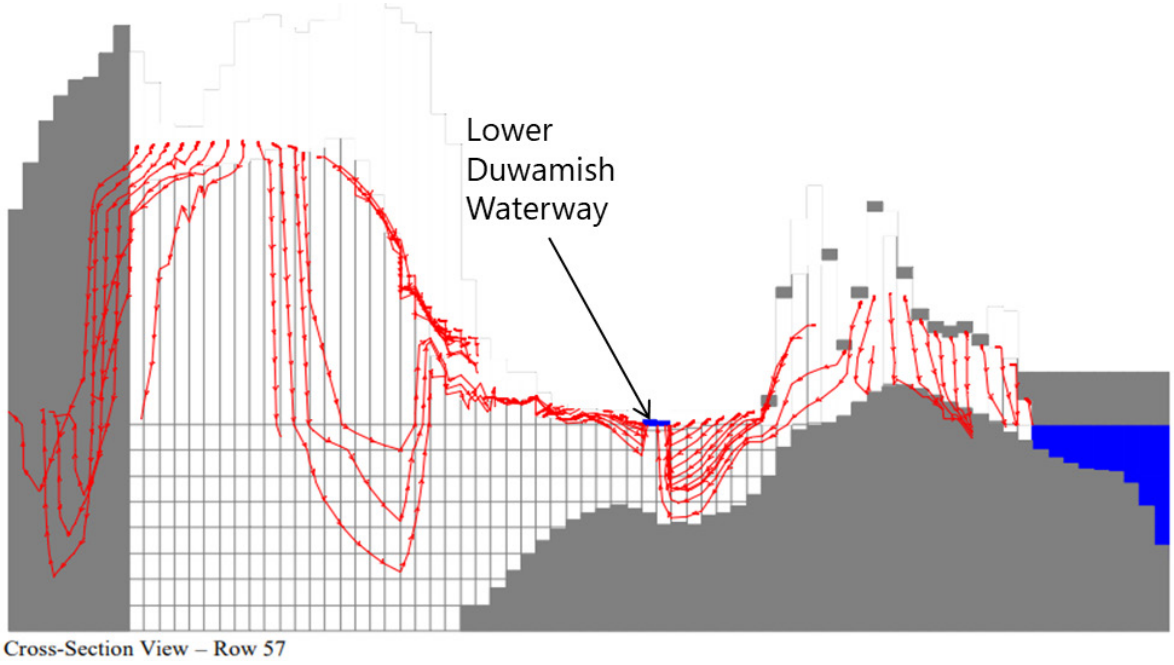
Notes:
Source: Fabritz et. al. (1998), Figure 11
The vertical blue lines and yellow box were not part of original figure.
The cap design area is represented by the yellow box. Seepage was calculated as the change in cumulative discharge between the two vertical blue lines (i.e., the extent of the middle reach of 1.4 miles).

Within the middle reach, discharge changes by approximately 1.5 cubic feet per second (cfs) over 1.4 miles (7,392 feet). The LDW is approximately 530 feet wide in this section. The seepage rate can therefore be calculated as the change in discharge over a specified distance (1.5 cfs), divided by surface area, which equals the specified distance (7,392 feet) multiplied by the width of the river (530 feet). The resulting seepage rate is approximately 368 centimeters per year (cm/yr). For the cap modeling, the value was rounded up to a seepage rate of 400 cm/yr to be conservative.

This calculation assumes the flow to the river is distributed evenly across its width. Figure H3-2, which is adapted from Figure 8 of Fabritz et. al. (1998), shows a cross-section view of the river approximately 1 to 2 miles upstream of the cap design areas of the middle reach, with model-predicted groundwater flow paths. Based on this figure, the majority of the flow is expected to discharge in the nearshore areas (which is consistent with hydrogeological principles based on the break in free surface slope that occurs between the upland and offshore, and further affected by any density differences between estuarine water in the LDW and fresher groundwater). Thus, the seepage

rate closer to the center of the channel could be closer to 100 cm/yr or less, whereas closer to shore within the cap/cover RAAs, the seepage rates could be closer to 800 cm/yr (assuming the majority of flow discharges to half the area along shore). Because of the uncertainty and spatial variability associated with the estimated average value of 400 cm/yr, the model simulations were conducted using values of 400 and 800 cm/yr in RAAs located in the intertidal and subtidal areas (i.e., RAAs 5B, 8B, 9D, 15B, 20B, 23A, 24I, 26, and 30A), and 100 and 400 cm/yr in RAAs located in the middle of the channel, defined by the FNC (i.e., RAAs 1B, 9J, 9K, 22, 30B, 30C, 30D, 30E, 30F, 30G, and 30H). Each of these values is considered equally valid in the absence of site-specific measurements.

Figure H3-2
Flow Paths to Lower Duwamish Waterway Predicted by MODFLOW Model



Note:
Source: Fabritz et. al. (1998), Figure 8

Seepage rates assumed in cap design evaluations performed for other portions of the LDW range from 56.8 to 590 cm/yr, as shown in Table H3-4, which are generally consistent with the range considered here. The seepage rates of 100 to 800 cm/yr are also consistent with the range used in the Final (100%) RD for the upper reach of the LDW (Table H3-4).

Table H3-4
Seepage Rates Assumed for Modeling Conducted for Cap Design at Other Nearby Sites

Site	Assumed Seepage Rate (cm/yr)	Reference
EMJ Jorgensen	250	USACE (2016)
Duwamish Diagonal	56.8	Anchor Environmental (2003)
Slip 4 100% Design	312	Integral (2007)
LDW FS	250 (106–590)	AECOM (2010)
LDW upper reach Final (100%) RD	400 (100–800)	Anchor QEA and Windward (2024)

Notes:
Values in parentheses represent the bounding values used for each site.
cm/yr: centimeter per year
FS: feasibility study
LDW: Lower Duwamish Waterway
RD: remedial design

The water levels in the LDW are influenced by tidal fluctuations, which can affect hydraulic gradients between groundwater and surface water, and hence groundwater seepage rates. At low tides, seepage rates could be greater than the daily average, and at high tides, seepage rates could be less than the daily average. Extreme conditions, such as king tides, would result in even lower and higher seepage rates as compared to the long-term average. Despite such short-term variation, using long-term average seepage rates is most appropriate for simulation of the overall net advective transport of COCs in sediment porewater, especially when considering time scales of decades or longer.

3.5 Dispersion

Notwithstanding the discussion in the previous section about using average seepage rates for long-term advective transport modeling, dissolved-phase transport within the cap may also be influenced by tidal fluctuations in the LDW. Specifically, tidal fluctuations can result in daily oscillations (and even reversals) in hydraulic gradient and seepage. Representing such tidal variations with a mixing or dispersion coefficient is a common approach in groundwater modeling (e.g., La Licata et al. 2011). Dispersion in the cap model is represented as the product of dispersivity (i.e., dispersion length) and pore velocity (i.e., seepage rate divided by porosity; Freeze and Cherry 1979). Dispersivity values for flow in porous media over relatively short distances are typically in the range of 1% of the model or evaluation domain length (consistent with typical values used in cap modeling [Reible 2012]), whereas those associated with large-scale groundwater plumes are on the order of 10% (Gelhar et al. 1992; Neuman 1990). A higher dispersivity value or seepage rate would result in higher dispersive transport within the cap.

The dispersivity for this modeling evaluation was set to a higher value of 20% of the cap or cover thickness to represent hydraulic gradient variations and reversals from tidal fluctuations as a dispersion process. This dispersivity value (i.e., 20% of domain length) is consistent with the value used in the RD for the LDW upper reach (Anchor QEA and Windward 2024). It is also consistent with values used in the final cap designs conducted at other tidally influenced sites, such as the Former Portland Gas Manufacturing Site (located on the Lower Willamette River just upstream of Portland Harbor, Oregon), where dispersivity was estimated based on the comparative strengths of tidal signals in hourly seepage meter measurements (Appendix C of Anchor QEA 2020), and Gloucester Harbor, Massachusetts, where dispersivity was derived from model calibrations to vertical profiles of salinity in porewater (Anchor QEA and GZA 2015; Reidy et al. 2015). Because this value contains uncertainty, a sensitivity analysis was performed for select RAAs by reducing the input dispersivity value by half (i.e., 10% of the domain thickness) to evaluate its impact on the cap design. Results of the sensitivity evaluation are presented in Section 5.1.

4 Model Results

Modeling was conducted to evaluate the effectiveness of engineered caps (standard and modified) and cover as part of the utility crossing AST in each RAA evaluated (listed in Tables H1-1 and H1-2, respectively). The modeling was conducted for a range of seepage rates: a lower-bound and upper-bound seepage rate of 100 cm/yr and 400 cm/yr for RAAs in the FNC areas, and 400 cm/yr and 800 cm/yr for RAAs outside the FNC areas, as described in Section 3.4. Model-predicted concentrations over the 100-year simulation period were compared to the RALs for each COC (see Tables H2-1 and H2-2) over the applicable depth interval(s) to evaluate the performance of the engineered cap or cover and to evaluate whether concentrations were predicted to exceed the RALs (and if so, when).

4.1 Standard Cap

Table H4-1 summarizes the model results for each standard cap simulation (for both groundwater seepage rates), indicating the following:

- The driving COC(s), if any, that correspond to the COC(s) for which concentrations were predicted to exceed the RAL for a given scenario. For cases in which RAL exceedance was predicted, the predicted time for such exceedance is provided as well.
- The chemical isolation layer thickness and amendment content (if any) determined through iterative modeling to produce no predicted RAL exceedances for cases in which they were initially predicted for the starting case of a 15-cm sand-only chemical isolation layer.

For the evaluation of standard caps, model-predicted concentrations for the top 10 cm of the armor layer were averaged vertically. Model-predicted sorbed- and dissolved-phase COC concentrations at the end of the 100-year simulation for each RAA and seepage rate listed in Table H4-1, along with the applicable RALs, are provided in Table H.2.1 of Attachment H.2 and Table H.3.1 of Attachment H.3, respectively. Depth profiles of model-predicted COC concentrations at Years 0, 20, 40, 60, 80, and 100 for each RAA and seepage rate are presented in Attachment H.4.

Table H4-1
Summary of Standard Cap Model Scenarios and Model Results

RAA	Chemical Isolation Layer		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed Top 10 cm RAL (years)	COC That Exceeded RAL in Less Than 100 Years
	Thickness and Material	Amendment				
1B	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None
9J	15 cm gravelly sand	None	100	Total PCBs, dioxin/furan TEQ	>100	None
			400		>100	None

RAA	Chemical Isolation Layer		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed Top 10 cm RAL (years)	COC That Exceeded RAL in Less Than 100 Years
	Thickness and Material	Amendment				
14A	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None
15B	15 cm gravelly sand	None	400	Total PCBs	>100	None
			800		>100	None
22	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None
23A	15 cm gravelly sand	None	400	Total PCBs	>100	None
			800		>100	None
30A	15 cm gravelly sand	None	400	Total PCBs, mercury	>100	None
			800		>100	None
30B	15 cm gravelly sand	None	100	Total PCBs, dioxin/furan TEQ	>100	None
			400		>100	None
30C	15 cm gravelly sand	None	100	Total PCBs, dioxin/furan TEQ	>100	None
			400		>100	None
30D	15 cm gravelly sand	None	100	Total PCBs, dioxin/furan TEQ	>100	None
			400		>100	None
30E	15 cm gravelly sand	None	100	Total PCBs, dioxin/furan TEQ	>100	None
			400		>100	None
30F	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None
30G	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None
30H	15 cm gravelly sand	None	100	Total PCBs	>100	None
			400		>100	None

Notes:
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
TEQ: toxic equivalents

Model results shown in Table H4-1 indicate that a 15-cm (0.5-foot) sand-only chemical isolation layer with no amendment is sufficient to maintain model-predicted COC concentrations less than the RALs

for more than 100 years under both seepage rates evaluated in the RAAs receiving standard caps. Additional details on the results, which are contained in Table H.2.1 of Attachment H.2, are as follows:

- Model results indicated that in RAAs 1B, 14A, 15B, 22, 23A, 30F, 30G, and 30H, which were evaluated for total PCBs only, model-predicted concentrations at 100 years, based on the upper-bound seepage rate for each RAA, are 1.7 to 41 times less than the 0- to 10-cm RAL (see Table H.2.1 in Attachment H.2 for the predicted concentrations and the corresponding RALs).
- Model results indicated that in RAAs 9J, 30B, 30C, 30D, 30E, which were evaluated for total PCBs and dioxin/furan TEQ, model-predicted total PCB concentrations at 100 years, based on the upper-bound seepage rate, are 8.6 to 80 times less than the surface (top 10-cm) RAL, whereas the corresponding model-predicted dioxin/furan TEQ concentrations are 10,000 to 71,428 times less than the surface (top 10-cm) RAL (see Table H.2.1 in Attachment H.2).
- Model results indicated that in RAA 30A, which was evaluated for total PCBs and mercury, model-predicted total PCB concentration at 100 years, at the upper-bound seepage rate, is 1.6 times less than the surface (top 10-cm) RAL, whereas the corresponding mercury is not predicted to be present at meaningful concentrations within the top 10 cm of the cap (see Table H.2.1 in Attachment H.2).

4.2 Modified Cap

Table H4-2 summarizes the model results for each modified cap simulation, indicating which COC(s) if any, were predicted to exceed the RAL for the starting cap configuration, and when, as well as increased cap thickness or amendment values needed to achieve predicted concentrations less than the RALs for cases in which such exceedances were predicted. Model-predicted sorbed- and dissolved-phase COC concentrations for each simulation listed in Table H4-2, along with the applicable RALs, are provided in Table H.2.2 of Attachment H.2 and Table H3.2 of Attachment H.3, respectively. Depth profiles of model-predicted COC concentrations at Years 0, 20, 40, 60, 80, and 100 for each RAA and seepage rate are presented in Attachment H.4.

RAAs proposed for modified caps were first evaluated for a 15-cm chemical isolation layer without amendment. Further evaluations were performed with a thicker chemical isolation layer and/or with amendment[9] if a RAL exceedance was predicted within 100 years for a given RAA and COC. Model results show that a 15-cm gravel chemical isolation layer was predicted to be sufficient to meet the RALs in one of the six modified caps (RAA 20B) for more than 100 years. In the other five RAAs, additional thickness and/or an amendment was predicted to be needed to meet the RALs for more than 100 years, as discussed in the paragraphs that follow. As noted in Section 1, the model analyses

[9] As described in Section 2.2.1, TOC was used as a generic representative for carbon-based amendments that can sorb organic contaminants, such as AC.

for the modified cap in the Intermediate (60%) RD are the same as presented in the Preliminary (30%) RD. The modeling analysis will be updated in the Pre-Final (90%) RD to incorporate additional data collected as part of the Phase III PDI and other modifications to the RAAs and the cap design.

Model results indicated that for RAA 5B, both 15-cm and 30-cm chemical isolation layer thicknesses with only gravel were insufficient for meeting the RALs for more than 100 years and that an amendment is required. For a 15-cm chemical isolation layer thickness, an amendment content equivalent to 2% TOC was predicted to meet both the 0- to 10-cm and 0- to 45-cm RAL for PCBs at both seepage rates. For a 30-cm chemical isolation layer thickness, an amendment content equivalent to 1% TOC was predicted to meet the RALs at both seepage rates (Table H4-2). At the higher seepage rate and a 15-cm chemical isolation layer amended with 2% TOC, model results show that 100-year concentrations in the top 10 cm and top 45 cm of the cap are 16 and 4.1 times less than the corresponding RALs, respectively (Table H.2.2 of Attachment H.2). At the higher seepage rate and a 30-cm chemical isolation layer amended with 1% TOC, model results show that the 100-year concentrations in the top 10 and top 45 cm are 5.6 and 1.2 times less than the corresponding RALs, respectively (Table H.2.2 of Attachment H.2). The TOC requirement could be met with various carbon-based sorbents, some of which sorb more strongly than natural TOC such that their equivalent contents would be less (e.g., activated carbon).

Model results indicated that in RAA 8B, a chemical isolation layer thickness of 76 cm (2.5 feet) with an amendment content equivalent to 73% TOC is predicted to meet the top 10- and 45-cm RALs at both seepage rates (Table H4-2). At the higher seepage rate, the 100-year concentration of 1,2,4-trichlorobenzene is essentially zero in the top 10- and 45-cm intervals, whereas the 100-year concentration of 1,4-dichlorobenzene is 1.6 and 1.03 times lower than the top 10- and 45-cm RALs, respectively (Table H2.2 of Attachment H.2). It is noted that for a thinner chemical isolation layer thickness of 60 cm (2 feet) and the amendment content equivalent to 100% TOC, the predicted top 10- and top 45-cm 1,4-dichlorobenzene concentrations were less than the corresponding RALs for over 100 years under the lower seepage rate. Under the higher seepage rate, the predicted top 10-cm concentration was also below the RAL; however, the predicted top 45-cm concentration exceeded the RAL in Year 96.

Model results indicated that in RAA 9D, for a 15-cm chemical isolation layer thickness, an amendment content equivalent to 1% TOC is predicted to meet the top 10- and top 45-cm RALs at both seepage rates. For a 30-cm chemical isolation layer, no amendment was needed to meet the top 10- and top 45-cm RALs at either seepage rate (Table H4-2). For a 15-cm chemical isolation layer with amendment content equivalent to 1% TOC at the higher seepage rate, the 100-year total PCB concentrations in the top 10- and top 45-cm were 4.0 and 3.9 times less than the corresponding RALs, respectively. For a 30-cm chemical isolation layer with no amendment at the higher seepage

rate, the 100-year total PCB concentrations in the top 10 and top 45 cm were 1.4 and 1.2 times less than the corresponding RALs, respectively (Table H.2.2 of Attachment H.2).

Model results indicated that in RAA 20B, a 15-cm chemical isolation layer with no amendment was predicted to be sufficient to meet the top 10-cm and top 45-cm RALs at both seepage rates (Table H4-2). For a 15-cm chemical isolation layer at the higher seepage rate, the 100-year total PCB concentrations in the top 10- and 45-cm were 18 and 3.1 times less than the corresponding RALs, respectively, whereas the dioxin/furan TEQ concentrations in the top 10- and top 45-cm were 160 and 8.2 times less than the corresponding RALs, respectively (Table H.2.2 of Attachment H.2).

Model results indicated that in RAA 24I, for a 15-cm chemical isolation layer thickness, an amendment content equivalent to 1% TOC is predicted to meet the top 10- and top 45-cm RALs at both seepage rates. For a 30-cm chemical isolation layer, no amendment was needed to meet the top 10- and top 45-cm RALs at either seepage rate (Table H4-2). For a 15-cm chemical isolation layer with an amendment content equivalent to 1% TOC at the higher seepage rate, the 100-year total PCB concentrations in the top 10- and top 45-cm were 2.7 and 3.1 times less than the corresponding RALs, respectively. For a 30-cm chemical isolation layer with no amendment at the higher seepage rate, the 100-year total PCB concentrations in the top 10 and top 45 cm were 1.1 and 1.2 times less than the corresponding RALs, respectively (Table H.2.2 of Attachment H.2).

In RAA 26, a 15-cm chemical isolation layer with no amendment was predicted to be sufficient to meet applicable RALs at both seepage rates for all evaluated COCs, except for BBP. Model results indicated that with a 15-cm chemical isolation layer, an amendment content equivalent to 48% TOC was needed to meet the applicable RALs for both the lower and upper seepage rates (Table H4-2). At 100 years, model results indicate a top 10-cm average BBP concentration of 9.3 milligrams per kilogram (mg/kg) OC, which is less than the RAL of 9.8 mg/kg OC. At the higher seepage rate, the predicted COC concentrations at 100 years for anthracene, fluoranthene, phenanthrene, pyrene, total HPAHs, BBP, and 2,4-dimethylphenol are 1.1 to 870 times less than the surface (top 10-cm) RAL, respectively, whereas concentrations for the remaining COCs are very small or essentially zero (Table H.2.2 of Attachment H.2). A similar level of protection can also be achieved by a 30-cm chemical isolation layer with an amendment content equivalent to 14% TOC (Table H4-2). At the higher seepage rate, the predicted COC concentrations at 100 years for anthracene, fluoranthene, phenanthrene, pyrene, total HPAHs, BBP, and 2,4-dimethylphenol are 1.1 to 1,000 times less than their respective surface (top 10-cm) RAL, whereas concentrations for the remaining COCs are very small or essentially zero (Table H.2.2 of Attachment H.2).

The changes in model-predicted BBP concentrations over time within the top 10-cm of the cap in RAA 26 are shown in Figures H4-1a and H4-1b for lower and higher seepage rates evaluated, respectively, as a representative "worst case" example of the transport behavior for one of the most mobile COCs within the cap. A subset of the chemical isolation layer configurations listed in

Table H4-2 were included in these figures: the 15-cm, 30-cm, and amended 15-cm chemical isolation layers. At the lower seepage rate, the top 10-cm average BBP concentration is predicted to exceed the surface RAL in 6 years and 8 years for the 15- and 30-cm unamended chemical isolation layers, respectively. When the 15-cm chemical isolation layer is amended with 48% TOC, the top 10-cm average BBP concentration is less than the RAL throughout the 100-year evaluation period (Figure H4-1a). Under the higher seepage rate, the top 10-cm average BBP concentration is predicted to exceed the surface RAL sooner for the 15- and 30-cm unamended chemical isolation layer compared to the lower seepage rate condition, and to gradually approach the surface RAL by the end of Year 100 for the amended 15-cm chemical isolation layer (Figure H4-1b).

Table H4-2
Summary of Modified Cap Model Scenarios and Model Results

RAA	Chemical Isolation Layer		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed RAL (years)		COC that Exceeded RAL in less than 100 Years
	Thickness and Material	Amendment[1]			Top 10 cm	Top 45 cm	
5B	15 cm gravelly sand	None	400	Total PCBs[2]	>100	26	Total PCBs
			800		63	13	Total PCBs
	15 cm gravelly sand	1% TOC (<1% AC)	400		>100	>100	None
			800		>100	62	Total PCBs
	15 cm gravelly sand	2% TOC (<1% AC)	400		>100	>100	None
			800		>100	>100	None
	30 cm gravelly sand	None	400		>100	59	Total PCBs
			800		85	30	Total PCBs
	30 cm gravelly sand	1% TOC (<1% AC)	400		>100	>100	None
			800		>100	>100	None
8B	15 cm gravelly sand	None	400	1,2,4-trichlorobenzene, 1,4-dichlorobenzene	1	1	1,2,4-trichlorobenzene, 1,4-dichlorobenzene
			800		1	1	1,2,4-trichlorobenzene, 1,4-dichlorobenzene
	15 cm gravelly sand	100% TOC (10% AC)	400		24	19	1,2,4-trichlorobenzene, 1,4-dichlorobenzene
			800		11	9	1,2,4-trichlorobenzene, 1,4-dichlorobenzene
	30 cm gravelly sand	100% TOC (10% AC)	400		78	63	1,4-dichlorobenzene
			800		37	31	1,4-dichlorobenzene
	60 cm gravelly sand	100% TOC (10% AC)	400		>100	>100	None
			800		>100	96	1,4-dichlorobenzene

RAA	Chemical Isolation Layer		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed RAL (years)		COC that Exceeded RAL in less than 100 Years
	Thickness and Material	Amendment[1]			Top 10 cm	Top 45 cm	
8B (cont.)	76 cm gravelly sand	36% TOC (4% AC)	400	1,2,4-trichlorobenzene, 1,4-dichlorobenzene (cont.)	>100	>100	None
			800		57	50	1,4-dichlorobenzene
	76 cm gravelly sand	73% TOC (7.5% AC)	400		>100	>100	None
			800		>100	>100	None
9D[2]	15 cm gravelly sand	None	400	Total PCBs[2]	>100	>100	None
			800		89	68	Total PCBs
	15 cm gravelly sand	1% TOC (<1% AC)	400		>100	>100	None
			800		>100	>100	None
	30 cm gravelly sand	None	400		>100	>100	None
			800		>100	>100	None
20B	15 cm gravelly sand	None	400	Total PCBs, dioxin/furan TEQ	>100	>100	None
			800		>100	>100	None
24I	15 cm gravelly sand	None	400	Total PCBs	>100	>100	None
			800		77	68	Total PCBs
	15 cm gravelly sand	1% TOC (<1% AC)	400		>100	>100	None
			800		>100	>100	None
	30 cm gravelly sand	None	400		>100	>100	None
			800		>100	>100	None

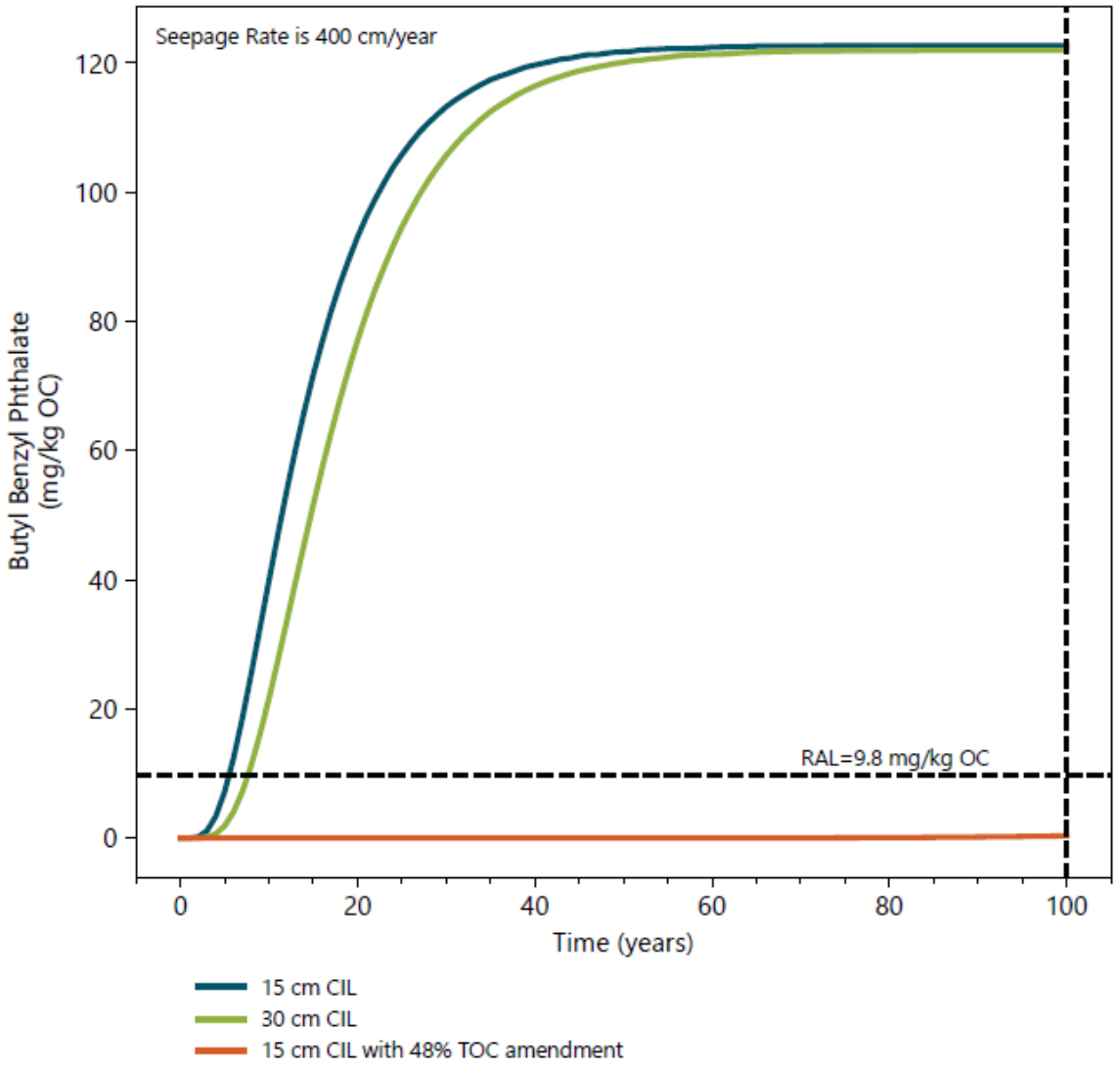
RAA	Chemical Isolation Layer		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed RAL (years)		COC that Exceeded RAL in less than 100 Years
	Thickness and Material	Amendment[1]			Top 10 cm	Top 45 cm	
26	15 cm gravelly sand	None	400	cPAHs, dioxin/furan TEQ, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, total benzofluoranthenes, total HPAHs, BBP, 2,4-dimethylphenol	6	>100	BBP
			800		3	>100	BBP
	30 cm gravelly sand	None	400		8	>100	BBP
			800		4	>100	BBP
	15 cm gravelly sand	48% TOC (5% AC)	400		>100	>100	None
			800		>100	>100	None
	30 cm gravelly sand	14% TOC (1.5% AC)	400		>100	>100	None
			800		>100	>100	None

Notes:

1. Amendment dosage is given as percent by weight. As described in Section 2.2.1, for PAHs and PCBs, literature shows that AC is 10 to 100 times more sorptive than TOC (e.g., Jonker and Koelmans 2002; Hale and Werner 2010). Therefore, for the purposes of the 60% RD, it is assumed that AC is 10 times more sorptive than TOC (. The AC dosage needed for those RAAs will be further evaluated during Pre-Final (90%) RD.
2. Based on the results of the Phase III investigation, arsenic and other metals may be added to the list of COCs to be modeled during the Pre-Final 90% RD. This may also result in the need for modified caps in RAAs 9A, 9B, and 9C. Based on these results, a potential treatability study to select the type and dose of an iron-based amendment was included in the Phase III PDI.

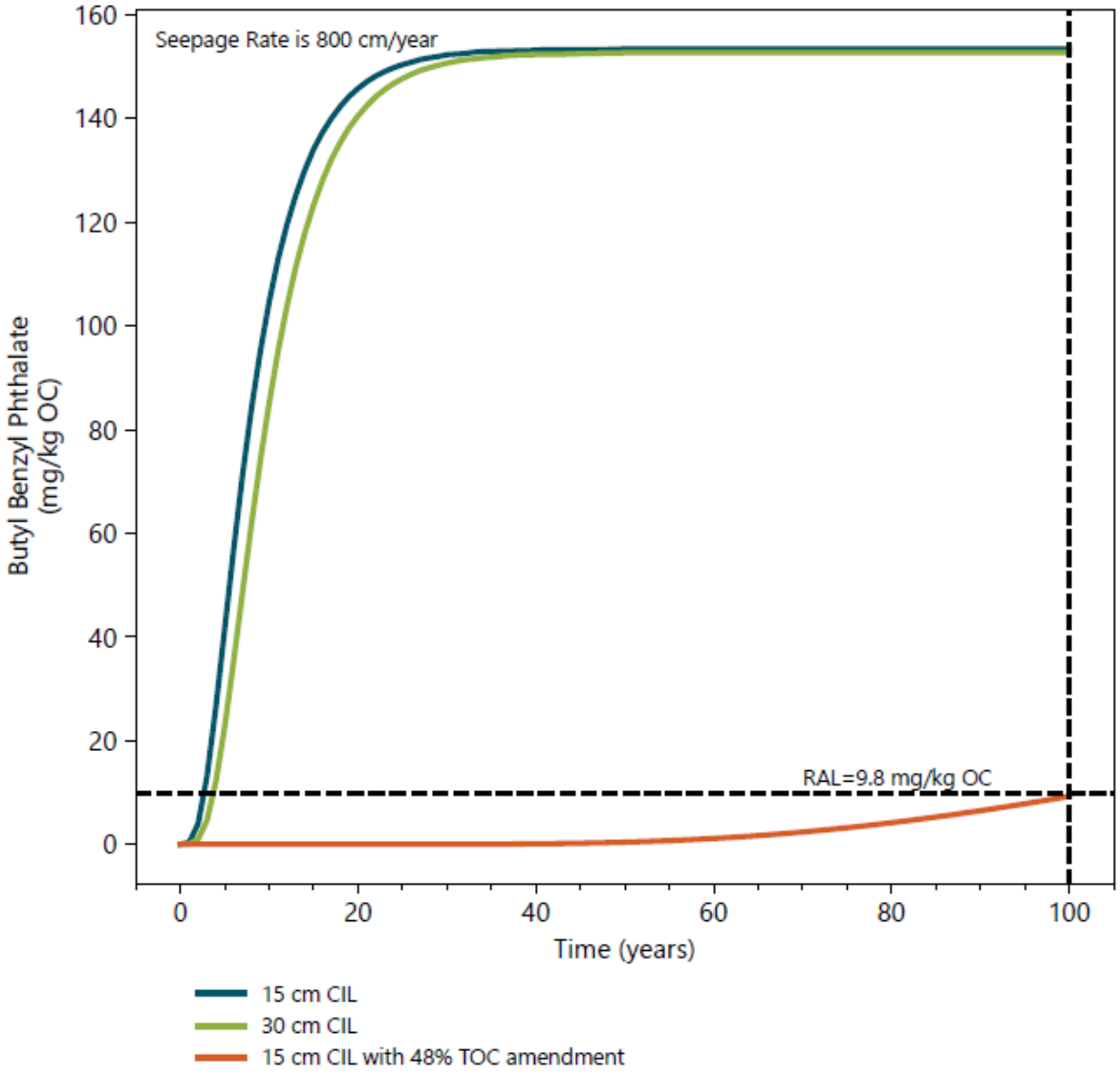
AC: activated carbon
BBP: butyl benzyl phthalate
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
TEQ: toxic equivalents
TOC: total organic carbon

Figure H4-1a
Temporal Profile of Butyl Benzyl Phthalate Within the Surface (0–10 cm) of the RAA 26 Cap



Notes:
The vertical dashed line at 100 years represents the end of the assessment period.
The horizontal dashed line represents the top 10-cm RAL.
CIL: chemical isolation layer
mg/kg: milligram per kilogram
OC: organic carbon
RAA: remedial action area
RAL: remedial action level
TOC: total organic carbon

Figure H4-1b
Temporal Profile of Butyl Benzyl Phthalate Within the Surface (0–10 cm) of the RAA 26 Cap



Notes:
The vertical dashed line at 100 years represents the end of the assessment period.
The horizontal dashed line represents the top 10-cm RAL.
CIL: chemical isolation layer
cm: centimeter
mg/kg: milligram per kilogram
OC: organic carbon
RAA: remedial action area
RAL: remedial action level
TOC: total organic carbon

4.3 Utility Crossing AST

Table H4-3 summarizes the model results for the utility crossing AST simulations, indicating which COCs were predicted to exceed the RAL for each scenario, if any. Model-predicted sorbed and dissolved-phase concentrations for each scenario and COC, along with the applicable RALs, are provided in Tables H.2.3 of Attachment H.2 and H3.3 of Attachment H.3, respectively. Depth profiles of model-predicted COC concentrations at Years 0, 20, 40, 60, 80, and 100 are presented in Attachment H.4.

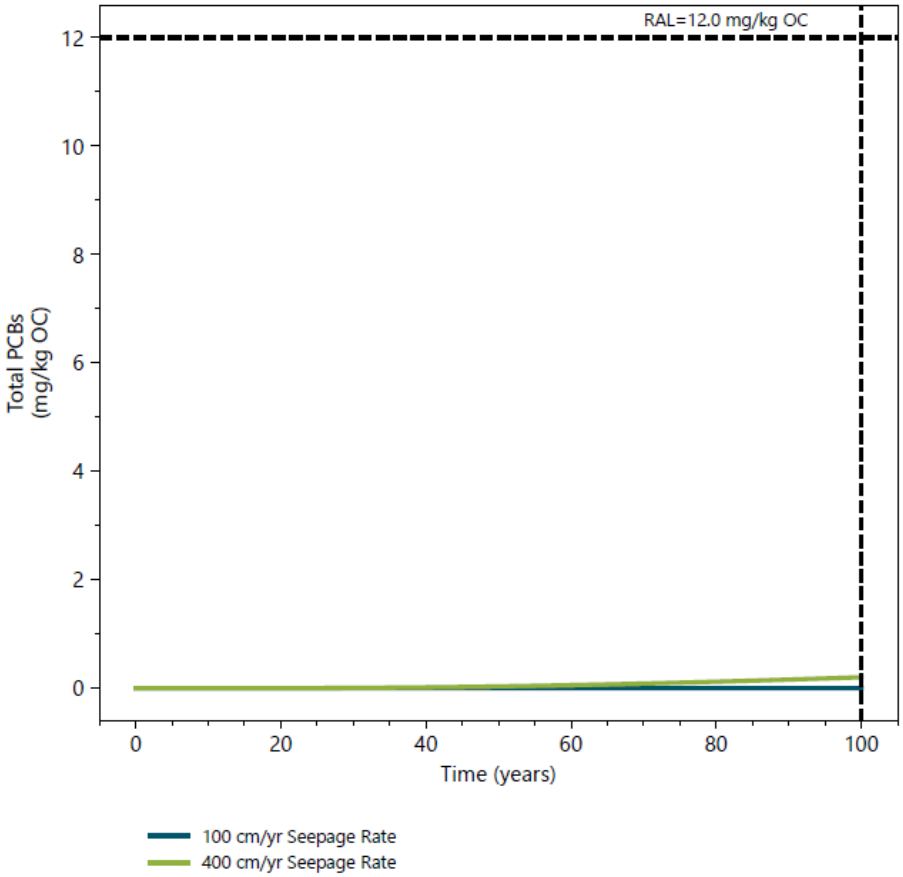
Model results indicated that the top 10-cm RALs would not be exceeded at 100 years under either seepage rate for RAA 9K. RAA 9K was evaluated for total PCBs, and the predicted 100-year concentration within the top 10 cm of the cap was 10 times less than the applicable RALs for the range of seepages rates evaluated (Table H.2.3 of Attachment H.2). Figure H4-2 shows the change in model-predicted PCB concentrations over time within the top 10 cm of the AST cover for RAA 9K. Throughout the 100-year simulation, the model-predicted concentrations averaged over the top 10 cm of the AST cover were less than the surface RAL under the range of seepage rates evaluated, with the higher seepage rate model scenario resulting in slightly higher concentrations compared with the lower seepage rate.

Table H4-3
Summary of Utility Crossing AST Model Scenarios and Model Results

RAA	Cover		Seepage Rate (cm/yr)	Modeled COC	Time to Exceed Top 10-cm RAL (years)	COC That Exceeded RAL in Less than 100 Years
	Thickness and Material	Amendment				
9K	60 cm sandy gravel	None	100	Total PCBs	>100	None
			400		>100	None

Notes
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level

Figure H4-2
Temporal Profile of PCBs Within the Surface (top 10 cm) of the RAA 9K AST Cover



Notes:
The vertical dashed line at 100 years represents the end of the assessment period.
The horizontal dashed line represents the top 10-cm RAL for total PCBs.
AST: area-specific technology
cm: centimeter
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level

5 Sensitivity Analyses

Sensitivity analyses were conducted to further evaluate the influence of the hydrodynamic dispersivity and boundary layer mass transfer coefficient (Kbl) on model-predicted contaminant transport. These parameters were selected because their values were determined based on profession judgement with consideration of site conditions.

5.1 Hydrodynamic Dispersivity Sensitivity Analysis

As discussed in Section 3.5, a sensitivity analysis was performed to evaluate how an alternate value for the input hydrodynamic dispersivity affects model results. The base case model simulations discussed in the previous sections used a dispersivity value that was set to 20% of the cap or cover thickness, which is at the upper end of literature on porous media transport, and was selected to represent anticipated tidal fluctuations in groundwater seepage as a dispersion process. Although the selected value is consistent with values used in cap designs at other tidally influenced sites (including the upper reach of the LDW), the value is uncertain. Therefore, a sensitivity analysis was performed for RAA9J (PCBs and dioxin/furan TEQ) and RAA 30A (PCBs and mercury) by setting the dispersivity to a lower value, equivalent to 10% of the cap or cover thickness. These RAAs were selected to cover multiple COCs and the full range of seepage rates (i.e., RAA 9J is within the FNC, and RAA 30A is adjacent to the channel in the subtidal area). This sensitivity analysis was not performed for the RAAs receiving a modified cap because the cap modeling for these RAAs is expected to be updated to incorporate additional data collected during the Phase III PDI.

The top 10-cm average sorbed phase concentrations predicted at Year 100 for the base case and sensitivity analysis are shown in Table H5-1. Depth profiles of model-predicted COC concentrations at Year 100 for both the base case and sensitivity analysis are provided in Attachment 6.1. The results indicate that the base case model (using the higher dispersivity value) is more conservative, resulting in higher (or similar) concentrations than predicted using the lower dispersivity value. The concentration difference between the base and sensitivity analysis decreases as the contaminant transport within the cap is more dominated by advection (i.e., higher seepage rate), as expected.

Table H5-1
Summary of Hydrodynamic Dispersivity Sensitivity Model Results

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	0- to 10-cm Model-Predicted 100-Year Sorbed Phase Concentration	
					Base (Dispersion Length of 12 cm)	Dispersion Length of 6 cm
9J	15 cm gravelly sand; no amendment	100	Total PCBs	mg/kg OC	0.014	0.004
			Dioxin/Furan TEQ	ng/kg	3.2E-07	2.4E-10
		400	Total PCBs	mg/kg OC	0.81	0.40
			Dioxin/Furan TEQ	ng/kg	0.0025	0.00046
30A	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	1.8	0.87
			Mercury	mg/kg	0	0
		800	Total PCBs	mg/kg OC	7.4	4.9

Notes:
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
RAA: remedial action area
TEQ: toxic equivalents

5.2 Boundary Layer Mass Transfer Coefficient Sensitivity Analysis

A sensitivity analysis on Kbl was performed to evaluate the effects of uncertainty in that coefficient on model results. This sensitivity analysis evaluates the influence of Kbl on the computed 0- to 10-cm vertical average concentrations used to assess compliance with RALs (see Section 2.2.1). The sensitivity analysis was performed for all RAAs and COCs listed in Tables H4-1 through H4-3. Depth profiles of model-predicted COC concentrations at Year 100 for both the base case and sensitivity analysis are provided in Attachment H6.2.

Kbl governs the calculated rate of dissolved phase diffusive contaminant exchange across the sediment-water interface in the model (Lampert and Reible 2009). A higher Kbl value increases the

rate of contaminant transport from the cap surface to the overlying water column, which tends to reduce the porewater concentrations within the uppermost portion of the cap (because the mass transfer is represented as a diffusive exchange between surface porewater and surface water, which has a much lower concentration [represented as zero in the model]).

As presented in Table H3-1, a base value for Kbl of 0.3 cm/hr was used in the cap modeling evaluation. This value is consistent with the coefficient used in cap model evaluation for the upper reach of the LDW and represents the midpoint of values reported in the literature and applied at other contaminated sediment sites. The selected value is supported by laboratory measurements, field site measurements, and values used to calibrate site-specific models of sediment/water exchange for numerous other sites and for a range of COCs that is consistent with those evaluated in this modeling.

Further support for the selected Kbl value is provided by site-specific measurements collected in the LDW. Specifically, Apell et al. (2018) measured PCB fluxes resulting from porewater diffusion and bioirrigation at three locations in the LDW. The study demonstrated that sediment-water exchange processes generally result in vertical gradients in porewater PCB concentrations within the top 10 cm of sediment, consistent with the processes represented by the CapSim model (i.e., Kbl, as well as bioturbation/bioirrigation). The total mass transfer coefficients (diffusion and bioirrigation combined) estimated from the Apell et al. (2018) study across the three locations and seven PCB congeners evaluated averaged 0.3 cm/hr (consistent with the base value selected for this modeling), with an uncertainty range of 0.1 to 0.8 cm/hr.[10]

To evaluate the sensitivity of model predictions to Kbl, a test value of 0.1 cm/hr, representing the lower bound of the site-specific range reported by Apell et al. (2018), was selected for the sensitivity analysis. This value is also consistent with the lower end of the range reported in the literature from other sites (see citations in Table H3-1). Because a lower Kbl value reduces contaminant exchange with the overlying water column and thereby would result in higher predicted porewater concentrations at the cap surface, it represents a conservative test of the potential influence of the sediment-water boundary condition on predicted sediment concentrations within the top 10-cm depth interval used to assess RAL compliance. Higher Kbl values were not tested because these values would increase the degree of surface water exchange within the cap surface, thereby reducing predicted concentrations relative to the base value.

The sensitivity analysis results are provided in Tables H5.1 through H5.3 of Attachment H5. For the model-predicted top 10-cm sediment COC concentrations at Year 100, the Kbl value had a greater influence on PAHs and VOCs/SVOCs than on PCBs and dioxin/furan TEQ. Relative to the base-case Kbl value of 0.3 cm/hr, the lower bound Kbl value of 0.1 cm/hr increased the predicted top 10-cm

[10] Based on 10th to 90th percentile of all measurements.

concentrations by up to 16% for PCBs, up to 6% for dioxin/furan TEQ, and nearly 40% for PAHs and VOCs/SVOCs. Despite these increases, the cap design remained unchanged for all RAAs except RAA 24I (PCBs) and RAA 26 (BBP) under the upper-bound seepage rate of 800 cm/yr. For these cases, the model-predicted top 10-cm concentrations exceeded the applicable RALs by only 4% and 12%, respectively. Both RAAs are located in intertidal areas that will receive modified caps. Given the relatively small magnitude of the exceedances, the uncertainty associated with hydrodynamic dispersivity (discussed in Section 5.1), seepage rates, and the conservative assumptions incorporated into the cap modeling evaluation (e.g., used the maximum COC concentration measured beneath the cap as the source concentration, assumption of an infinite contaminant source, assumption of no net sediment deposition over the cap, and the inclusion of only 1 foot of the 1.5-foot habitat layer in the simulation; see further discussion in Section 6), no additional modifications to the cap design were made for these RAAs as part of the Intermediate (60%) RD.

As described in Section 1, the cap modeling evaluation for RAAs receiving modified caps will be updated to incorporate additional data collected as part of the Phase III PDI. The Kbl sensitivity analysis will be updated accordingly, and the results will be presented in the Pre-Final (90%) RD.

6 Summary

Chemical transport modeling was conducted to evaluate the performance of the proposed engineered caps and a utility crossing AST cover to maintain concentrations less than RALs for more than 100 years. For the middle reach of the LDW, 14 RAAs were evaluated for a standard cap, six for a modified cap, and one for the utility crossing AST.

For the standard cap, modeling indicates that a 15-cm sand chemical isolation layer with no amendment is predicted to meet the applicable RALs for more than 100 years in all FNC and subtidal RAAs (i.e., RAAs 1B, 9J, 14A, 15B, 22, 23A, 30A, 30B, 30C, 30D, 30E, 30F, 30G, 30H).

For the modified cap, a range of thickness and sorptive amendment contents were evaluated for the six RAAs; those predicted to meet the applicable RALs for more than 100 years under both the lower and upper seepage rate for each RAA are as follows:

- RAA 20B: A 15-cm gravel chemical isolation layer with no amendment
- RAAs 9D and 24I: A 15-cm gravel chemical isolation layer with an amendment content equivalent to 1% TOC or a 30-cm gravel chemical isolation layer with no amendment
- RAA 5B: Either a 15-cm gravel chemical isolation layer with amendment content equivalent to 2% TOC or a 30-cm gravel chemical isolation layer with amendment content equivalent to 1% TOC
- RAA 26: Either a 15- or 30-cm gravel chemical isolation layer with amendment contents equivalent to 48% TOC or 14% TOC, respectively
- RAA 8B: A 76-cm gravel chemical isolation layer with an amendment content equivalent to 73% TOC. However, due to the possible limitation on dredge depth at this RAA, a 60-cm gravel chemical isolation layer with an amendment content equivalent to 100% TOC was selected for the 60% design. This configuration is predicted to meet the top 10- and top 45-cm RALs for all COCs throughout 100 years under both the lower and upper seepage rates, with the exception of 1,4-dichlorobenzene, for which RAL exceedances will not occur until Year 96 under the higher seepage rate (i.e., 800 cm/yr).

For the utility crossing AST, the COC concentrations within the 60-cm gravelly sand cover are predicted to meet the applicable RALs for more than 100 years in RAA 9K.

As described previously, TOC was used in this evaluation as a generic representative for amendments that can sorb organic contaminants, such as AC. As described in Section 2.2.1, in the absence of a site-specific treatability study, AC was assumed to be 10 times more sorptive than TOC for PCBs and PAHs (e.g., Jonker and Koelmans 2002; Hale and Werner 2010). Therefore, an AC content of approximately 1% by dry weight was assumed to provide the same sorptive capacity as 10% TOC. For VOCs and SVOCs, a treatability study will be conducted to evaluate the site-specific sorption characteristics of AC for select RAAs as part of the Phase III PDI. The results of this evaluation will be

presented in the Pre-Final (90%) RD and be used in the updated modeling to refine the activated carbon dosage required to meet the RALs and benthic SCOs long-term.

The evaluation results were further summarized in Table H6-1. This table includes the calculated AC dose to meet the RALs long-term, the COC that drives the cap design, and the resulting concentrations in the top 10-cm interval.

The evaluation results for the utility crossing AST are summarized in Table H6-2.

Sensitivity analyses were conducted to evaluate the effect of lower hydrodynamic dispersivity and Kbl values on model-predicted COC concentrations within the top 10 cm of the cap. Reducing the hydrodynamic dispersity by half for two select RAAs generally resulted in lower predicted top 10-cm concentrations, with the magnitude of the change varied by COC and seepage rates. In contrast, reducing the Kbl value from the base-case value of 0.3 cm/hr to the lower bound value of 0.1 cm/hr increased the predicted top 10-cm concentration by up to 40% for all RAAs in evaluation. Under the lower-bound Kbl value, the predicted top 10-cm concentrations were below the applicable RAL for all RAAs except for RAAs 24I and 26, where concentrations exceeded the applicable RALs by 4% and 12%, respectively.

Additional uncertainties in the modeling include the use of the following: 1) calculated porewater concentrations using sediment data and literature-based partition coefficients; and 2) seepage rates that are based on MODFLOW predicted discharge and an assumed range.[11] The Phase III PDI will produce data within intertidal RAAs to reduce the uncertainty associated with porewater concentrations and seepage rates, as applicable. Although these uncertainties exist, the simulations presented in this appendix are still considered conservative. Examples of the conservative assumptions include the following:

- The cap thickness represented in the modeling is based on the thinnest cap thicknesses (though it could be 30 to 45 cm thicker than simulated for the standard cap and modified cap, respectively, in some areas due to overplacement allowances).
- Maximum COC concentrations based on the single highest measurement within a given cap/cover RAAs (regardless of depth) were assumed for the source term.
- Infinite source of a COC beneath the cap was assumed in the modeling.
- Net sedimentation atop the armor layer, habitat layer material, or AST cover, which would increase the thickness of the model domain, was ignored.
- No degradation was simulated in the cap modeling, which is conservative for some COCs that have been shown to degrade in sediment, such as some of the PAHs, SVOCs, and VOCs evaluated herein.

[11] As discussed in Section 3.3, the range of groundwater seepages was based on the particle tracking results shown in Figure H3-2 that show greater seepage nearshore compared with the middle of the channel.

Table H6-1
Summary of Engineered Cap Evaluation

RAA	Cap Location	RC	Cap Type	Chemical Isolation Layer			COC Driven the Cap Design	RAL (mg/kg OC)	Predicted 0- to 10-cm Concentration at Year 100 (mg/kg OC)	
				Thickness (inch)	Amendment (simulated as TOC)	AC Dose[1]			Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[3]
1B	FNC	1	Standard	6	None	None	Total PCBs	12	0.0051	0.29
5B	Intertidal	2	Modified	6	2%	1%	Total PCBs	12	0.23	2.1
				12	1%	1%	Total PCBs	12	0.070	0.75
8B	Intertidal	1	Modified	24	100%	10%	1,4-dichlorobenzene	3.1	0.061	2.3
				30	73%	8%	1,4-dichlorobenzene	3.1	0.031	1.9
9D	Intertidal	2	Modified	6	1%	1%	Total PCBs	12	0.38	3.0
				12	None	None	Total PCBs	12	1.4	8.4
9J	FNC	3	Standard	6	None	None	Total PCBs	12	0.014	0.81
14A	FNC	3	Standard	6	None	None	Total PCBs	12	0.019	1.1
15B	Subtidal	1	Standard	6	None	None	Total PCBs	12	0.71	2.9
20B	Intertidal	1	Modified	6	None	None	Total PCBs	12	0.15	0.65
22	FNC	3	Standard	6	None	None	Total PCBs	12	0,031	1.8
23A	Subtidal	1	Standard	6	None	None	Total PCBs	12	1.7	7.0
24I	Intertidal	2	Modified	6	1%	1%	Total PCBs	12	0.57	4.4
				12	None	None	Total PCBs	12	2.1	11
26	Intertidal	2	Modified	6	48%	5%	BBP	9.8	0.35	9.3
				12	14%	2%	BBP	9.8	0.19	8.6
30A	Subtidal	1	Standard	6	None	None	Total PCBs	12	1.8	7.4
30B	FNC	1	Standard	6	None	None	Total PCBs	12	0.025	1.4

RAA	Cap Location	RC	Cap Type	Chemical Isolation Layer			COC Driven the Cap Design	RAL (mg/kg OC)	Predicted 0- to 10-cm Concentration at Year 100 (mg/kg OC)	
				Thickness (inch)	Amendment (simulated as TOC)	AC Dose[1]			Lower Bound Seepage Rate[2]	Upper Bound Seepage Rate[3]
30C	FNC	1	Standard	6	None	None	Total PCBs	12	0.0025	0.15
30D	FNC	3	Standard	6	None	None	Total PCBs	12	0.013	0.77
30E	FNC	3	Standard	6	None	None	Total PCBs	12	0.014	0.82
30F	FNC	3	Standard	6	None	None	Total PCBs	12	0.015	0.89
30G	FNC	3	Standard	6	None	None	Total PCBs	12	0.0095	0.57
30H	FNC	3	Standard	6	None	None	Total PCBs	12	0.012	0.72

Notes:

1. It was assumed that 1% of AC is equivalent to 10% TOC. For the evaluation, AC was assumed to be applied at a minimum dosage of 1%. The AC dosage needed for RAAs requiring an amendment will be further evaluated in the Pre-Final (90%) RD using results from the Phase III PDI treatability study.
2. Seepage rates of 100 cm/yr and 400 cm/yr were applied to RAAs located within and outside the FNC, respectively.
3. Seepage rates of 400 cm/yr and 800 cm/yr were applied to RAAs located within and outside the FNC, respectively.

BBP: butyl benzyl phthalate
cm: centimeter
cm/yr: centimeter per year
FNC: federal navigation channel
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
RC: recovery category
TOC: total organic carbon

Table H6-2
Summary of Utility Crossing AST Evaluation

RAA	Location	RC	Backfill Thickness (inch)	Model COC	RAL (mg/kg OC)	Predicted 0- to 10-cm Concentration in Year 100 (mg/kg OC)	
						100 cm/yr Seepage Rate	400 cm/yr Seepage Rate
9K	FNC	3	24	Total PCBs	12	0.0034	0.20

Notes:
AST: area-specific technology
cm: centimeter
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
RAA: remedial action area
RC: recovery category

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Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

Attachment H.1
Input Porewater Concentrations for the Cap Model

Table H.1.1
Porewater Concentrations Used in the Cap Model for the Engineered Cap Evaluation

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
1B	LDW24-SC1582E	PCB-Mono	0.084	2.8E-05
		PCB-Di	2.6	4.5E-04
		PCB-Tri	40	2.7E-03
		PCB-Tetra	132	4.4E-03
		PCB-Penta	185	3.1E-03
		PCB-Hexa	130	1.1E-03
		PCB-Hepta	58	2.4E-04
		PCB-Octa	12	2.4E-05
		PCB-Nona	1.1	1.4E-06
		PCB-Deca	0.079	5.3E-08
5B	LDW24-IT1560D	PCB-Mono	0.087	6.9E-04
		PCB-Di	2.5	1.0E-02
		PCB-Tri	34	5.4E-02
		PCB-Tetra	152	1.2E-01
		PCB-Penta	307	1.2E-01
		PCB-Hexa	195	3.9E-02
		PCB-Hepta	67	6.7E-03
		PCB-Octa	13	6.3E-04
		PCB-Nona	1.2	3.7E-05
		PCB-Deca	0.083	1.3E-06
8B	LDW24-IT1562E	1,2,4-trichlorobenzene	42	1.3
		1,4-dichlorobenzene	180	21
9D	LDW24-IT1551D	PCB-Mono	0.16	3.7E-04
		PCB-Di	4.3	5.0E-03
		PCB-Tri	57	2.7E-02
		PCB-Tetra	247	5.8E-02
		PCB-Penta	499	5.8E-02
		PCB-Hexa	366	2.1E-02
		PCB-Hepta	155	4.6E-03
		PCB-Octa	31	4.5E-04
		PCB-Nona	2.8	2.6E-05
		PCB-Deca	0.21	9.7E-07

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
9J	LDW24-SC1542I	PCB-Mono	0.17	7.1E-05
		PCB-Di	5.8	1.2E-03
		PCB-Tri	92	7.6E-03
		PCB-Tetra	285	1.2E-02
		PCB-Penta	341	7.1E-03
		PCB-Hexa	196	2.0E-03
		PCB-Hepta	72	3.8E-04
		PCB-Octa	14	3.6E-05
		PCB-Nona	1.3	2.1E-06
		PCB-Deca	0.094	7.8E-08
	LDW24-SC1542K	2,3,7,8-TCDD	0.00033	5.2E-09
		1,2,3,7,8-PeCDD	0.0019	9.7E-09
		1,2,3,4,7,8-HxCDD	0.0020	4.0E-09
		1,2,3,6,7,8-HxCDD	0.022	4.5E-08
		1,2,3,7,8,9-HxCDD	0.006	1.2E-08
		1,2,3,4,6,7,8-HpCDD	0.45	2.2E-07
		OCDD	3.7	9.4E-07
		2,3,7,8-TCDF	0.0036	1.1E-07
		1,2,3,7,8-PeCDF	0.0022	2.7E-08
		2,3,4,7,8-PeCDF	0.010	1.3E-07
		1,2,3,4,7,8-HxCDF	0.11	5.4E-07
		1,2,3,6,7,8-HxCDF	0.019	9.3E-08
		1,2,3,7,8,9-HxCDF	0.013	6.7E-08
		2,3,4,6,7,8-HxCDF	0.028	1.4E-07
		1,2,3,4,6,7,8-HpCDF	0.25	5.0E-07
		1,2,3,4,7,8,9-HpCDF	0.037	7.4E-08
		OCDF	0.24	1.9E-07
14A	LDW24-SC1489J	PCB-Mono	0.30	8.8E-05
		PCB-Di	11	1.6E-03
		PCB-Tri	177	1.0E-02
		PCB-Tetra	503	1.5E-02
		PCB-Penta	462	6.8E-03
		PCB-Hexa	229	1.7E-03
		PCB-Hepta	79	2.9E-04
		PCB-Octa	15	2.8E-05
		PCB-Nona	1.4	1.7E-06

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
14A (cont.)	LDW24-SC1489J (cont.)	PCB-Deca	0.11	6.2E-08
15B	LDW24-SC1493G	PCB-Mono	0.22	6.5E-05
		PCB-Di	7.2	1.1E-03
		PCB-Tri	113	6.8E-03
		PCB-Tetra	338	1.0E-02
		PCB-Penta	376	5.7E-03
		PCB-Hexa	249	1.9E-03
		PCB-Hepta	113	4.3E-04
		PCB-Octa	23	4.3E-05
		PCB-Nona	2.1	2.5E-06
		PCB-Deca	0.16	9.5E-08
20B	LDW24-IT1470E	PCB-Mono	0.053	2.1E-05
		PCB-Di	1.3	2.5E-04
		PCB-Tri	18	1.4E-03
		PCB-Tetra	61	2.4E-03
		PCB-Penta	104	2.0E-03
		PCB-Hexa	115	1.1E-03
		PCB-Hepta	70	3.4E-04
		PCB-Octa	15	3.6E-05
		PCB-Nona	1.4	2.1E-06
		PCB-Deca	0.10	7.9E-08
		2,3,7,8-TCDD	0.0026	5.0E-08
		1,2,3,7,8-PeCDD	0.041	2.5E-07
		1,2,3,4,7,8-HxCDD	0.12	3.0E-07
		1,2,3,6,7,8-HxCDD	0.72	1.8E-06
		1,2,3,7,8,9-HxCDD	0.20	5.0E-07
		1,2,3,4,6,7,8-HpCDD	12	7.4E-06
		OCDD	63	1.9E-05
		2,3,7,8-TCDF	0.026	1.0E-06
		1,2,3,7,8-PeCDF	0.014	2.1E-07
		2,3,4,7,8-PeCDF	0.016	2.5E-07
		1,2,3,4,7,8-HxCDF	0.19	1.2E-06
		1,2,3,6,7,8-HxCDF	0.10	5.9E-07
		1,2,3,7,8,9-HxCDF	0.051	3.1E-07
		2,3,4,6,7,8-HxCDF	0.056	3.5E-07
		1,2,3,4,6,7,8-HpCDF	2.3	5.6E-06

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
20B (cont.)	LDW24-IT1470E (cont.)	1,2,3,4,7,8,9-HpCDF	0.25	6.1E-07
		OCDF	3.87	3.8E-06
22	LDW24-SC1431L	PCB-Mono	0.46	1.5E-04
		PCB-Di	16	2.7E-03
		PCB-Tri	265	1.7E-02
		PCB-Tetra	757	2.5E-02
		PCB-Penta	720	1.2E-02
		PCB-Hexa	385	3.2E-03
		PCB-Hepta	146	6.0E-04
		PCB-Octa	28	5.9E-05
		PCB-Nona	2.7	3.5E-06
		PCB-Deca	0.20	1.3E-07
23A	LDW24-SC1432I	PCB-Mono	0.41	1.5E-04
		PCB-Di	14	2.6E-03
		PCB-Tri	219	1.6E-02
		PCB-Tetra	678	2.5E-02
		PCB-Penta	800	1.5E-02
		PCB-Hexa	461	4.3E-03
		PCB-Hepta	170	8.0E-04
		PCB-Octa	33	7.7E-05
		PCB-Nona	3.0	4.5E-06
		PCB-Deca	0.22	1.7E-07
24I	LDW24-IT1428E	PCB-Mono	0.81	4.3E-04
		PCB-Di	27	7.1E-03
		PCB-Tri	420	4.4E-02
		PCB-Tetra	1,270	6.7E-02
		PCB-Penta	1,458	3.9E-02
		PCB-Hexa	960	1.3E-02
		PCB-Hepta	428	2.9E-03
		PCB-Octa	86	2.9E-04
		PCB-Nona	8.1	1.7E-05
		PCB-Deca	0.60	6.3E-07

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
26	STM-BS-3	Anthracene	3,500	1.8E+00
		Benzo(a)anthracene	4,800	1.9E-01
		Benzo(a)pyrene	6,000	8.8E-02
		Benzo(g,h,i)perylene	10,000	5.9E-02
		Total benzofluoranthenes	10,000	9.9E-02
		Chrysene	6,300	2.3E-01
		Dibenzo(a,h)anthracene	2,200	8.2E-03
		Fluoranthene	13,000	1.9E+00
		Indeno(1,2,3-cd)pyrene	7,600	2.8E-02
		Phenanthrene	3,200	1.5E+00
		Pyrene	11,000	2.4E+00
		BBP	23,000	5.9E+00
		2_4-Dimethylphenol	330	2.4E+01
		Zinc	1,120,000	8.9E+01
		2,3,7,8-TCDD	0.00036	2.1E-09
		1,2,3,7,8-PeCDD	0.0054	1.0E-08
		1,2,3,4,7,8-HxCDD	0.015	1.1E-08
		1,2,3,6,7,8-HxCDD	0.11	8.2E-08
		1,2,3,7,8,9-HxCDD	0.033	2.4E-08
		1,2,3,4,6,7,8-HpCDD	7.1	1.3E-06
		OCDD	71	6.6E-06
		2,3,7,8-TCDF	0.0042	4.9E-08
		1,2,3,7,8-PeCDF	0.0079	3.7E-08
		2,3,4,7,8-PeCDF	0.0071	3.3E-08
		1,2,3,4,7,8-HxCDF	0.025	4.7E-08
		1,2,3,6,7,8-HxCDF	0.010	1.8E-08
		1,2,3,7,8,9-HxCDF	0.012	2.2E-08
		2,3,4,6,7,8-HxCDF	0.014	2.6E-08
		1,2,3,4,6,7,8-HpCDF	0.31	2.3E-07
		1,2,3,4,7,8,9-HpCDF	0.025	1.9E-08
		OCDF	1.4	4.1E-07

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
30A	LDW24-SC1386H	PCB-Mono	0.41	1.7E-04
		PCB-Di	13	2.7E-03
		PCB-Tri	200	1.6E-02
		PCB-Tetra	654	2.7E-02
		PCB-Penta	890	1.8E-02
		PCB-Hexa	606	6.2E-03
		PCB-Hepta	263	1.4E-03
		PCB-Octa	52	1.4E-04
		PCB-Nona	4.9	8.0E-06
		PCB-Deca	0.36	2.9E-07
	LDW24-SC1386F	Mercury	530	6.7E-03
30B	LDW24-SC1382C	PCB-Mono	0.34	1.3E-04
		PCB-Di	11	2.1E-03
		PCB-Tri	169	1.3E-02
		PCB-Tetra	544	2.1E-02
		PCB-Penta	716	1.4E-02
		PCB-Hexa	459	4.5E-03
		PCB-Hepta	187	9.2E-04
		PCB-Octa	37	9.0E-05
		PCB-Nona	3.42	5.3E-06
		PCB-Deca	0.25	2.0E-07
	LDW24-SC1383E	2,3,7,8-TCDD	0.00021	1.2E-09
		1,2,3,7,8-PeCDD	0.00044	8.2E-10
		1,2,3,4,7,8-HxCDD	0.00057	4.2E-10
		1,2,3,6,7,8-HxCDD	0.016	1.2E-08
		1,2,3,7,8,9-HxCDD	0.0034	2.5E-09
		1,2,3,4,6,7,8-HpCDD	0.47	8.7E-08
		OCDD	3.7	3.5E-07
		2,3,7,8-TCDF	0.0011	1.3E-08
		1,2,3,7,8-PeCDF	0.0027	1.3E-08
		2,3,4,7,8-PeCDF	0.015	7.1E-08
		1,2,3,4,7,8-HxCDF	0.079	1.5E-07
		1,2,3,6,7,8-HxCDF	0.012	2.3E-08
		1,2,3,7,8,9-HxCDF	0.013	2.4E-08
		2,3,4,6,7,8-HxCDF	0.018	3.4E-08
		1,2,3,4,6,7,8-HpCDF	0.25	1.8E-07

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
30B (cont.)	LDW24-SC1383E (cont.)	1,2,3,4,7,8,9-HpCDF	0.044	3.3E-08
		OCDF	0.71	2.1E-07
30C	LDW24-SC1346F	PCB-Mono	0.047	1.7E-05
		PCB-Di	1.3	2.4E-04
		PCB-Tri	19	1.4E-03
		PCB-Tetra	65	2.4E-03
		PCB-Penta	102	1.9E-03
		PCB-Hexa	87	8.0E-04
		PCB-Hepta	45	2.1E-04
		PCB-Octa	9.2	2.2E-05
		PCB-Nona	0.87	1.3E-06
		PCB-Deca	0.064	4.7E-08
		2,3,7,8-TCDD	0.00048	8.9E-09
		1,2,3,7,8-PeCDD	0.0016	9.2E-09
		1,2,3,4,7,8-HxCDD	0.0023	5.3E-09
		1,2,3,6,7,8-HxCDD	0.032	7.4E-08
		1,2,3,7,8,9-HxCDD	0.0058	1.3E-08
		1,2,3,4,6,7,8-HpCDD	1.0	6.1E-07
		OCDD	8.5	2.5E-06
		2,3,7,8-TCDF	0.0020	7.3E-08
		1,2,3,7,8-PeCDF	0.048	7.1E-07
		2,3,4,7,8-PeCDF	0.015	2.1E-07
		1,2,3,4,7,8-HxCDF	0.10	6.0E-07
		1,2,3,6,7,8-HxCDF	0.017	9.9E-08
		1,2,3,7,8,9-HxCDF	0.017	1.0E-07
		2,3,4,6,7,8-HxCDF	0.0041	2.4E-08
		1,2,3,4,6,7,8-HpCDF	0.54	1.3E-06
		1,2,3,4,7,8,9-HpCDF	0.074	1.7E-07
		OCDF	2.7	2.5E-06

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
30D	LDW24-SC1344L	PCB-Mono	0.14	9.3E-05
		PCB-Di	3.8	1.3E-03
		PCB-Tri	54	7.2E-03
		PCB-Tetra	190	1.3E-02
		PCB-Penta	320	1.1E-02
		PCB-Hexa	280	4.7E-03
		PCB-Hepta	140	1.2E-03
		PCB-Octa	30	1.3E-04
		PCB-Nona	2.8	7.4E-06
		PCB-Deca	0.21	2.7E-07
	LDW24-SC1344G	2,3,7,8-TCDD	0.00055	1.1E-08
		1,2,3,7,8-PeCDD	0.0024	1.5E-08
		1,2,3,4,7,8-HxCDD	0.0040	1.0E-08
		1,2,3,6,7,8-HxCDD	0.056	1.4E-07
		1,2,3,7,8,9-HxCDD	0.0091	2.3E-08
		1,2,3,4,6,7,8-HpCDD	2.1	1.4E-06
		OCDD	15	4.7E-06
		2,3,7,8-TCDF	0.0022	8.9E-08
		1,2,3,7,8-PeCDF	0.030	4.8E-07
		2,3,4,7,8-PeCDF	0.018	3.0E-07
		1,2,3,4,7,8-HxCDF	0.084	5.4E-07
		1,2,3,6,7,8-HxCDF	0.015	9.3E-08
		1,2,3,7,8,9-HxCDF	0.015	9.4E-08
		2,3,4,6,7,8-HxCDF	0.025	1.6E-07
		1,2,3,4,6,7,8-HpCDF	1	2.6E-06
		1,2,3,4,7,8,9-HpCDF	0.097	2.5E-07
		OCDF	6.4	6.5E-06

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
30E	LDW24-SC1341K	PCB-Mono	0.26	7.2E-05
		PCB-Di	9.3	1.3E-03
		PCB-Tri	150	8.4E-03
		PCB-Tetra	430	1.2E-02
		PCB-Penta	400	5.6E-03
		PCB-Hexa	200	1.4E-03
		PCB-Hepta	71	2.5E-04
		PCB-Octa	14	2.4E-05
		PCB-Nona	1.3	1.4E-06
		PCB-Deca	0.095	5.3E-08
	LDW24-SC1341J	2,3,7,8-TCDD	0.0011	1.3E-08
		1,2,3,7,8-PeCDD	0.0023	8.1E-09
		1,2,3,4,7,8-HxCDD	0.0041	5.7E-09
		1,2,3,6,7,8-HxCDD	0.024	3.3E-08
		1,2,3,7,8,9-HxCDD	0.010	1.4E-08
		1,2,3,4,6,7,8-HpCDD	0.72	2.5E-07
		OCDD	6.5	1.1E-06
		2,3,7,8-TCDF	0.0035	7.6E-08
		1,2,3,7,8-PeCDF	0.0055	4.8E-08
		2,3,4,7,8-PeCDF	0.016	1.4E-07
		1,2,3,4,7,8-HxCDF	0.042	1.5E-07
		1,2,3,6,7,8-HxCDF	0.011	3.7E-08
		1,2,3,7,8,9-HxCDF	0.0070	2.4E-08
		2,3,4,6,7,8-HxCDF	0.014	4.9E-08
		1,2,3,4,6,7,8-HpCDF	0.24	3.3E-07
		1,2,3,4,7,8,9-HpCDF	0.027	3.7E-08
		OCDF	0.95	5.2E-07

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
30F	LDW24-SC1340K	PCB-Mono	0.094	7.6E-05
		PCB-Di	3.5	1.4E-03
		PCB-Tri	57	9.2E-03
		PCB-Tetra	160	1.3E-02
		PCB-Penta	150	6.0E-03
		PCB-Hexa	68	1.4E-03
		PCB-Hepta	20	2.0E-04
		PCB-Octa	3.6	1.8E-05
		PCB-Nona	0.33	1.1E-06
		PCB-Deca	0.025	4.0E-08
30G	LDW24-SC1328M	PCB-Mono	0.18	5.6E-05
		PCB-Di	5.8	9.2E-04
		PCB-Tri	88	5.6E-03
		PCB-Tetra	290	9.2E-03
		PCB-Penta	400	6.3E-03
		PCB-Hexa	250	2.0E-03
		PCB-Hepta	97	3.9E-04
		PCB-Octa	19	3.8E-05
		PCB-Nona	1.7	2.2E-06
		PCB-Deca	0.13	8.1E-08
30H	LDW24-SC1325K	PCB-Mono	0.23	7.0E-05
		PCB-Di	7.5	1.2E-03
		PCB-Tri	110	7.0E-03
		PCB-Tetra	380	1.2E-02
		PCB-Penta	530	8.2E-03
		PCB-Hexa	330	2.5E-03
		PCB-Hepta	120	4.7E-04
		PCB-Octa	23	4.5E-05
		PCB-Nona	2.2	2.6E-06
		PCB-Deca	0.16	9.7E-08

Notes:
µg/kg: microgram per kilogram
µg/L: microgram per liter
BBP: butyl benzyl phthalate
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
OCDD: octachlorodibenzo-p-dioxin
OCDF: octachlorodibenzofuran
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
RAA: remedial action area
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran

Table H.1.2
Porewater Concentrations Used in the Cap Model for the AST Evaluation

RAA	Sample ID	Chemical Name	Sediment Concentration (µg/kg)	Porewater Concentration (µg/L)
9K	LDW24-SC1558C	PCB-Mono	0.055	1.9E-05
		PCB-Di	1.8	3.1E-04
		PCB-Tri	27	1.9E-03
		PCB-Tetra	92	3.2E-03
		PCB-Penta	133	2.4E-03
		PCB-Hexa	82	7.3E-04
		PCB-Hepta	31	1.4E-04
		PCB-Octa	6	1.3E-05
		PCB-Nona	0.54	7.6E-07
		PCB-Deca	0.040	2.8E-08

Notes:
µg/kg: microgram per kilogram
µg/L: microgram per liter
AST: area-specific technology
PCB: polychlorinated biphenyl
RAA: remedial action area

Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

Attachment H.2
Model Simulation Results at Year 100

Table H.2.1
Model-Predicted COC Concentrations in Year 100 for the Standard Cap Evaluation

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL	Model-Predicted Sediment Concentration
							0–10 cm	0–10 cm
1B	15 cm gravelly sand; no amendment	100	Total PCBs	mg/kg OC	23.7	12	12	0.0051
		400	Total PCBs	mg/kg OC	23.7	12	12	0.29
9J	15 cm gravelly sand; no amendment	100	Total PCBs	mg/kg OC	53	12	12	0.014
			Dioxin/furan TEQ	ng/kg	34	--	25	3.2E-07
		400	Total PCBs	mg/kg OC	53	12	12	0.81
			Dioxin/furan TEQ	ng/kg	34	--	25	0.0025
14A	15 cm gravelly sand; no amendment	100	Total PCBs	mg/kg OC	55	12	12	0.019
		400	Total PCBs	mg/kg OC	55	12	12	1.1
15B	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	46	12	12	0.71
		800	Total PCBs	mg/kg OC	46	12	12	2.9
22	15 cm gravelly sand; no amendment	100	Total PCBs	mg/kg OC	96	12	12	0.031
		400	Total PCBs	mg/kg OC	96	12	12	1.8
23A	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	112	12	12	1.7
		800	Total PCBs	mg/kg OC	112	12	12	7.0
30A	15 cm gravelly sand; no amendment	400	Total PCB	mg/kg OC	139	12	12	1.8
			Mercury	mg/kg	0.53	0.41	0.41	0
		800	Total PCB	mg/kg OC	139	12	12	7.4
			Mercury	mg/kg	0.53	0.41	0.41	0
30B	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	104	12	12	0.025
			Dioxin/furan TEQ	ng/kg	29	--	25	3.6E-08
		400	Total PCB	mg/kg OC	104	12	12	1.4
			Dioxin/furan TEQ	ng/kg	29	--	25	0.00035

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL	Model-Predicted Sediment Concentration
							0–10 cm	0–10 cm
30C	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	15.3	12	12	0.0025
			Dioxin/furan TEQ	ng/kg	46	--	25	2E-07
		400	Total PCB	mg/kg OC	15.3	12	12	0.15
			Dioxin/furan TEQ	ng/kg	46	--	25	0.0019
30D	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	87	12	12	0.013
			Dioxin/furan TEQ	ng/kg	69	--	25	2.5E-07
		400	Total PCB	mg/kg OC	87	12	12	0.77
			Dioxin/furan TEQ	ng/kg	69	--	25	0.0023
30E	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	45	12	12	0.014
			Dioxin/furan TEQ	ng/kg	32	--	25	2.1E-07
		400	Total PCB	mg/kg OC	45	12	12	0.82
			Dioxin/furan TEQ	ng/kg	32	--	25	0.0019
30F	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	47	12	12	0.015
		400	Total PCB	mg/kg OC	47	12	12	0.89
30G	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	46	12	12	0.0095
		400	Total PCB	mg/kg OC	46	12	12	0.57
30H	15 cm gravelly sand; no amendment	100	Total PCB	mg/kg OC	58	12	12	0.012
		400	Total PCB	mg/kg OC	58	12	12	0.72

Notes:
1. Benthic SCOs were used for the establishment of the 0- to 10-cm RALs.
--: not applicable

BBP: butyl benzyl phthalate
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
RAA: remedial action area
RAL: remedial action level
SCO: sediment cleanup objective
TEQ: toxic equivalents quotient

Table H.2.2
Model-Predicted COC Concentrations in Year 100 for the Modified Cap Evaluation

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
5B	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	774	12	12	12	6.6	97
		800	Total PCBs	mg/kg OC	774	12	12	12	31	190
	15 cm gravelly sand; 1% TOC	400	Total PCBs	mg/kg OC	774	12	12	12	0.76	7.3
		800	Total PCBs	mg/kg OC	774	12	12	12	6.1	34
	15 cm gravelly sand; 2% TOC	400	Total PCBs	mg/kg OC	774	12	12	12	0.23	1.6
		800	Total PCBs	mg/kg OC	774	12	12	12	2.1	10
	30 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	774	12	12	12	2.8	36
		800	Total PCBs	mg/kg OC	774	12	12	12	17	110
	30 cm gravelly sand; 1% TOC	400	Total PCBs	mg/kg OC	774	12	12	12	0.070	0.34
		800	Total PCBs	mg/kg OC	774	12	12	12	0.75	2.9
8B	15 cm gravelly sand; no amendment	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	4.3	7.6
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	19	33
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	5.1	8.1
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	22	35
	15 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	0.91	1.7
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	16	28
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	2.8	4.5
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	22	34

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
8B (cont.)	30 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	0.0074	0.014
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	5.3	9.4
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	0.27	0.44
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	15	23
	60 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	1.6E-10	3.5E-10
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	0.061	0.11
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	3.2E-05	5.5E-05
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	2.3	3.6
	76 cm gravelly sand; 36% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	5.7E-06	1.2E-05
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	1.7	3.0
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	0.013	0.021
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	11	18
	76 cm gravelly sand; 73% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	3.6E-12	8.2E-12
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	0.031	0.055
		800	1,2,4-trichlorobenzene	mg/kg OC	11	0.81	0.81	0.81	5.9E-06	1.0E-05
			1,4-dichlorobenzene	mg/kg OC	47	3.1	3.1	3.1	1.9	3.0
9D	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	401	12	12	65	3.2	47
		800	Total PCBs	mg/kg OC	401	12	12	65	15	94
	15 cm gravelly sand; 1% TOC	400	Total PCBs	mg/kg OC	401	12	12	65	0.38	0.35
		800	Total PCBs	mg/kg OC	401	12	12	65	3.0	16
	30 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	401	12	12	65	1.4	17
		800	Total PCBs	mg/kg OC	401	12	12	65	8.4	52

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
20B	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	19	12	12	12	0.15	2.0
			Dioxin/furan TEQ	ng/kg	360	--	25	28	0.020	0.99
		800	Total PCBs	mg/kg OC	19	12	12	12	0.65	3.9
			Dioxin/furan TEQ	ng/kg	360	--	25	28	0.16	3.4
	30 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	19	12	12	12	0.068	0.76
			Dioxin/furan TEQ	ng/kg	360	--	25	28	0.0037	0.18
		800	Total PCBs	mg/kg OC	19	12	12	12	0.38	2.1
			Dioxin/furan TEQ	ng/kg	360	--	25	28	0.068	0.81
24I	15 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	311	12	12	65	4.6	48
		800	Total PCBs	mg/kg OC	311	12	12	65	19	88
	15 cm gravelly sand; 1% TOC	400	Total PCBs	mg/kg OC	311	12	12	65	0.57	5.1
		800	Total PCBs	mg/kg OC	311	12	12	65	4.4	21
	30 cm gravelly sand; no amendment	400	Total PCBs	mg/kg OC	311	12	12	65	2.1	21
		800	Total PCBs	mg/kg OC	311	12	12	65	11	55
26	15 cm gravelly sand; no amendment	400	cPAHs	µg/kg	9,200	--	5,500	5,900	42	350
			Dioxin/furan TEQ	ng/kg	126	--	25	28	9.8E-04	0.061
			Zinc	mg/kg	1,120	410	820	--	1.1E-08	--
			Anthracene	mg/kg OC	52	220	440	--	19	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	13	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	2.7	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0.084	--
			Chrysene	mg/kg OC	93	110	220	--	16	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	5.3E-04	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; no amendment (cont.)	400 (cont.)	Fluoranthene	mg/kg OC	192	160	320	--	65	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0.0015	--
			Phenanthrene	mg/kg OC	47	100	200	--	18	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	58	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	1.1	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	160	--
			BBP	mg/kg OC	340	4.9	9.8	--	120	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	19	--
		800	cPAHs	µg/kg	9,200	--	5,500	5,900	170	570
			Dioxin/furan TEQ	ng/kg	126	--	25	28	0.0091	0.20
			Zinc	mg/kg	1,120	410	820	--	9.3E-04	--
			Anthracene	mg/kg OC	52	220	440	--	24	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	25	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	13	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	2.3	--
			Chrysene	mg/kg OC	93	110	220	--	32	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0.068	--
			Fluoranthene	mg/kg OC	192	160	320	--	85	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0.21	--
			Phenanthrene	mg/kg OC	47	100	200	--	22	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	73	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	10	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; no amendment (cont.)	800 (cont.)	Total HPAHs	mg/kg OC	1,050	960	1,920	--	250	--
			BBP	mg/kg OC	340	4.9	9.8	--	150	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	23	--
	30 cm gravelly sand; no amendment	400	cPAHs	µg/kg	9,200	--	5,500	5,900	19	190
			Dioxin/furan TEQ	ng/kg	126	--	25	28	1.8E-04	0.010
			Zinc	mg/kg	1,120	410	820	--	7.8E-15	--
			Anthracene	mg/kg OC	52	220	440	--	19	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	9.8	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	0.77	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0.0028	--
			Chrysene	mg/kg OC	93	110	220	--	11	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	2.4E-06	--
			Fluoranthene	mg/kg OC	192	160	320	--	65	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	6.3E-06	--
			Phenanthrene	mg/kg OC	47	100	200	--	18	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	57	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	0.16	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	150	--
			BBP	mg/kg OC	340	4.9	9.8	--	120	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	19	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	30 cm gravelly sand; no amendment (cont.)	800	cPAHs	µg/kg	9,200	--	5,500	5,900	108	430
			Dioxin/furan TEQ	ng/kg	126	--	25	28	0.0035	0.052
			Zinc	mg/kg	1,120	410	820	--	2.8E-07	--
			Anthracene	mg/kg OC	52	220	440	--	24	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	24	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	7.8	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0.46	--
			Chrysene	mg/kg OC	93	110	220	--	29	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0.0046	--
			Fluoranthene	mg/kg OC	192	160	320	--	84	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0.014	--
			Phenanthrene	mg/kg OC	47	100	200	--	22	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	72	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	4.2	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	230	--
			BBP	mg/kg OC	340	4.9	9.8	--	150	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	23	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; 48% TOC	400	cPAHs	µg/kg	9,200	--	5,500	5,900	8.4E-11	3.8E-09
			Dioxin/furan TEQ	ng/kg	126	--	25	28	0	7.2E-20
			Zinc	mg/kg	1,120	410	820	--	1.1E-08	--
			Anthracene	mg/kg OC	52	220	440	--	1.2	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	8.1E-11	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	2.1E-18	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0	--
			Chrysene	mg/kg OC	93	110	220	--	2.6E-11	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0	--
			Fluoranthene	mg/kg OC	192	160	320	--	0.0034	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0	--
			Phenanthrene	mg/kg OC	47	100	200	--	0.86	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	0.053	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	0	--
			Total HPAH	mg/kg OC	1,050	960	1,920	--	0.060	--
			BBP	mg/kg OC	340	4.9	9.8	--	0.35	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	19	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; 48% TOC (cont.)	800	cPAHs	µg/kg	9,200	--	5,500	5,900	1.4E-06	1.3E-05
			Dioxin/furan TEQ	ng/kg	126	--	25	28	1.6E-17	3.1E-15
			Zinc	mg/kg	1,120	410	820	--	9.3E-04	--
			Anthracene	mg/kg OC	52	220	440	--	7.2	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	1.3E-06	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	9.7E-13	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0	--
			Chrysene	mg/kg OC	93	110	220	--	5.4E-07	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0	--
			Fluoranthene	mg/kg OC	192	160	320	--	0.51	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0	--
			Phenanthrene	mg/kg OC	47	100	200	--	5.7	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	2.3	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	1.7E-15	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	3.0	--
			BBP	mg/kg OC	340	4.9	9.8	--	9.3	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	23	--
	30 cm gravelly sand; 14% TOC	400	cPAHs	µg/kg	9,200	--	5,500	5,900	3.9E-15	5.6E-13
			Dioxin/furan TEQ	ng/kg	126	--	25	28	0	0
			Zinc	mg/kg	1,120	410	820	--	7.8E-15	--
			Anthracene	mg/kg OC	52	220	440	--	1.2	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	3.8E-15	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	0	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	30 cm gravelly sand; 14% TOC (cont.)	400 (cont.)	Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0	--
			Chrysene	mg/kg OC	93	110	220	--	5.1E-16	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0	--
			Fluoranthene	mg/kg OC	192	160	320	--	6.0E-04	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0	--
			Phenanthrene	mg/kg OC	47	100	200	--	0.77	--
			Pyrene	mg/kg OC	163	1,000	2,000	--	0.021	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	0	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	0.024	--
			BBP	mg/kg OC	340	4.9	9.8	--	0.19	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	19	--
		800	cPAHs	µg/kg	9,200	--	5,500	5,900	1.4E-08	2.5E-07
			Dioxin/furan TEQ	ng/kg	126	--	25	28	0	0
			Zinc	mg/kg	1,120	410	820	--	2.8E-07	--
			Anthracene	mg/kg OC	52	220	440	--	8.0	--
			Benzo(a)anthracene	mg/kg OC	71	110	220	--	1.4E-08	--
			Benzo(a)pyrene	mg/kg OC	89	99	198	--	0	--
			Benzo(g,h,i)perylene	mg/kg OC	148	31	62	--	0	--
			Chrysene	mg/kg OC	93	110	220	--	3.3E-09	--
			Dibenzo(a,h)anthracene	mg/kg OC	33	12	24	--	0	--
			Fluoranthene	mg/kg OC	192	160	320	--	0.32	--
			Indeno(1,2,3-cd)pyrene	mg/kg OC	112	34	68	--	0	--
			Phenanthrene	mg/kg OC	47	100	200	--	6.3	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO[1]	RAL		Model-Predicted Sediment Concentration	
							0–10 cm	0–45 cm	0–10 cm	0–45 cm
26 (cont.)	30 cm gravelly sand; 14% TOC (cont.)	800 (cont.)	Pyrene	mg/kg OC	163	1,000	2,000	--	2.0	--
			Total benzofluoranthenes	mg/kg OC	148	230	460	--	0	--
			Total HPAHs	mg/kg OC	1,050	960	1,920	--	2.4	--
			BBP	mg/kg OC	340	4.9	9.8	--	8.6	--
			2,4-Dimethylphenol	µg/kg	330	29	58	--	23	--

Notes:
1. Benthic SCOs were used for the establishment of the 0- to 10-cm and 0- to 45-cm RALs.
--: not applicable
BBP: butyl benzyl phthalate
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
SCO: sediment cleanup objective
TEQ: toxic equivalents quotient
TOC: total organic carbon

Table H.2.3
Model-Predicted COC Concentrations in Year 100 for the Utility Crossing AST Evaluation

RAA	Backfill Thickness (cm)	Seepage Rate (cm/yr)	COC	Unit	Source Term Initial Sediment Concentration	Benthic SCO	RAL	Model-Predicted 0-to 10-cm Sediment Concentration
9K	60	100	Total PCBs	mg/kg OC	17	12	12	0.0034
		400	Total PCBs	mg/kg OC	17	12	12	0.20

Notes:
AST: area-specific technology
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level

Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

Attachment H.3
Model Simulated Porewater Concentrations at Year 100

Table H.3.1
Model-Predicted Porewater COC Concentrations for the Standard Cap Evaluation

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Initial Concentration in Sediment Porewater (µg/L)	Model-Predicted 0-10 cm Porewater Concentration at Year 100 (µg/L)
1B	15 cm gravelly sand; no amendment	100	Total PCBs	0.012	2.0E-05
		400	Total PCBs	0.012	5.2E-04
9J	15 cm gravelly sand; no amendment	100	Total PCBs	0.030	5.3E-05
			Dioxin/furan TEQ	1.6E-07	2.5E-14
		400	Total PCBs	0.030	0.0014
			Dioxin/furan TEQ	1.6E-07	1.9E-10
14A	15 cm gravelly sand; no amendment	100	Total PCBs	0.036	6.2E-05
		400	Total PCBs	0.036	0.0016
15B	15 cm gravelly sand; no amendment	400	Total PCBs	0.026	0.0013
		800	Total PCBs	0.026	0.004
22	15 cm gravelly sand; no amendment	100	Total PCBs	0.060	1.2E-04
		400	Total PCBs	0.060	0.0032
23A	15 cm gravelly sand; no amendment	400	Total PCBs	0.065	0.0031
		800	Total PCBs	0.065	0.0098
30A	15 cm gravelly sand; no amendment	400	Total PCB	0.072	0.0032
			Mercury	0.0067	0
		800	Total PCB	0.072	0.010
			Mercury	0.0067	0
30B	15 cm gravelly sand; no amendment	100	Total PCB	0.056	9.4E-05
			Dioxin/furan TEQ	5.3E-08	2.9E-15
		400	Total PCB	0.056	0.0025
			Dioxin/furan TEQ	5.3E-08	2.4E-11
30C	15 cm gravelly sand; no amendment	100	Total PCB	7.0E-03	1.1E-05
			Dioxin/furan TEQ	2.2E-07	1.6E-14
		400	Total PCB	7.0E-03	2.8E-04
			Dioxin/furan TEQ	2.2E-07	1.4E-10
30D	15 cm gravelly sand; no amendment	100	Total PCB	0.038	5.7E-05
			Dioxin/furan TEQ	2.9E-07	2.0E-14
		400	Total PCB	0.038	0.0014
			Dioxin/furan TEQ	2.9E-07	1.7E-10

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Initial Concentration in Sediment Porewater (µg/L)	Model-Predicted 0-10 cm Porewater Concentration at Year 100 (µg/L)
30E	15 cm gravelly sand; no amendment	100	Total PCB	0.029	5.6E-05
			Dioxin/furan TEQ	1.1E-07	1.7E-14
		400	Total PCB	0.029	0.0016
			Dioxin/furan TEQ	1.1E-07	1.4E-10
30F	15 cm gravelly sand; no amendment	100	Total PCB	0.031	6.1E-05
		400	Total PCB	0.031	0.0017
30G	15 cm gravelly sand; no amendment	100	Total PCB	0.024	4.0E-05
		400	Total PCB	0.024	0.0011
30H	15 cm gravelly sand; no amendment	100	Total PCB	0.031	5.0E-05
		400	Total PCB	0.031	0.0013

Notes:
--: Not applicable
µg/L: microgram per liter
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
PCB: polychlorinated biphenyl
RAA: remedial action area
TEQ: toxic equivalents

Table H.3.2
Model-Predicted Porewater COC Concentrations for the Modified Cap Evaluation

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
5B	15 cm gravelly sand; no amendment	400	Total PCBs	0.35	0.0095	0.072
		800	Total PCBs	0.35	0.032	0.12
	15 cm gravelly sand; 1% TOC	400	Total PCBs	0.35	0.0021	0.012
		800	Total PCBs	0.35	0.010	0.038
	15 cm gravelly sand; 2% TOC	400	Total PCBs	0.35	0.00083	0.0038
		800	Total PCBs	0.35	0.0048	0.016
	30 cm gravelly sand; no amendment	400	Total PCBs	0.35	0.0053	0.037
		800	Total PCBs	0.35	0.022	0.086
	30 cm gravelly sand; 1% TOC	400	Total PCBs	0.35	0.00030	0.0013
		800	Total PCBs	0.35	0.0028	0.0067
8B	15 cm gravelly sand; no amendment	400	1,2,4-trichlorobenzene	1.3	0.49	0.88
			1,4-dichlorobenzene	21	8.1	14
		800	1,2,4-trichlorobenzene	1.3	0.59	0.93
			1,4-dichlorobenzene	21	9.6	15
	15 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	1.3	0.1	0.19
			1,4-dichlorobenzene	21	6.9	12
		800	1,2,4-trichlorobenzene	1.3	0.32	0.51
			1,4-dichlorobenzene	21	9.5	15
	30 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	1.3	0.00085	0.0016
			1,4-dichlorobenzene	21	2.3	4.1
		800	1,2,4-trichlorobenzene	1.3	0.031	0.05
			1,4-dichlorobenzene	21	6.5	10
	60 cm gravelly sand; 100% TOC	400	1,2,4-trichlorobenzene	1.3	1.8E-11	4.1E-11
			1,4-dichlorobenzene	21	0.027	0.048
		800	1,2,4-trichlorobenzene	1.3	3.7E-06	6.3E-06
			1,4-dichlorobenzene	21	0.99	1.6
	76 cm gravelly sand; 36% TOC	400	1,2,4-trichlorobenzene	1.3	6.6E-07	1.4E-06
			1,4-dichlorobenzene	21	0.74	1.3
		800	1,2,4-trichlorobenzene	1.3	0.0015	0.0024
			1,4-dichlorobenzene	21	5.0	7.9

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
8b (cont.)	76 cm gravelly sand; 73% TOC	400	1,2,4-trichlorobenzene	1.3	4.2E-13	9.5E-13
			1,4-dichlorobenzene	21	0.013	0.024
		800	1,2,4-trichlorobenzene	1.3	6.8E-07	1.2E-06
			1,4-dichlorobenzene	21	0.83	1.3
9D	15 cm gravelly sand; no amendment	400	Total PCBs	0.17	0.0047	0.035
		800	Total PCBs	0.17	0.016	0.06
	15 cm gravelly sand; 1% TOC	400	Total PCBs	0.17	0.001	0.0057
		800	Total PCBs	0.17	0.0051	0.019
	30 cm gravelly sand; no amendment	400	Total PCBs	0.17	0.0026	0.018
		800	Total PCBs	0.17	0.011	0.041
20B	15 cm gravelly sand; no amendment	400	Total PCBs	0.0075	0.00023	0.0016
			Dioxin/furan TEQ	1.1E-06	1.5E-09	4.0E-08
		800	Total PCBs	0.0075	0.00072	0.0026
			Dioxin/furan TEQ	1.1E-06	1.1E-08	9.4E-08
	30 cm gravelly sand; no amendment	400	Total PCBs	0.0075	0.00013	0.00085
			Dioxin/furan TEQ	1.1E-06	3.0E-10	1.2E-08
		800	Total PCBs	0.0075	0.00051	0.0018
			Dioxin/furan TEQ	1.1E-06	5.2E-09	4.2E-08
24I	15 cm gravelly sand; no amendment	400	Total PCBs	0.17	0.0069	0.044
		800	Total PCBs	0.17	0.022	0.07
	15 cm gravelly sand; 1% TOC	400	Total PCBs	0.17	0.0015	0.0085
		800	Total PCBs	0.17	0.0076	0.026
	30 cm gravelly sand; no amendment	400	Total PCBs	0.17	0.004	0.025
		800	Total PCBs	0.17	0.015	0.053
26	15 cm gravelly sand; no amendment	400	cPAHs	6.1	0.0066	0.040
			Dioxin/furan TEQ	6.9E-08	7.5E-11	2.4E-09
			Zinc	8.9E+01	8.5E-10	--
			Anthracene	1.8E+00	0.68	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; no amendment (cont.)	400 (cont.)	Benzo(a)anthracene	1.9E-01	0.035	--
			Benzo(a)pyrene	8.8E-02	0.0026	--
			Benzo(g,h,i)perylene	5.9E-02	3.4E-05	--
			Chrysene	2.3E-01	0.038	--
			Dibenzo(a,h)anthracene	8.2E-03	1.3E-07	--
			Fluoranthene	1.9E+00	0.66	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	3.7E-07	--
			Phenanthrene	1.5E+00	0.57	--
			Pyrene	2.4+00	0.84	--
			Total benzofluoranthenes	9.9E-02	0.00075	--
			Total HPAHs	5.0	1.6	--
			BBP	5.9E+00	2.1	--
			2,4-Dimethylphenol	2.4E+01	9.6	--
		800	cPAHs	6.1	0.021	0.061
			Dioxin/furan TEQ	6.9E-08	5.9E-10	5.7E-09
			Zinc	8.9E+01	7.4E-05	--
			Anthracene	1.8E+00	0.83	--
			Benzo(a)anthracene	1.9E-01	0.067	--
			Benzo(a)pyrene	8.8E-02	0.013	--
			Benzo(g,h,i)perylene	5.9E-02	0.00093	--
			Chrysene	2.3E-01	0.077	--
			Dibenzo(a,h)anthracene	8.2E-03	1.2E-05	--
			Fluoranthene	1.9E+00	0.85	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	5.2E-05	--
			Phenanthrene	1.5E+00	0.69	--
			Pyrene	2.4+00	1.1	--
			Total benzofluoranthenes	9.9E-02	0.0067	--
			Total HPAHs	5.0	2.1	--
			BBP	5.9E+00	2.7	--
			2,4-Dimethylphenol	2.4E+01	11	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
26 (cont.)	30 cm gravel; no amendment	400	cPAHs	6.1	0.0036	0.024
			Dioxin/furan TEQ	6.9E-08	1.4E-11	6.5E-10
			Zinc	8.9E+01	6.2E-16	--
			Anthracene	1.8E+00	0.68	--
			Benzo(a)anthracene	1.9E-01	0.026	--
			Benzo(a)pyrene	8.8E-02	0.00076	--
			Benzo(g,h,i)perylene	5.9E-02	1.1E-06	--
			Chrysene	2.3E-01	0.027	--
			Dibenzo(a,h)anthracene	8.2E-03	6.2E-10	--
			Fluoranthene	1.9E+00	0.65	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	1.5E-09	--
			Phenanthrene	1.5E+00	0.57	--
			Pyrene	2.4+00	0.83	--
			Total benzofluoranthenes	9.9E-02	0.00010	--
			Total HPAHs	5.0	1.5	--
			BBP	5.9E+00	2.1	--
			2,4-Dimethylphenol	2.4E+01	9.6	--
		800	cPAHs	6.1	0.015	0.049
			Dioxin/furan TEQ	6.9E-08	2.6E-10	2.5E-09
			Zinc	8.9E+01	2.2E-08	--
			Anthracene	1.8E+00	0.82	--
			Benzo(a)anthracene	1.9E-01	0.062	--
			Benzo(a)pyrene	8.8E-02	0.0077	--
			Benzo(g,h,i)perylene	5.9E-02	0.00018	--
			Chrysene	2.3E-01	0.071	--
			Dibenzo(a,h)anthracene	8.2E-03	1.2E-06	--
			Fluoranthene	1.9E+00	0.85	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	3.3E-06	--
			Phenanthrene	1.5E+00	0.69	--
			Pyrene	2.4+00	1.1	--
			Total benzofluoranthenes	9.9E-02	0.0028	--
			Total HPAHs	5.0	2.0	--
			BBP	5.9E+00	2.7	--
			2,4-Dimethylphenol	2.4E+01	11.4	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; 48% TOC	400	cPAHs	6.1	2.2E-14	9.9E-13
			Dioxin/furan TEQ	6.9E-08	0	0
			Zinc	8.9E+01	8.5E-10	--
			Anthracene	1.8E+00	0.043	--
			Benzo(a)anthracene	1.9E-01	2.2E-13	--
			Benzo(a)pyrene	8.8E-02	2.1E-21	--
			Benzo(g,h,i)perylene	5.9E-02	0	--
			Chrysene	2.3E-01	6.4E-14	--
			Dibenzo(a,h)anthracene	8.2E-03	0	--
			Fluoranthene	1.9E+00	3.4E-05	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	0	--
			Phenanthrene	1.5E+00	0.028	--
			Pyrene	2.4+00	0.00076	--
			Total benzofluoranthenes	9.9E-02	0	--
			Total HPAH	5.0	0.00080	--
			BBP	5.9E+00	0.0061	--
			2,4-Dimethylphenol	2.4E+01	6.6	--
		800	cPAHs	6.1	3.6E-10	3.5E-09
			Dioxin/furan TEQ	6.9E-08	0	1.2E-22
			Zinc	8.9E+01	7.4E-05	--
			Anthracene	1.8E+00	0.25	--
			Benzo(a)anthracene	1.9E-01	3.4E-09	--
			Benzo(a)pyrene	8.8E-02	9.7E-16	--
			Benzo(g,h,i)perylene	5.9E-02	0	--
			Chrysene	2.3E-01	1.3E-09	--
			Dibenzo(a,h)anthracene	8.2E-03	0	--
			Fluoranthene	1.9E+00	0.0051	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	0	--
			Phenanthrene	1.5E+00	0.18	--
			Pyrene	2.4+00	0.03	--
			Total benzofluoranthenes	9.9E-02	1.1E-18	--
			Total HPAHs	5.0	0.039	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
26 (cont.)	15 cm gravelly sand; 48% TOC (cont.)	800 (cont.)	BBP	5.9E+00	0.16	--
			2,4-Dimethylphenol	2.4E+01	11	--
	30 cm gravelly sand; 14% TOC	400	cPAHs	6.1	1.0E-18	1.5E-16
			Dioxin/furan TEQ	6.9E-08	0	0
			Zinc	8.9E+01	6.2E-16	--
			Anthracene	1.8E+00	0.040	--
			Benzo(a)anthracene	1.9E-01	1.0E-17	--
			Benzo(a)pyrene	8.8E-02	0	--
			Benzo(g,h,i)perylene	5.9E-02	0	--
			Chrysene	2.3E-01	1.2E-18	--
			Dibenzo(a,h)anthracene	8.2E-03	0	--
			Fluoranthene	1.9E+00	6.0E-06	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	0	--
			Phenanthrene	1.5E+00	0.025	--
			Pyrene	2.4+00	0.00031	--
			Total benzofluoranthenes	9.9E-02	0	--
			Total HPAHs	5.0	0.00031	--
			BBP	5.9E+00	0.0033	--
			2,4-Dimethylphenol	2.4E+01	9.6	--
		800	cPAHs	6.1	3.7E-12	6.5E-11
			Dioxin/furan TEQ	6.9E-08	0	0
			Zinc	8.9E+01	2.2E-08	--
			Anthracene	1.8E+00	0.28	--
			Benzo(a)anthracene	1.9E-01	3.7E-11	--
			Benzo(a)pyrene	8.8E-02	0	--
			Benzo(g,h,i)perylene	5.9E-02	0	--
			Chrysene	2.3E-01	8.1E-12	--
			Dibenzo(a,h)anthracene	8.2E-03	0	--
			Fluoranthene	1.9E+00	0.0032	--
			Indeno(1,2,3-cd)pyrene	2.8E-02	0	--
			Phenanthrene	1.5E+00	0.20	--
			Pyrene	2.4+00	0.028	--
			Total benzofluoranthenes	9.9E-02	0	--
			Total HPAHs	5.0	0.032	--

RAA	Chemical Isolation Layer Configuration	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted Porewater Concentration At Year 100 (µg/L)	
					0–10 cm	0–45 cm
26 (cont.)	30 cm gravelly sand; 14% TOC (cont.)	800 (cont.)	BBP	5.9E+00	0.15	--
			2,4-Dimethylphenol	2.4E+01	11	--

Notes:
--: Not applicable
µg/L: microgram per liter
BBP: butyl benzyl phthalate
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAA: remedial action area
TEQ: toxic equivalents
TOC: total organic carbon

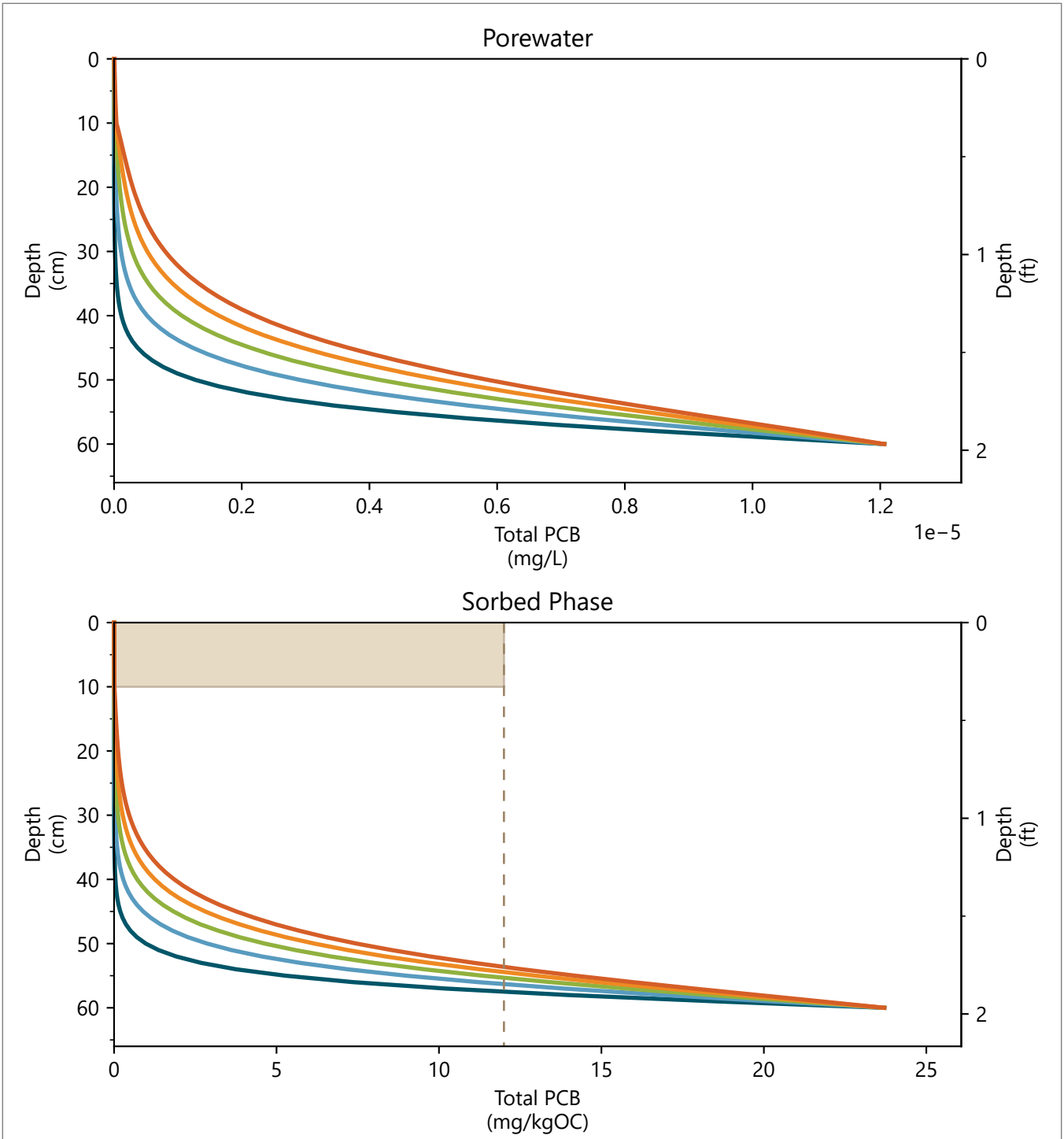
Table H.3.3
Model-Predicted Porewater COC Concentrations at Year 100 for the Utility Crossing AST Evaluation

RAA	Backfill Thickness (cm)	Seepage Rate (cm/yr)	COC	Source Term Concentration in Sediment Porewater (µg/L)	Model-Predicted 0-to 10-cm Porewater Concentration at Year 100 (µg/L)
9K	60	100	Total PCBs	0.0087	1.2E-05
		400	Total PCBs	0.0087	3.0E-04

Notes:
µg/L: microgram per liter
AST: area-specific technology
cm: centimeter
cm/yr: centimeter per year
COC: contaminant of concern
mg/kg: milligram per kilogram
PCB: polychlorinated biphenyl
RAA: remedial action area

Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

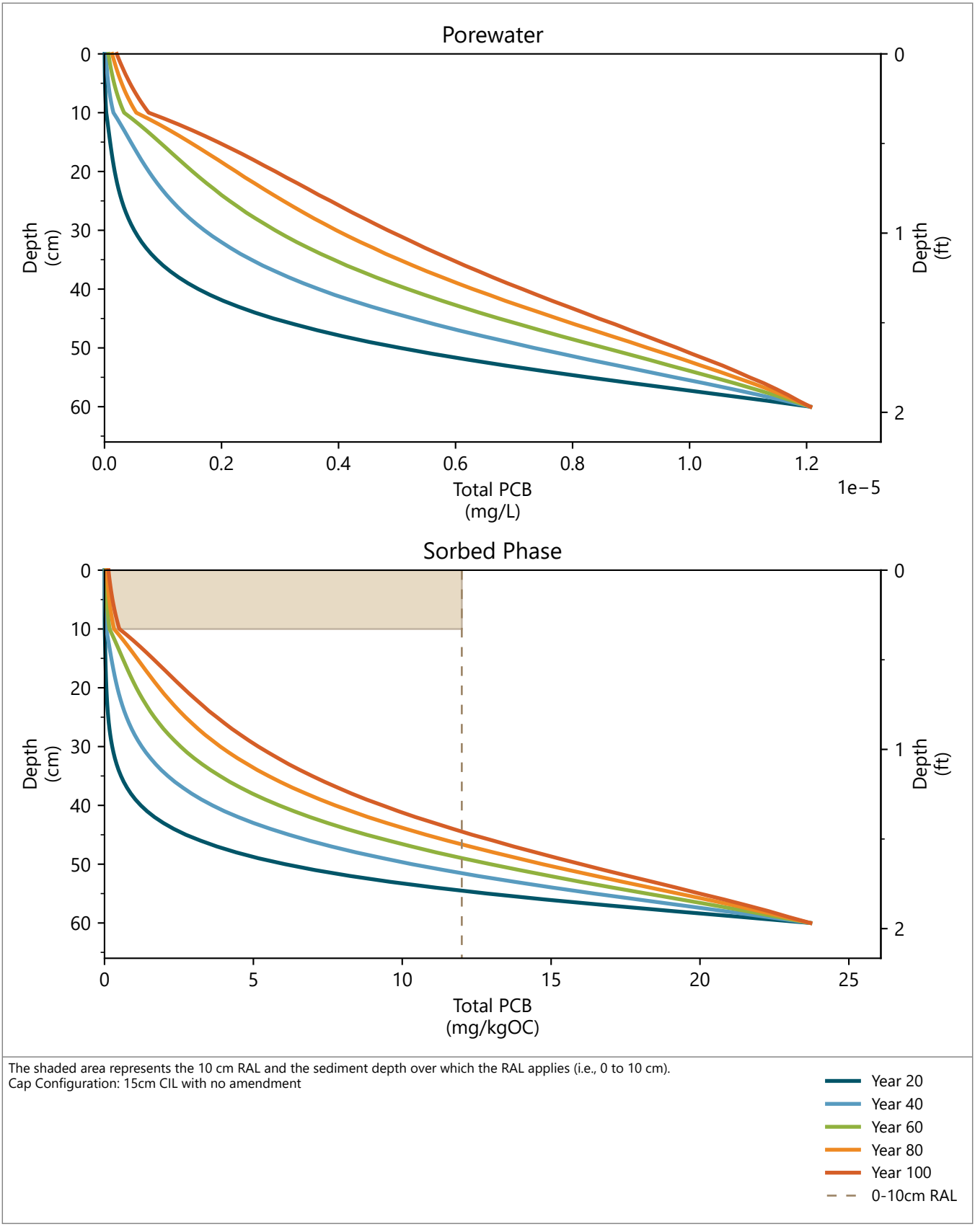
Attachment H.4
Depth Profiles of Model-Predicted COC Concentrations



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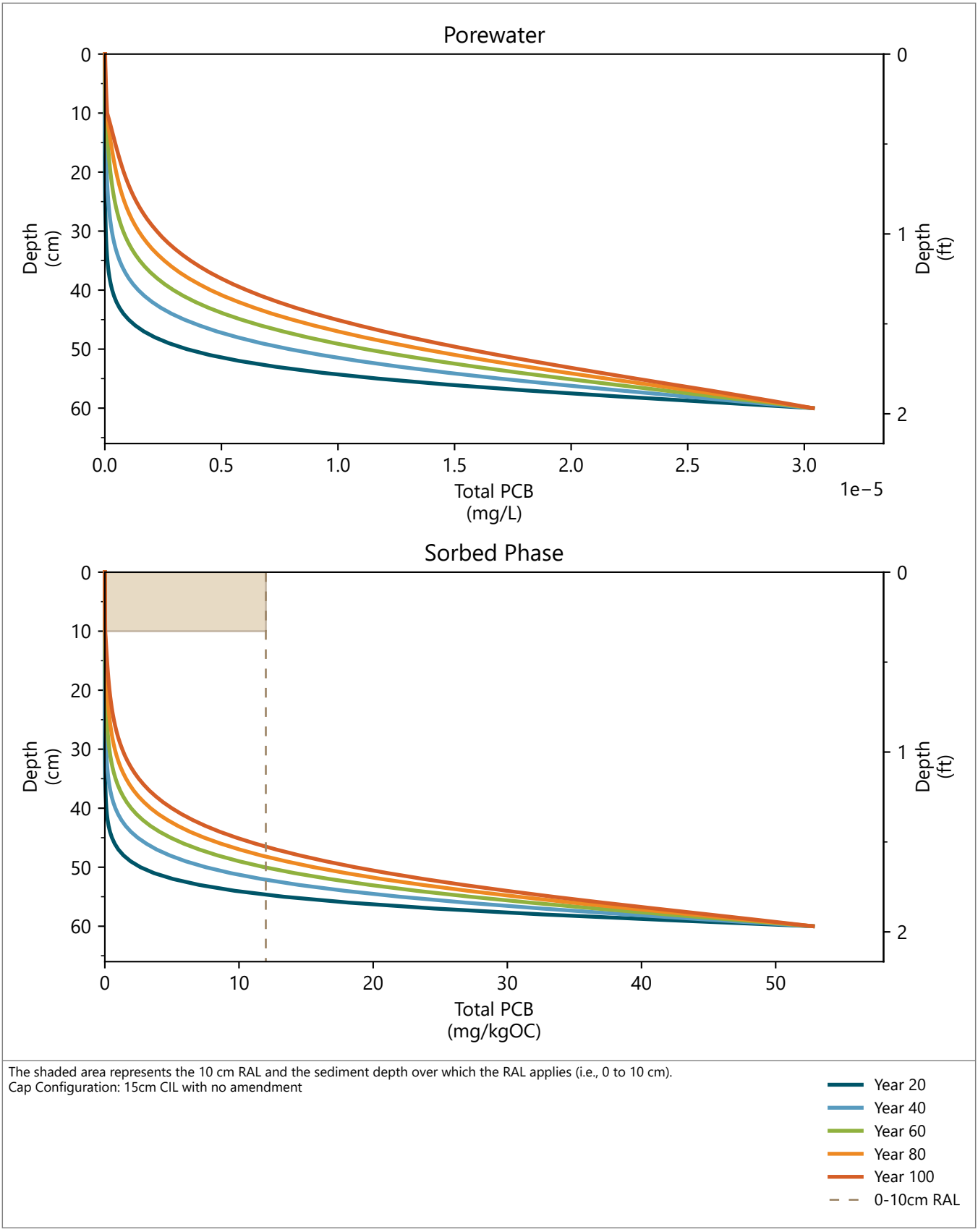
Figure H.4.1.1a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 1B Standard Cap (100 cm/yr Seepage)



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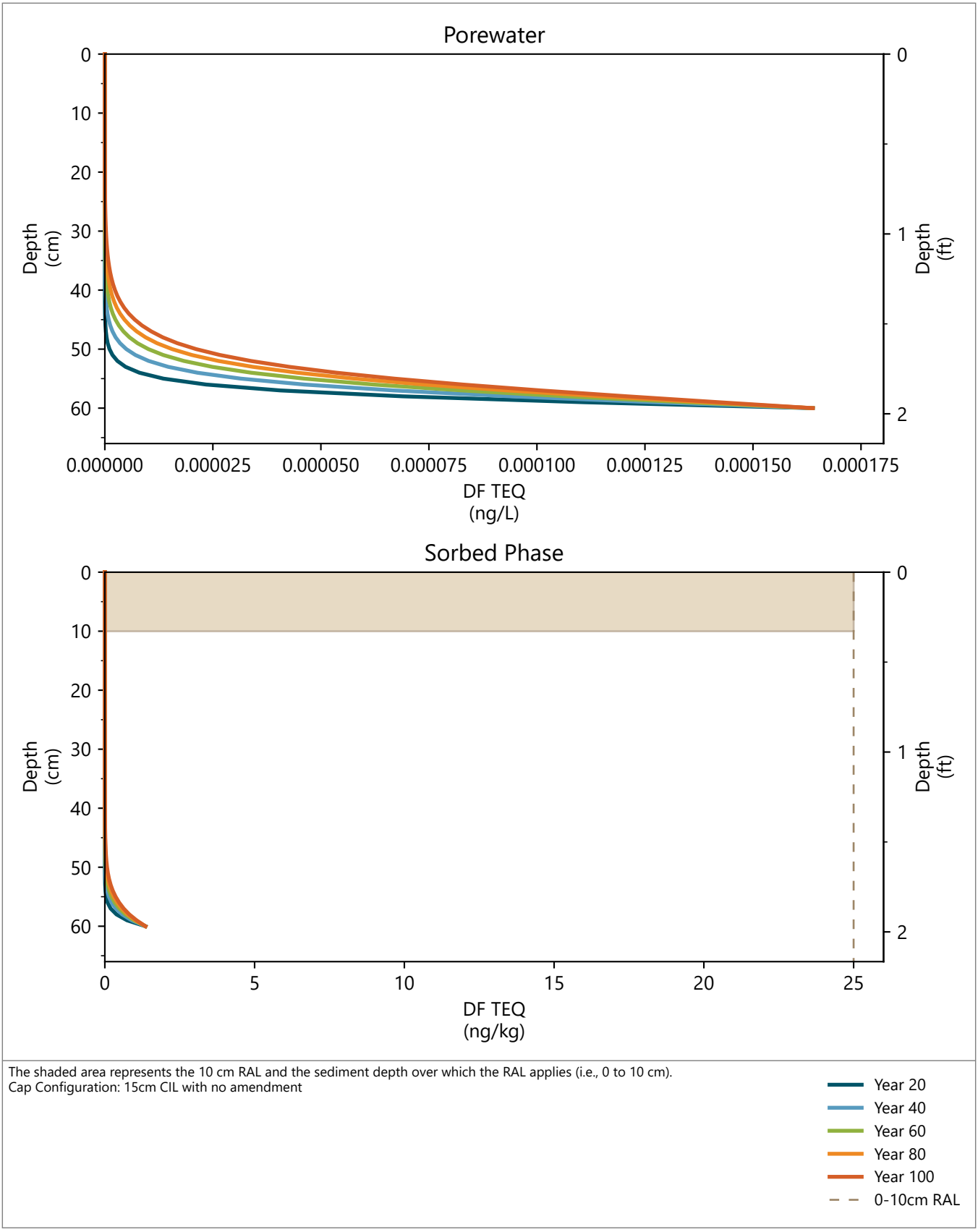
Figure H.4.1.2a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 1B Standard Cap (400 cm/yr Seepage)



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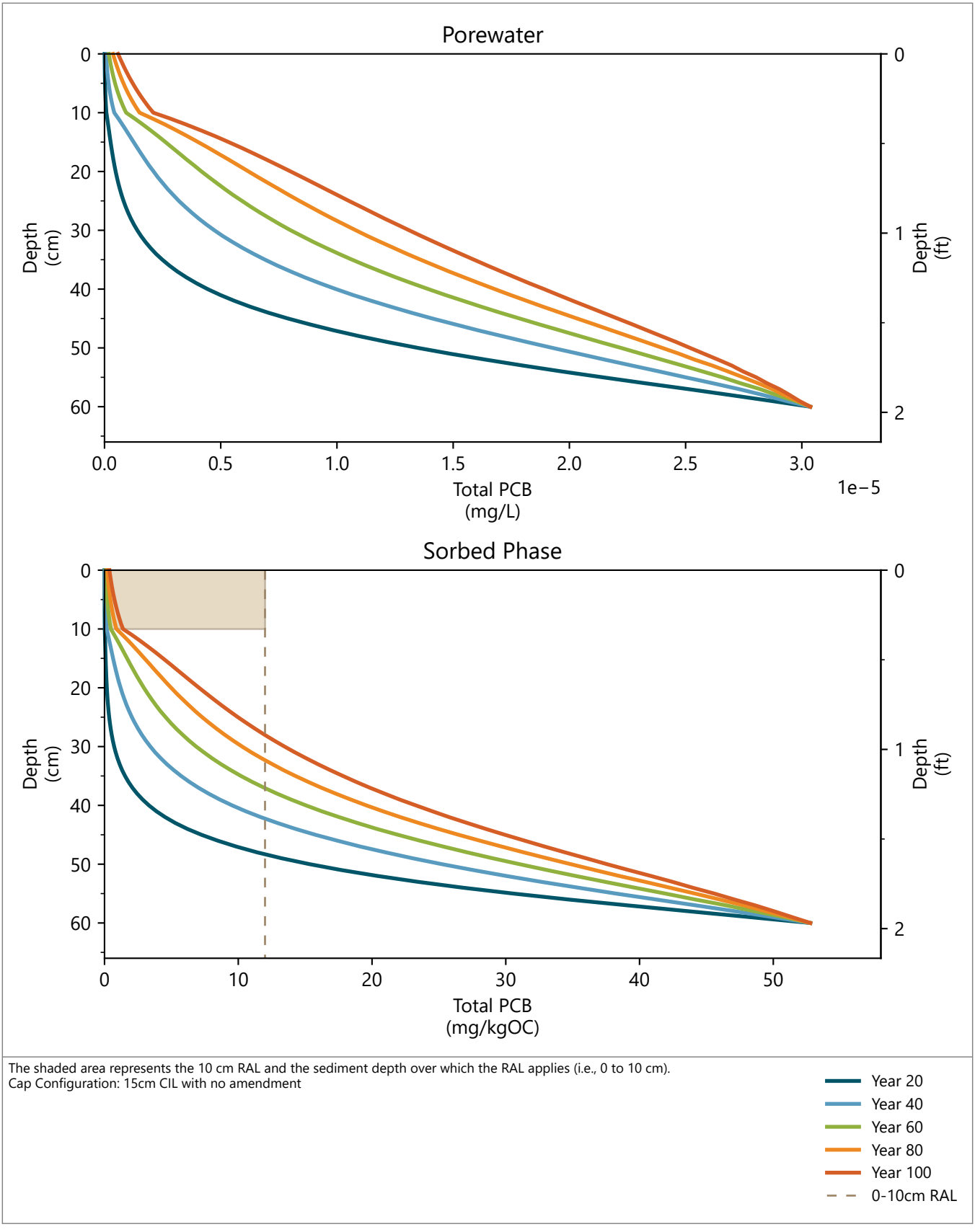
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Figure H.4.1.3a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9J Standard Cap (100 cm/yr Seepage)



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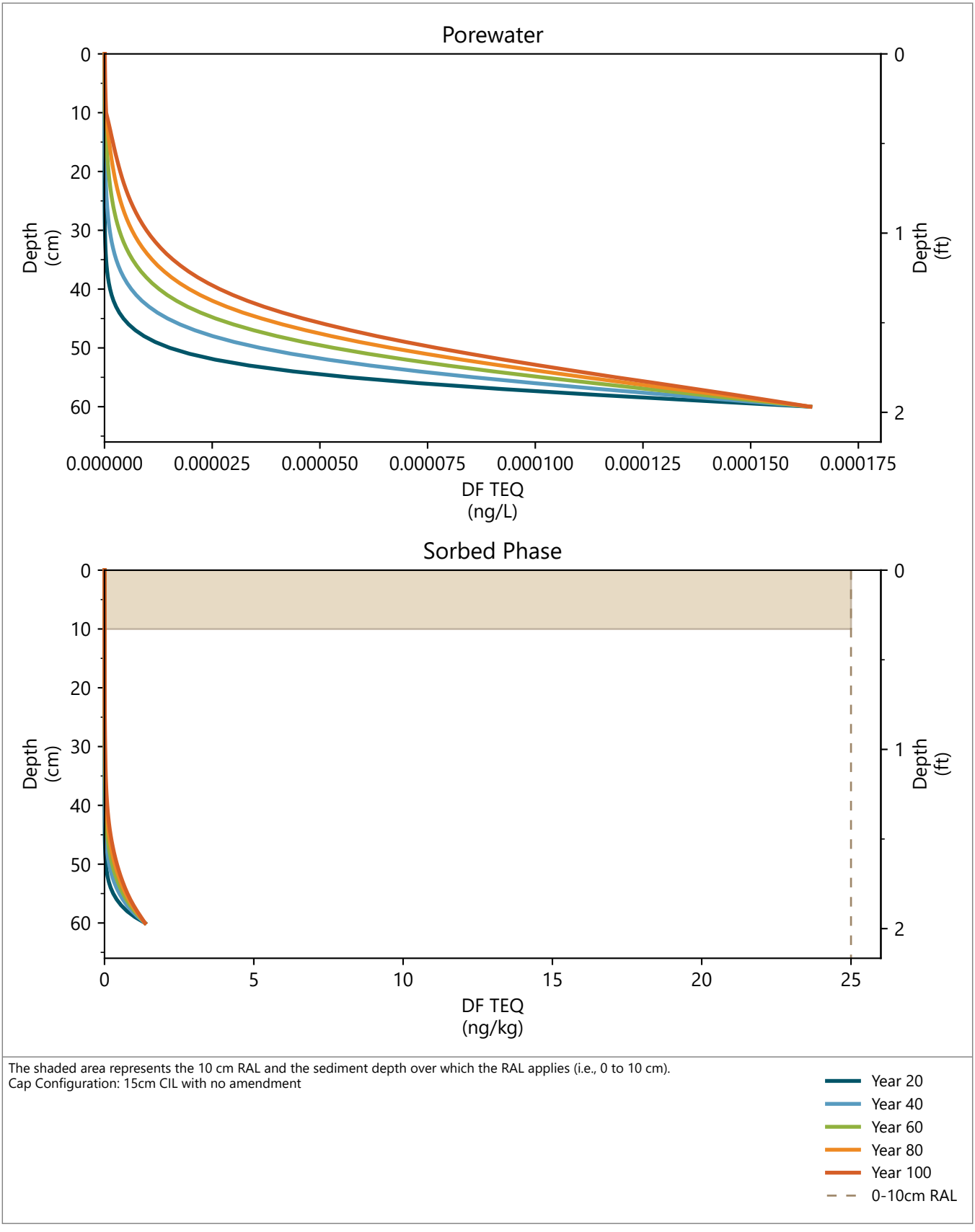
Figure H.4.1.3b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 9J Standard Cap (100 cm/yr Seepage)



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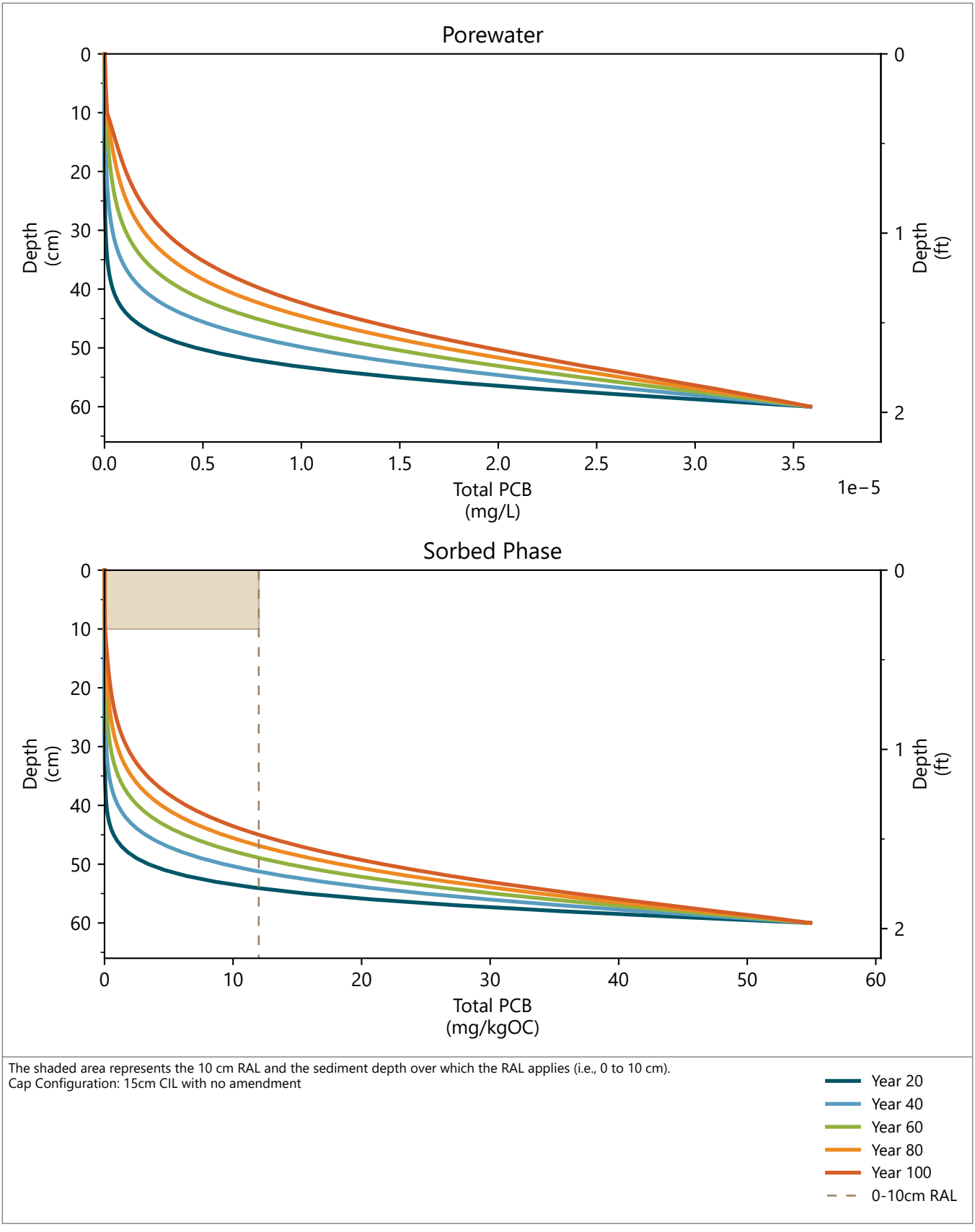
Figure H.4.1.4a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9J Standard Cap (400 cm/yr Seepage)



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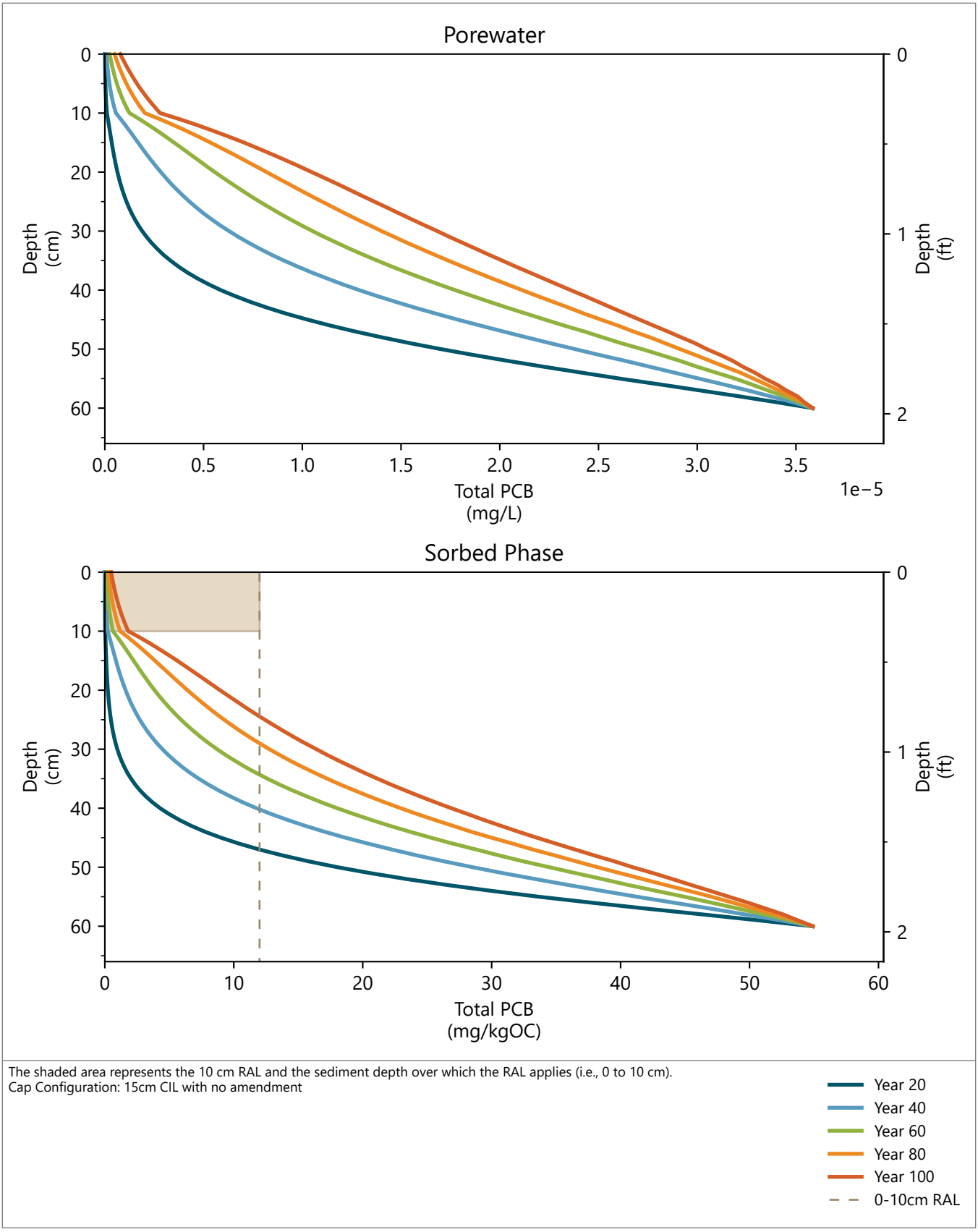
Figure H.4.1.4b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 9J Standard Cap (400 cm/yr Seepage)



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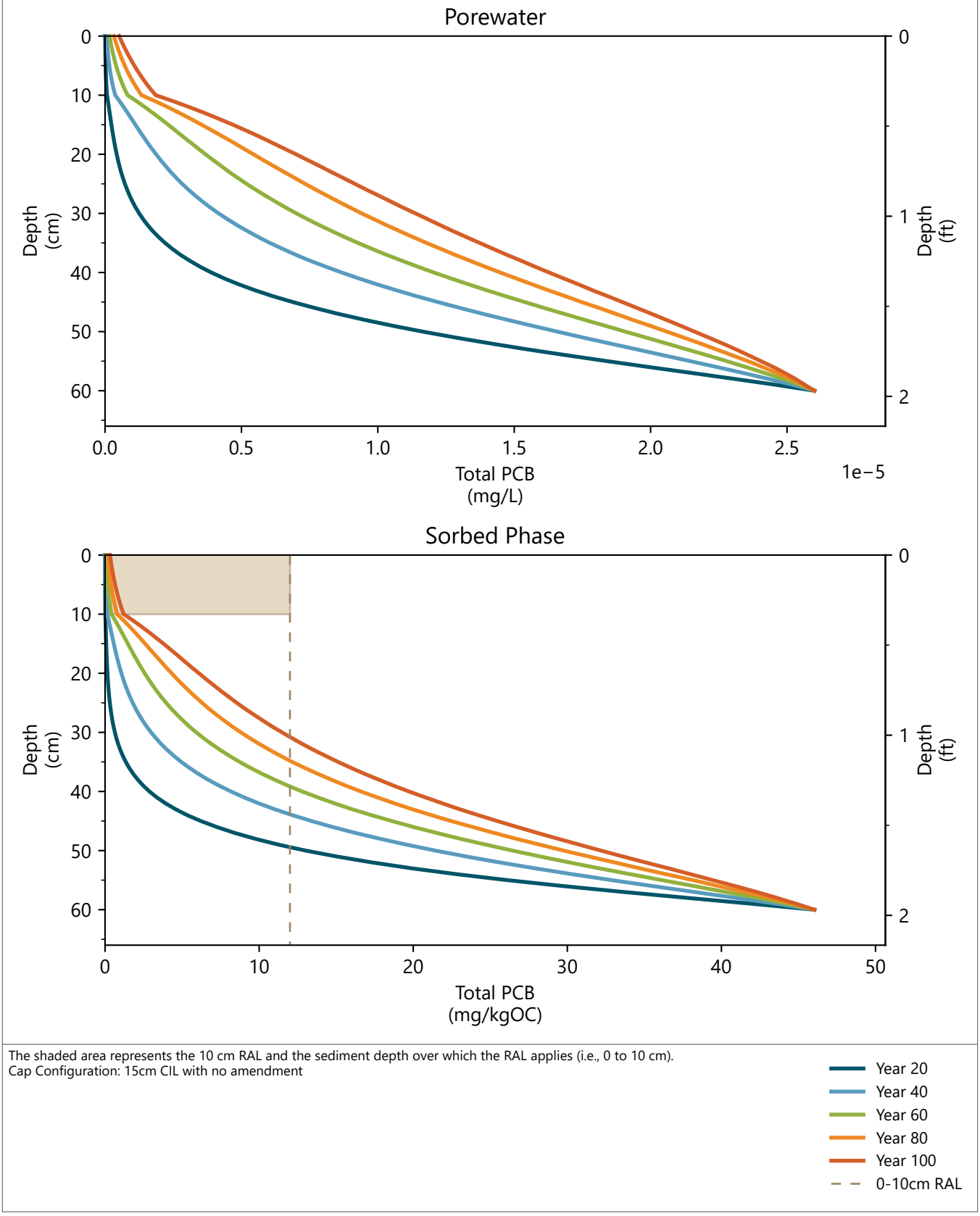
Figure H.4.1.5a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 14A Standard Cap (100 cm/yr Seepage)



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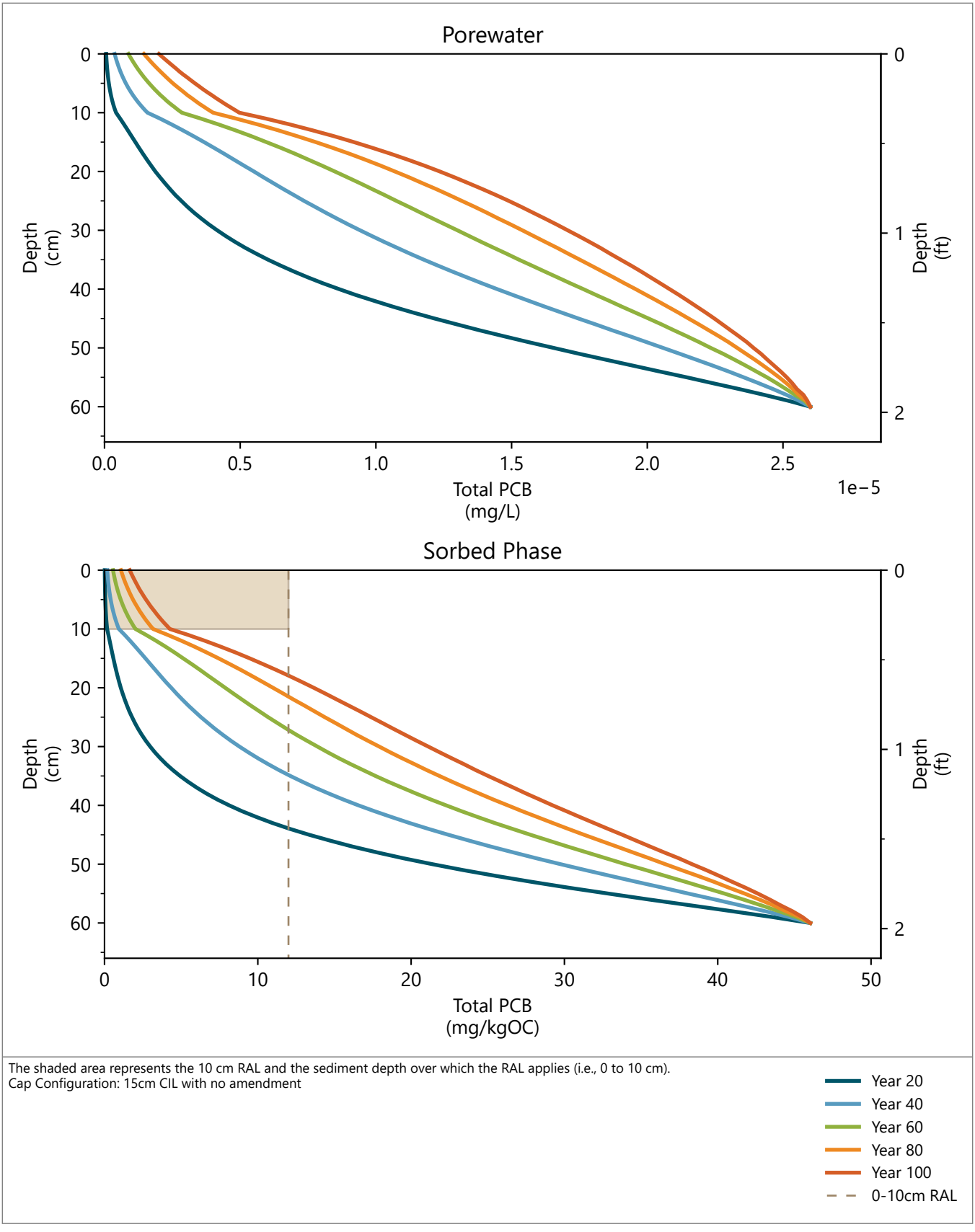
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Figure H.4.1.6a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 14A Standard Cap (400 cm/yr Seepage)



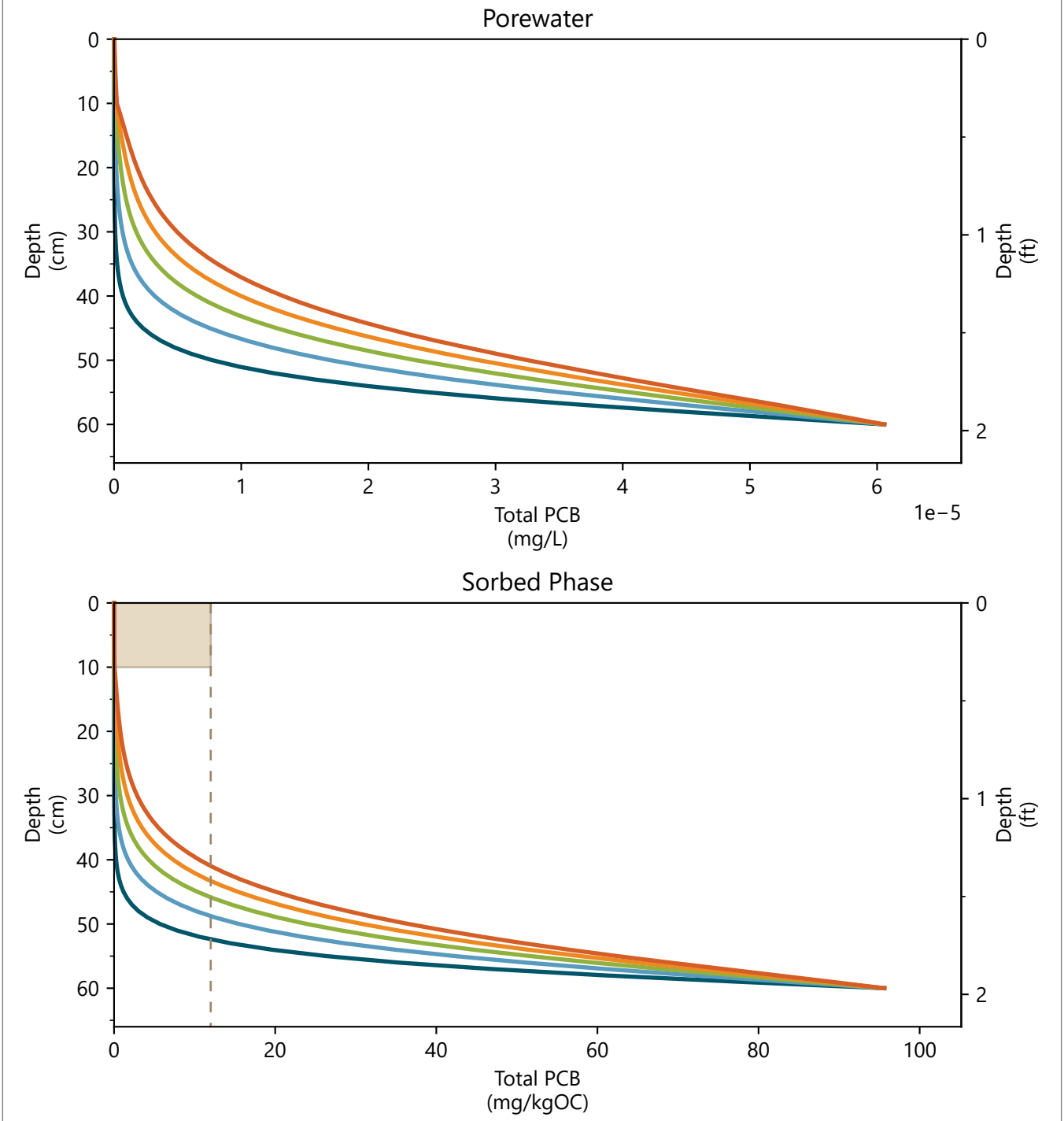
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Figure H.4.1.7a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 15B Standard Cap (400 cm/yr Seepage)



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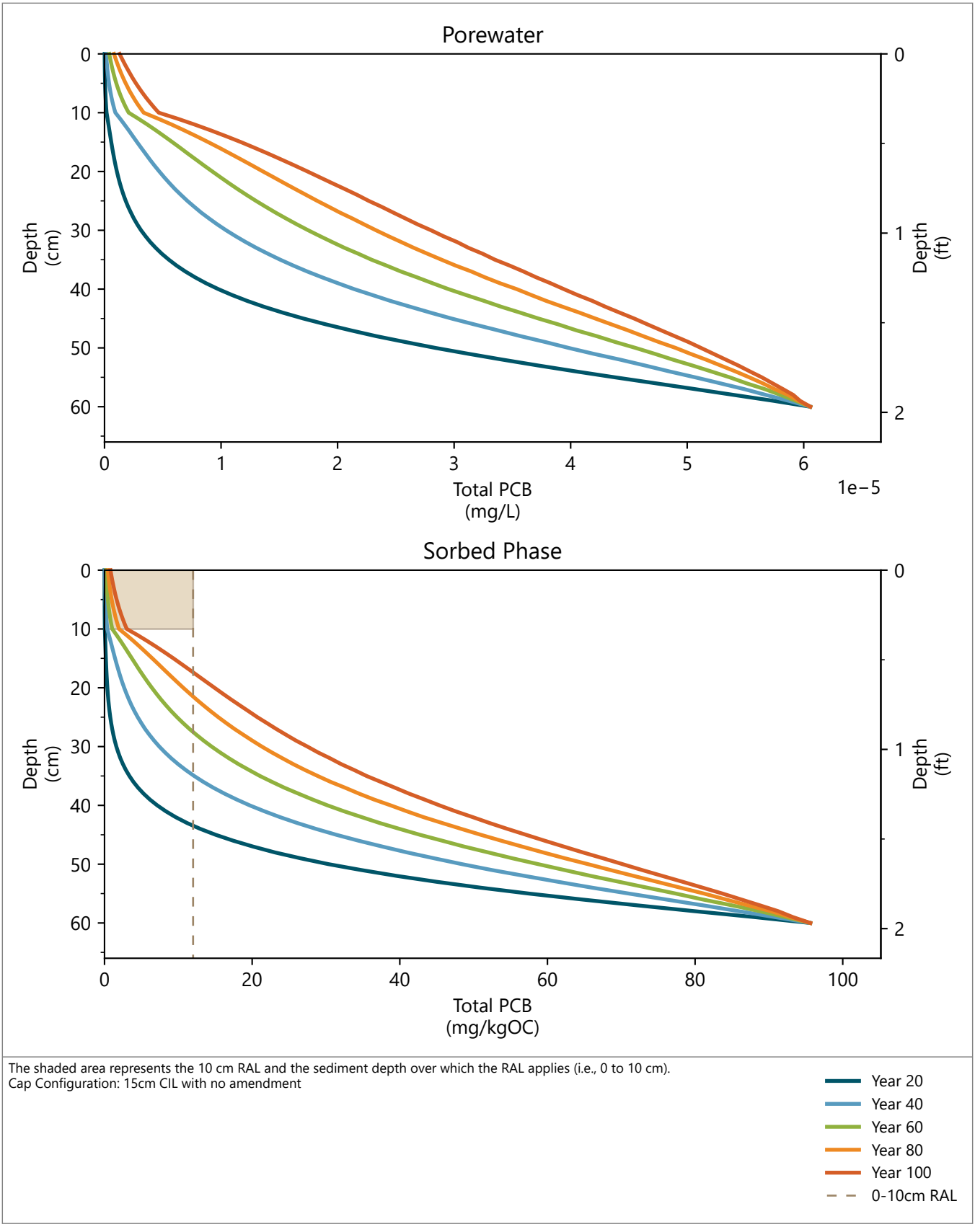
Figure H.4.1.8a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 15B Standard Cap (800 cm/yr Seepage)



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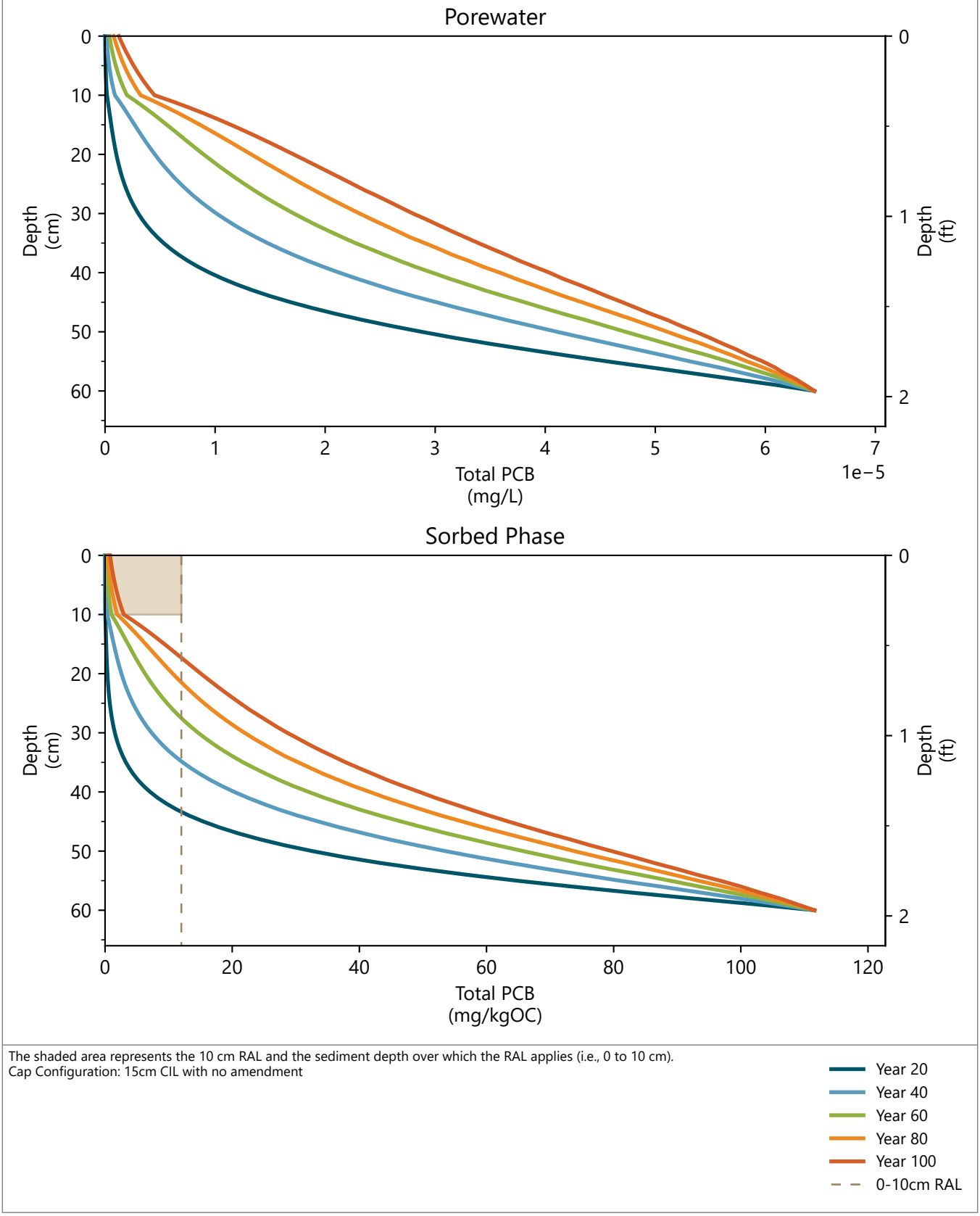
Figure H.4.1.9a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 22 Standard Cap (100 cm/yr Seepage)



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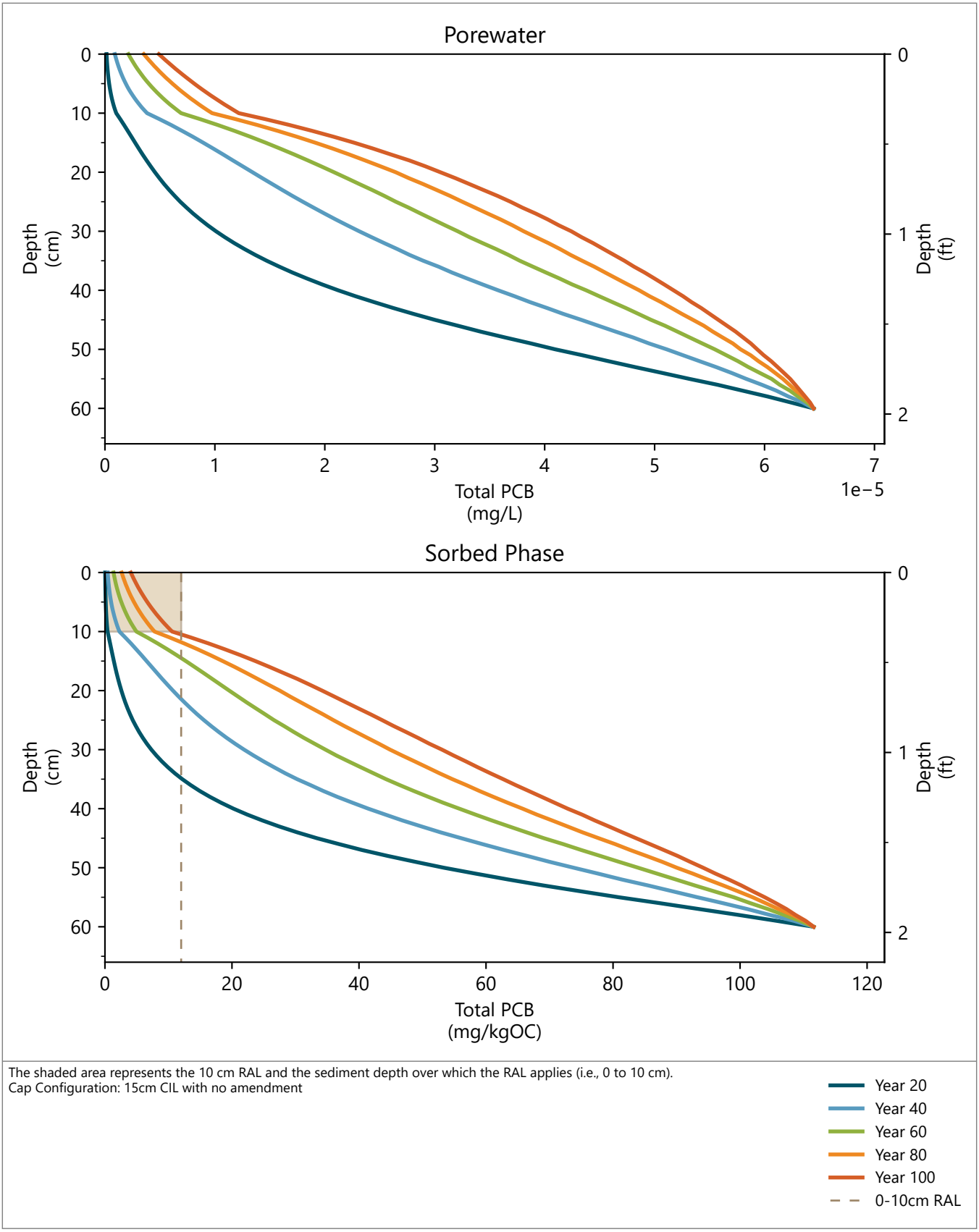
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Figure H.4.1.10a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 22 Standard Cap (400 cm/yr Seepage)



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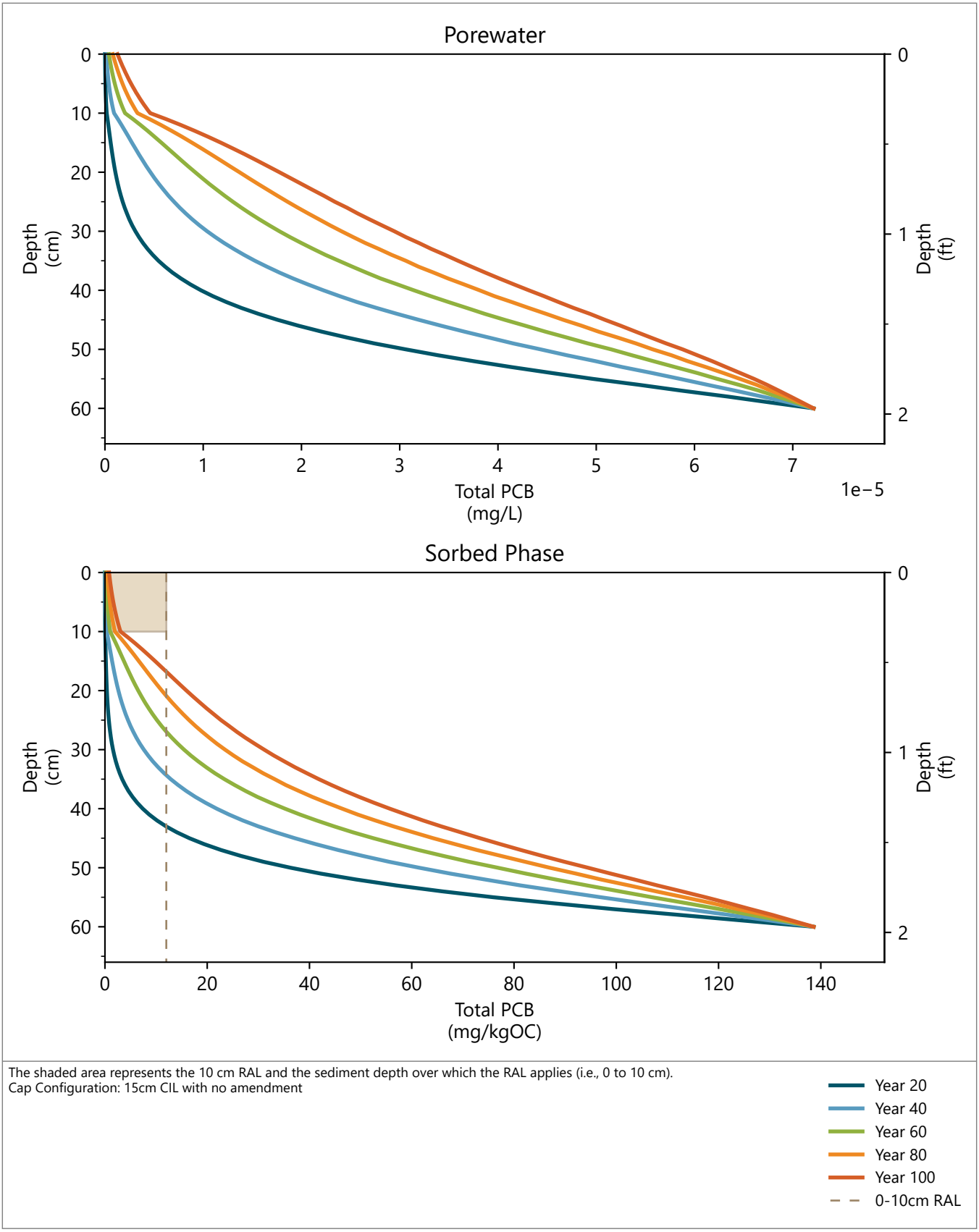
Figure H.4.1.11a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 23 Standard Cap (400 cm/yr Seepage)



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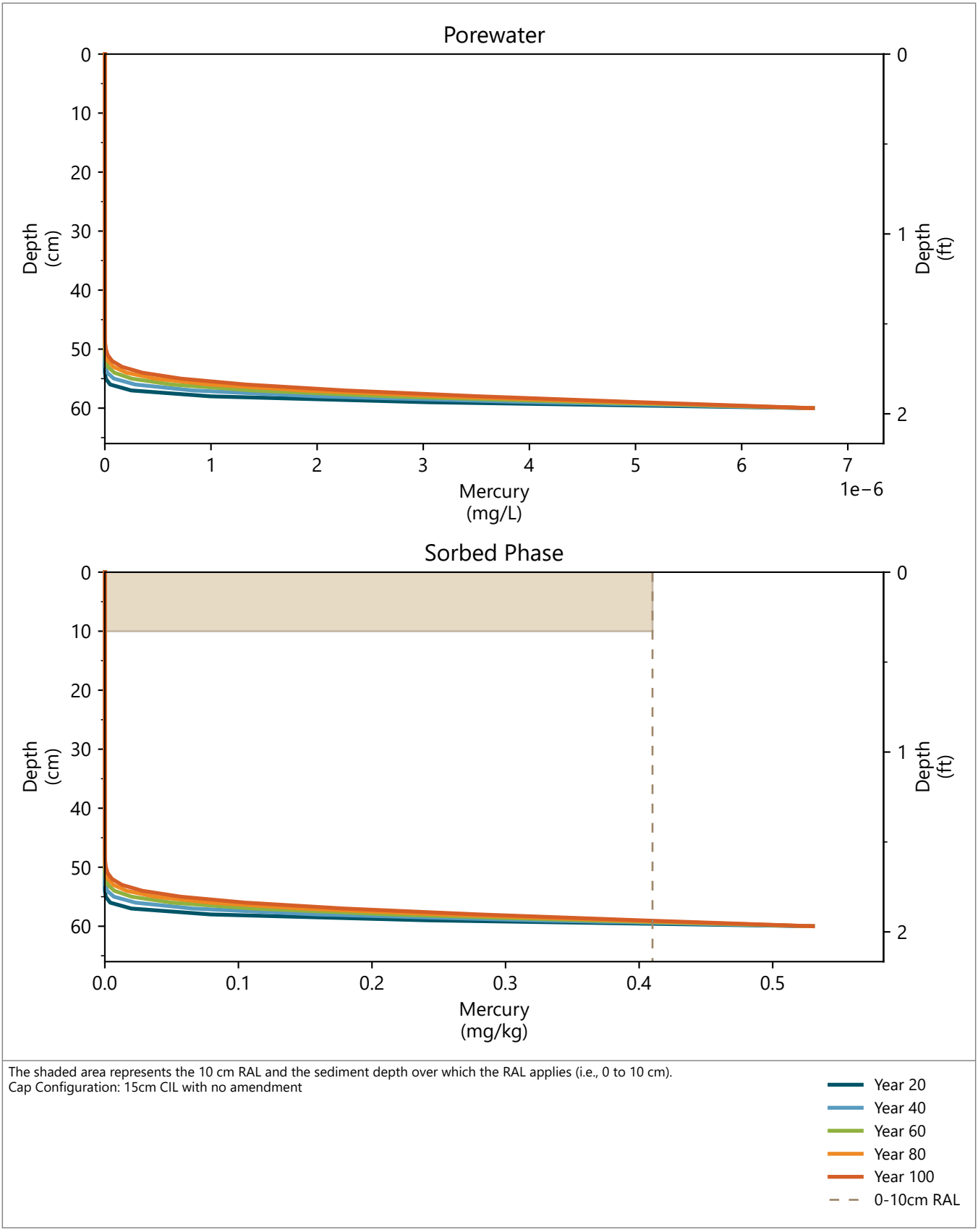
Figure H.4.1.12a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 23 Standard Cap (800 cm/yr Seepage)



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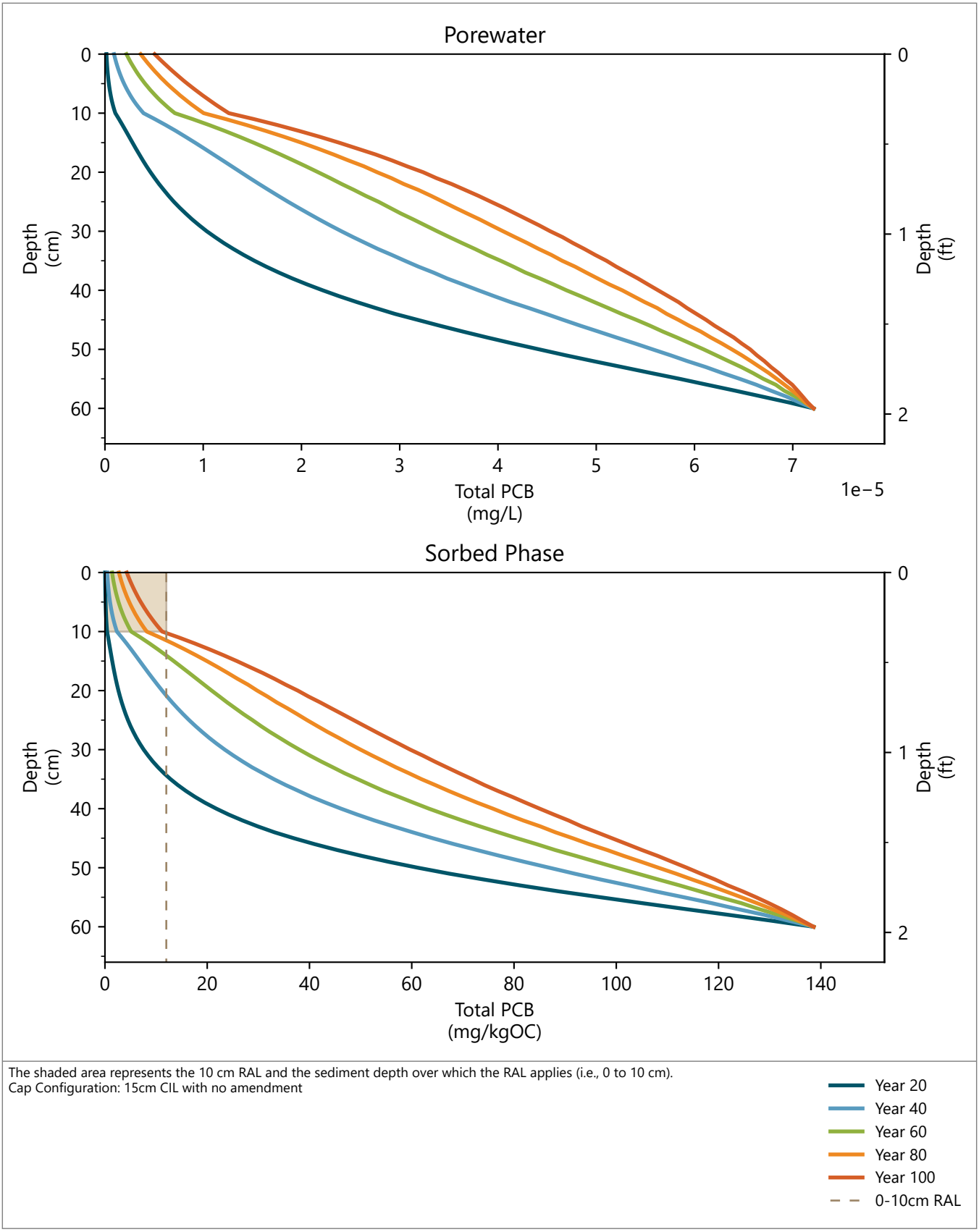
Figure H.4.1.13a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30A Standard Cap (400 cm/yr Seepage)



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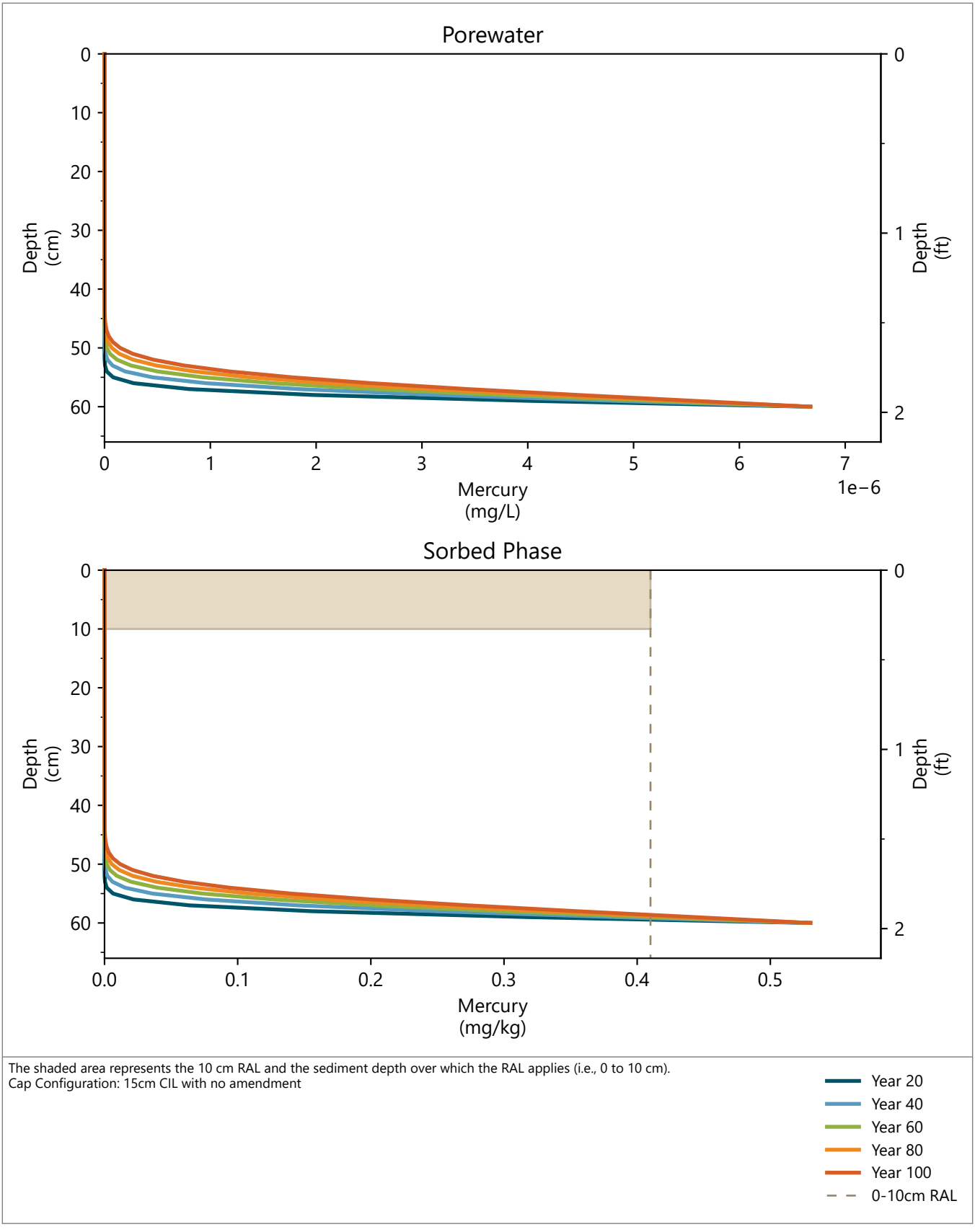
Figure H.4.1.13b
Depth Profiles Over Time of Model-Predicted Mercury Concentrations in RAA 30A Standard Cap (400 cm/yr Seepage)



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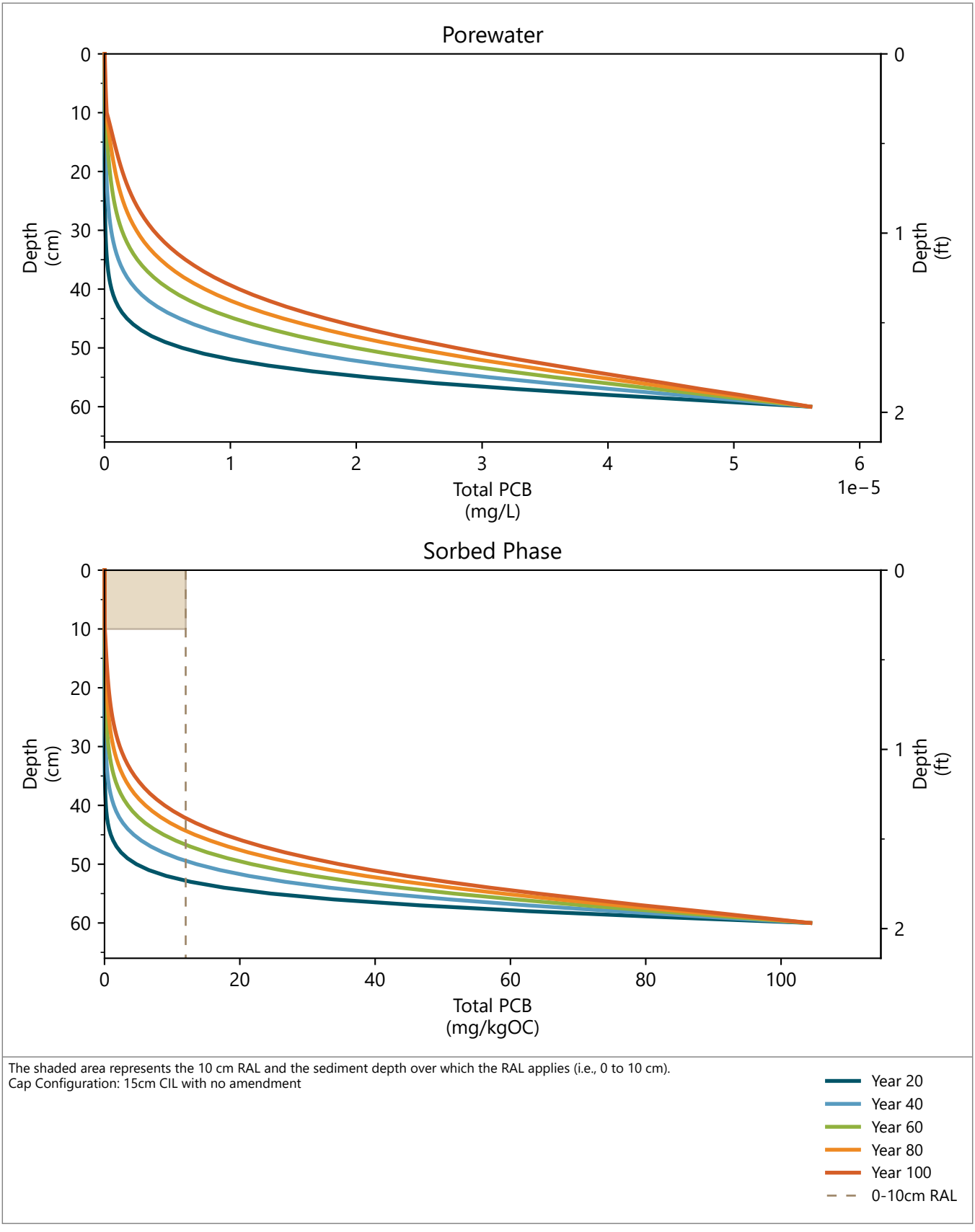
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Figure H.4.1.14a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30A Standard Cap (800 cm/yr Seepage)



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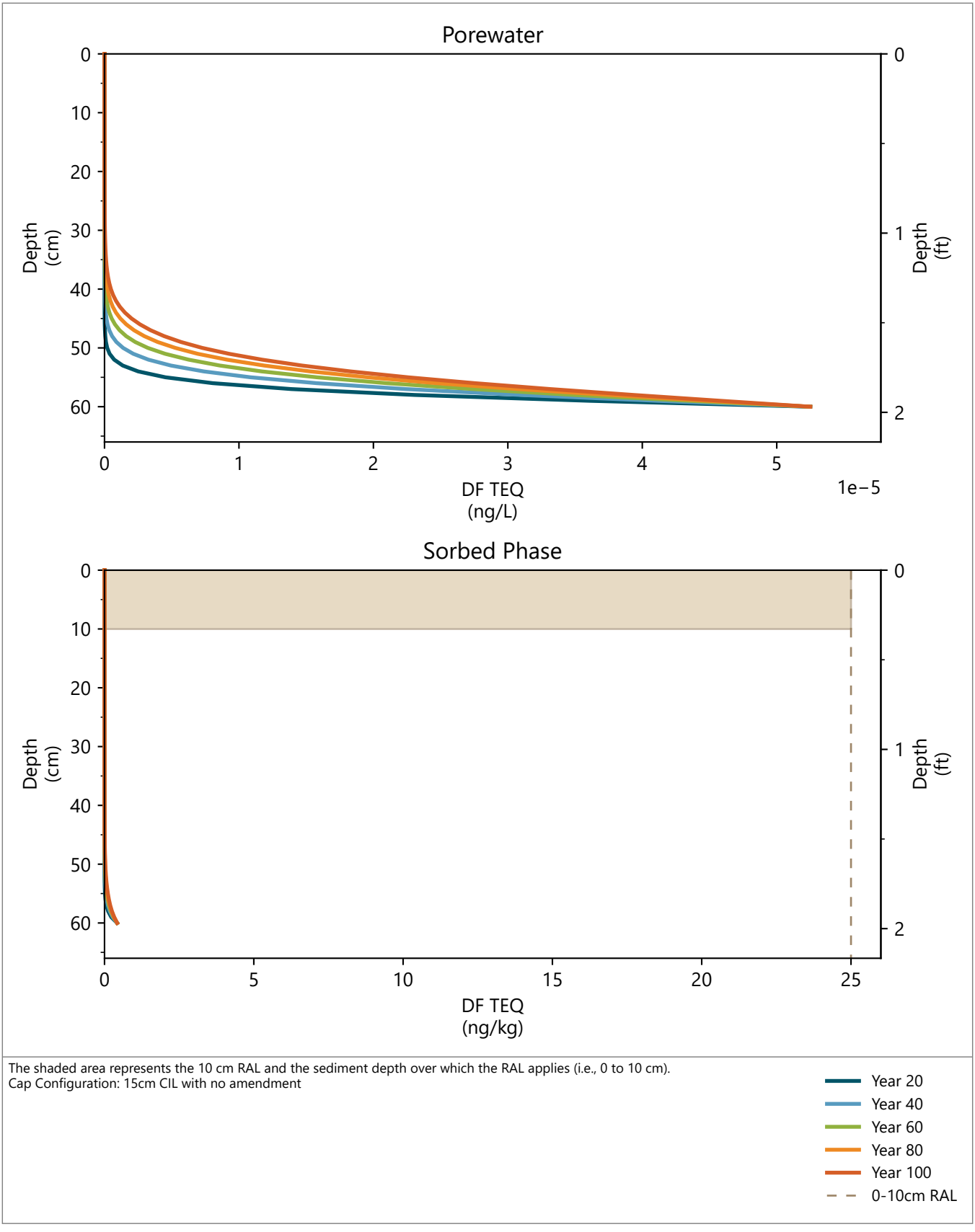
Figure H.4.1.14b
Depth Profiles Over Time of Model-Predicted Mercury Concentrations in RAA 30A Standard Cap (800 cm/yr Seepage)



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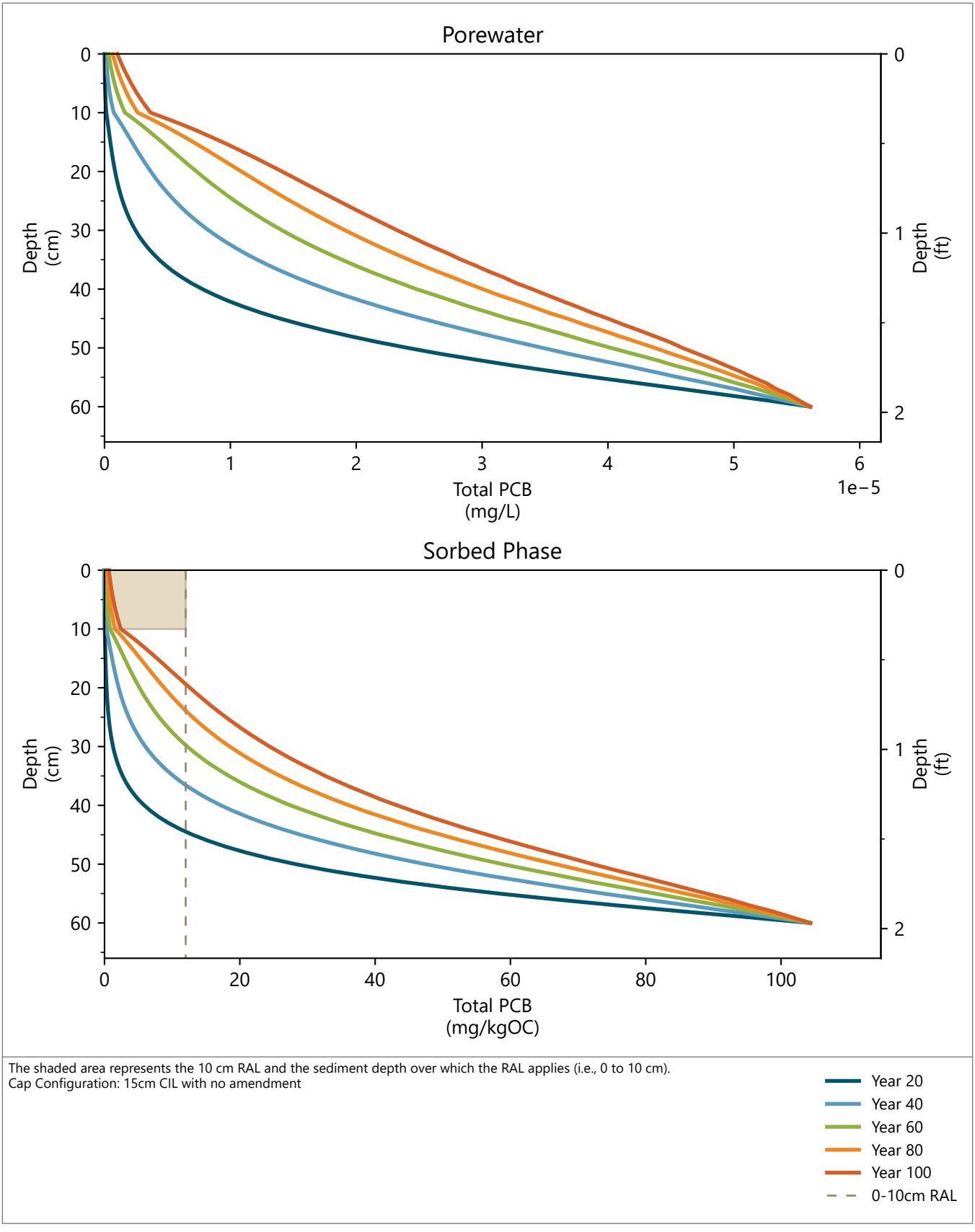
Figure H.4.1.15a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30B Standard Cap (100 cm/yr Seepage)



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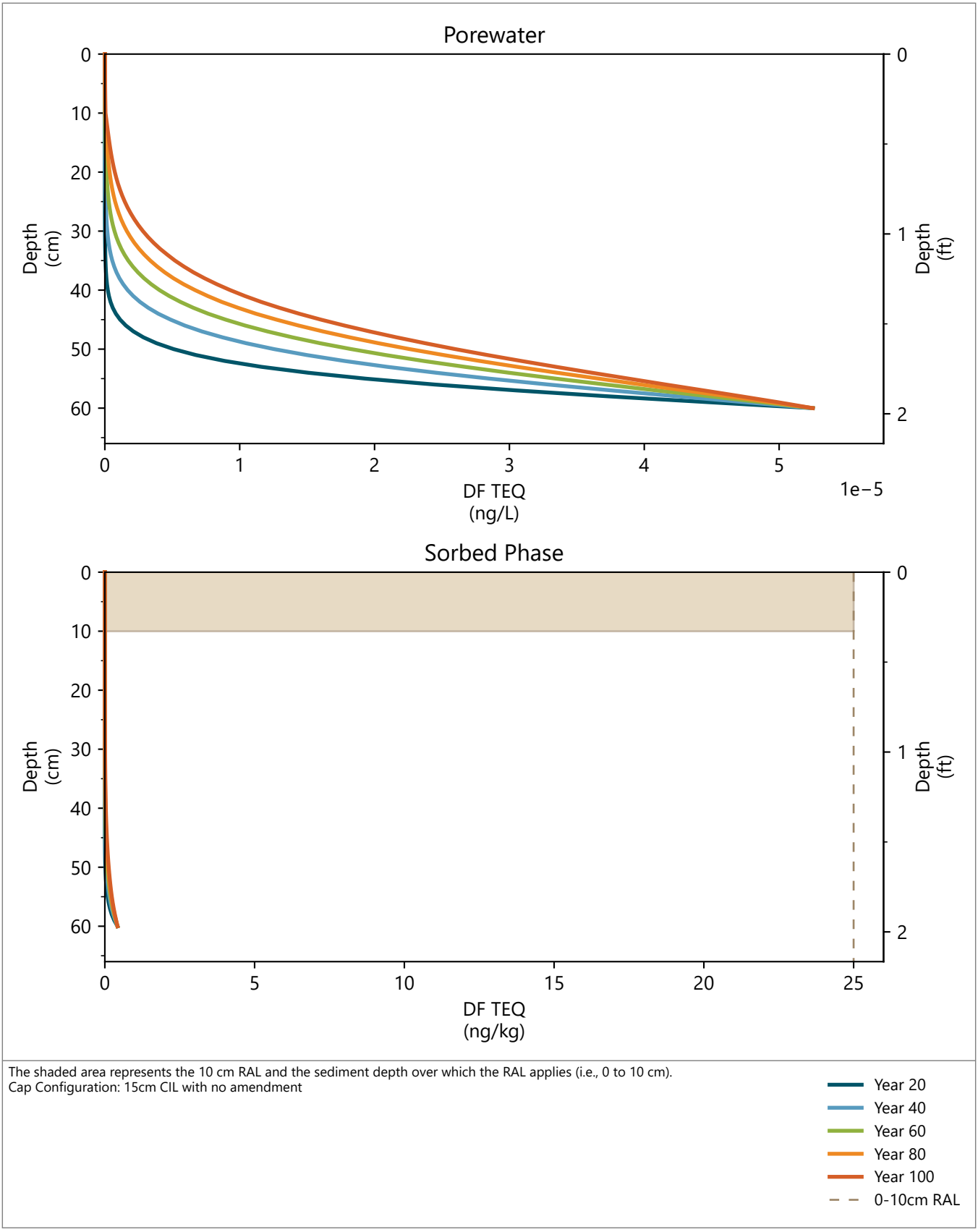
Figure H.4.1.15b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30B Standard Cap (100 cm/yr Seepage)



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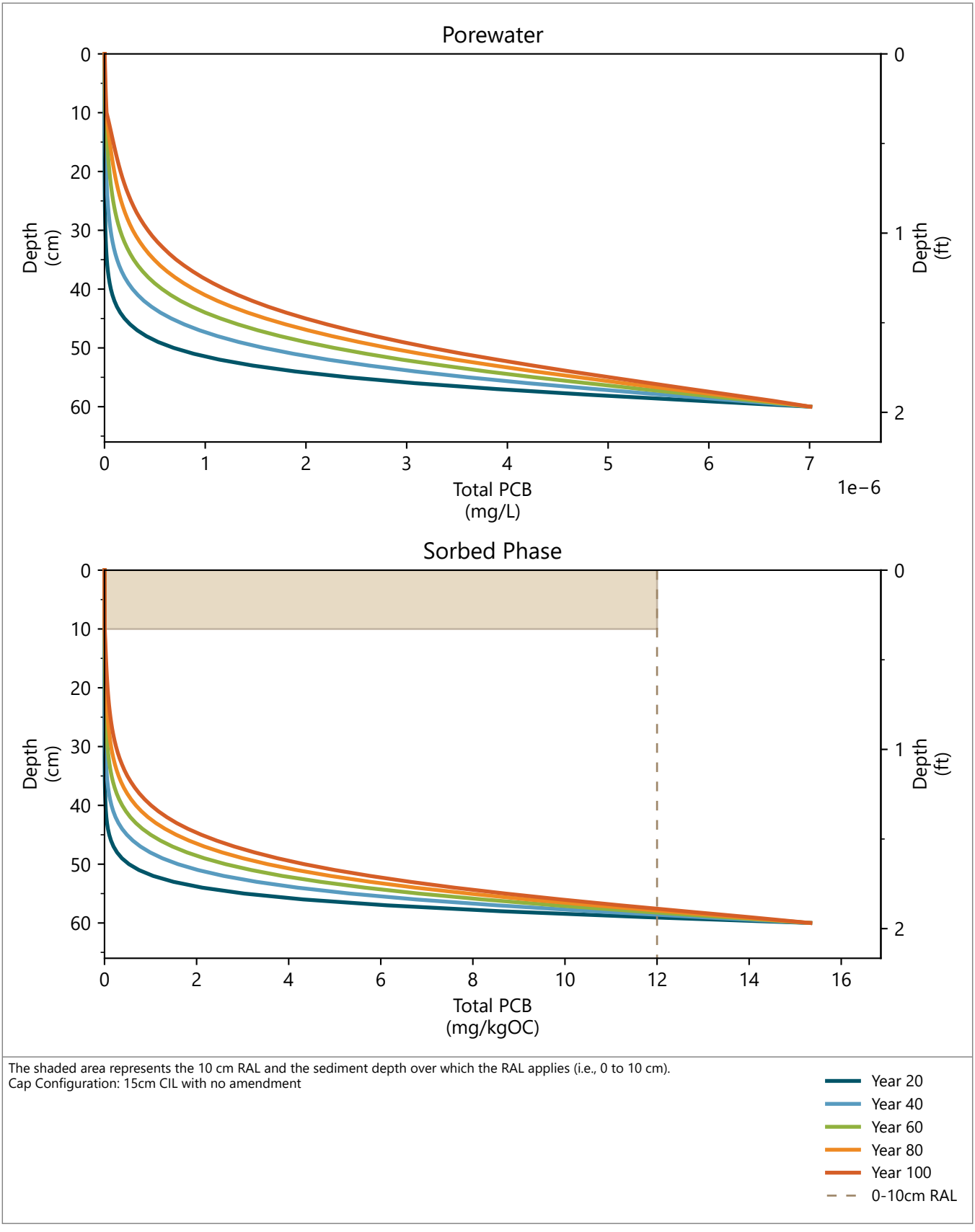
Figure H.4.1.16a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30B Standard Cap (400 cm/yr Seepage)



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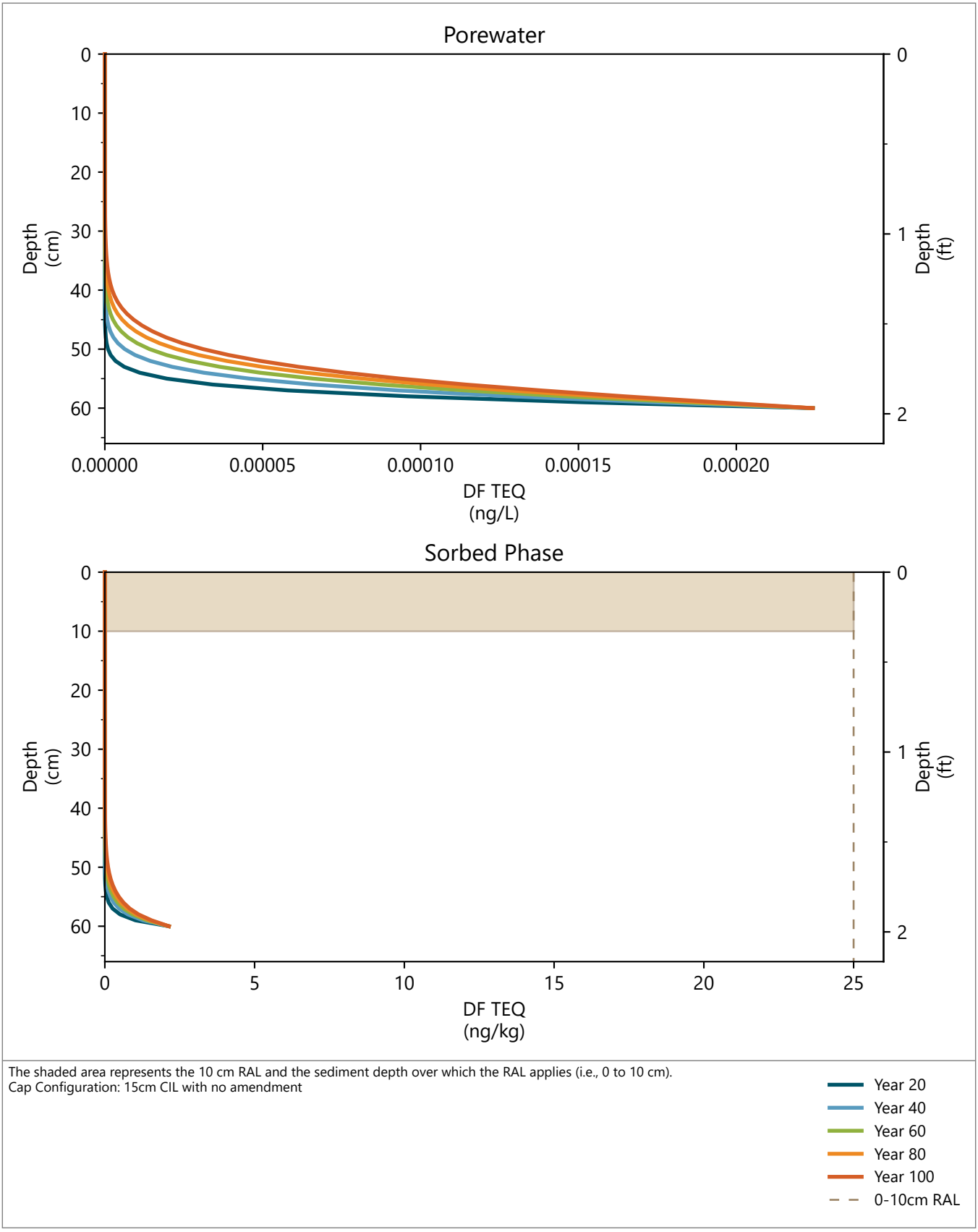
Figure H.4.1.16b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30B Standard Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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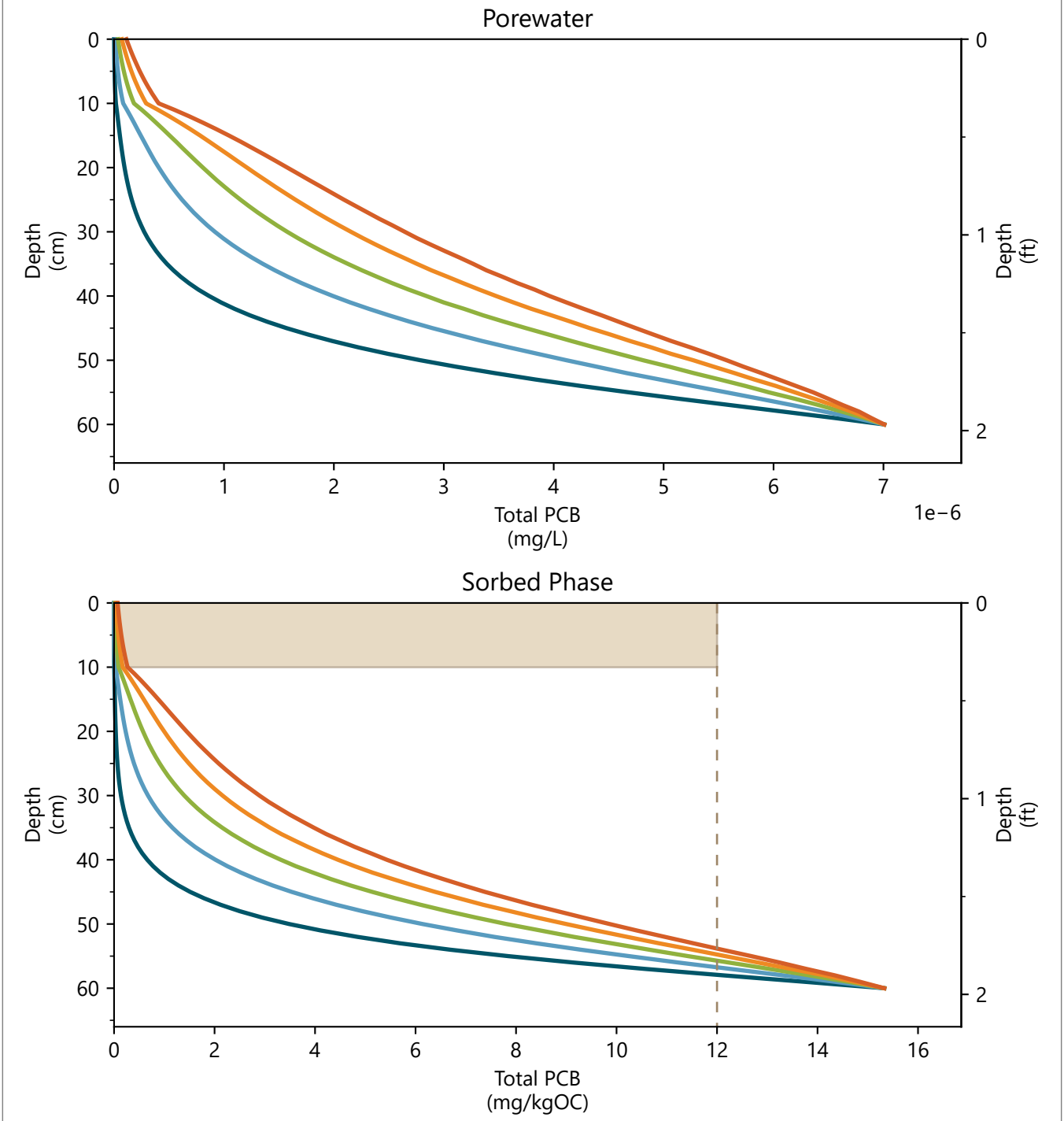
Figure H.4.1.17a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30C Standard Cap (100 cm/yr Seepage)



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Figure H.4.1.17b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30C Standard Cap (100 cm/yr Seepage)

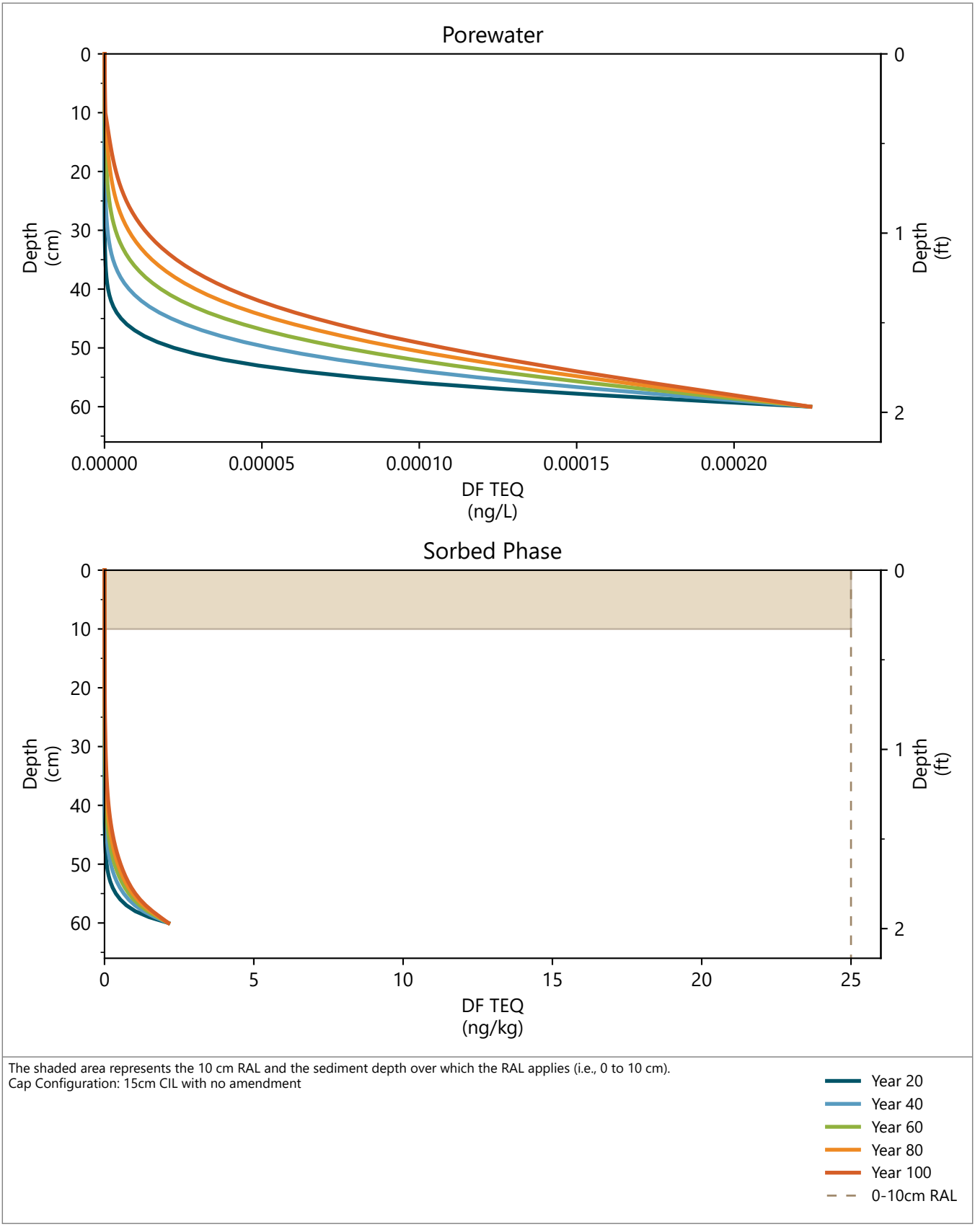


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment

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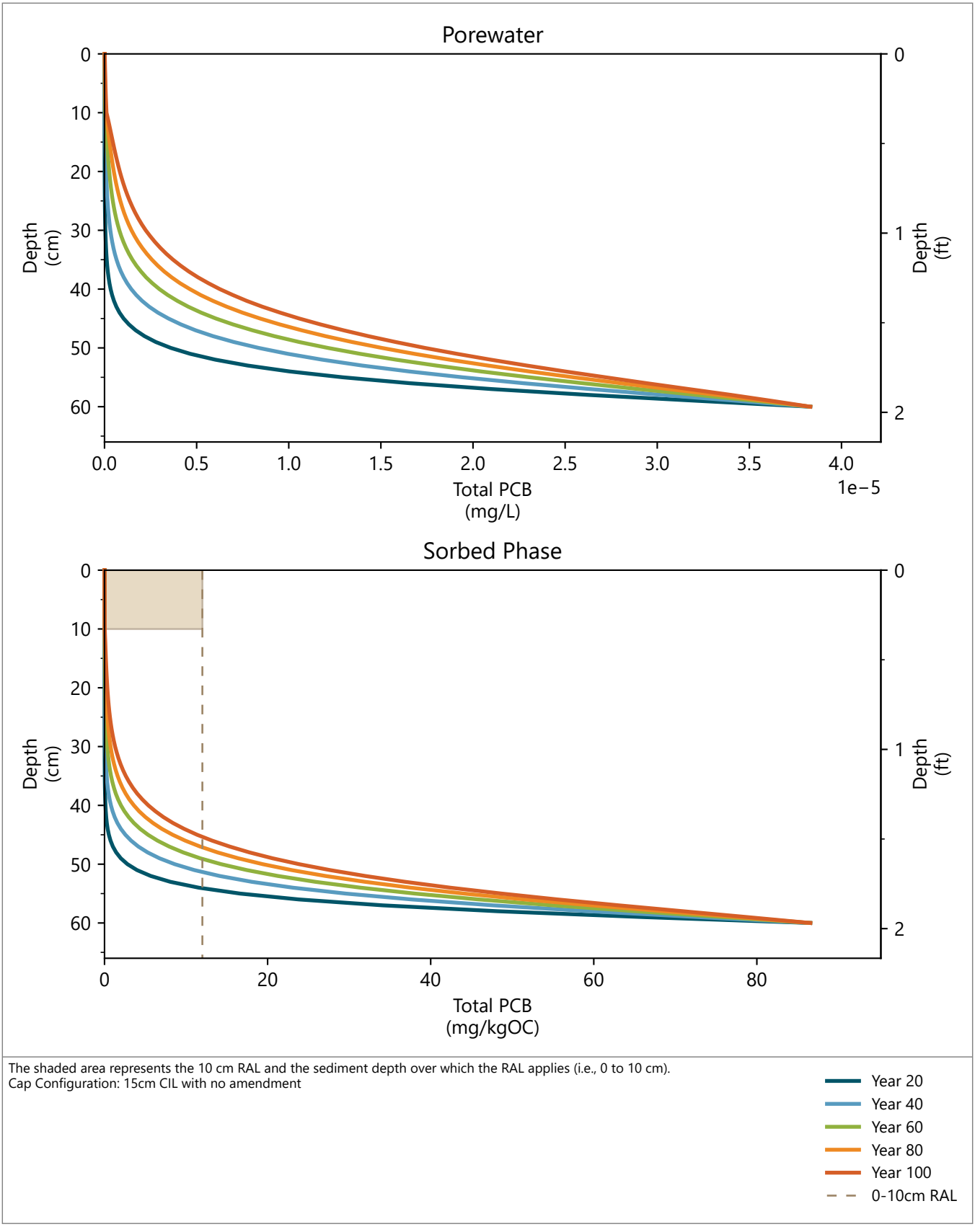
Figure H.4.1.18a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30C Standard Cap (400 cm/yr Seepage)



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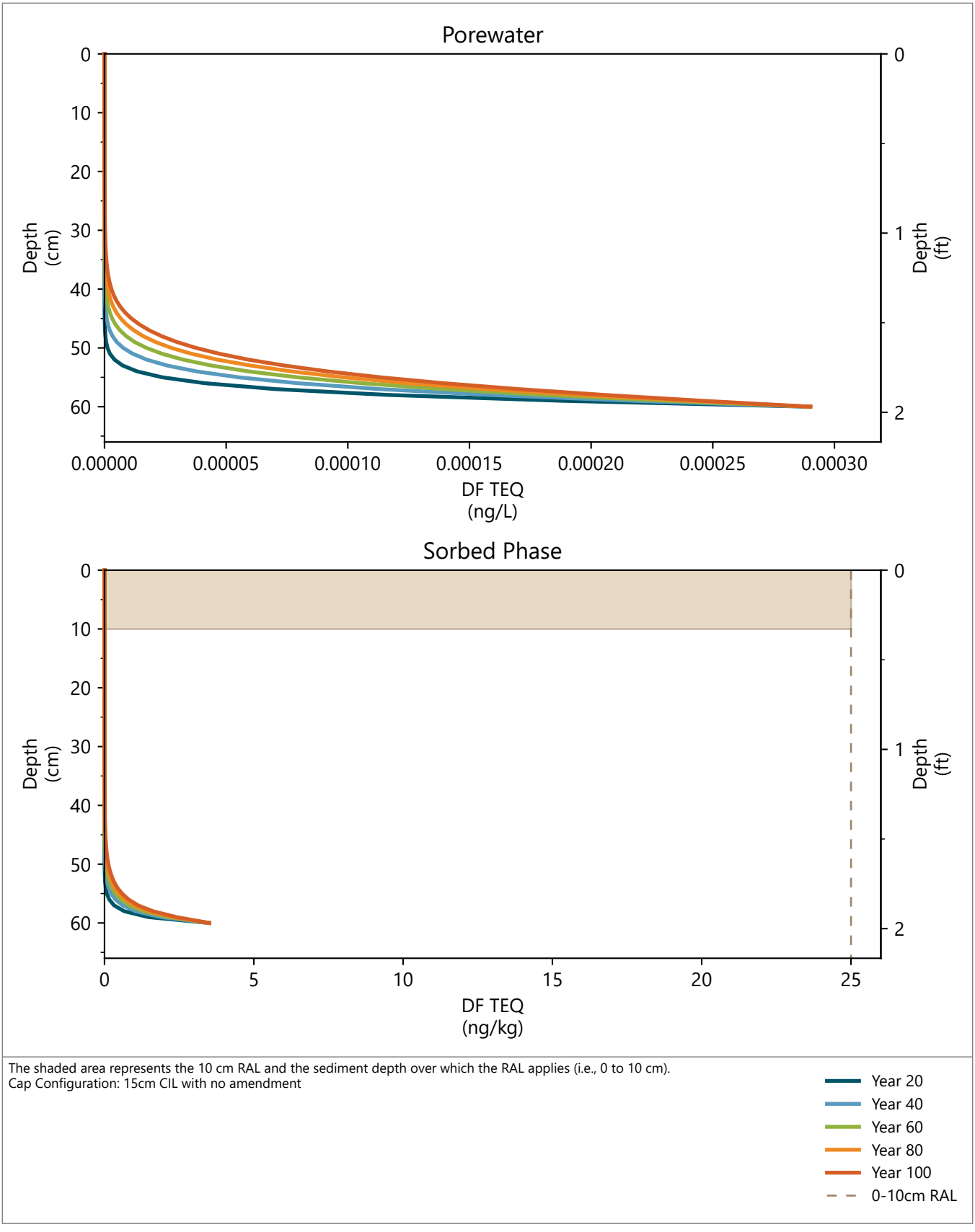
Figure H.4.1.18b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30C Standard Cap (400 cm/yr Seepage)



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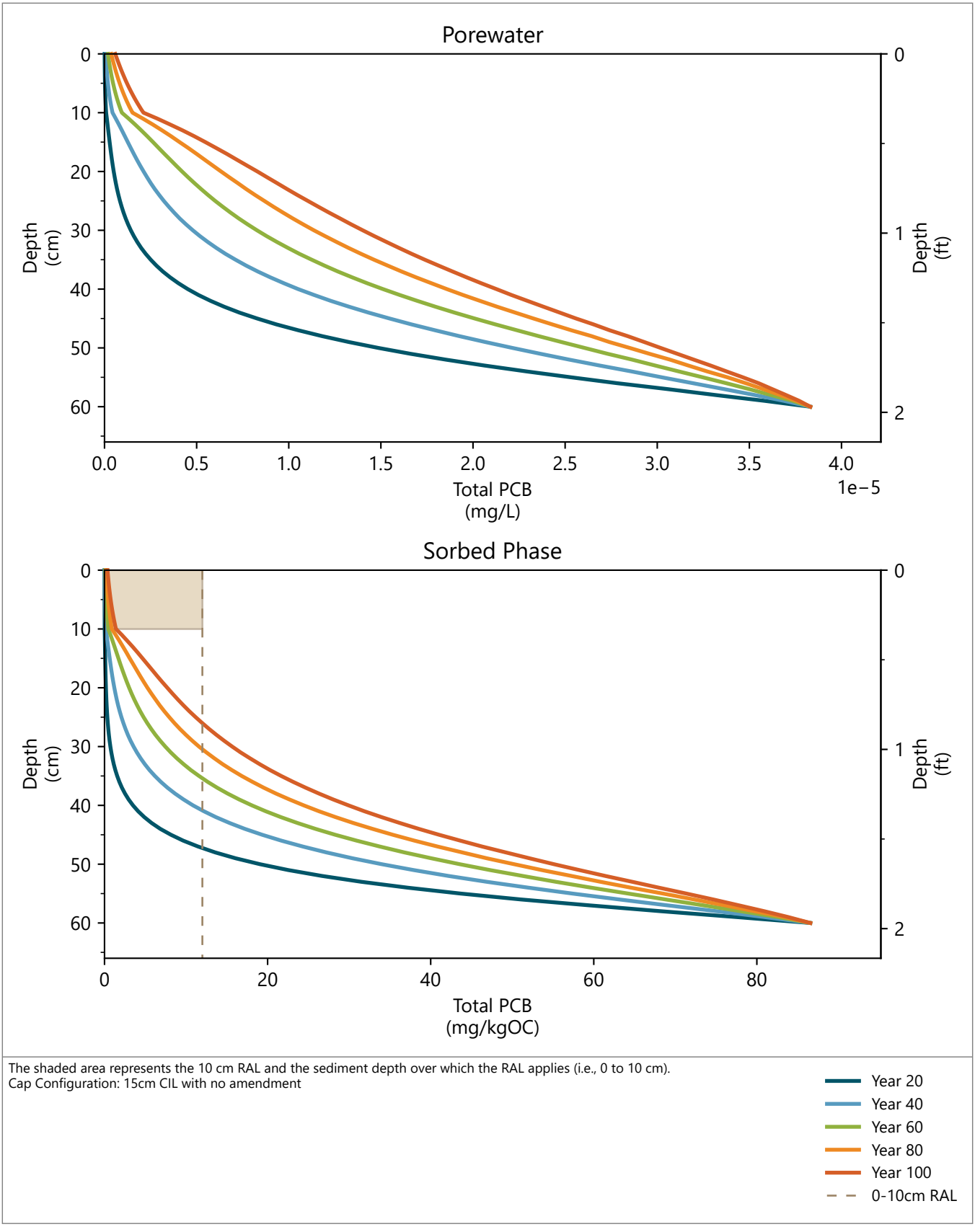
Figure H.4.1.19a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30D Standard Cap (100 cm/yr Seepage)



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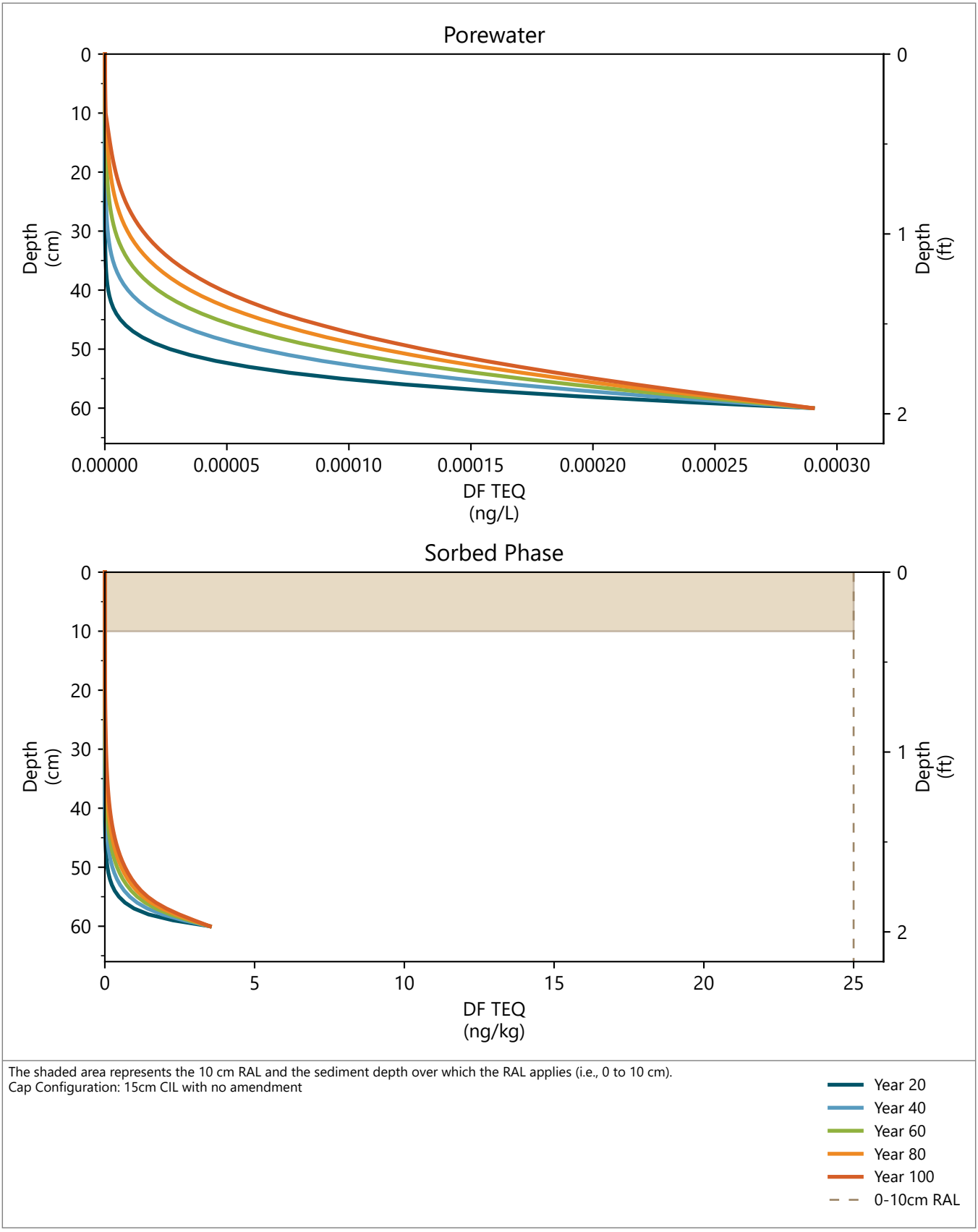
Figure H.4.1.19b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30D Standard Cap (100 cm/yr Seepage)



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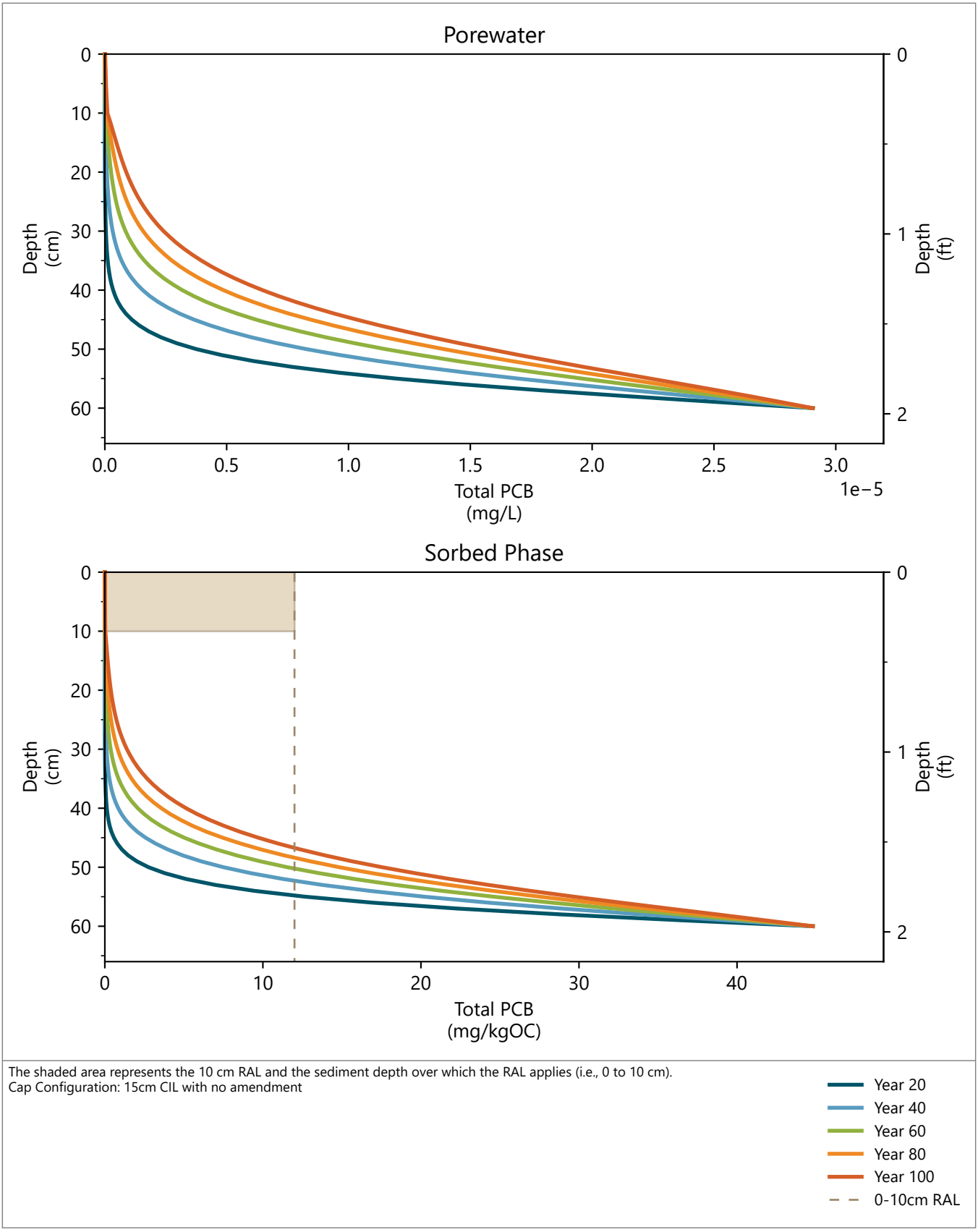
Figure H.4.1.20a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30D Standard Cap (400 cm/yr Seepage)



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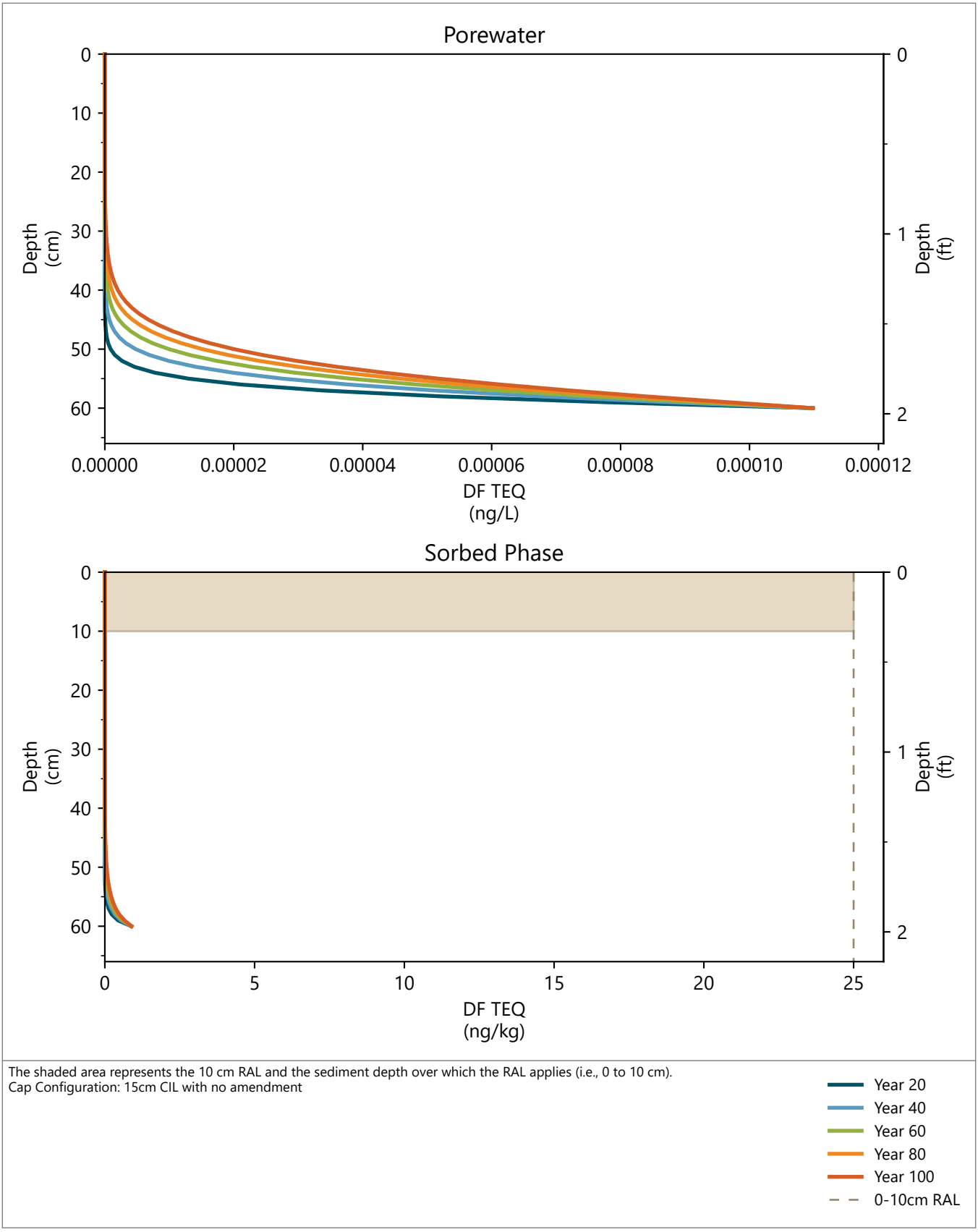
Figure H.4.1.20b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30D Standard Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

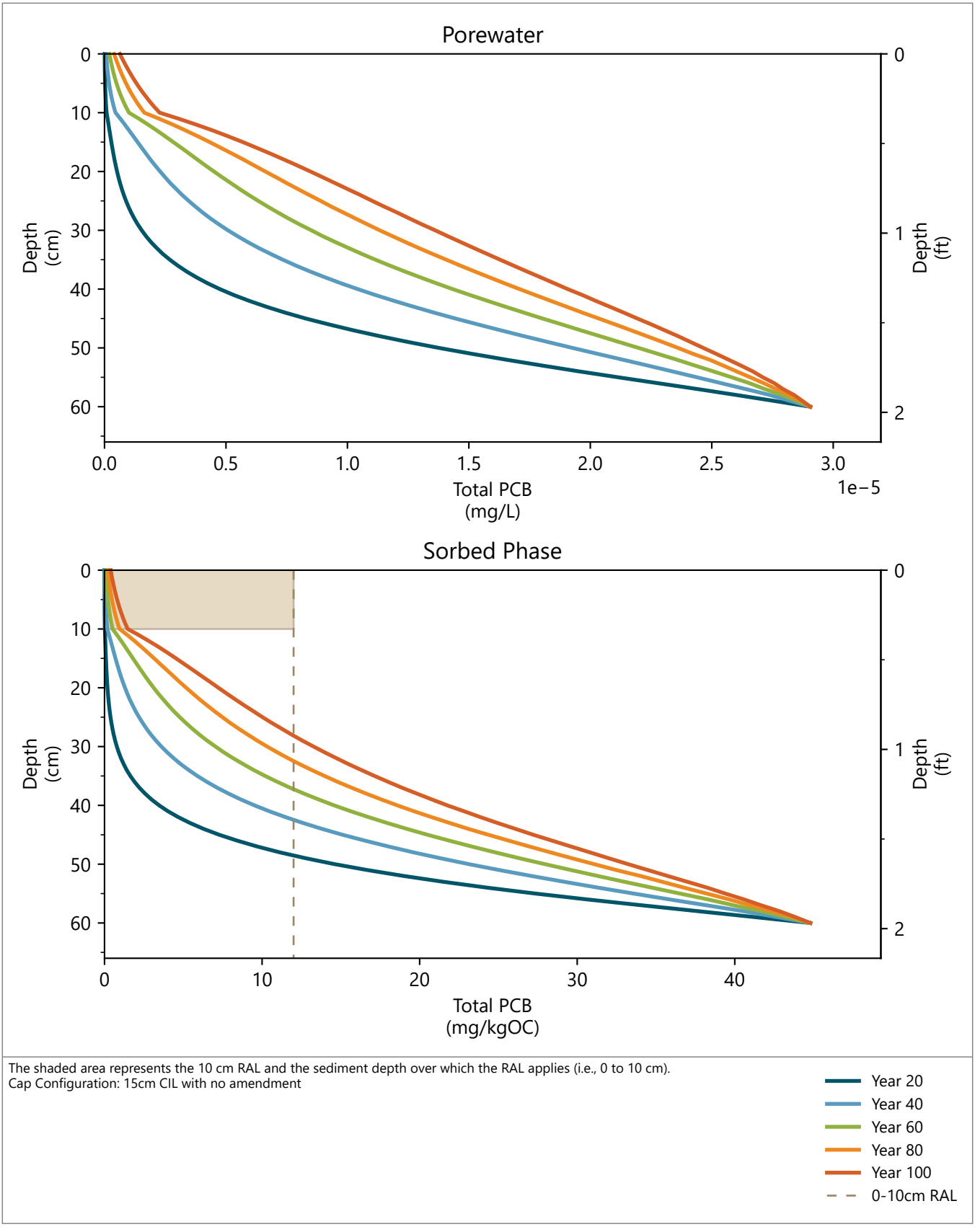
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Figure H.4.1.21a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30E Standard Cap (100 cm/yr Seepage)



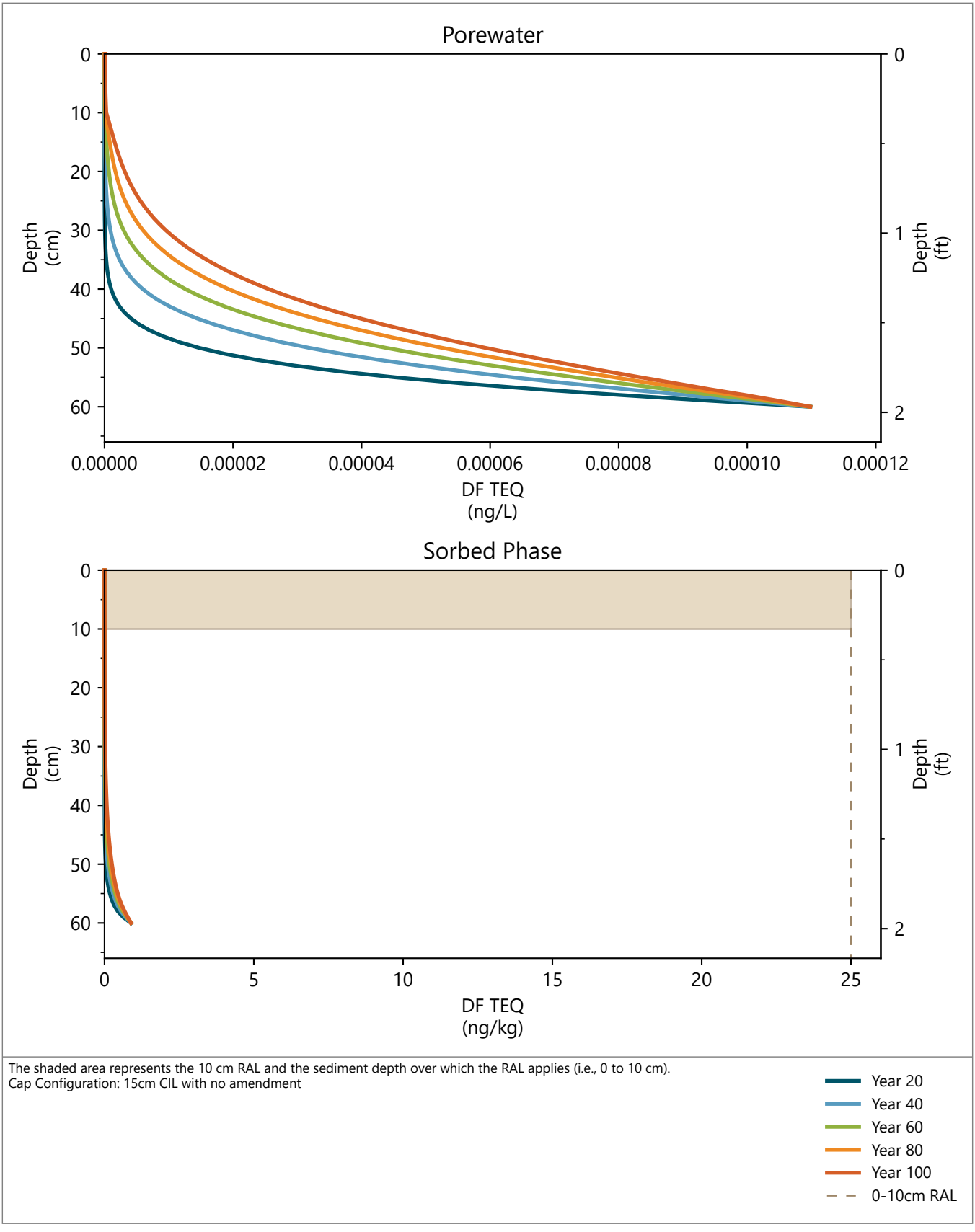
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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.1.21b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30E Standard Cap (100 cm/yr Seepage)



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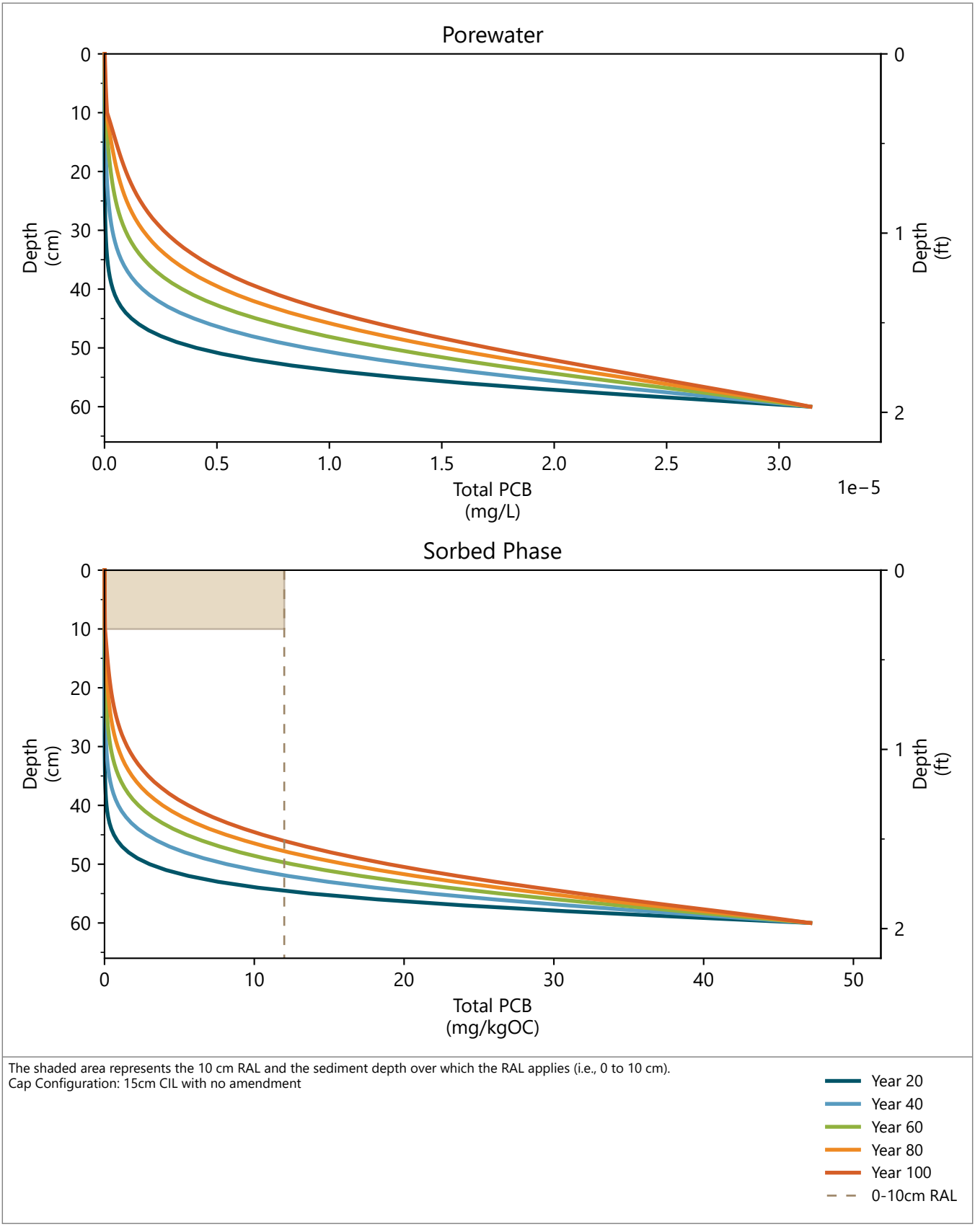
Figure H.4.1.22a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30E Standard Cap (400 cm/yr Seepage)



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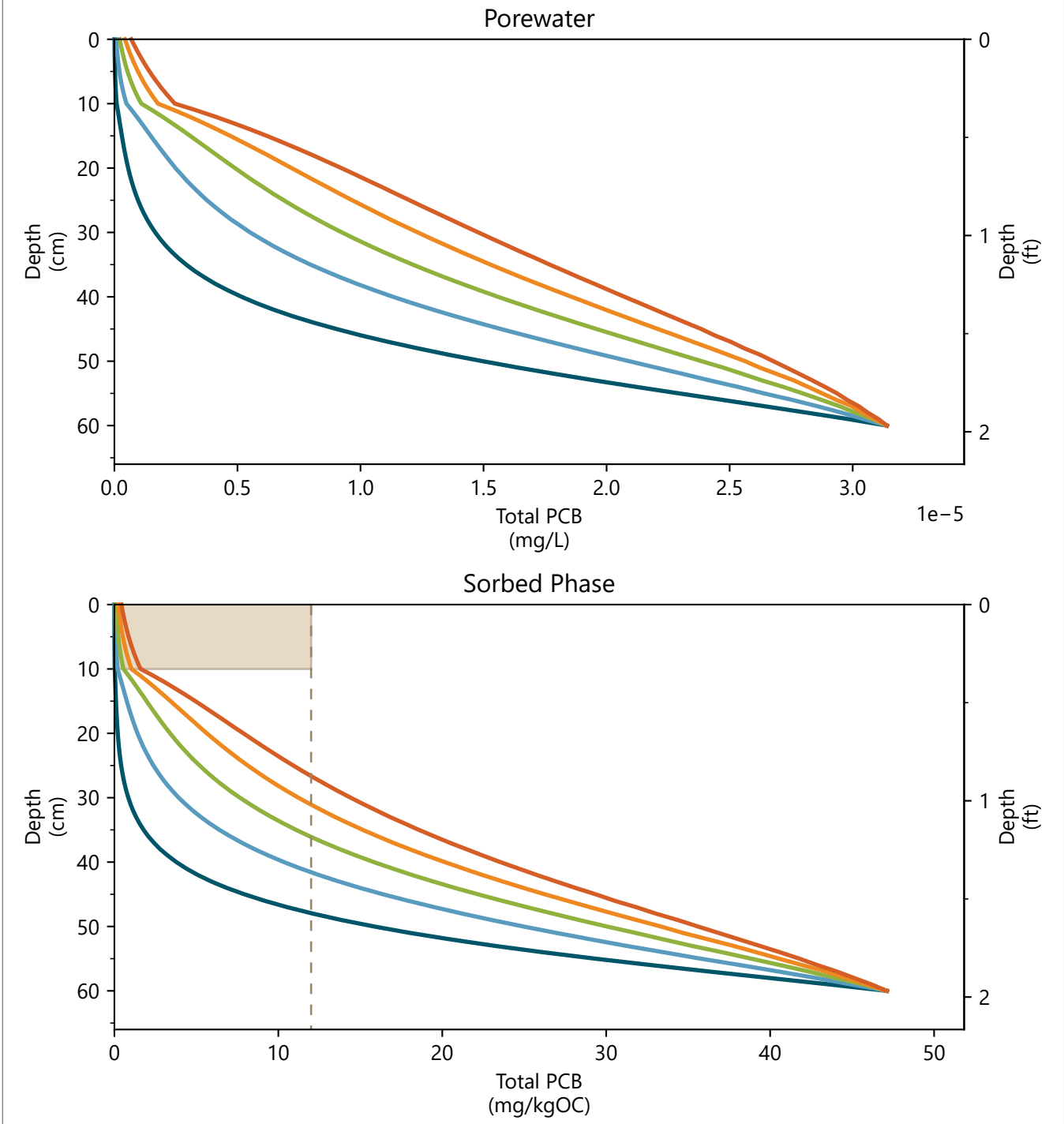
Figure H.4.1.22b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30E Standard Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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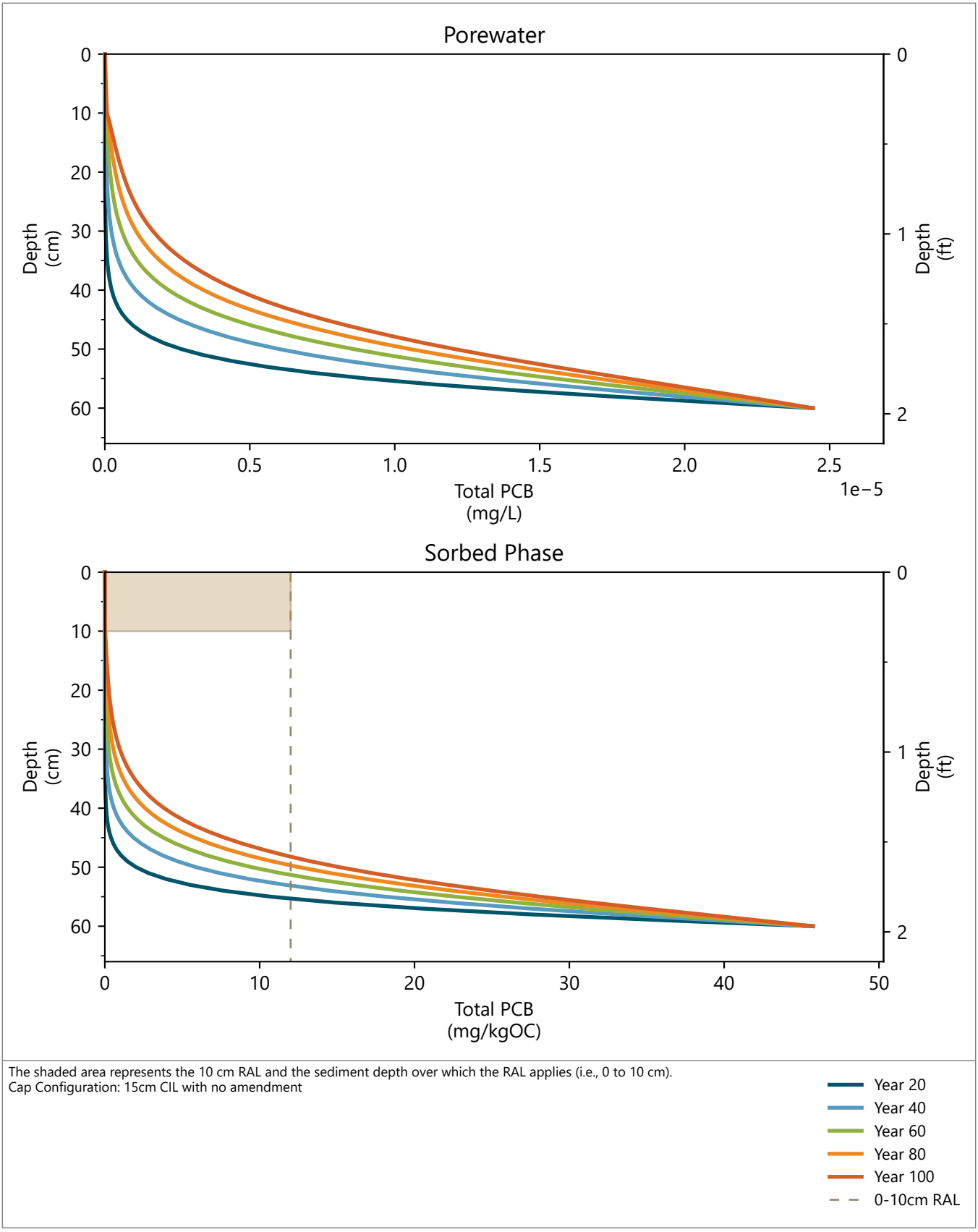
Figure H.4.1.23a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30F Standard Cap (100 cm/yr Seepage)



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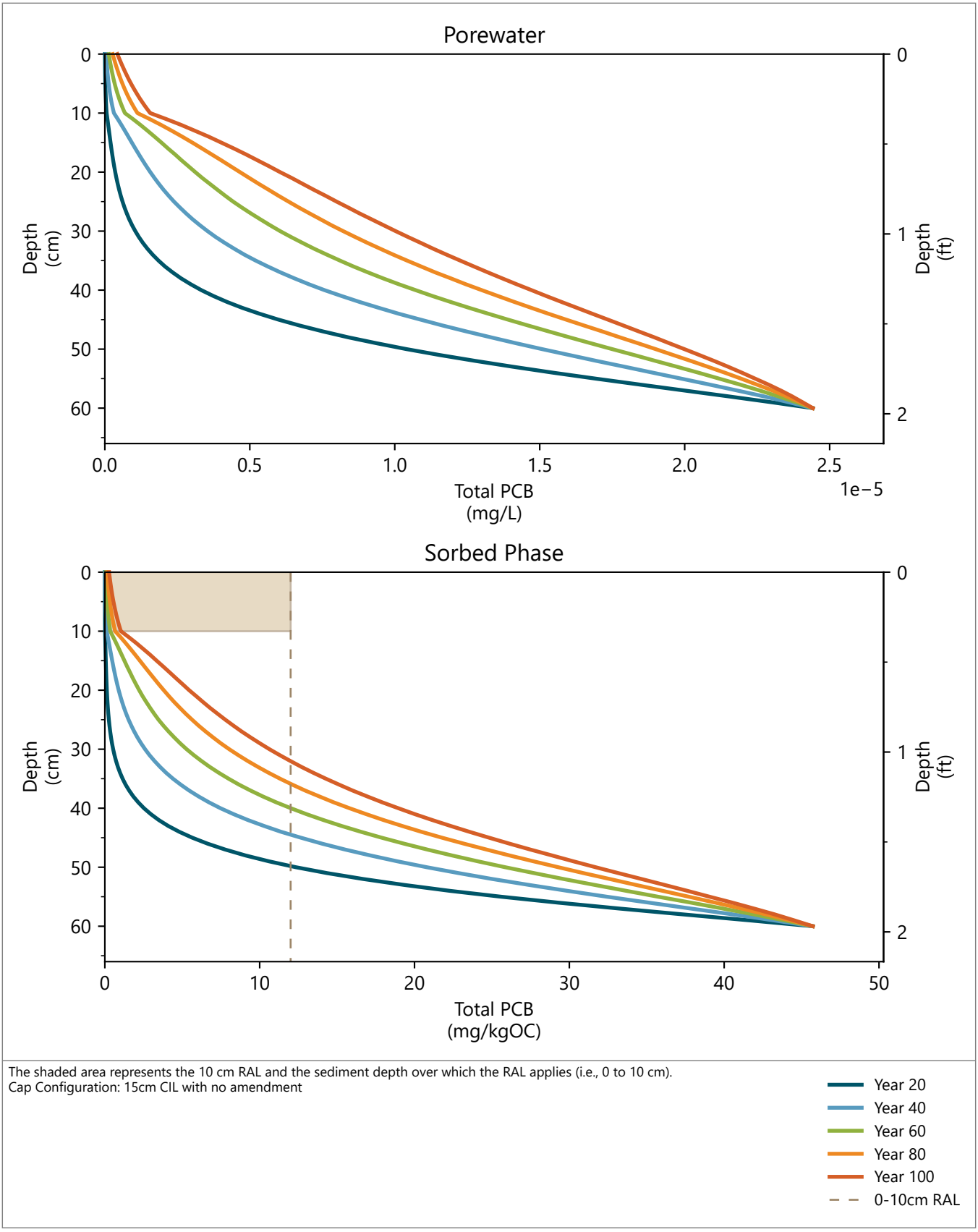
Figure H.4.1.24a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30F Standard Cap (400 cm/yr Seepage)



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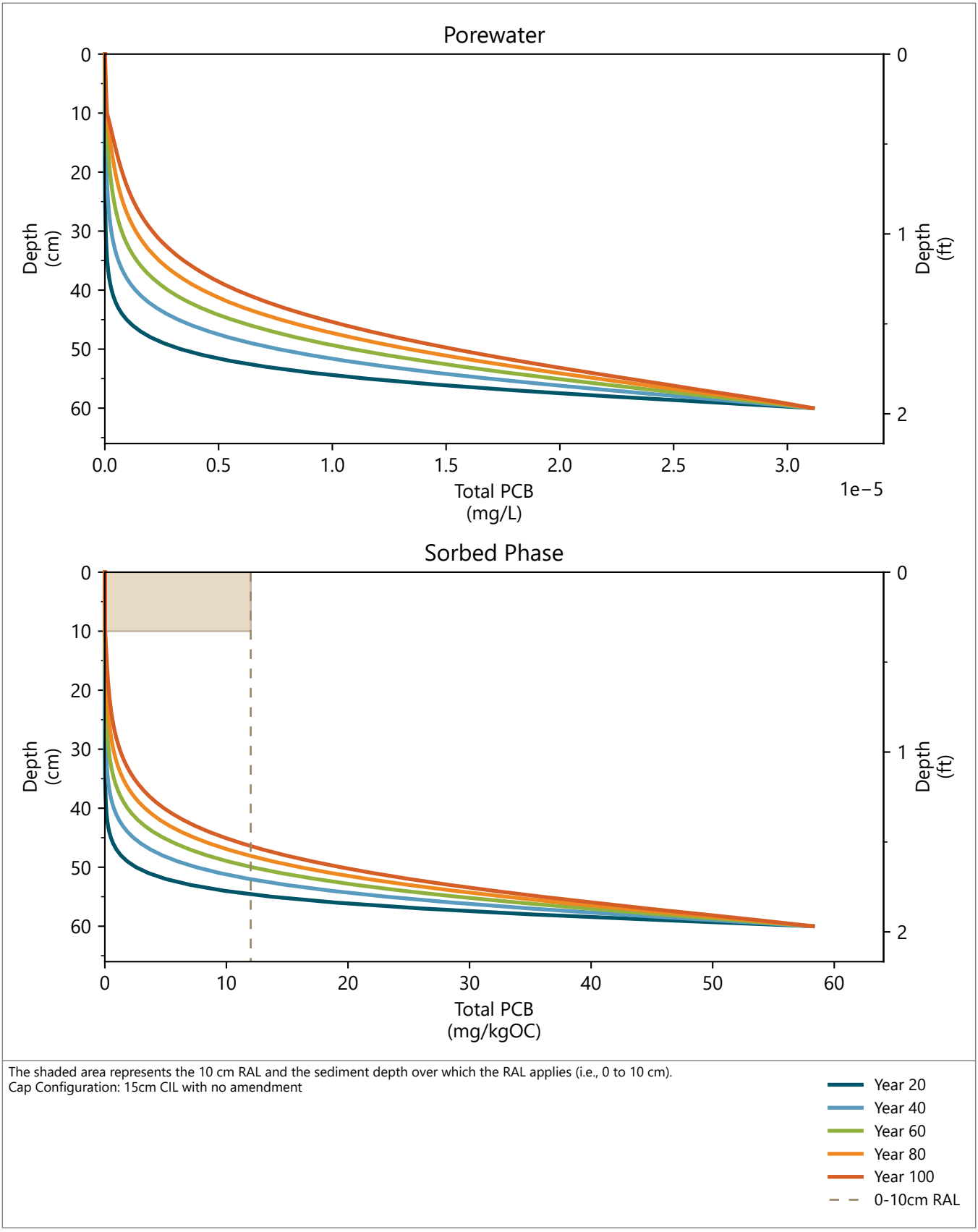
Figure H.4.1.25a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30G Standard Cap (100 cm/yr Seepage)



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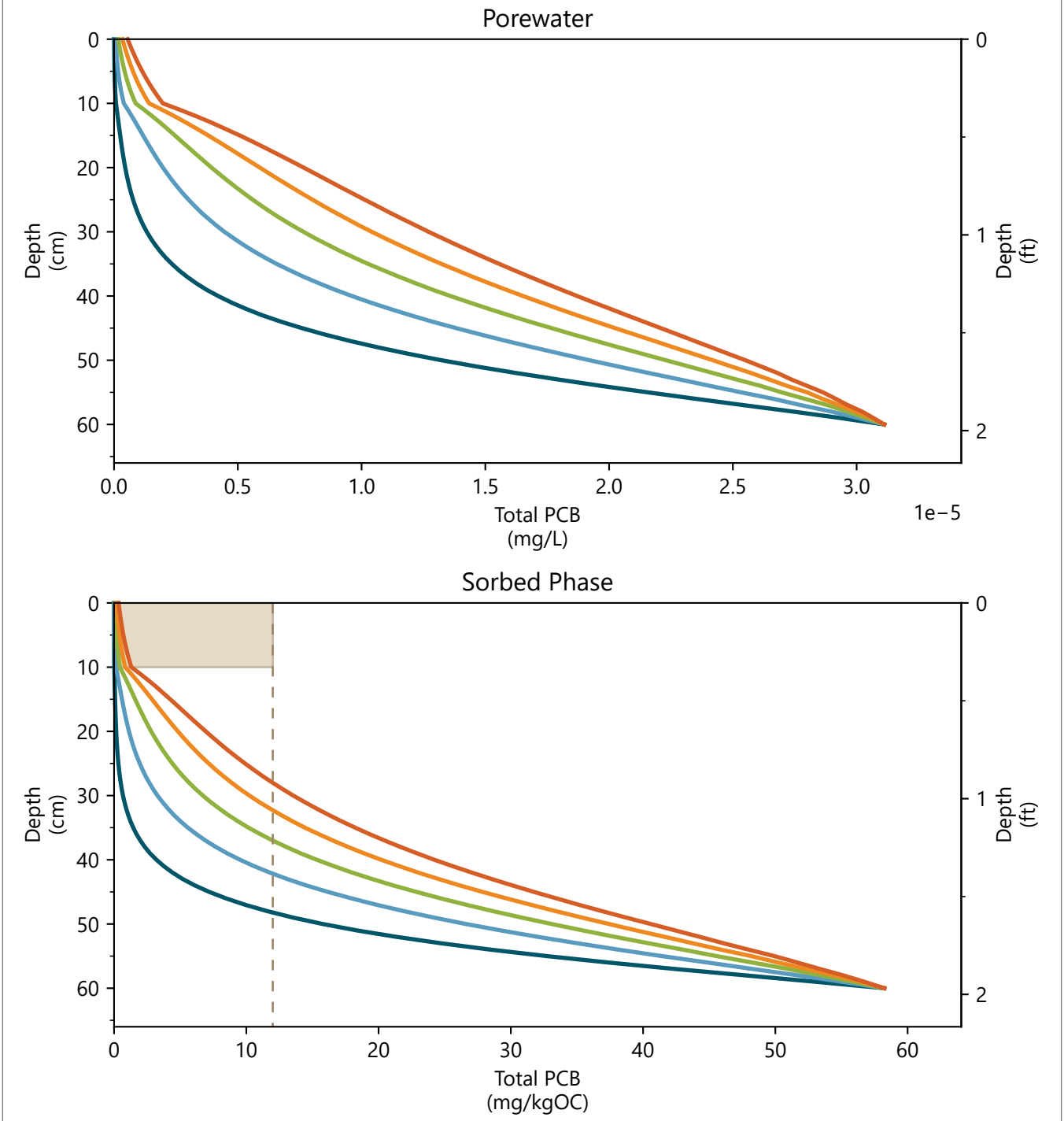
Figure H.4.1.26a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30G Standard Cap (400 cm/yr Seepage)



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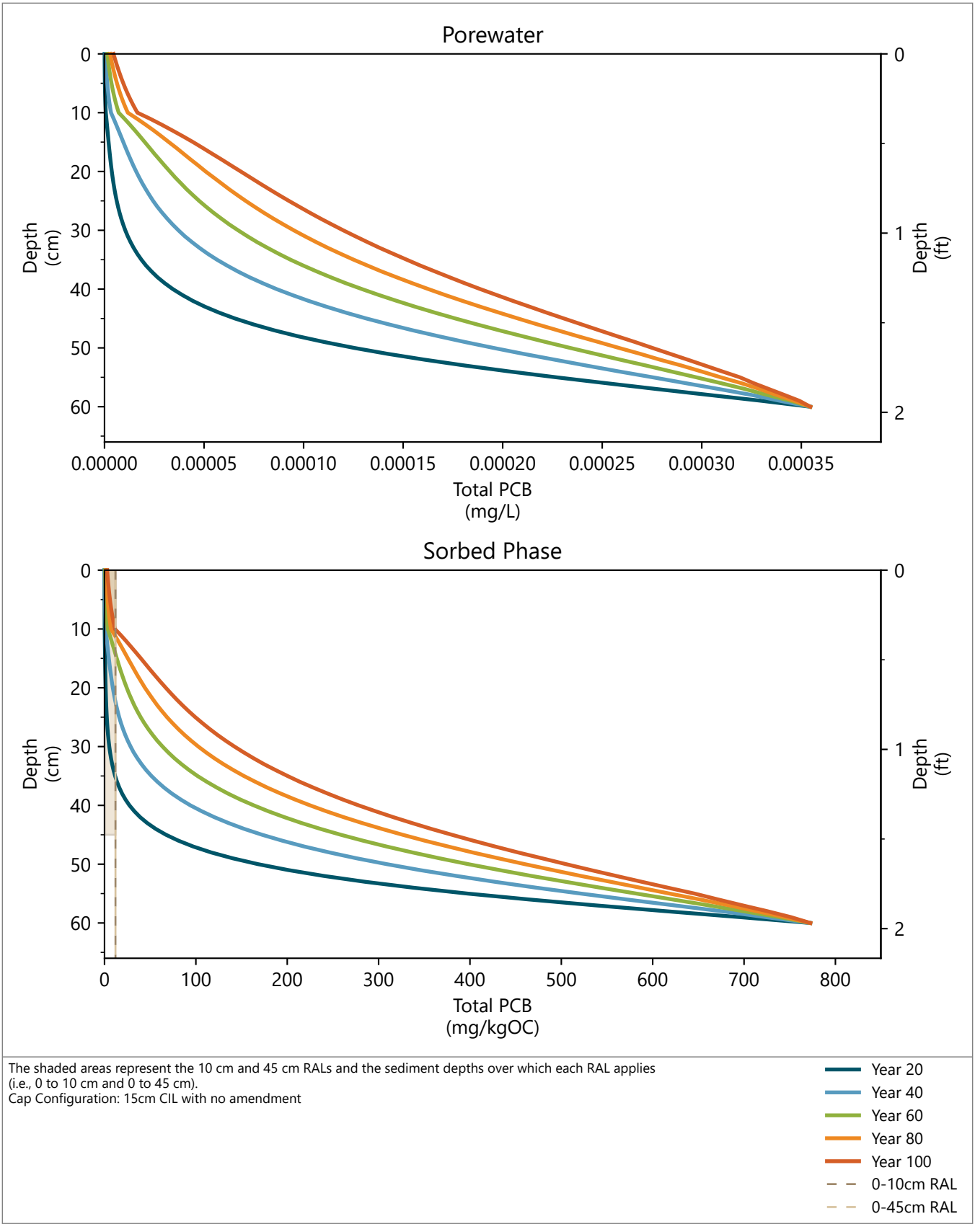
Figure H.4.1.27a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30H Standard Cap (100 cm/yr Seepage)



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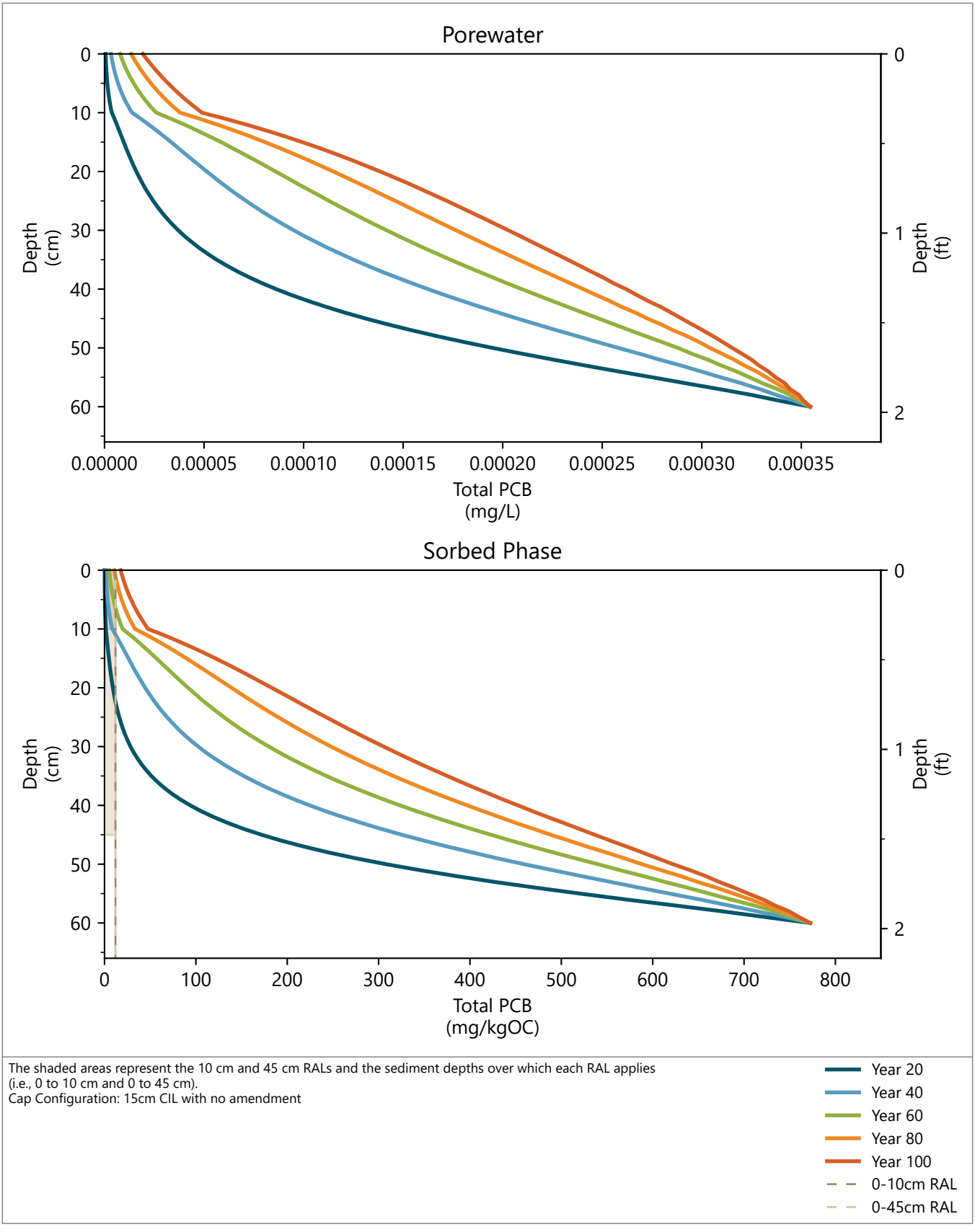
Figure H.4.1.28a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 30H Standard Cap (400 cm/yr Seepage)



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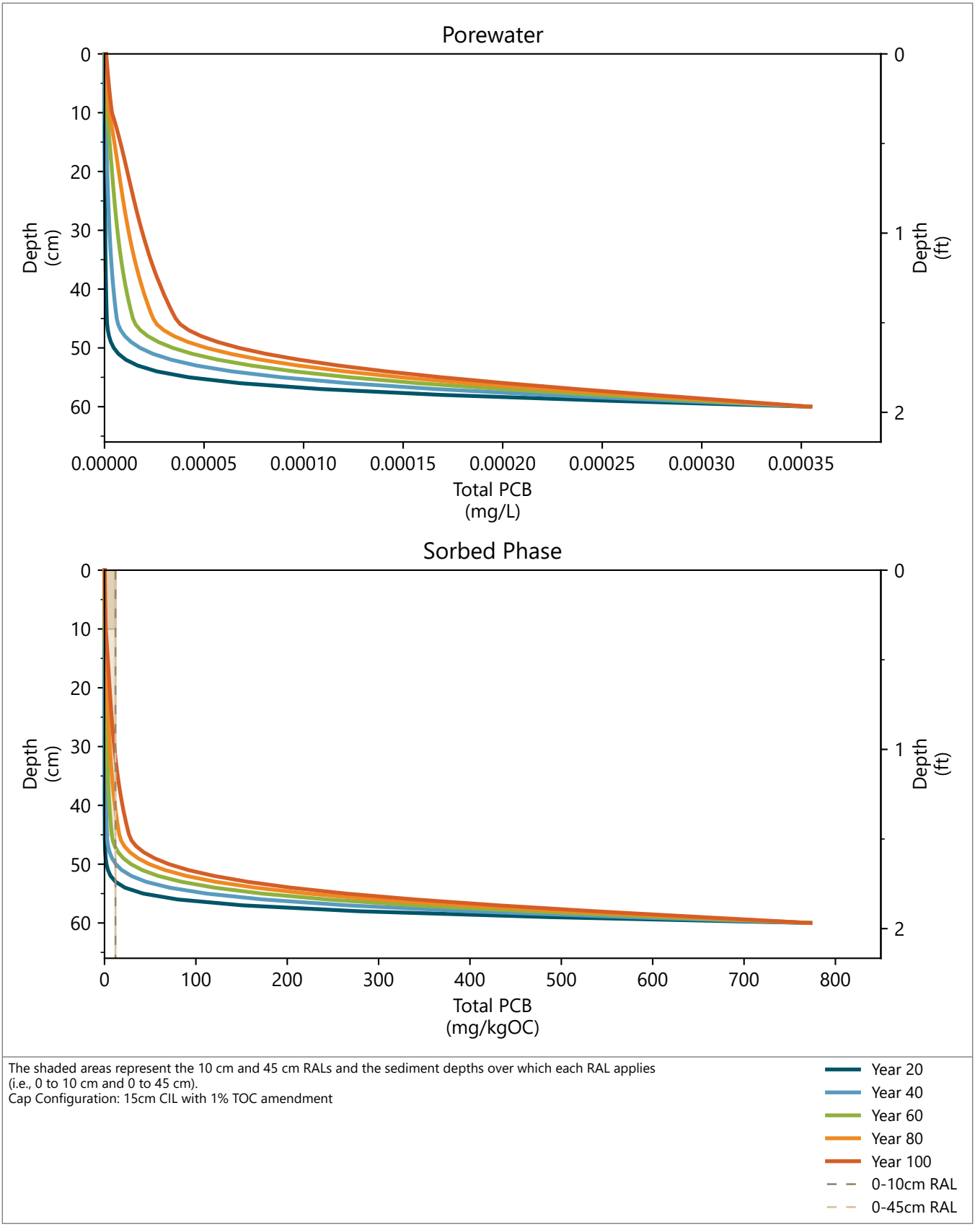
Figure H.4.2.1a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (400 cm/yr Seepage)



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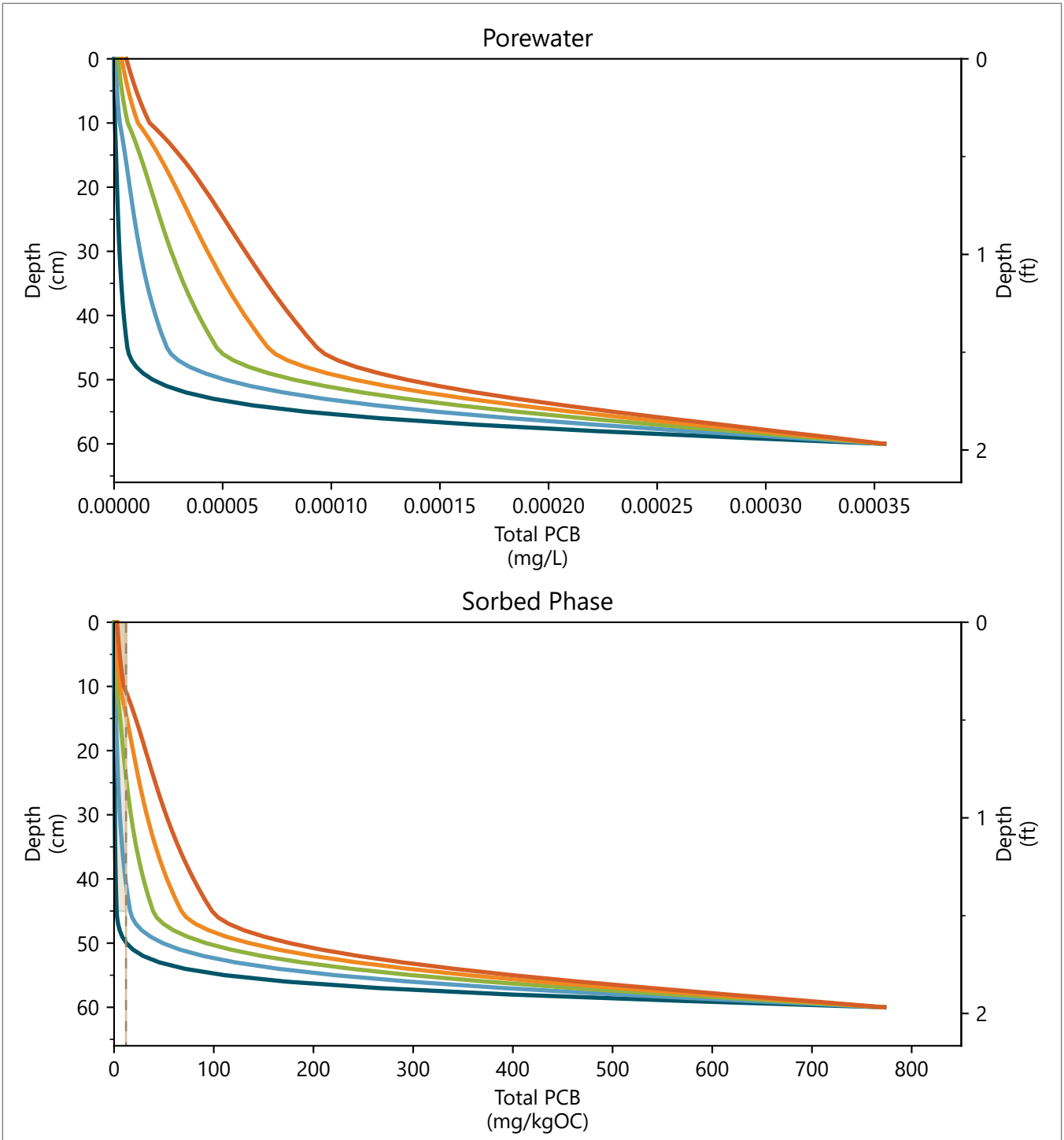
Figure H.4.2.2a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (800 cm/yr Seepage)



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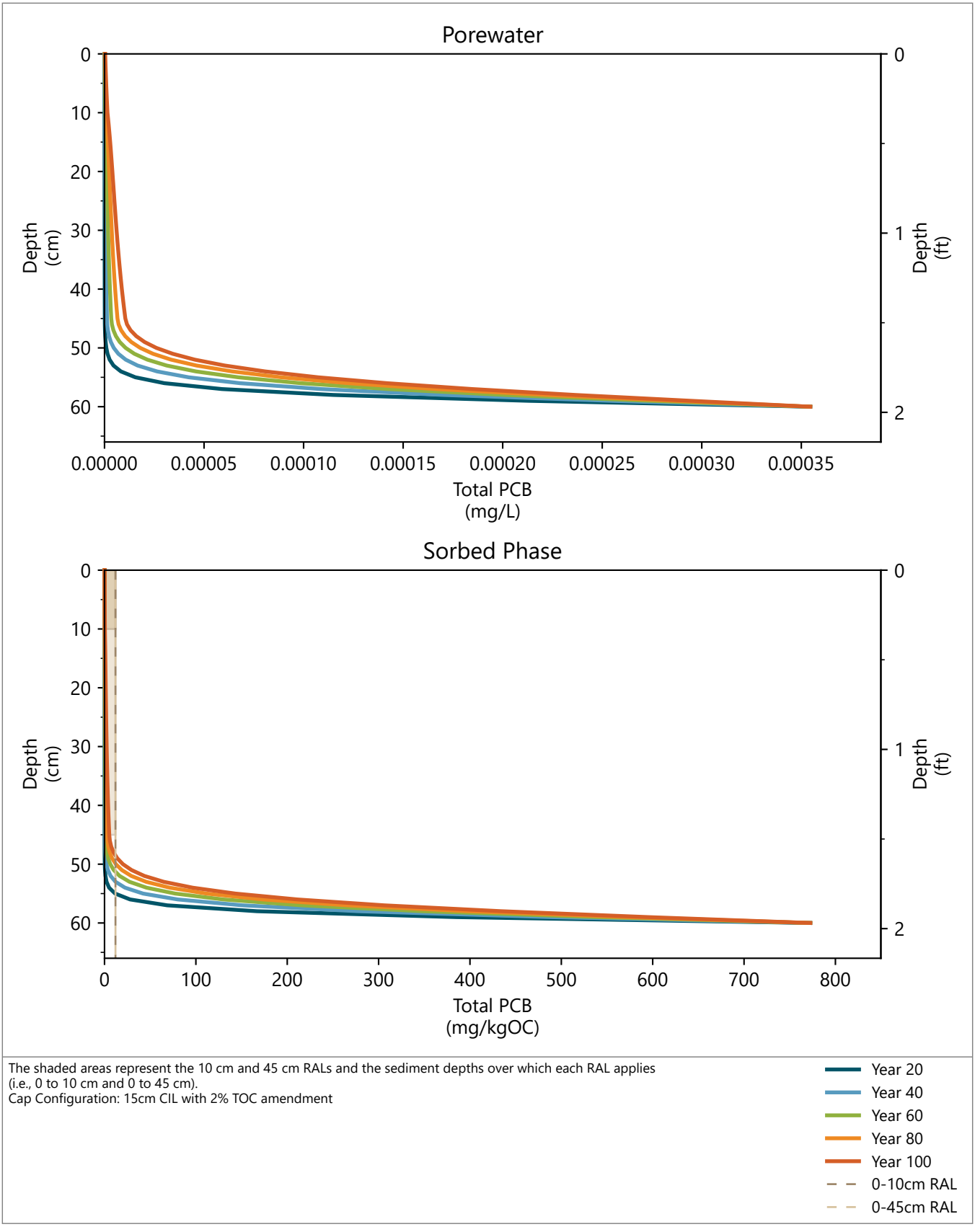
Figure H.4.2.3a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (400 cm/yr Seepage)



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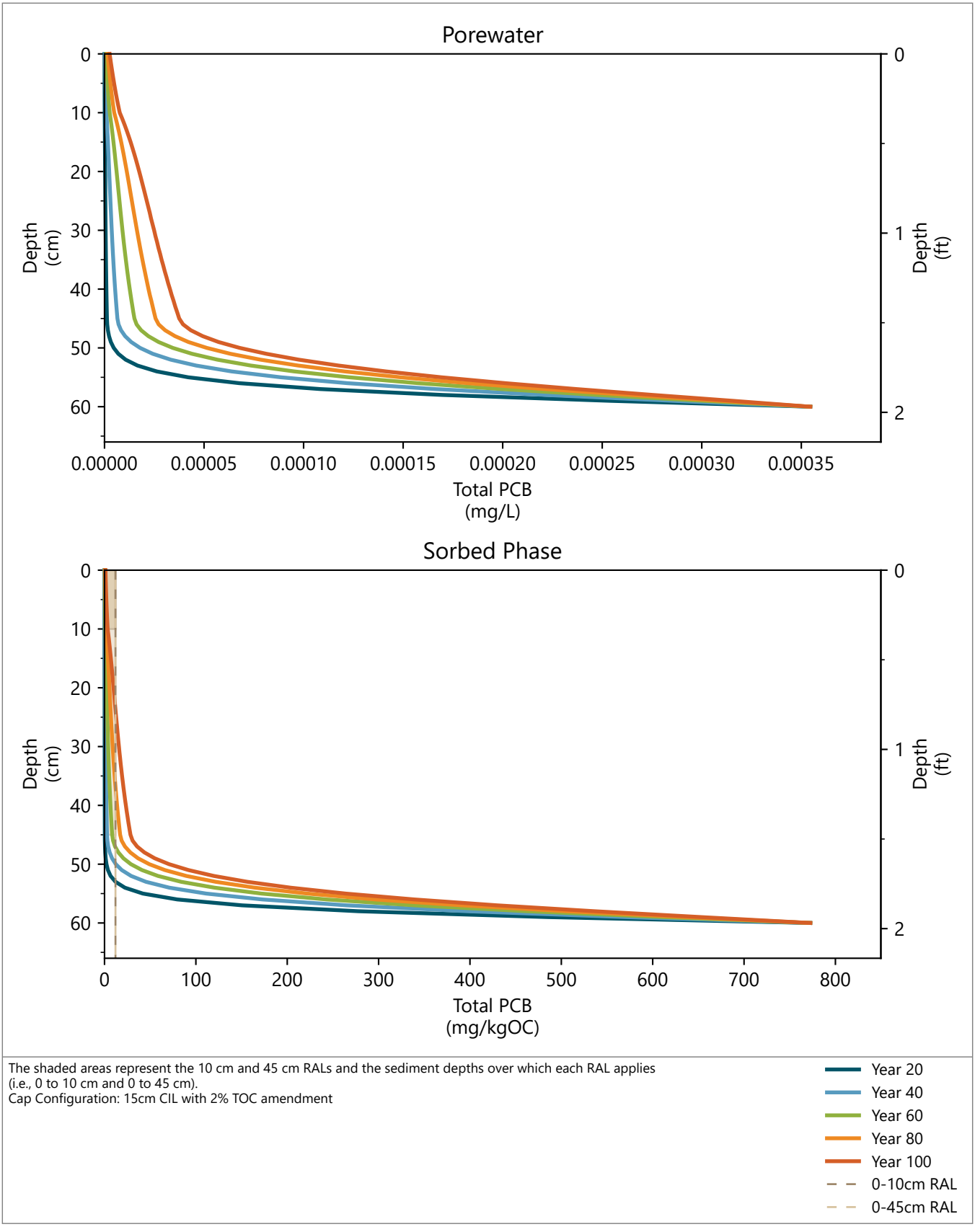
Figure H.4.2.4a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (800 cm/yr Seepage)



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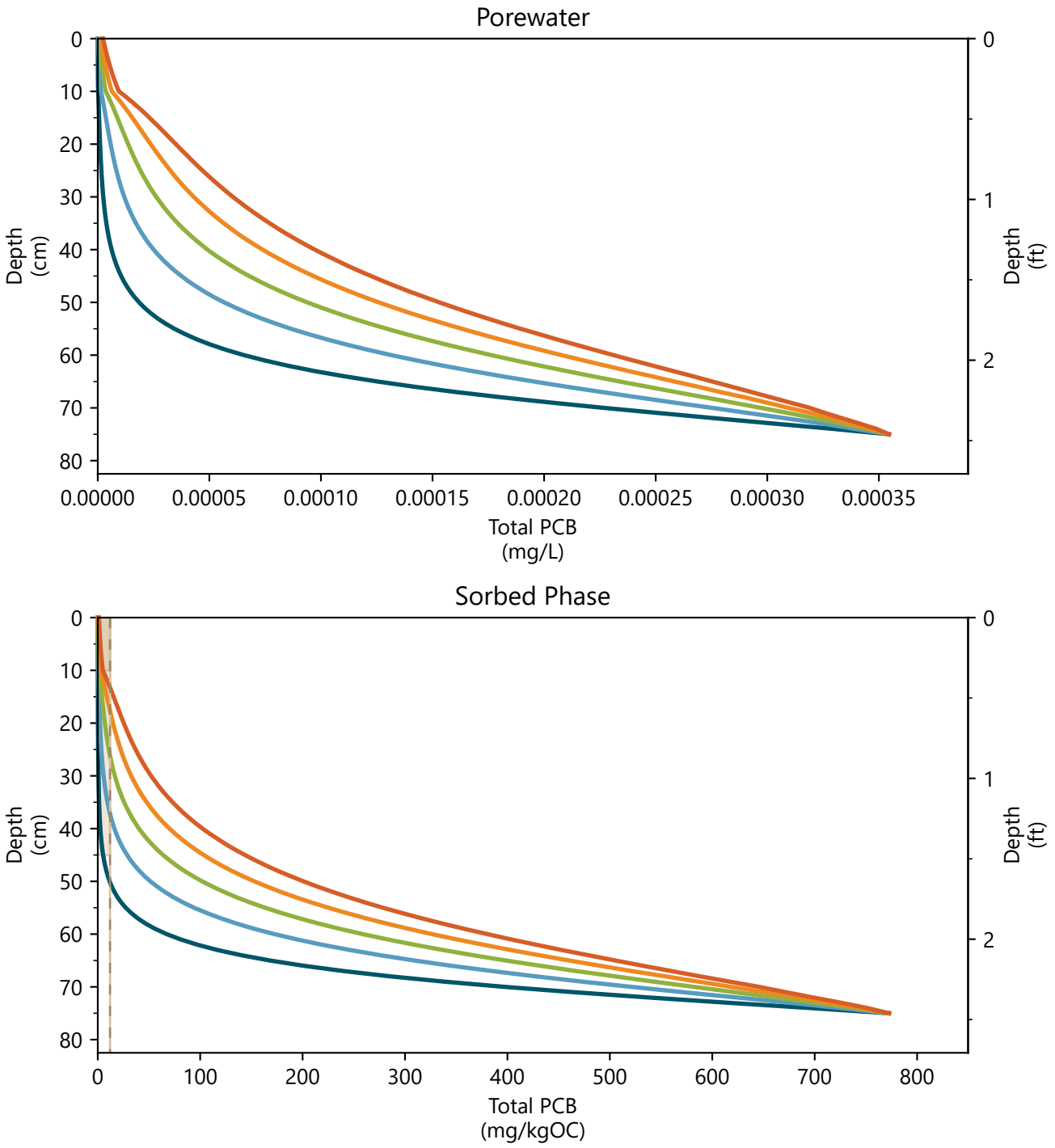
Figure H.4.2.5a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.6a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (800 cm/yr Seepage)



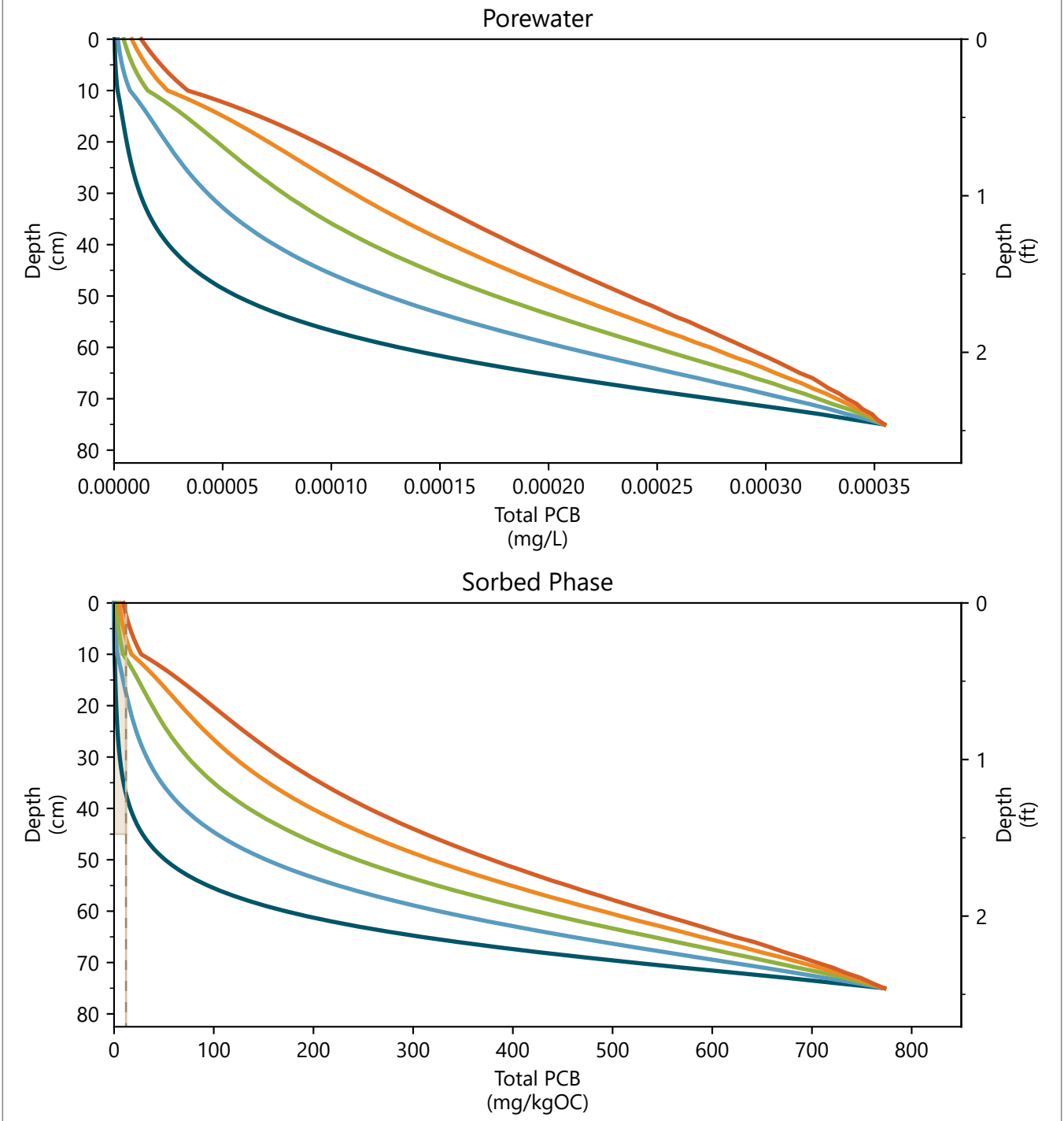
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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Figure H.4.2.7a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (400 cm/yr Seepage)

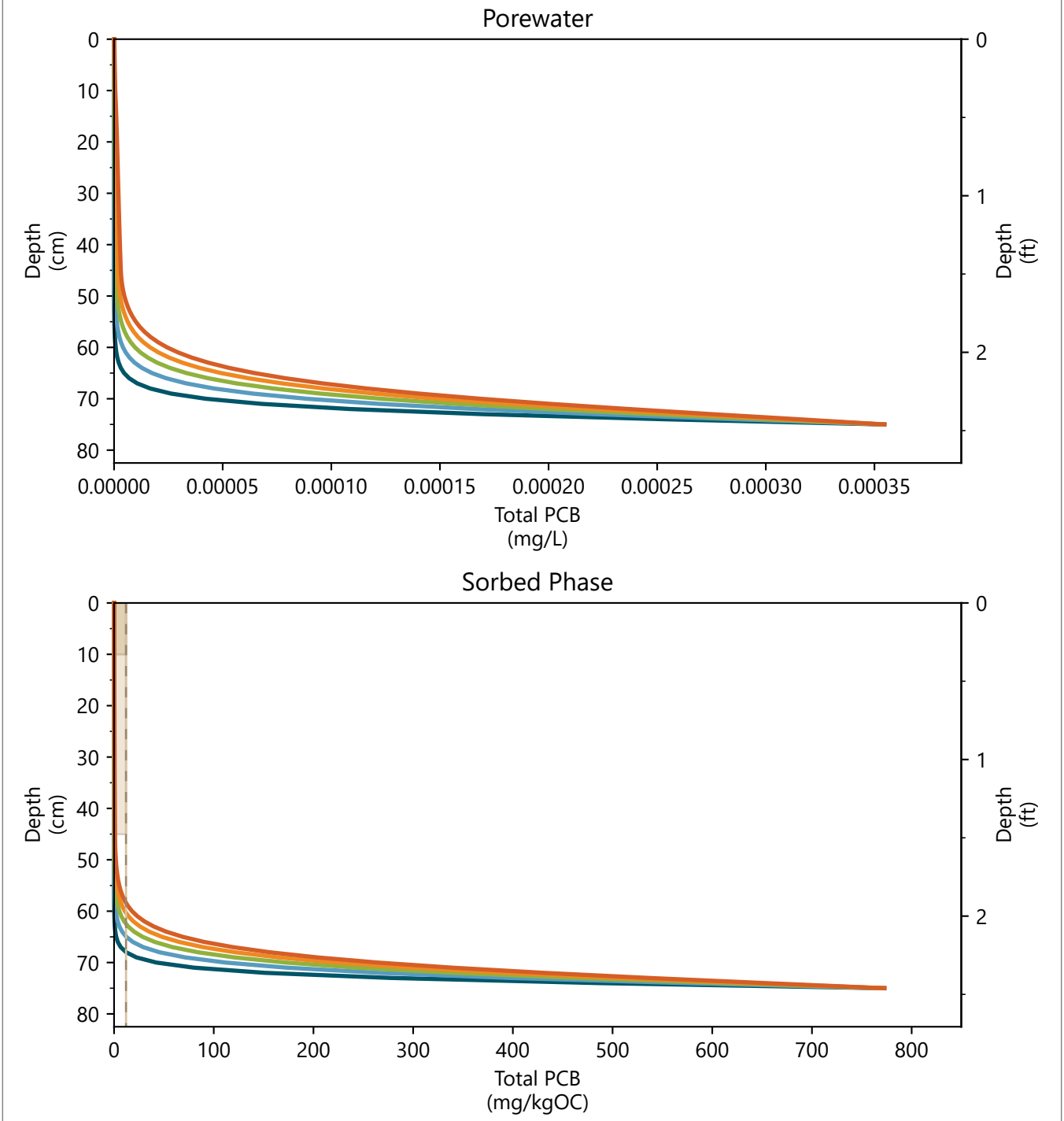


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

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Figure H.4.2.8a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (800 cm/yr Seepage)



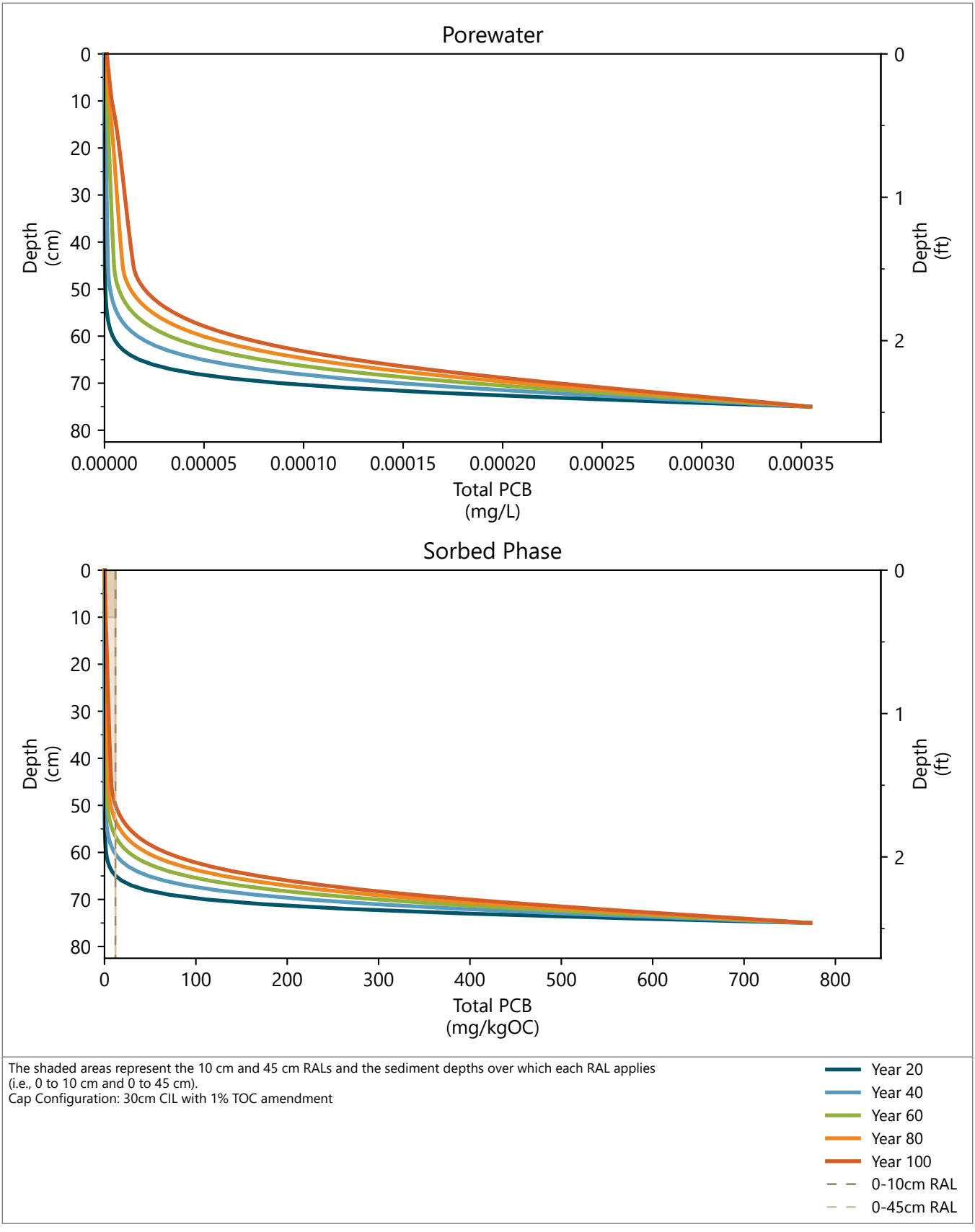
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 1% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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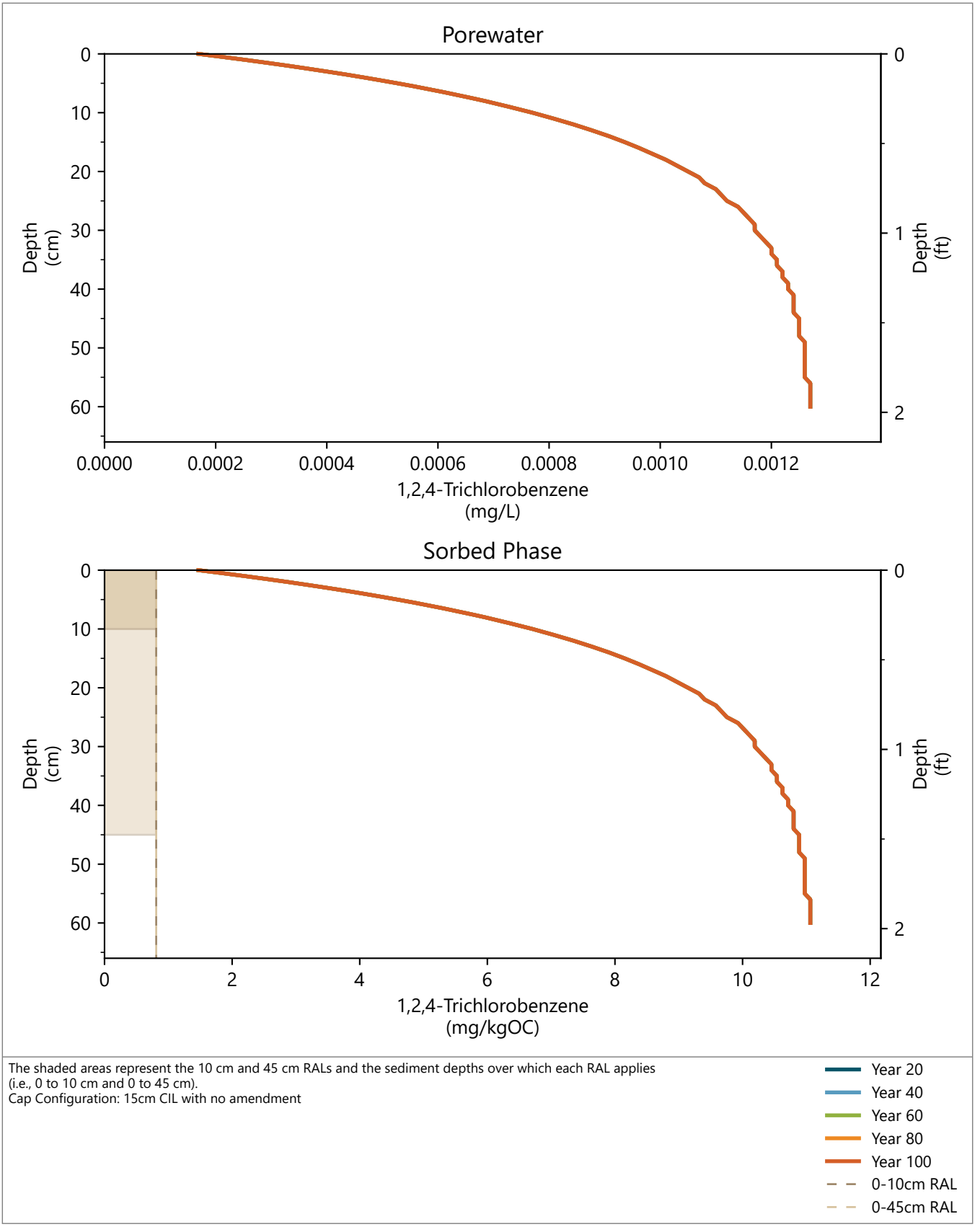
Figure H.4.2.9a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (400 cm/yr Seepage)



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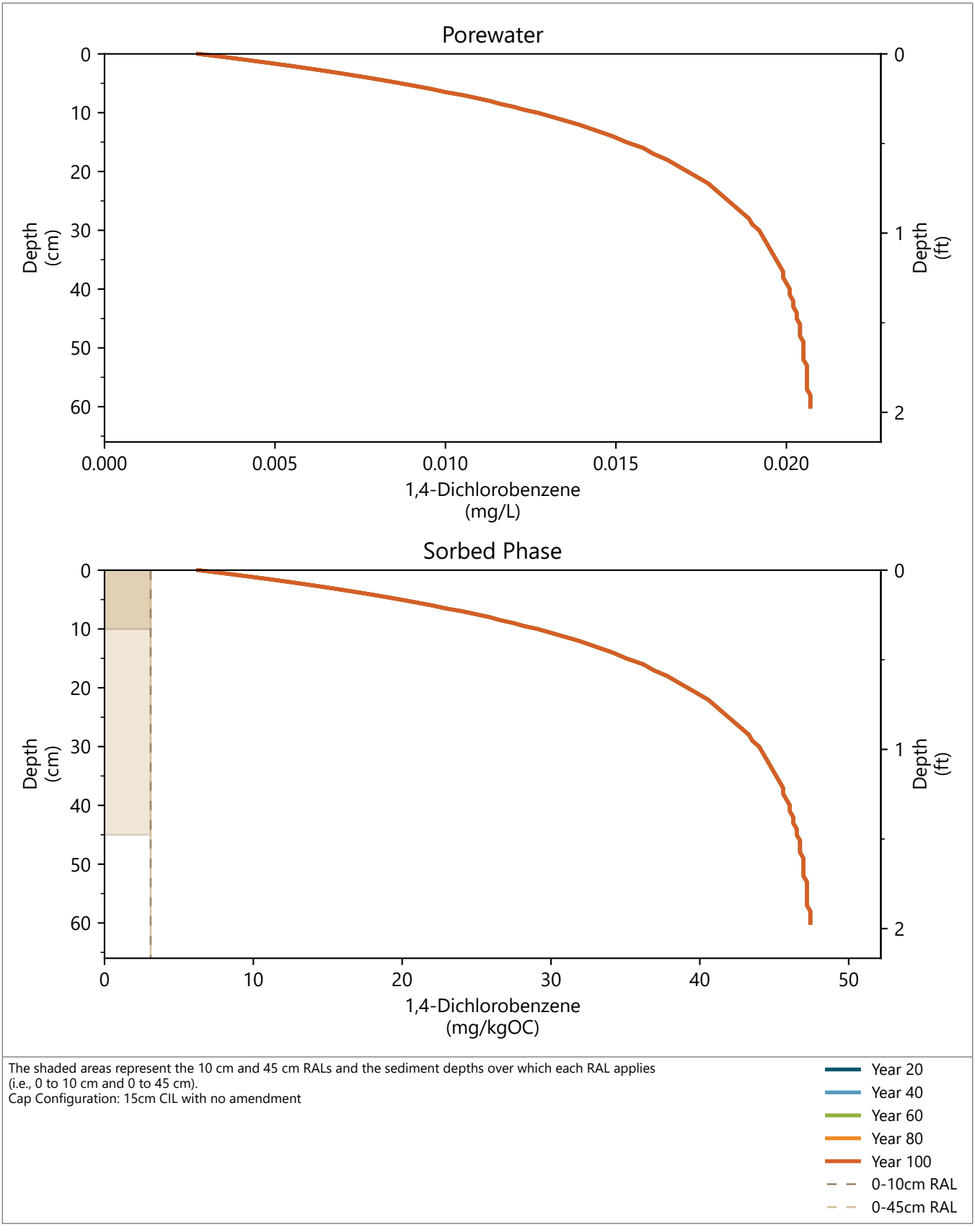
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Figure H.4.2.10a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap (800 cm/yr Seepage)



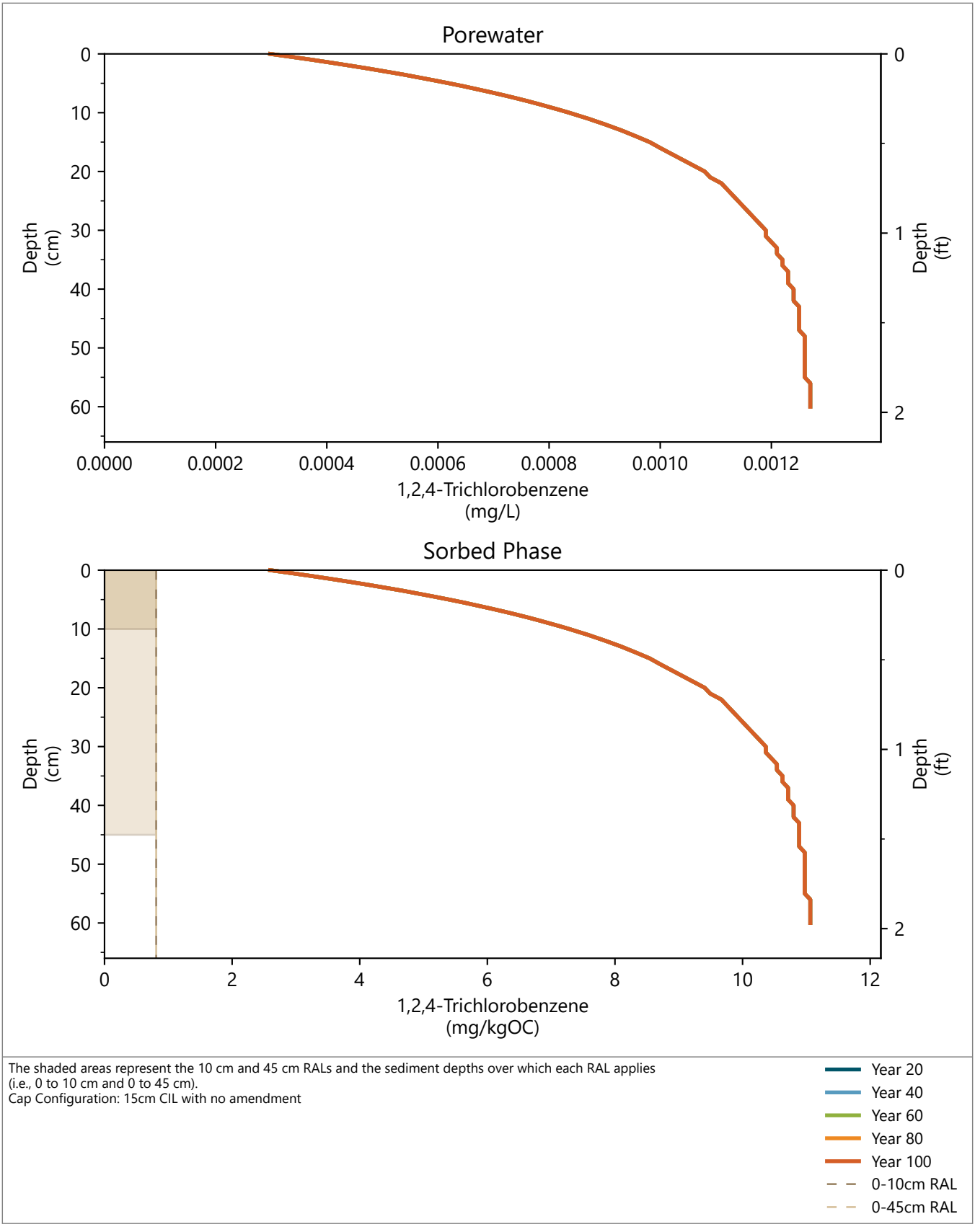
Publish Date: 07/30/2026 18:56 PM | User: WCL-EMES2
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Figure H.4.2.11a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



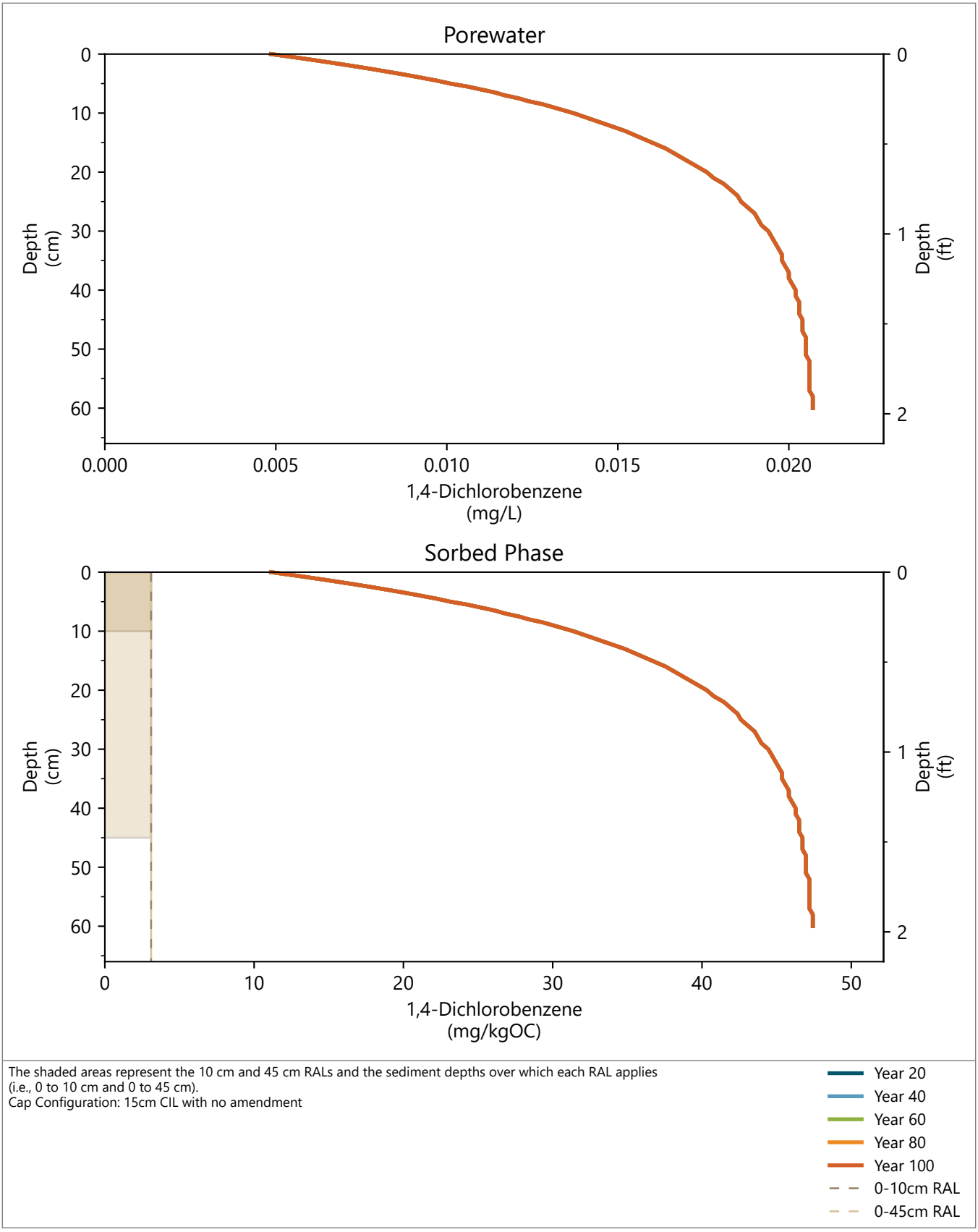
Publish Date: 07/30/2026 18:56 PM | User: WCL-EMES2
\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.11b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

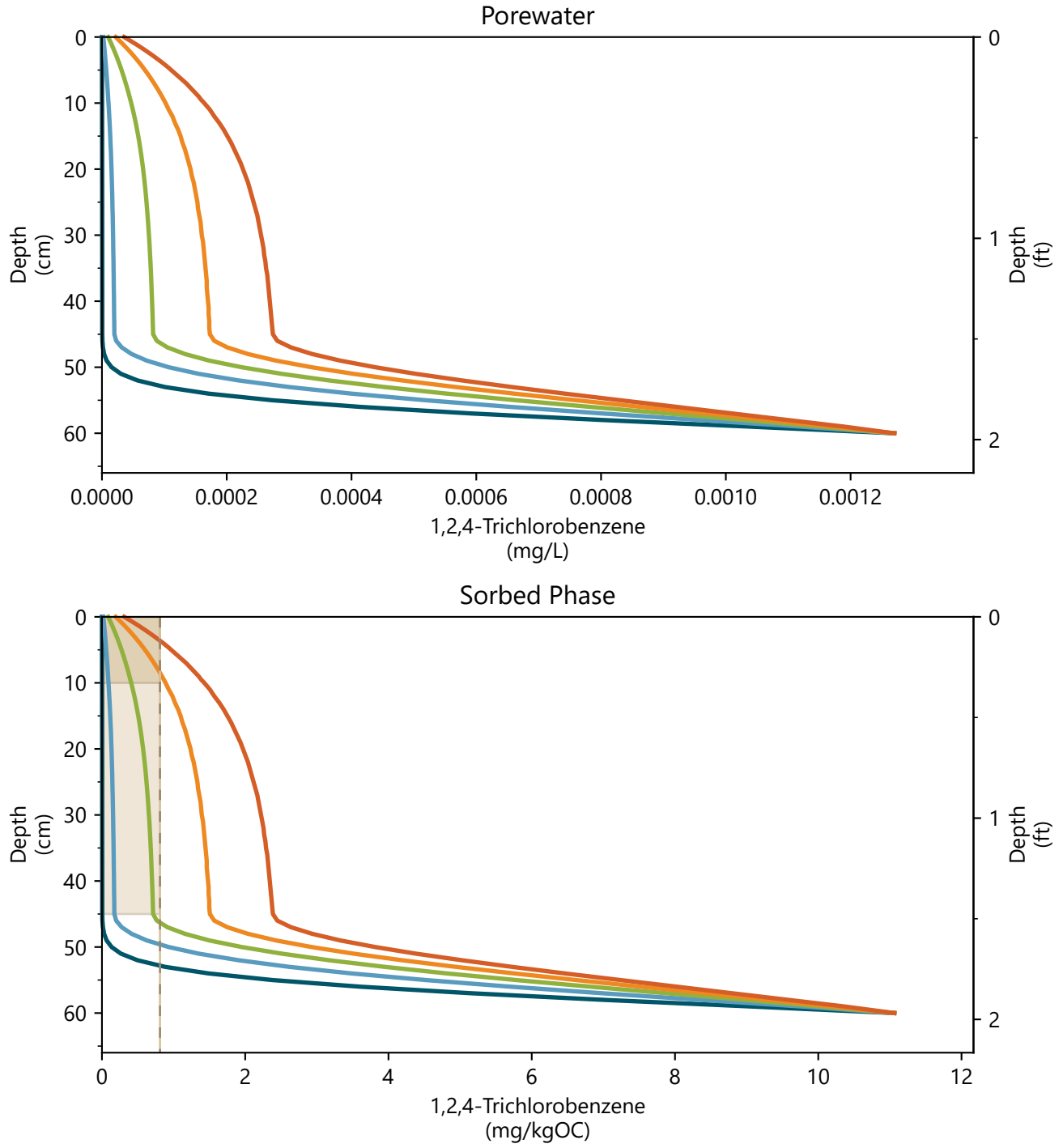
Figure H.4.2.12a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.12b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



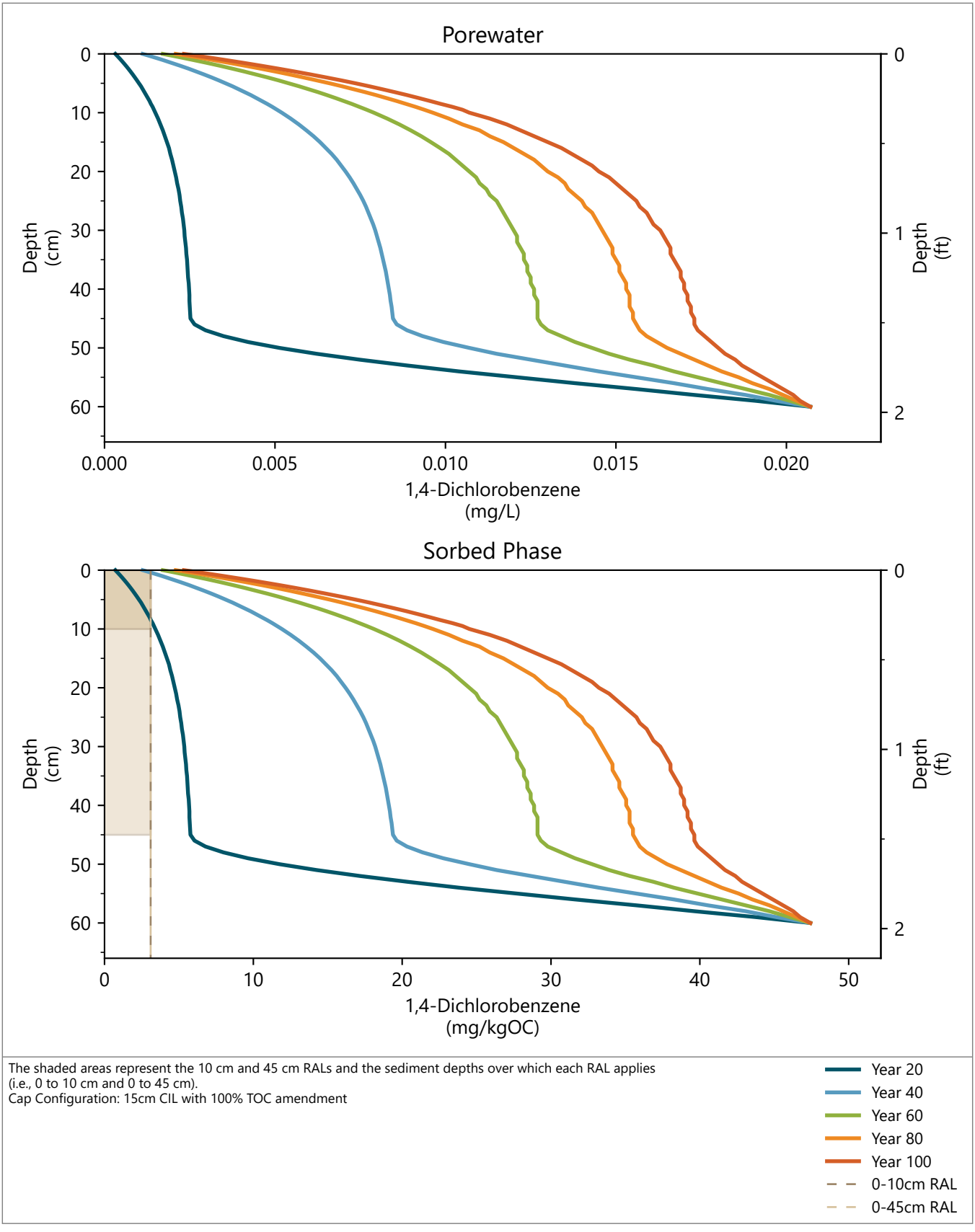
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with 100% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

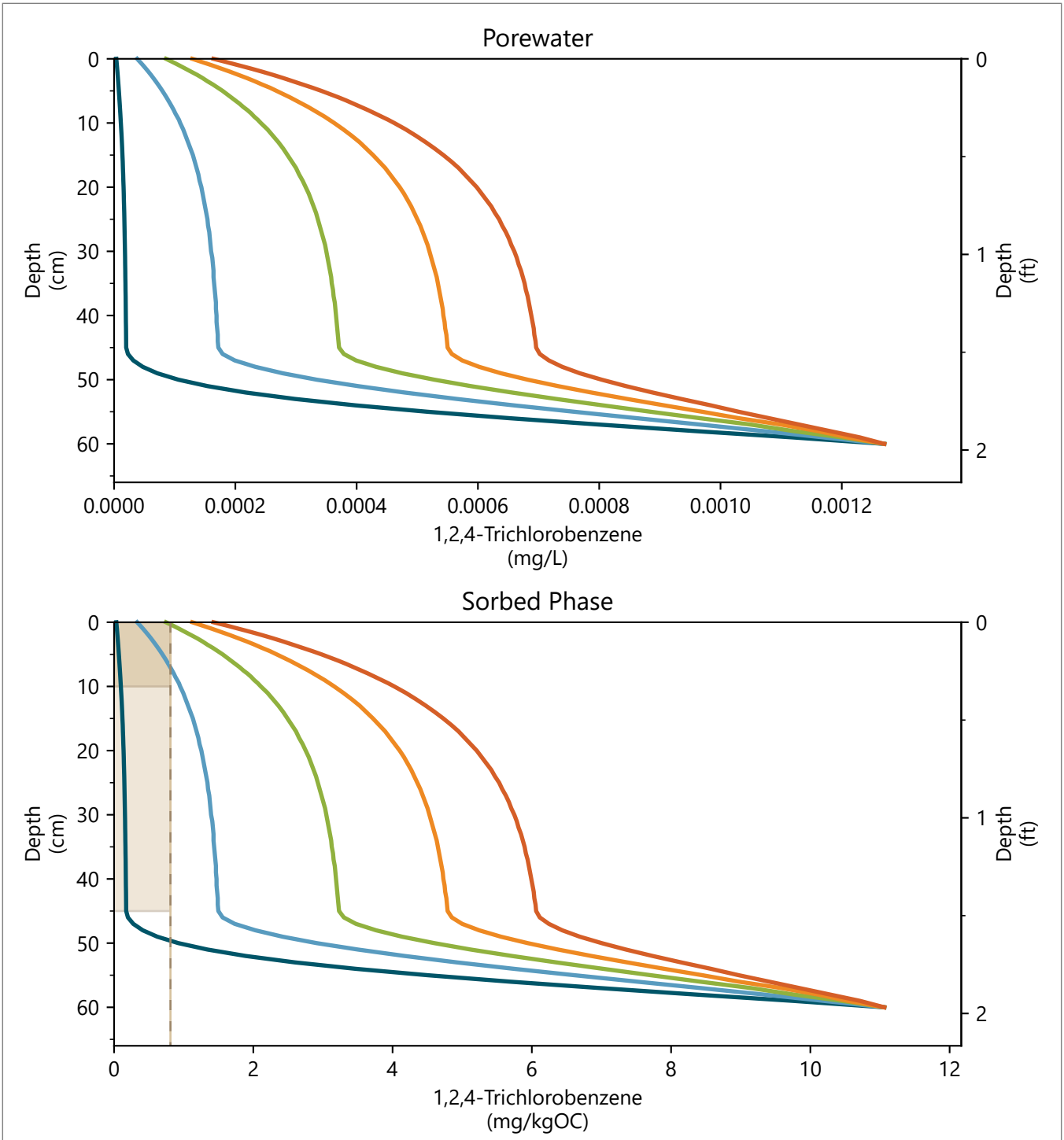
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Figure H.4.2.13a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.13b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



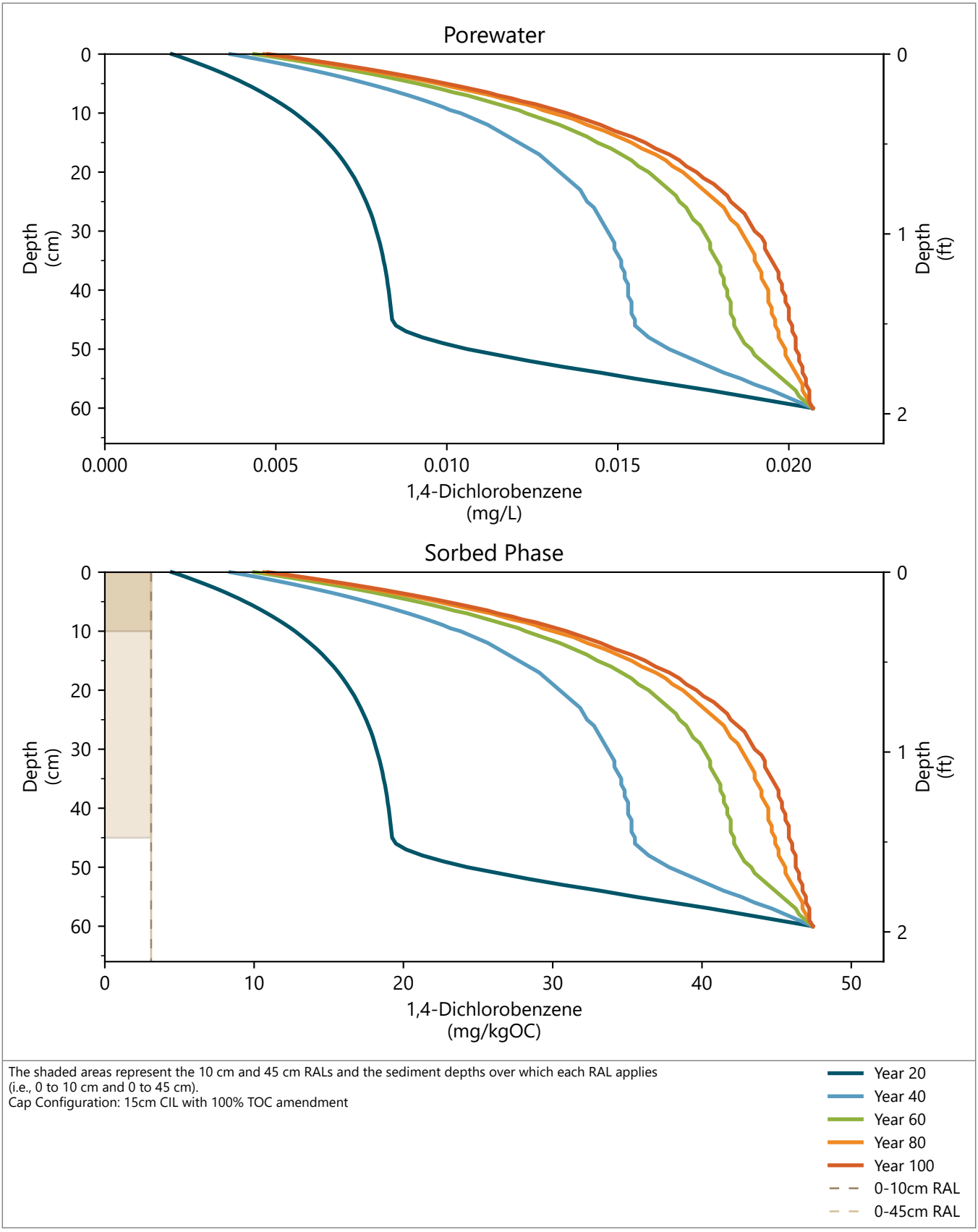
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with 100% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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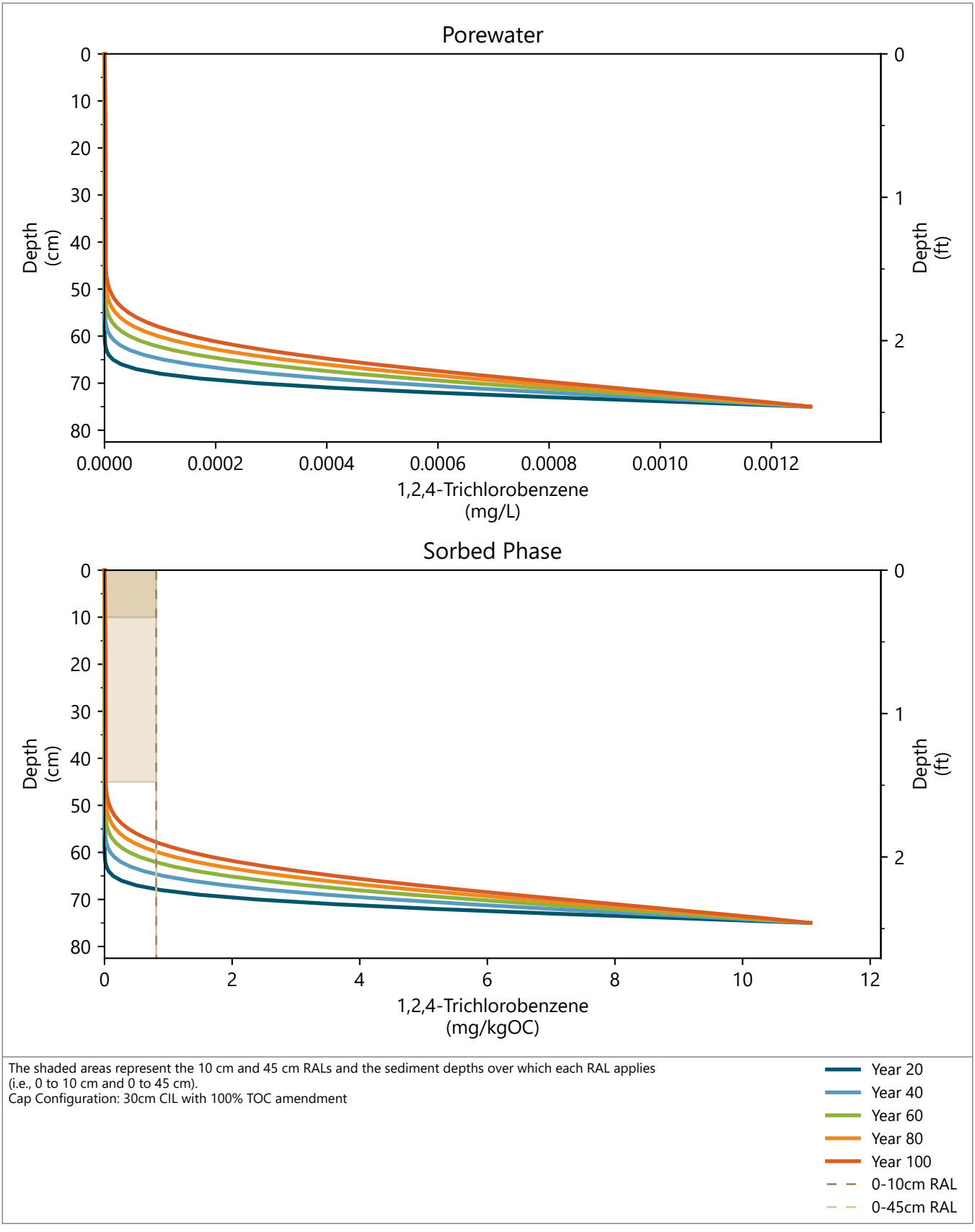
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Figure H.4.2.14a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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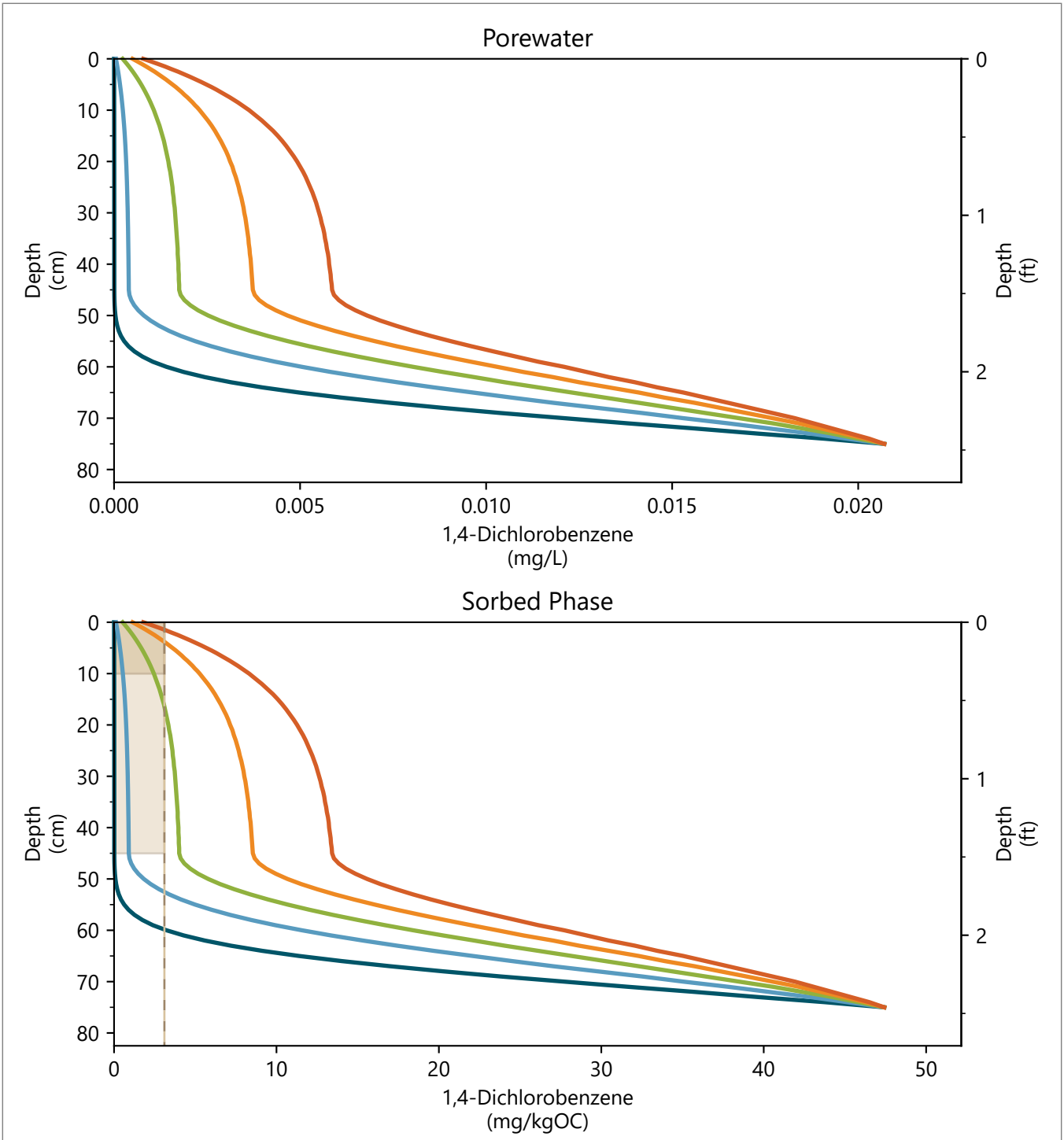
Figure H.4.2.14b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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).
Cap Configuration: 30cm CIL with 100% TOC amendment

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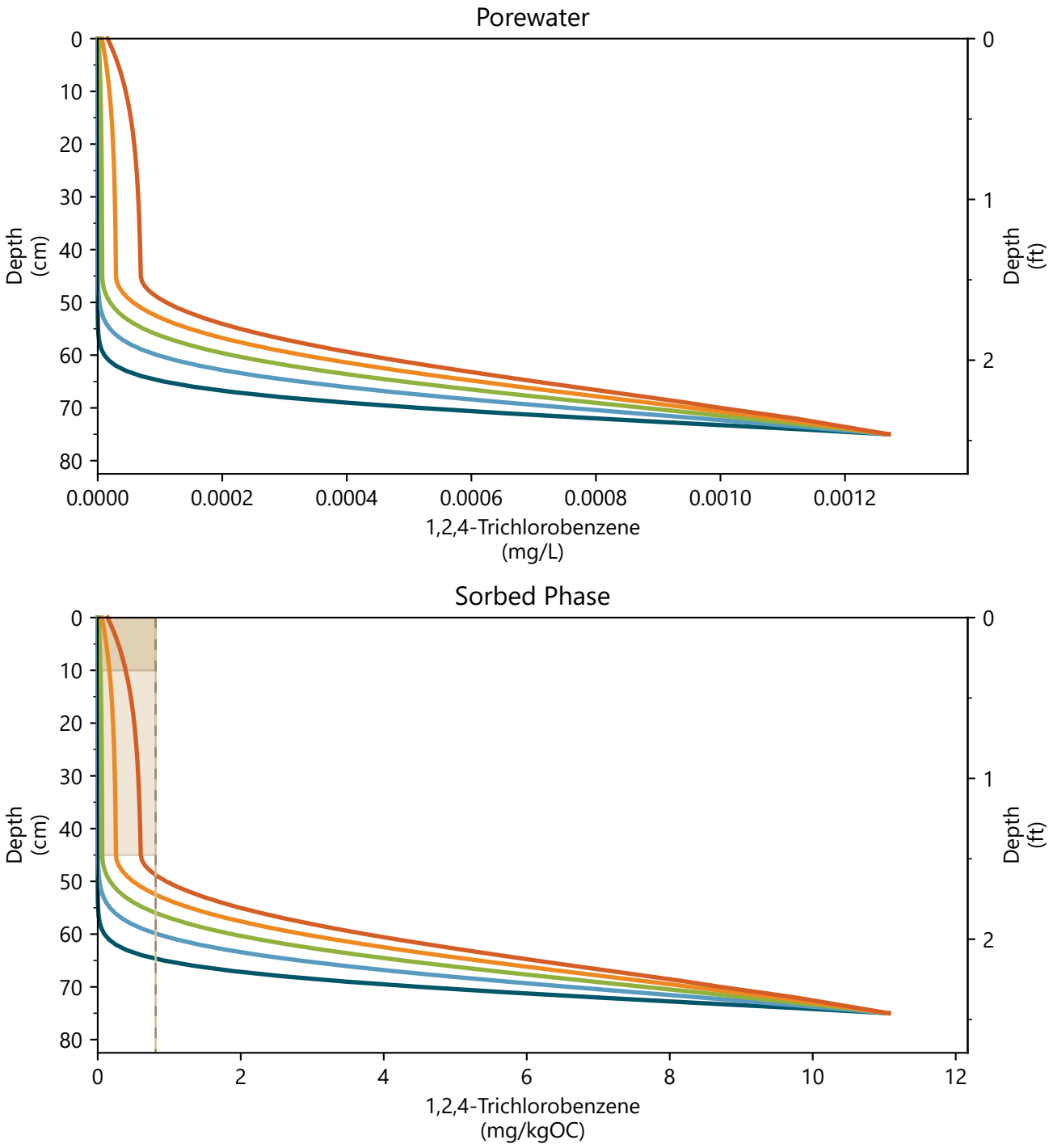
Figure H.4.2.15a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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).
Cap Configuration: 30cm CIL with 100% TOC amendment

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Figure H.4.2.15b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)

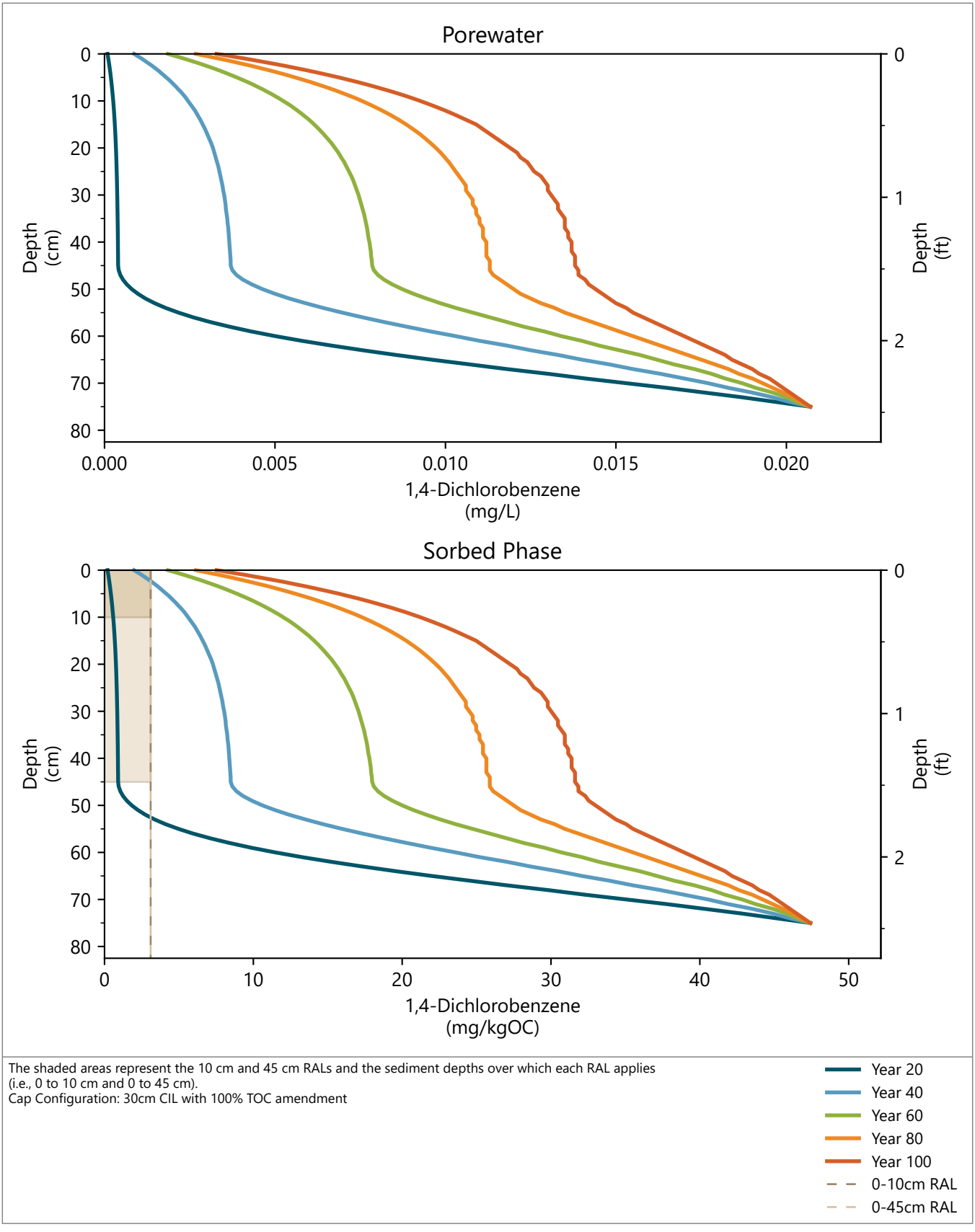


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 100% TOC amendment

- Year 20
- Year 40
- Year 60
- Year 80
- Year 100
- 0-10cm RAL
- 0-45cm RAL

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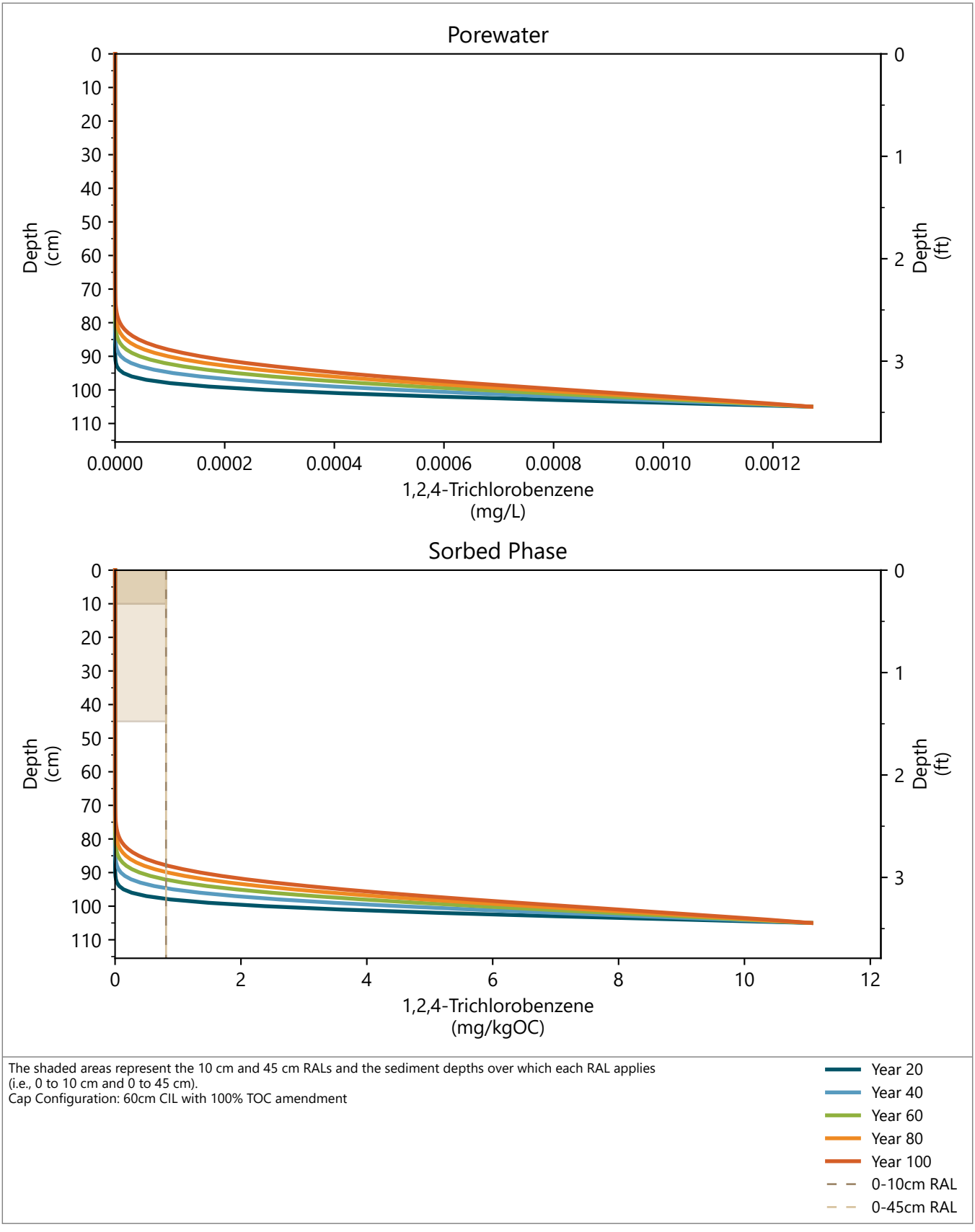
Figure H.4.2.16a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (800 m/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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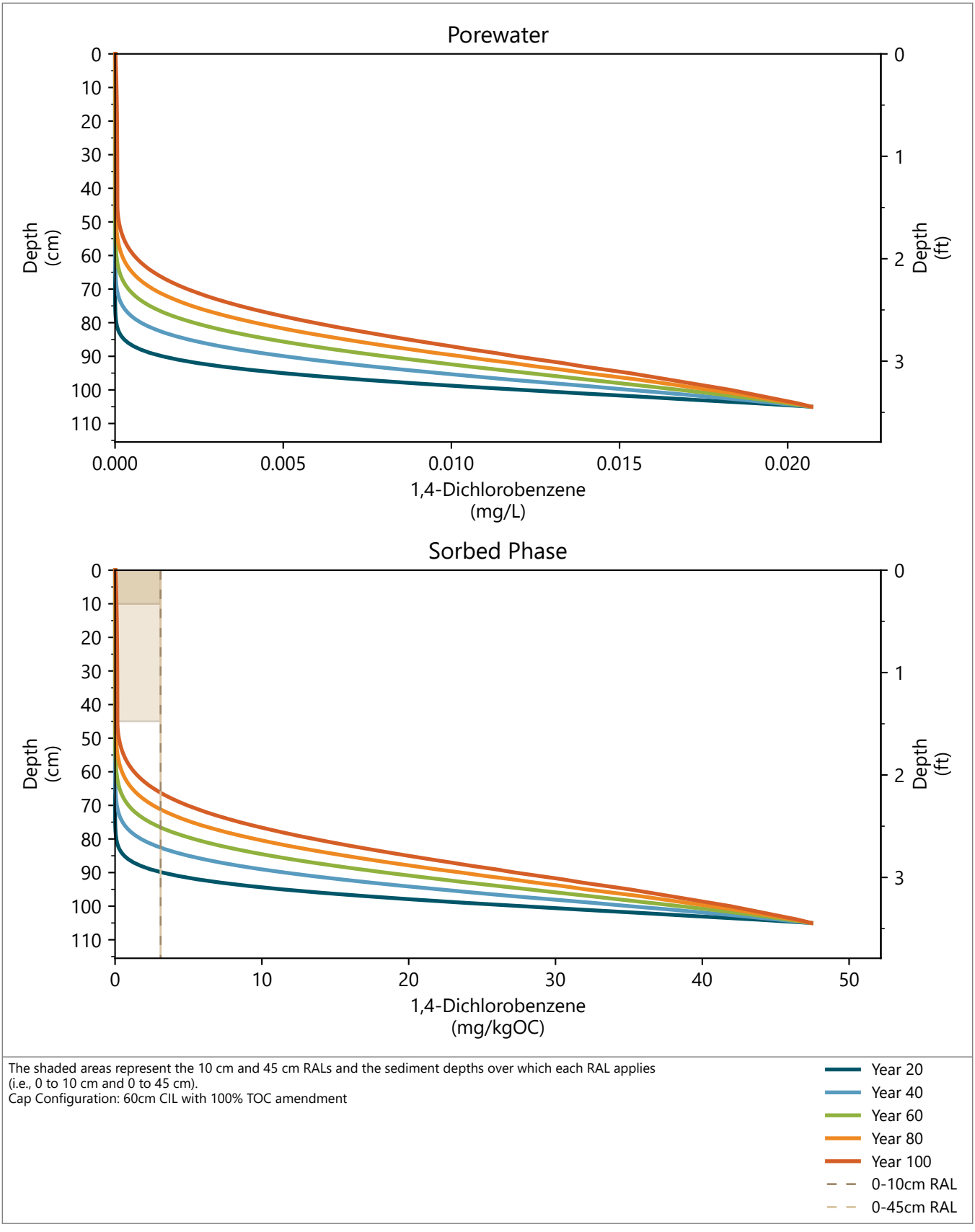
Figure H.4.2.16b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (800 m/yr Seepage)



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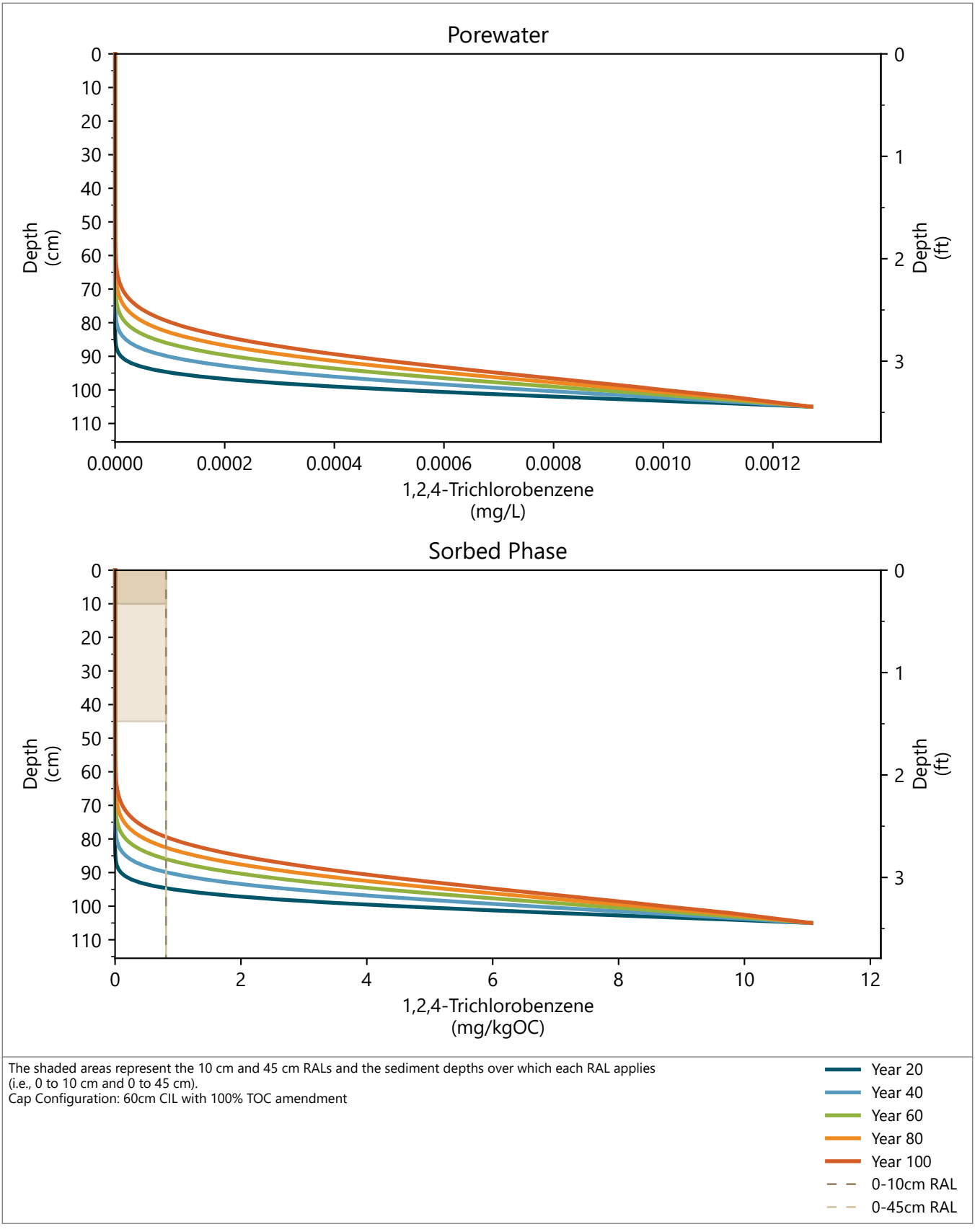
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Figure H.4.2.17a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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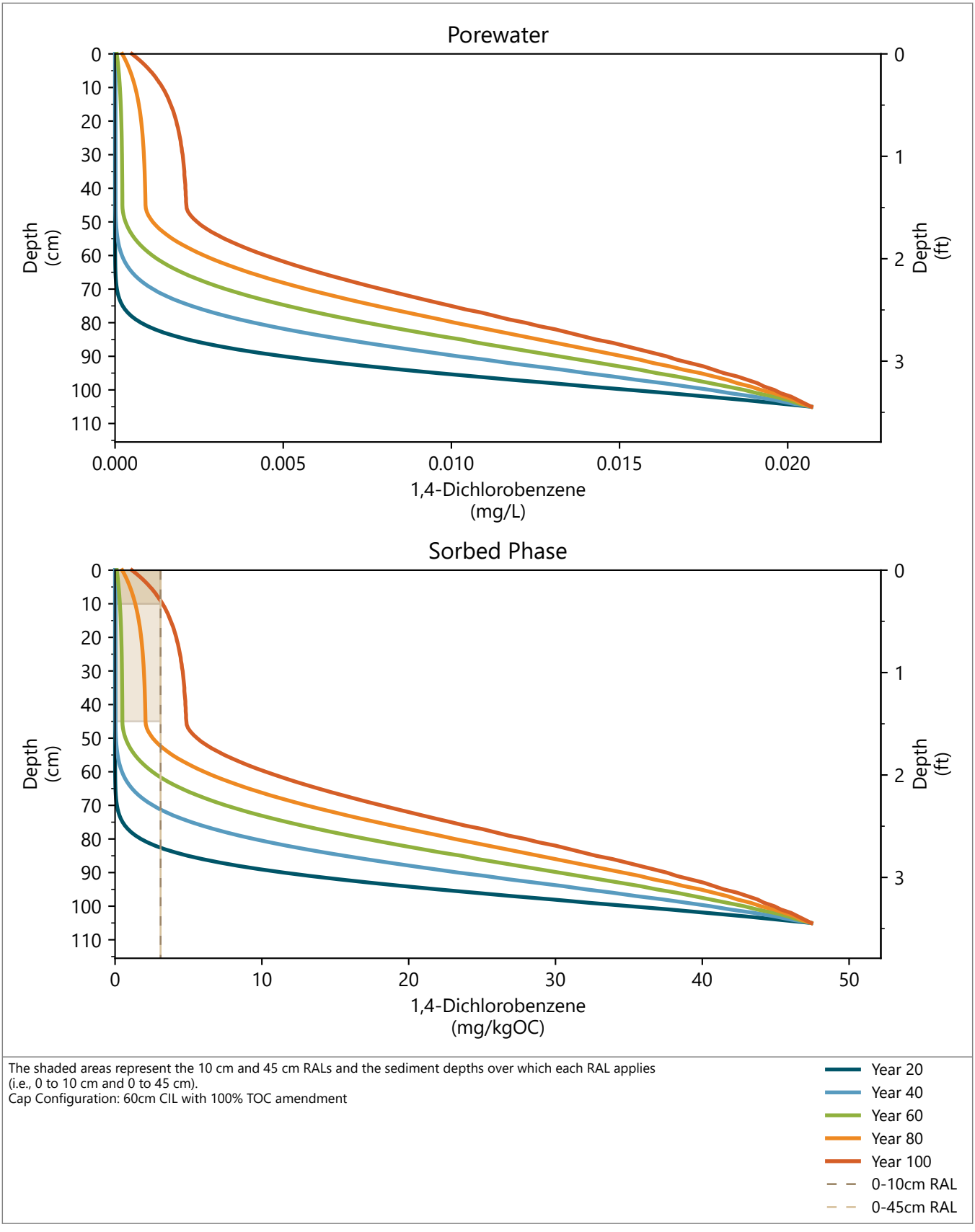
Figure H.4.2.17b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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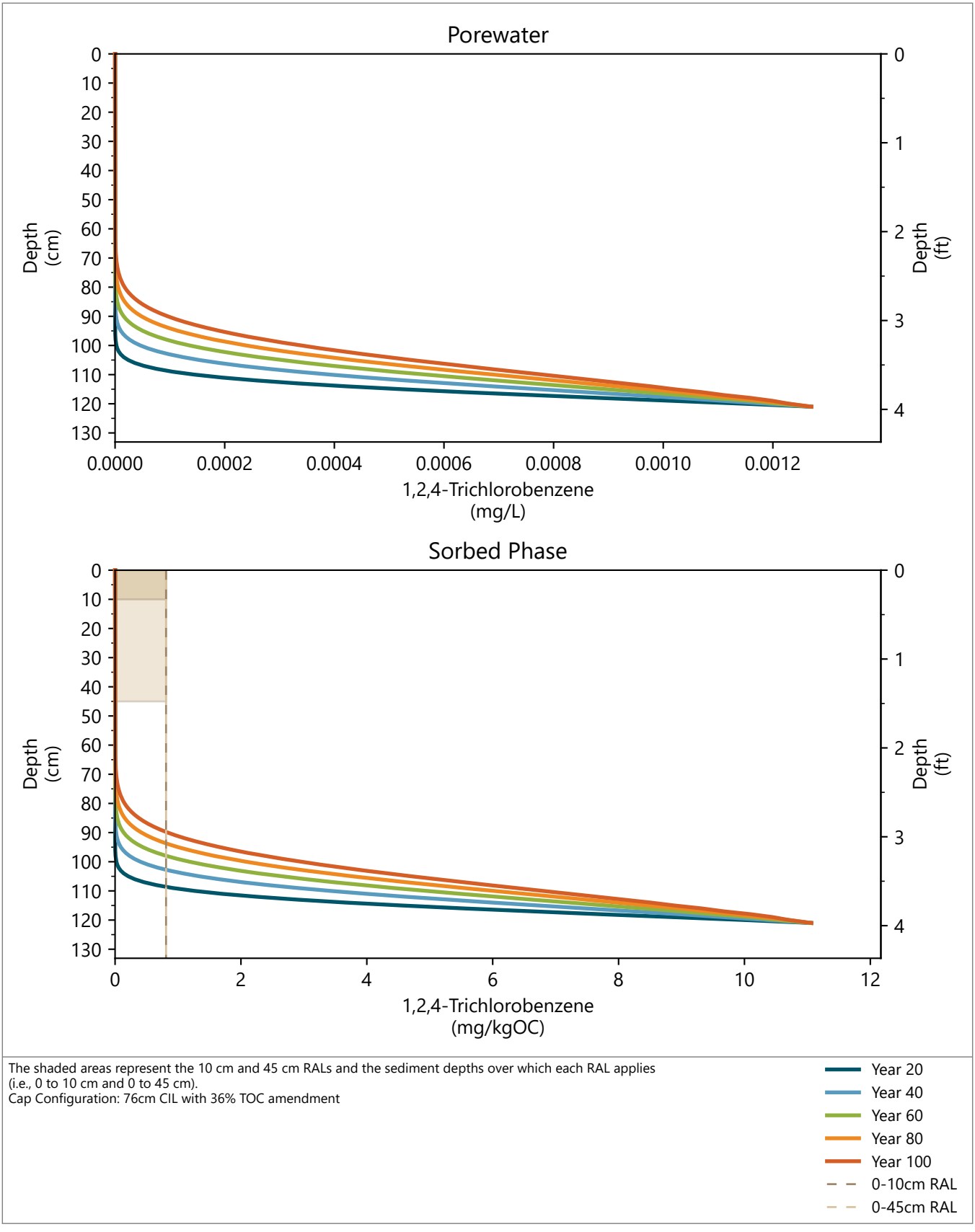
Figure H.4.2.18a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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).
Cap Configuration: 60cm CIL with 100% TOC amendment

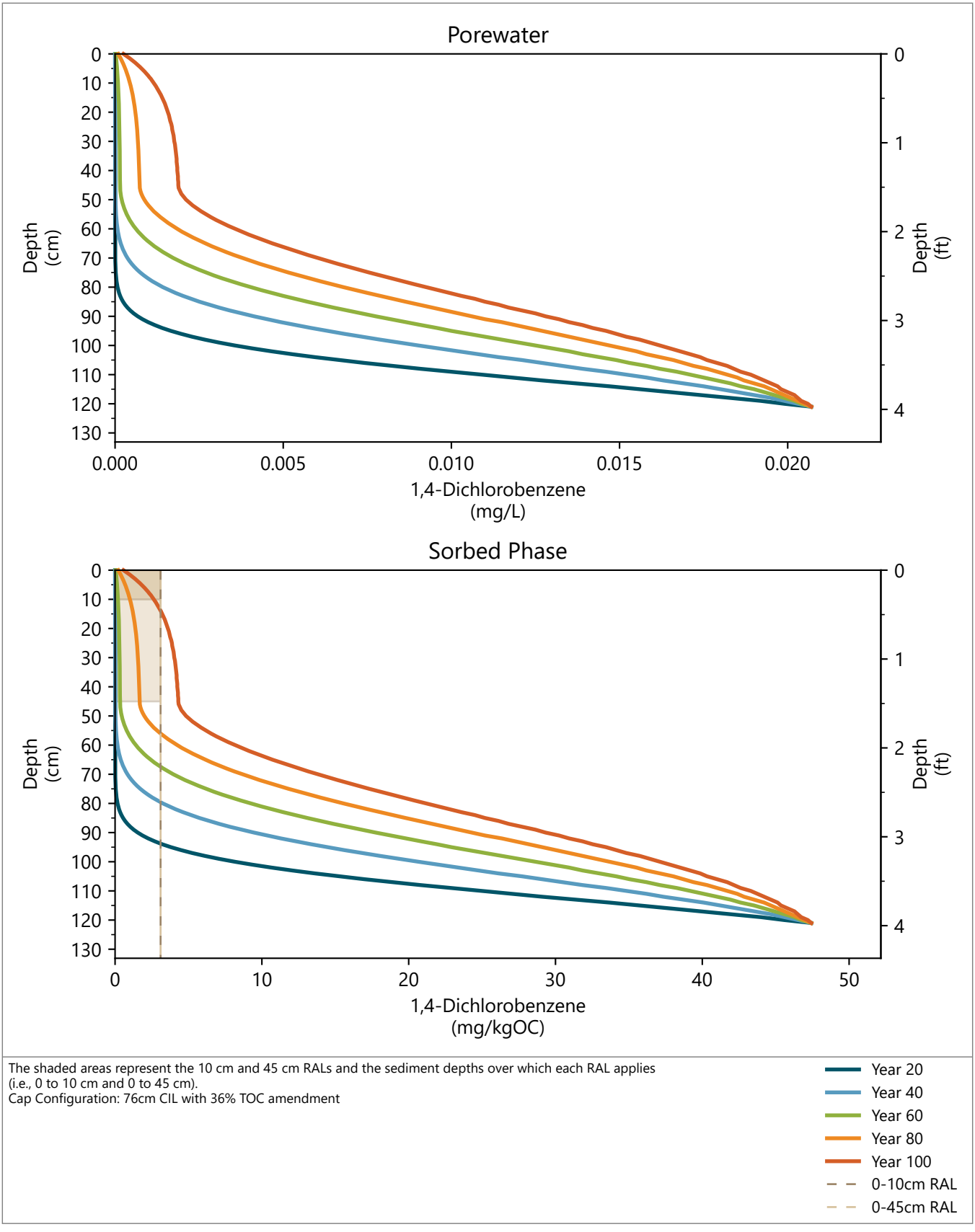
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Figure H.4.2.18b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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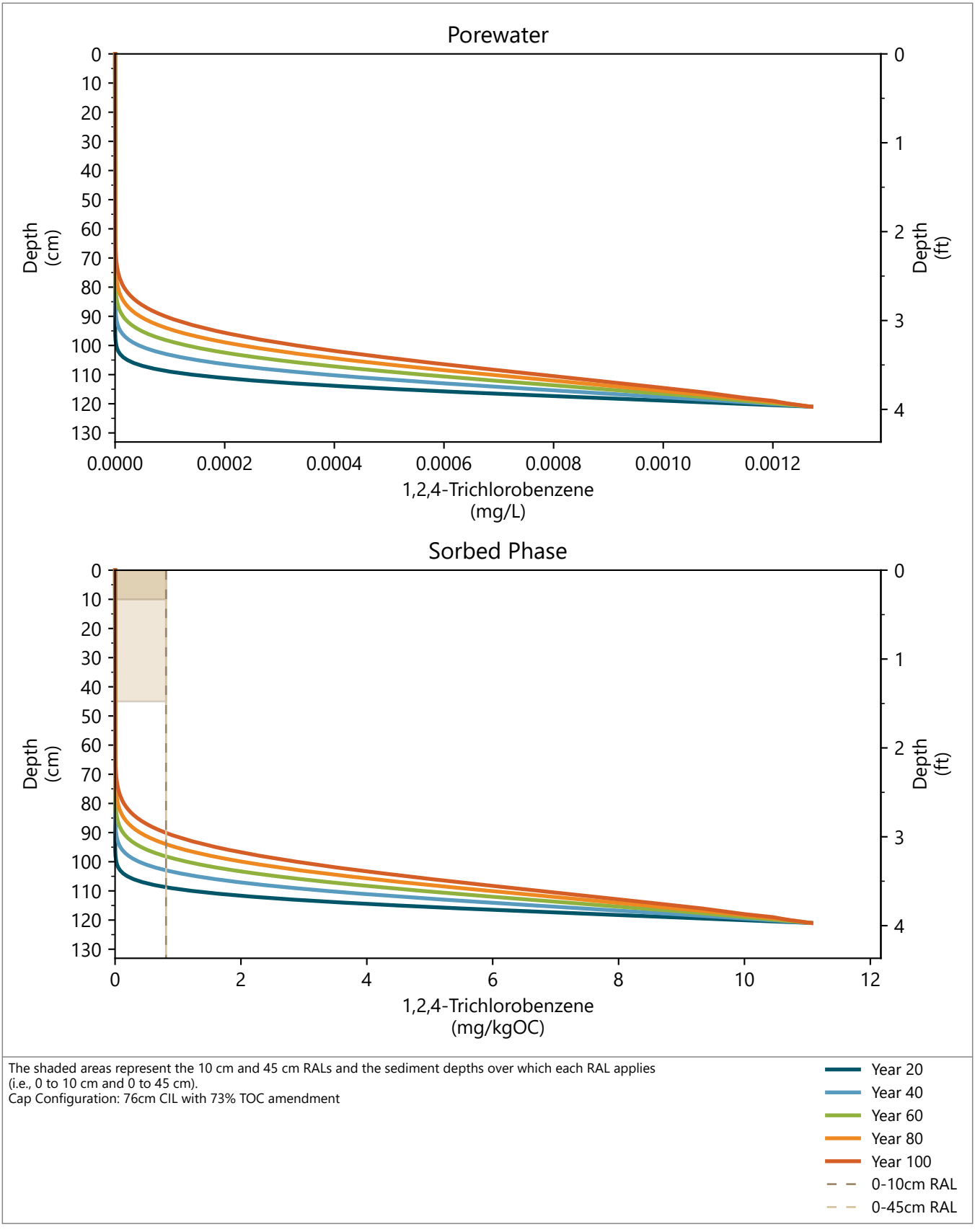
Figure H.4.2.19a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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).
Cap Configuration: 76cm CIL with 36% TOC amendment

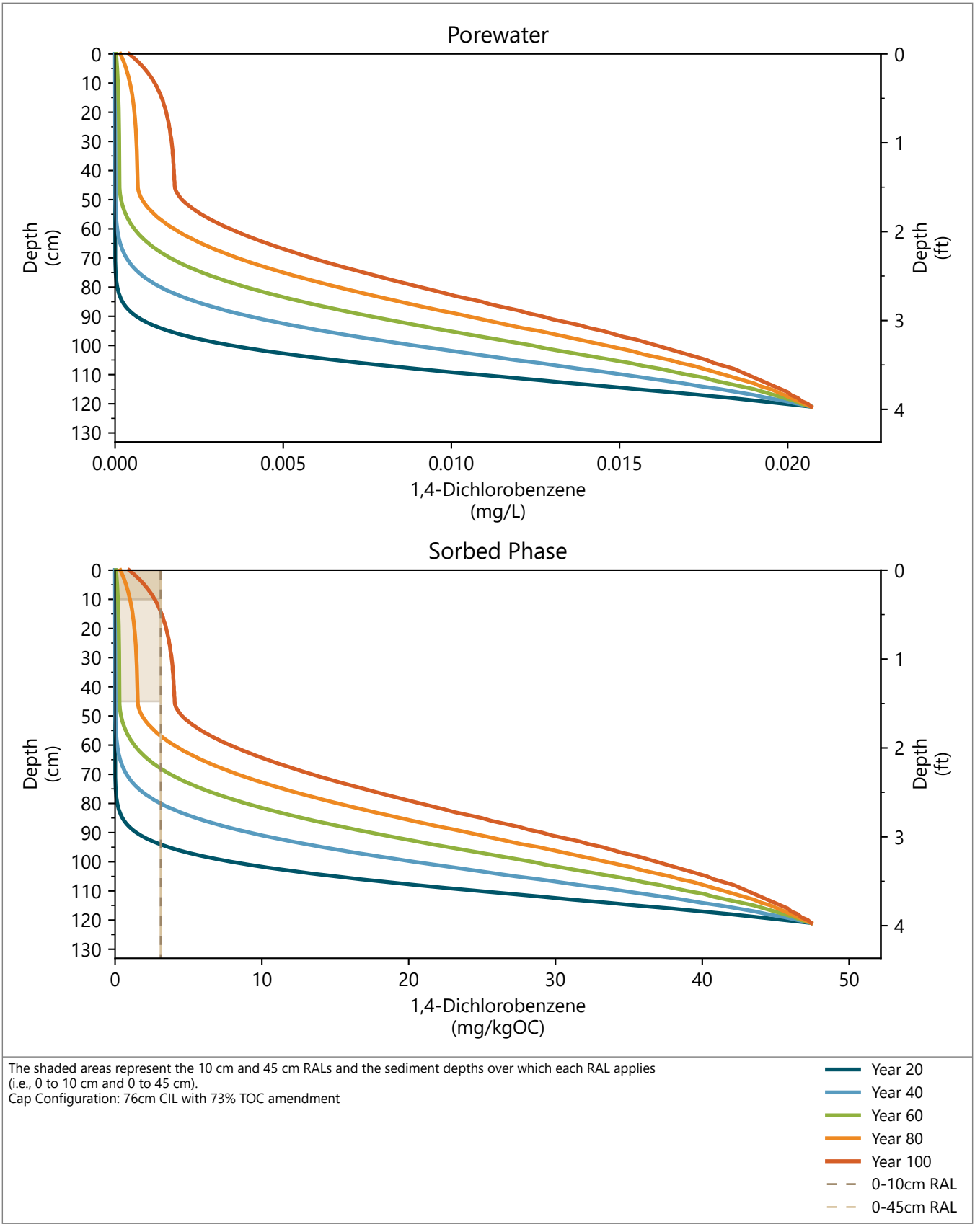
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Figure H.4.2.19b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (400 cm/yr Seepage)



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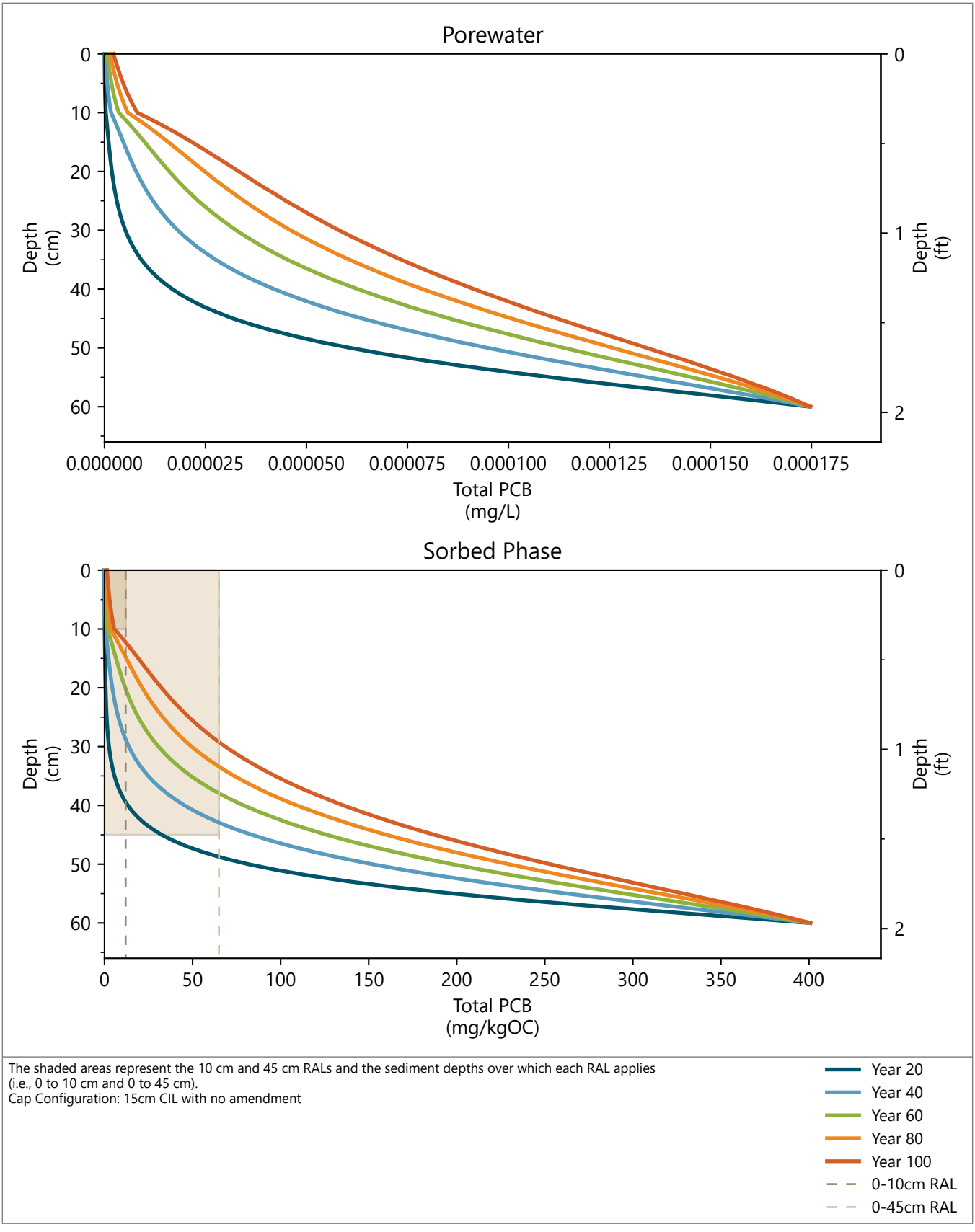
Figure H.4.2.20a
Depth Profiles Over Time of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)



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).
Cap Configuration: 76cm CIL with 73% TOC amendment

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Figure H.4.2.20b
Depth Profiles Over Time of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap (800 cm/yr Seepage)

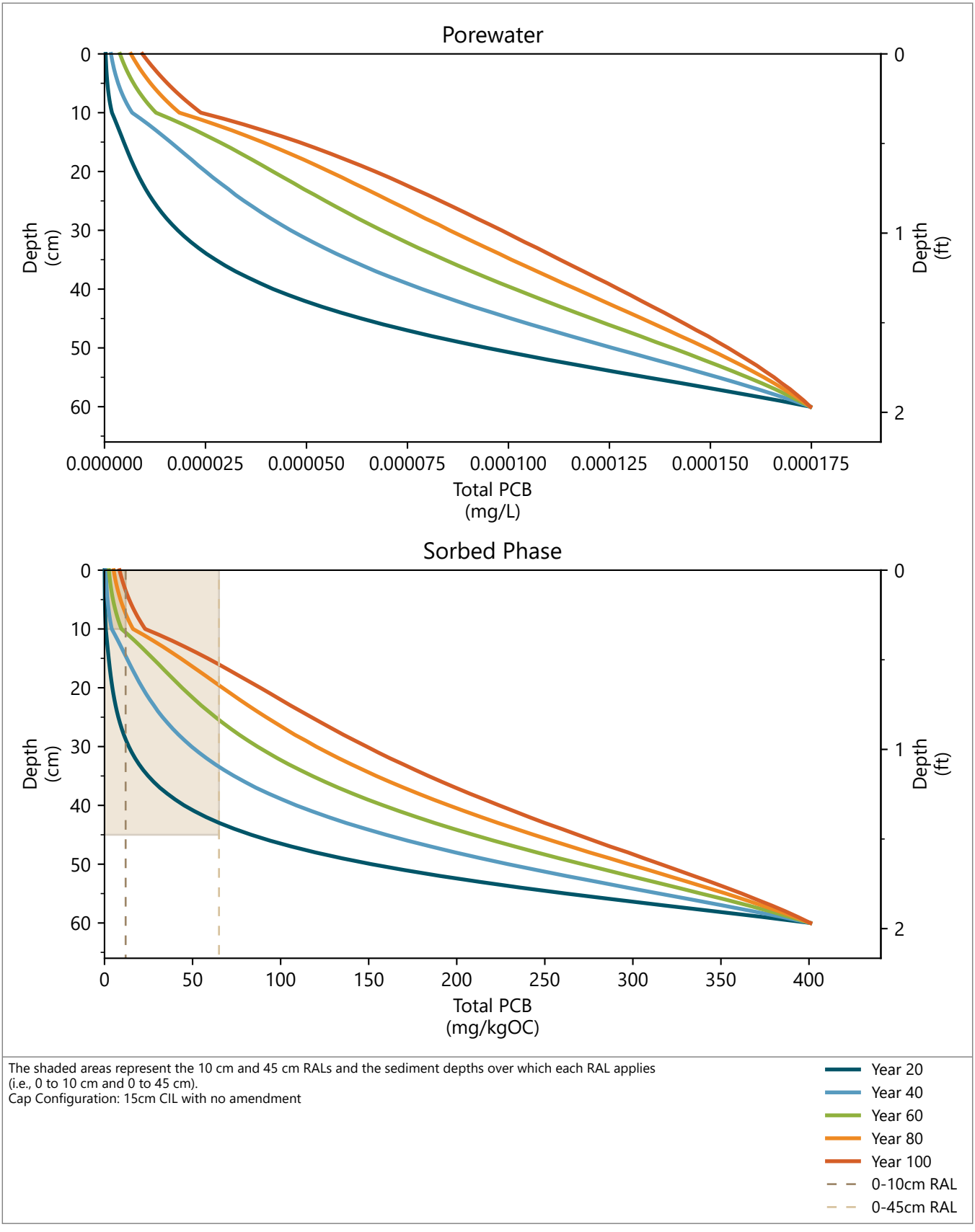


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

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Figure H.4.2.21a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (400 cm/yr Seepage)



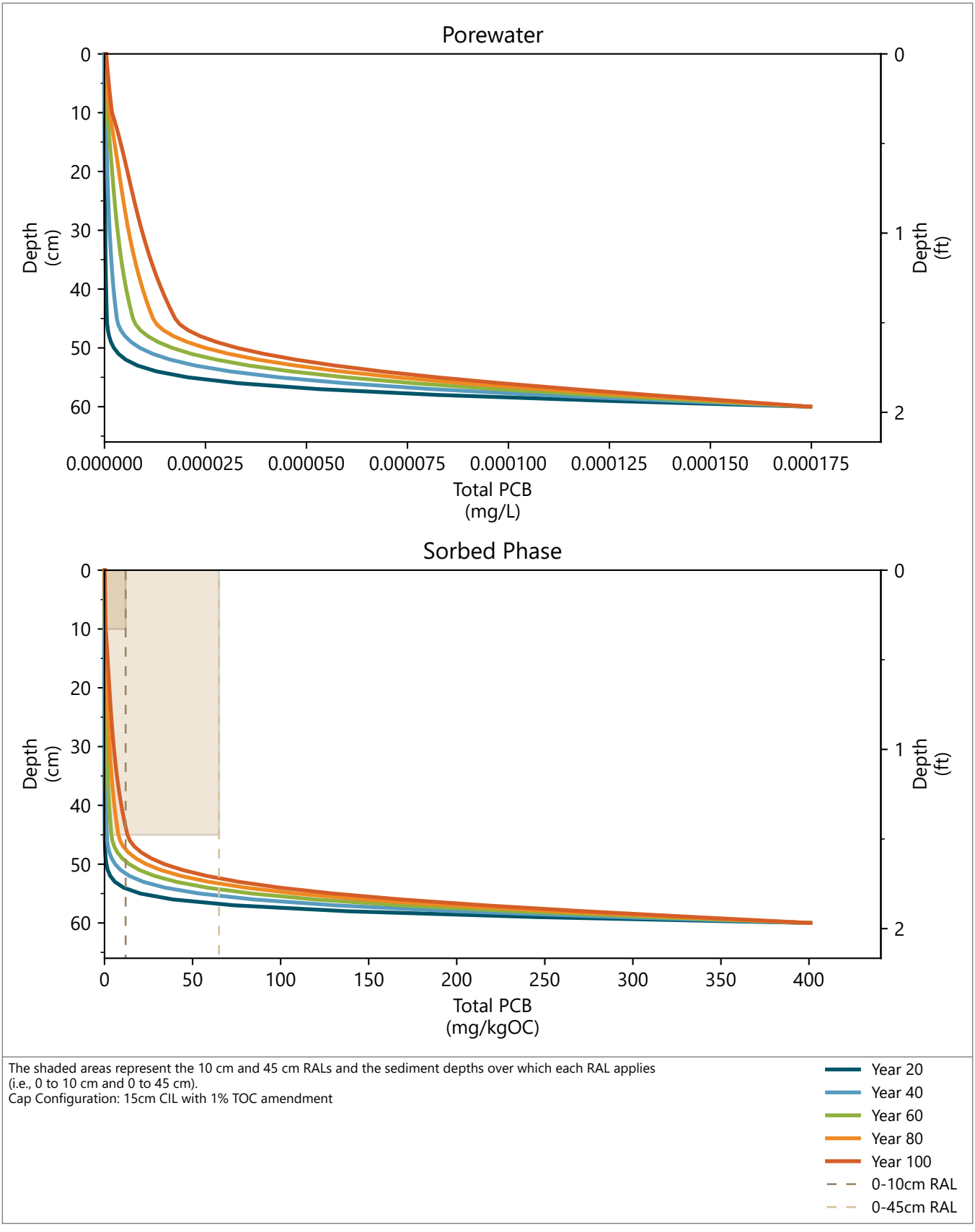
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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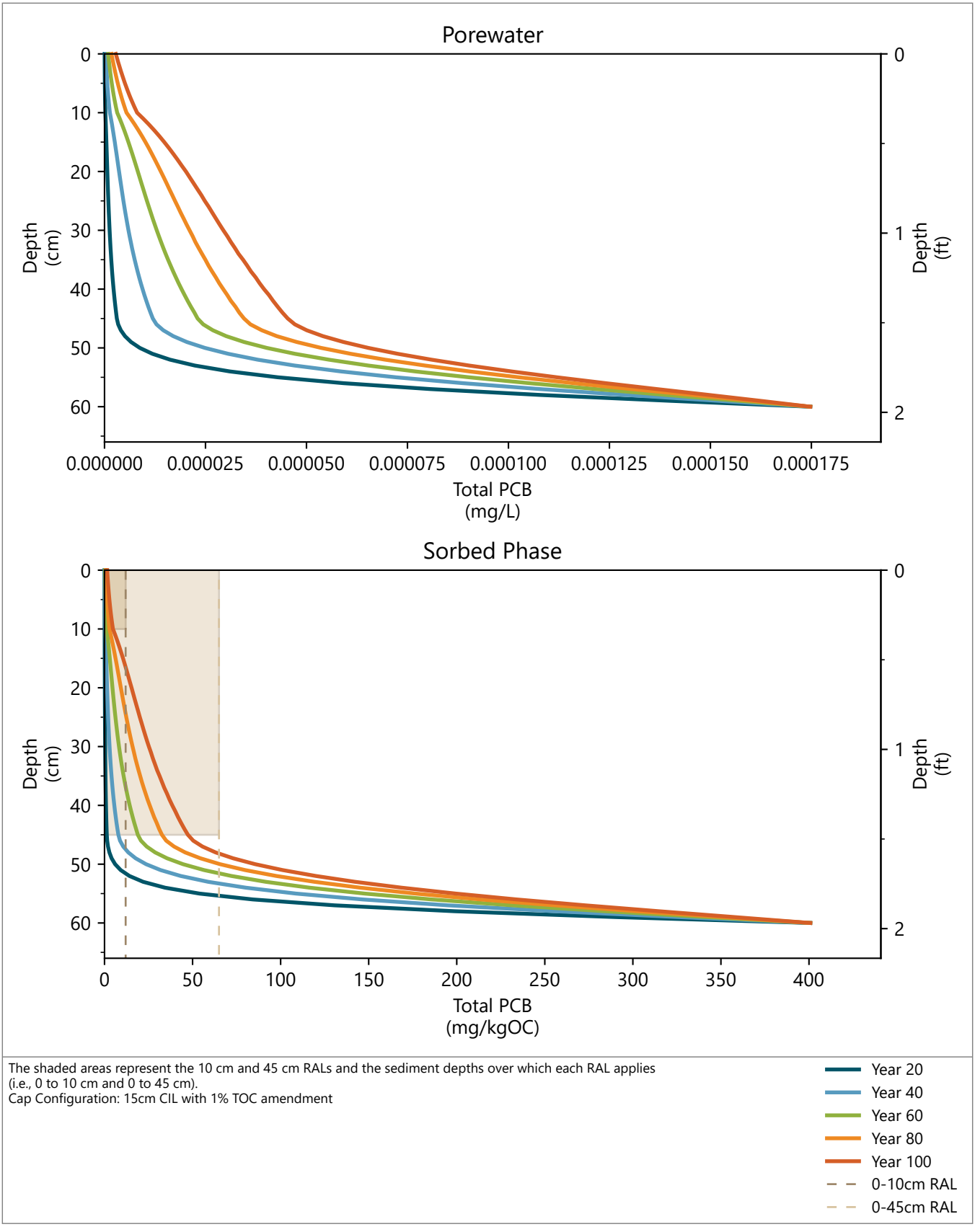
Figure H.4.2.22a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.23a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (400 cm/yr Seepage)

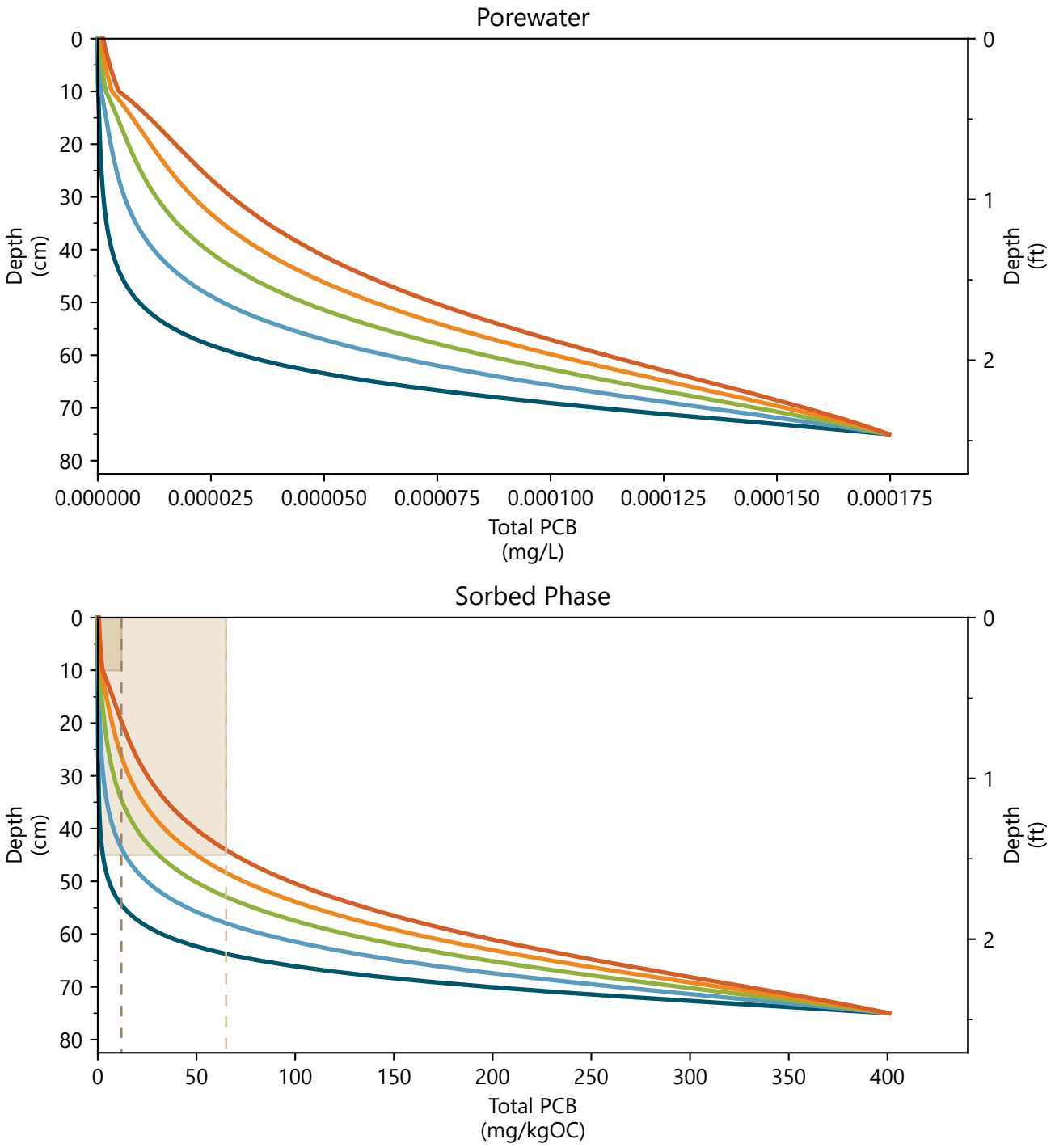


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with 1% TOC amendment

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Figure H.4.2.24a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (800 cm/yr Seepage)



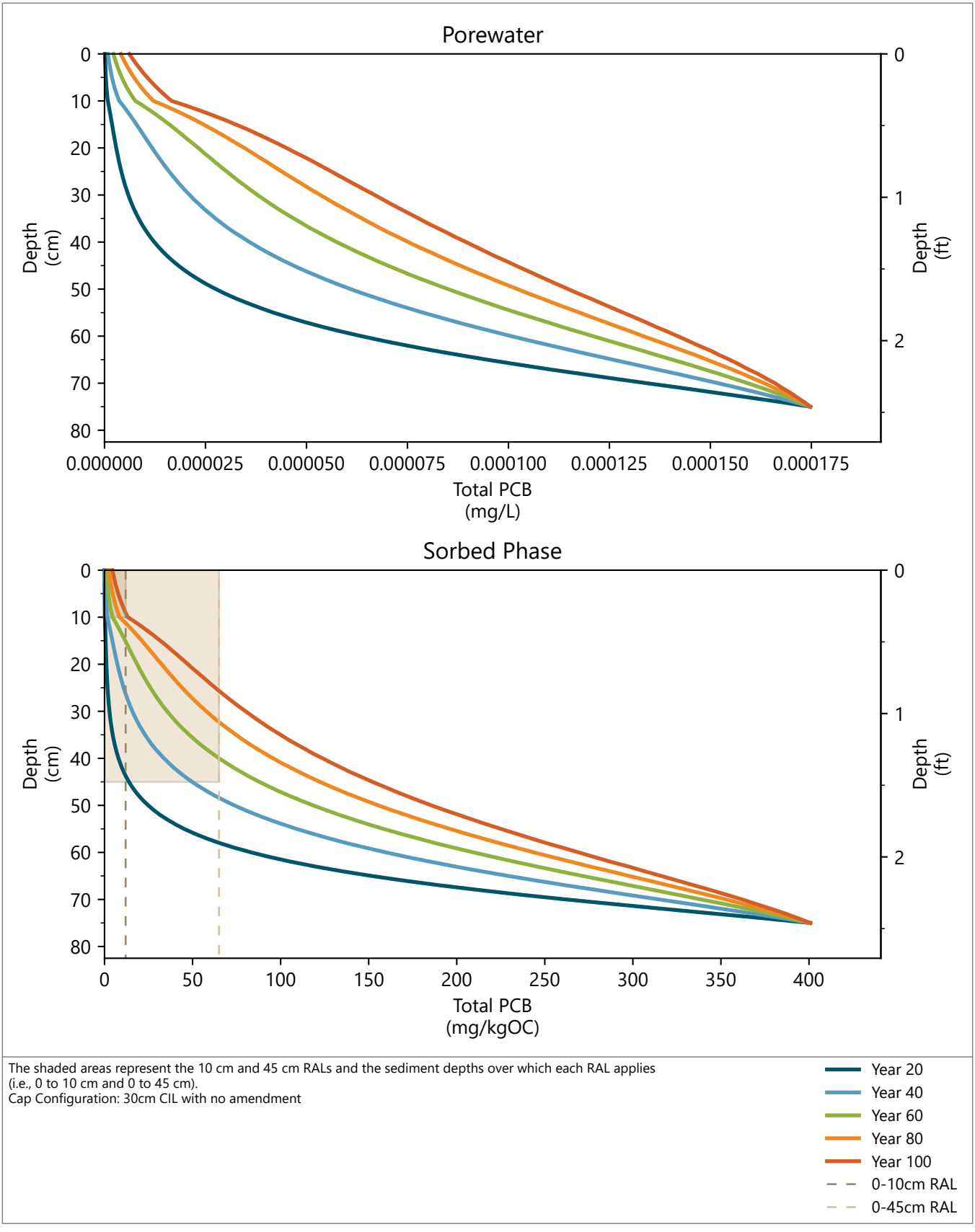
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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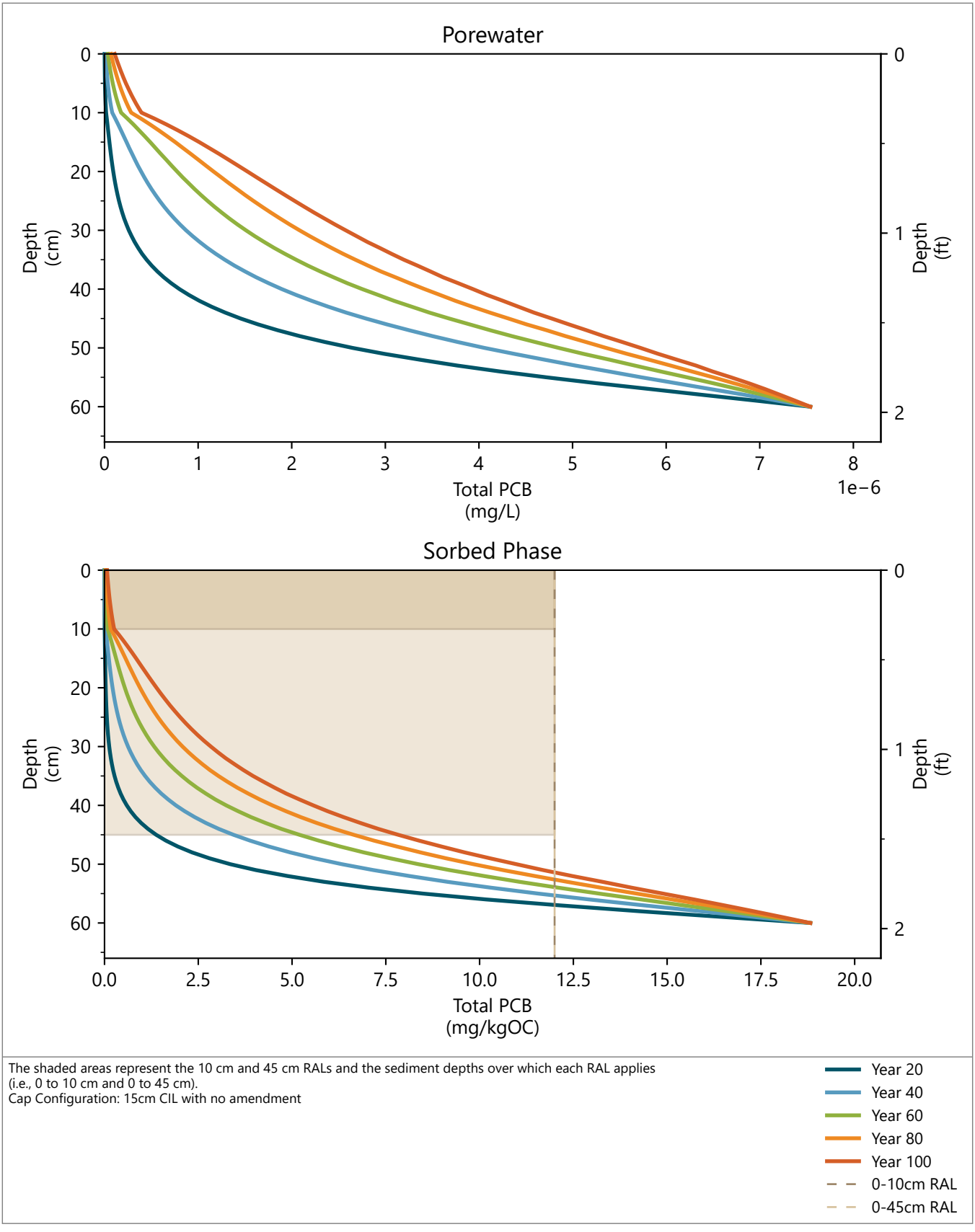
Figure H.4.2.25a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.26a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap (800 cm/yr Seepage)

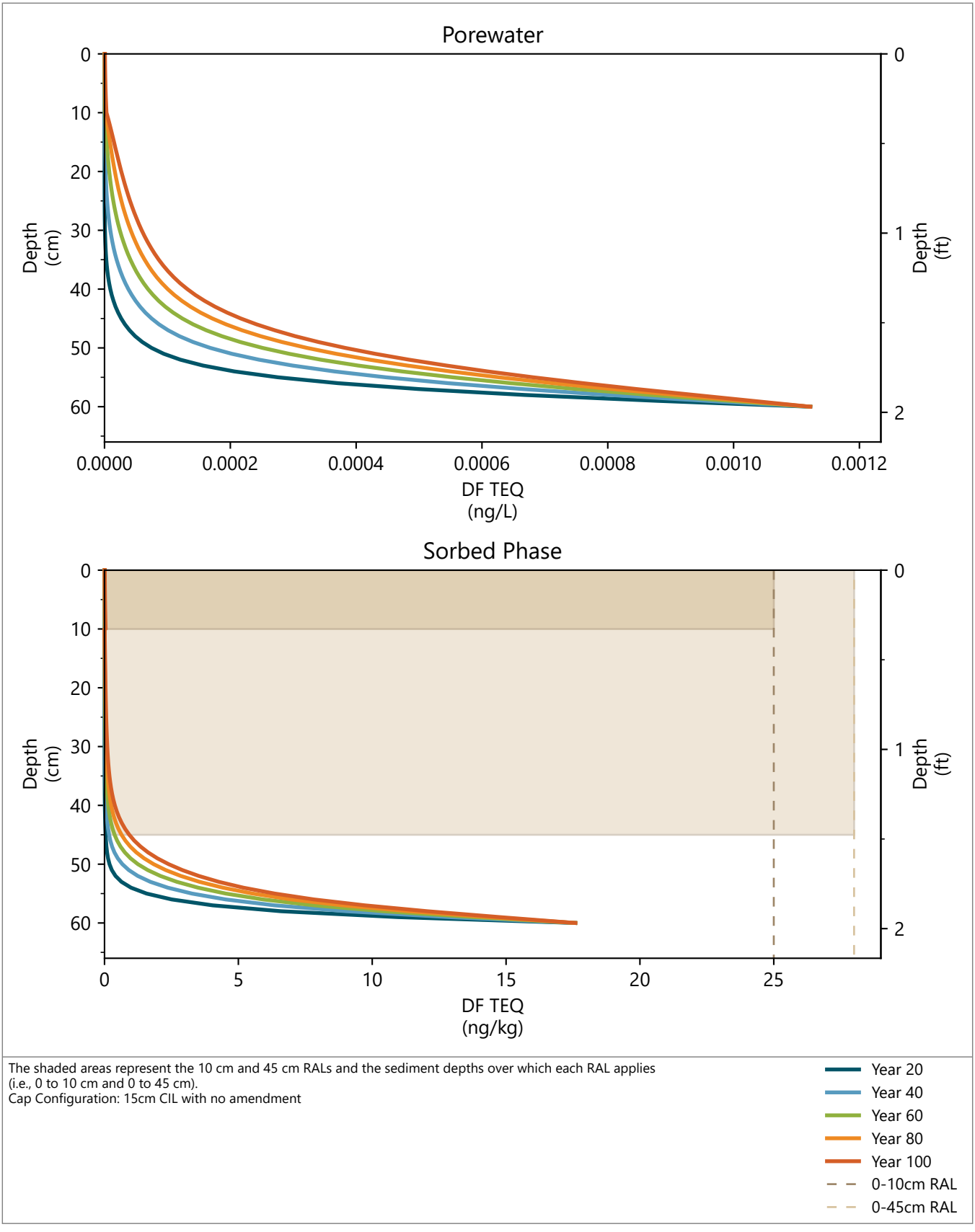


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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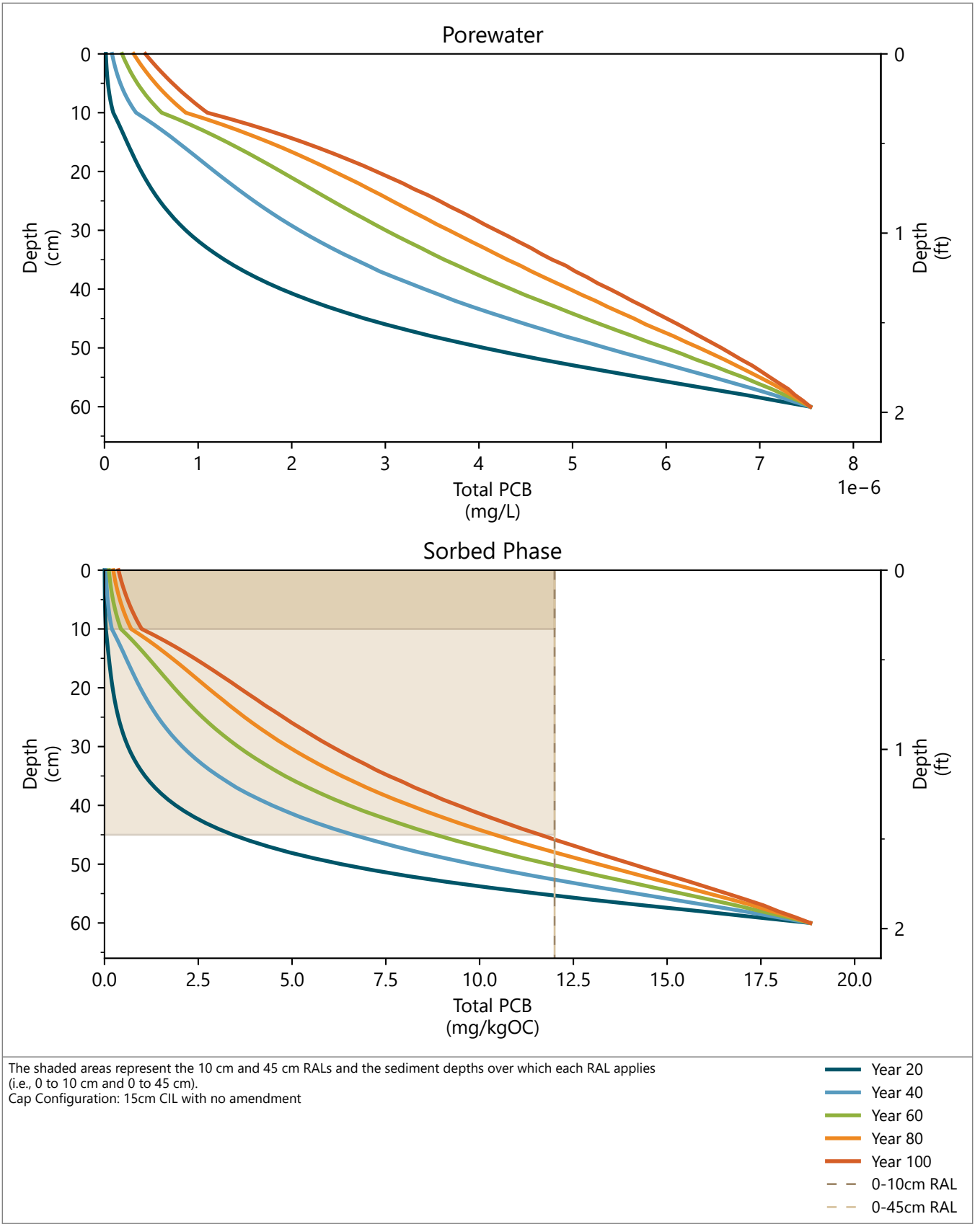
Figure H.4.2.27a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 20B Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.27b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 20B Modified Cap (400 cm/yr Seepage)

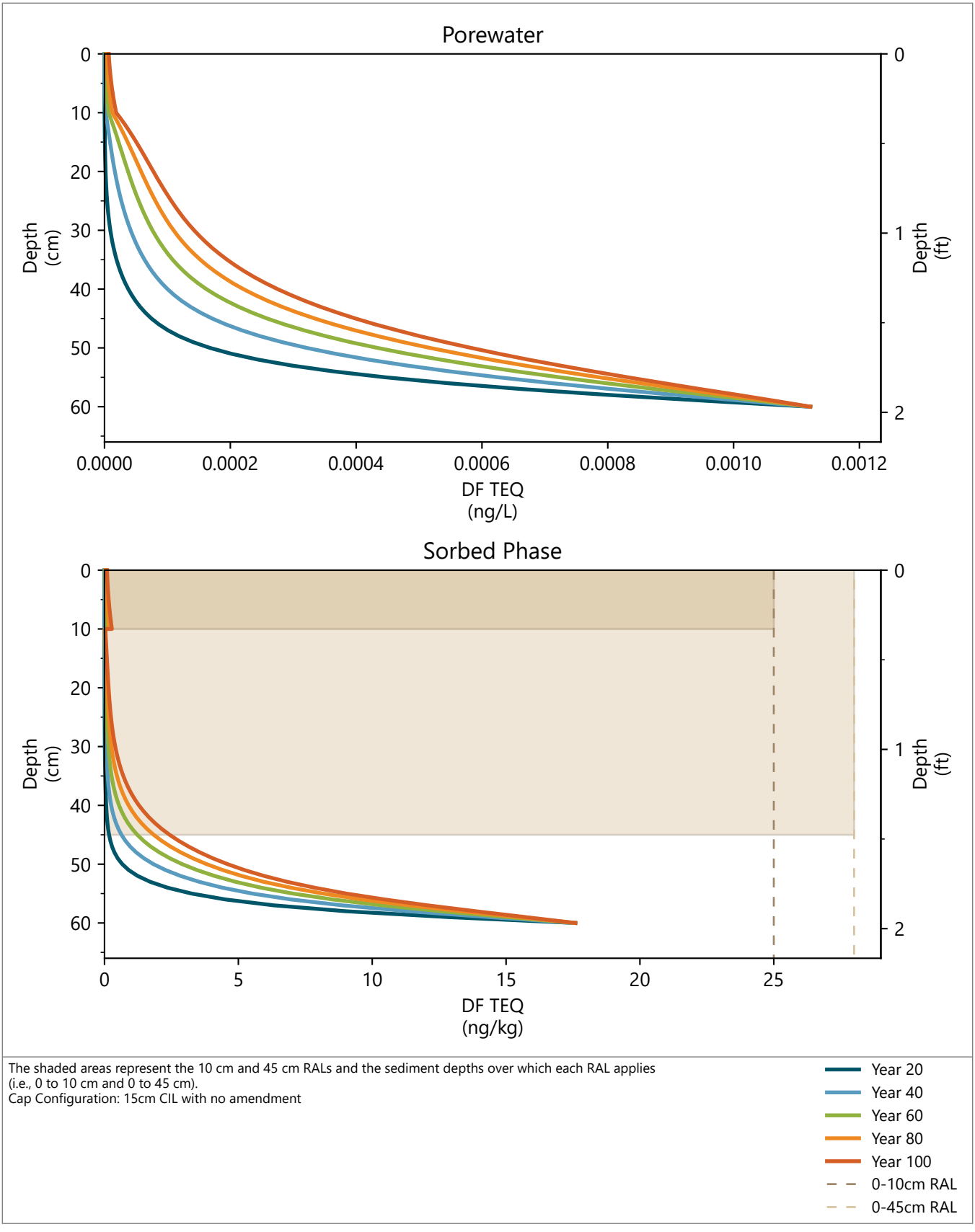


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

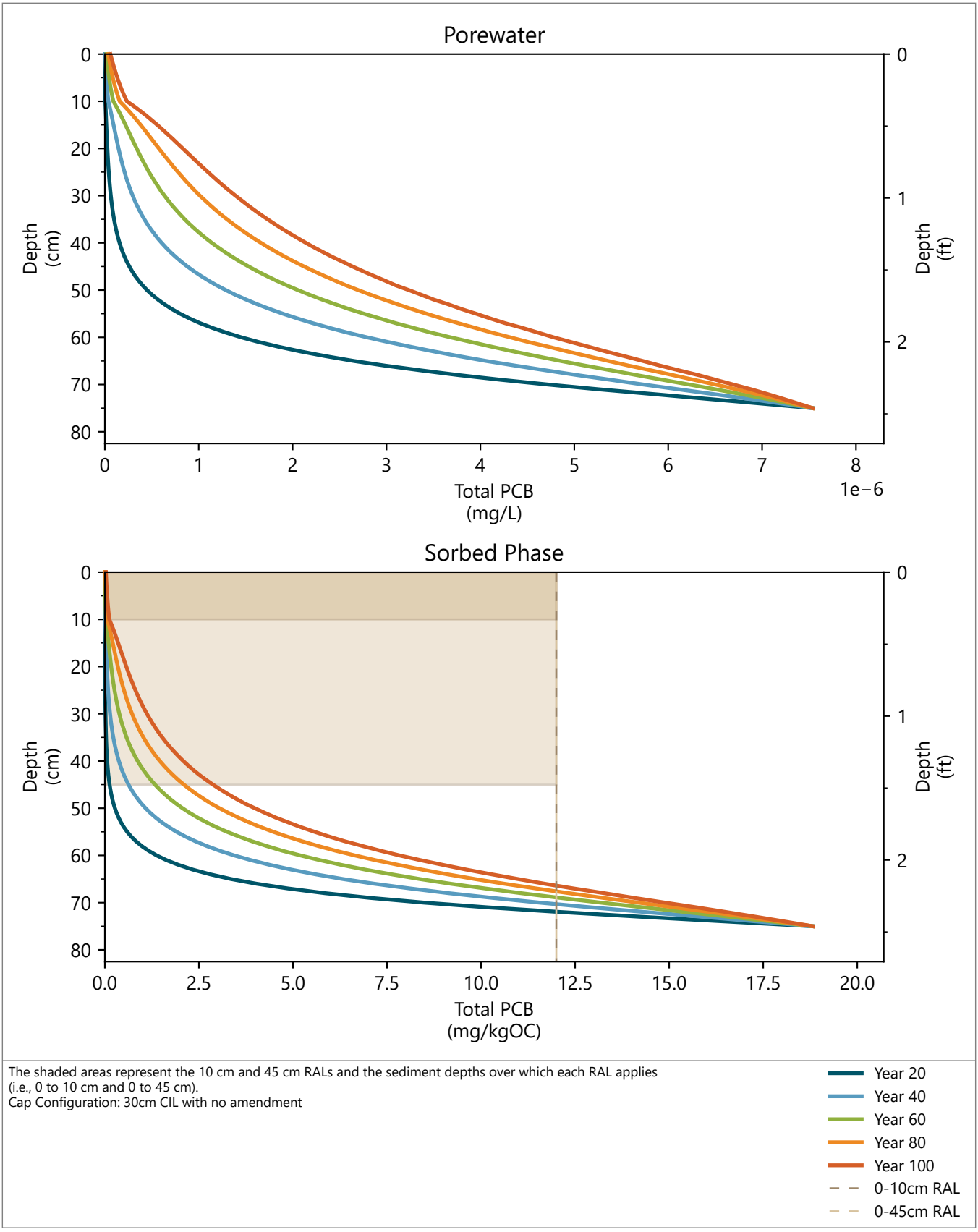
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Figure H.4.2.28a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 20B Modified Cap (800 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.28b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 20B Modified Cap (800 cm/yr Seepage)

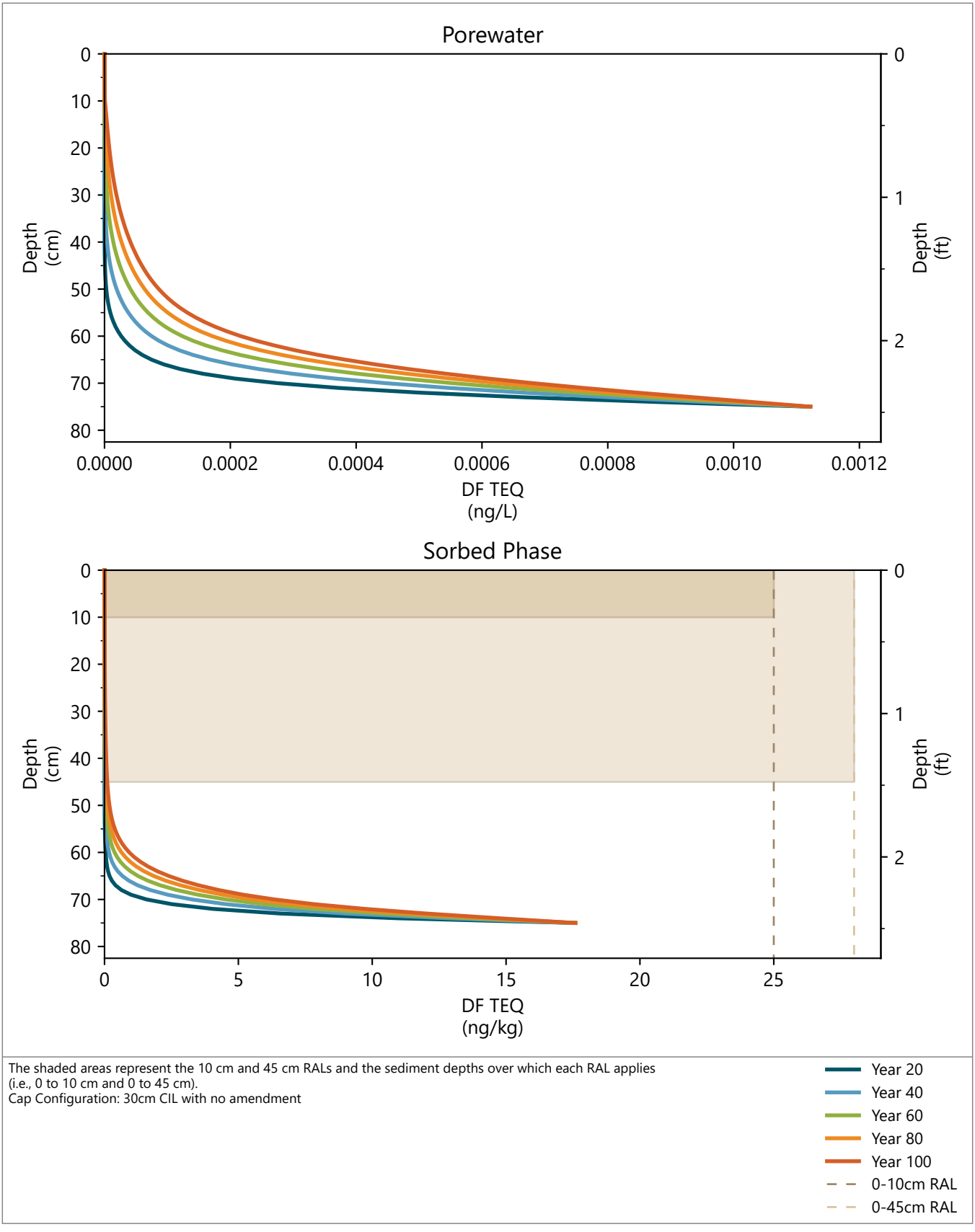


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

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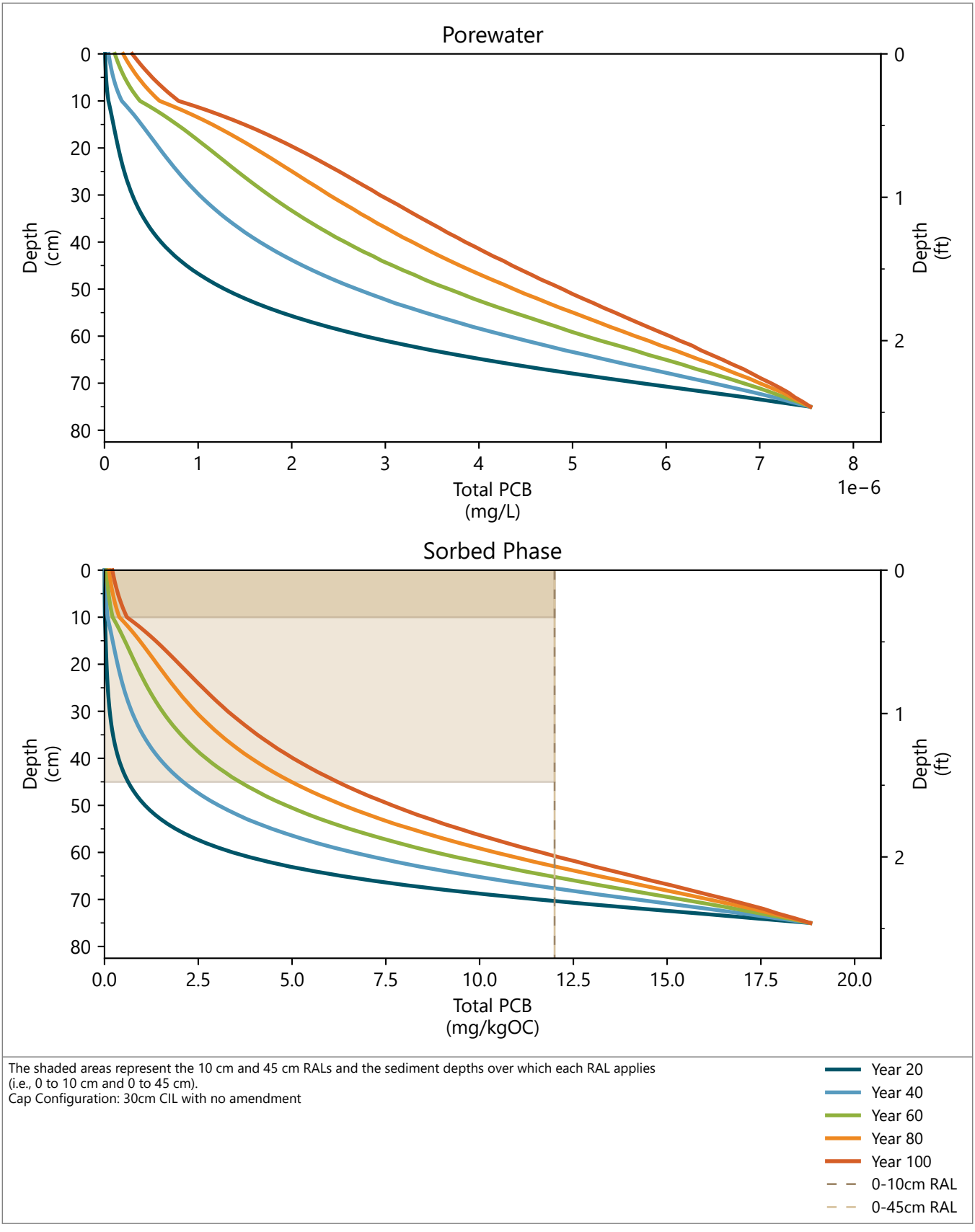
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Figure H.4.2.29a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 20B Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.29b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 20B Modified Cap (400 cm/yr Seepage)

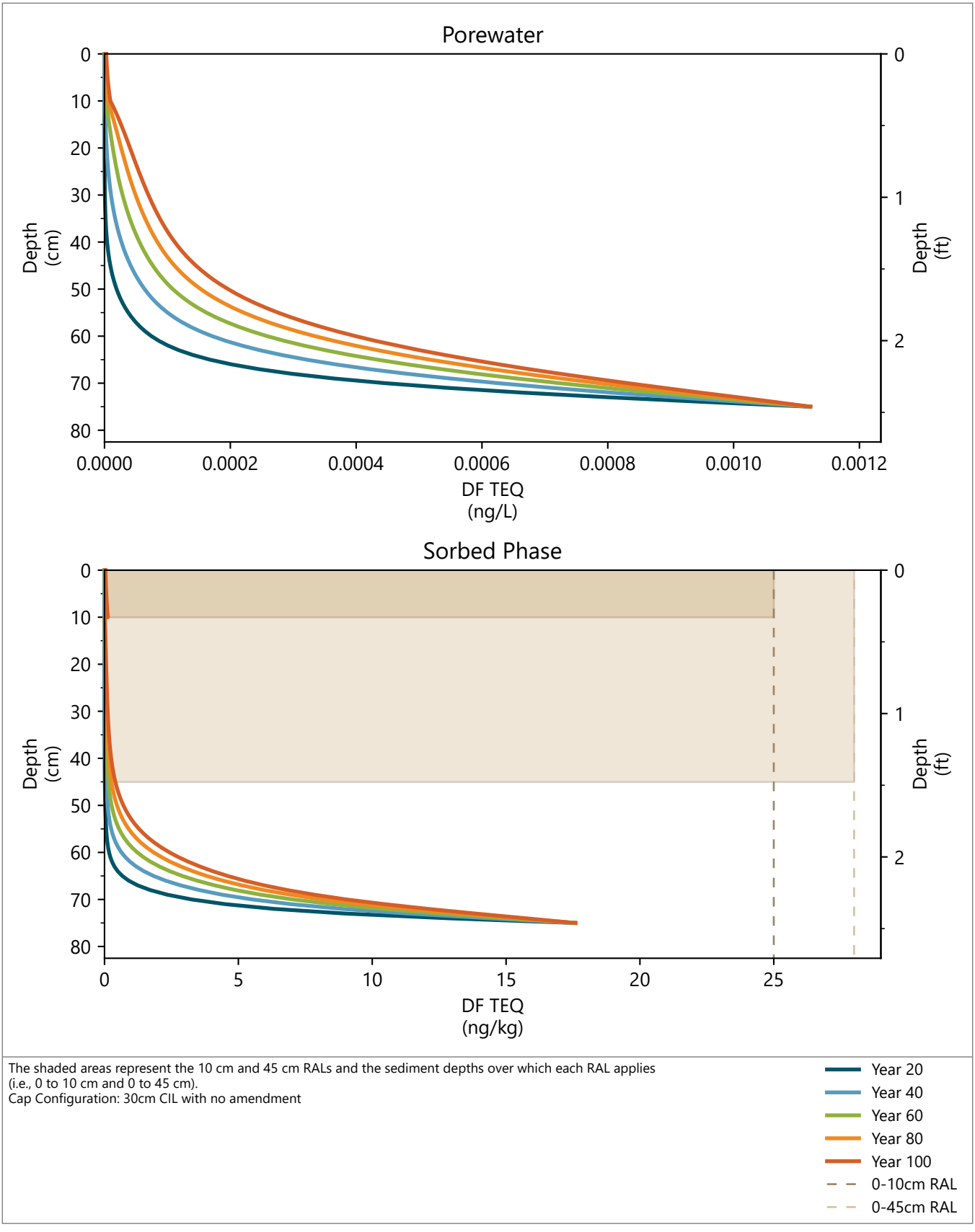


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

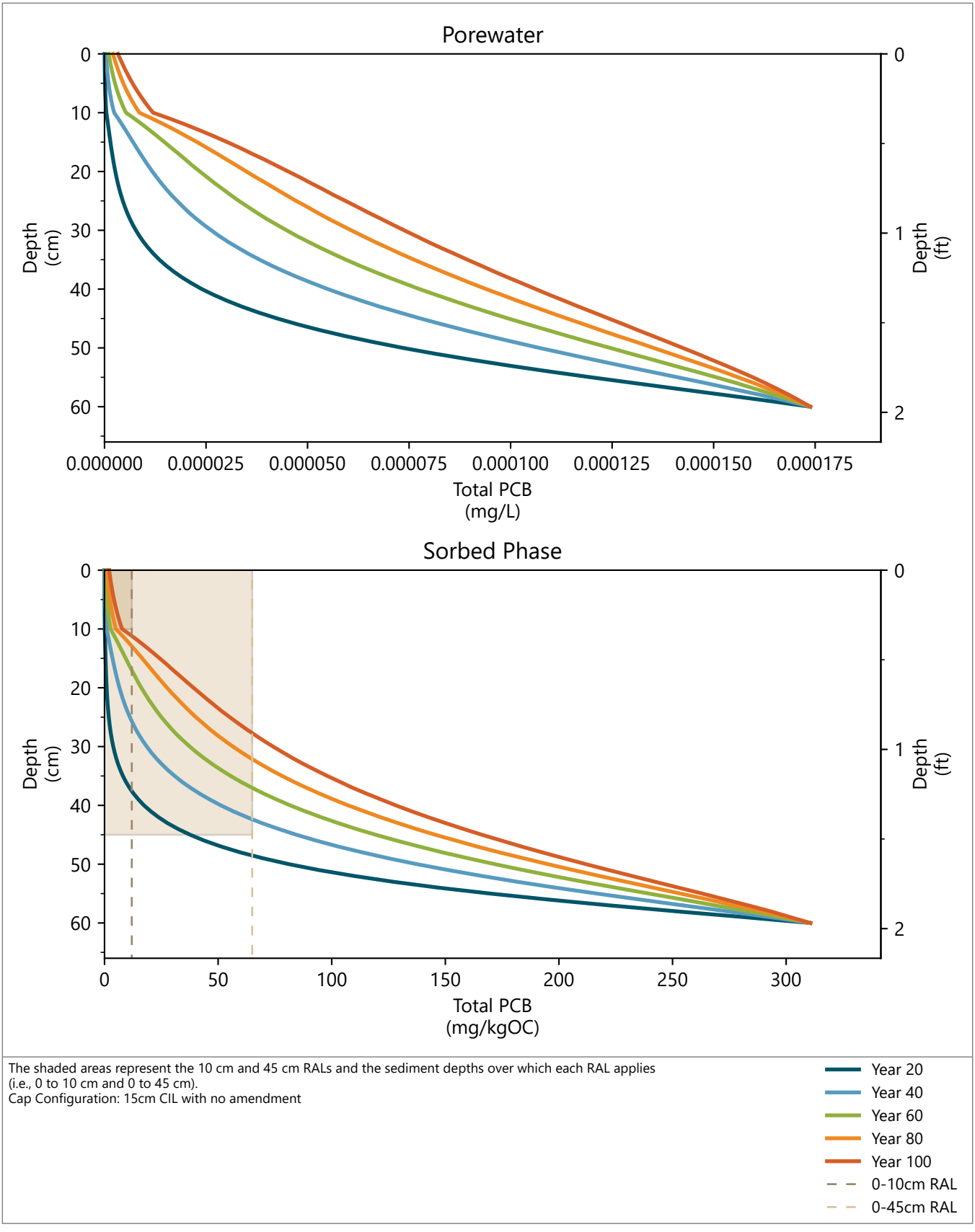
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Figure H.4.2.30a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 20B Modified Cap (800 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

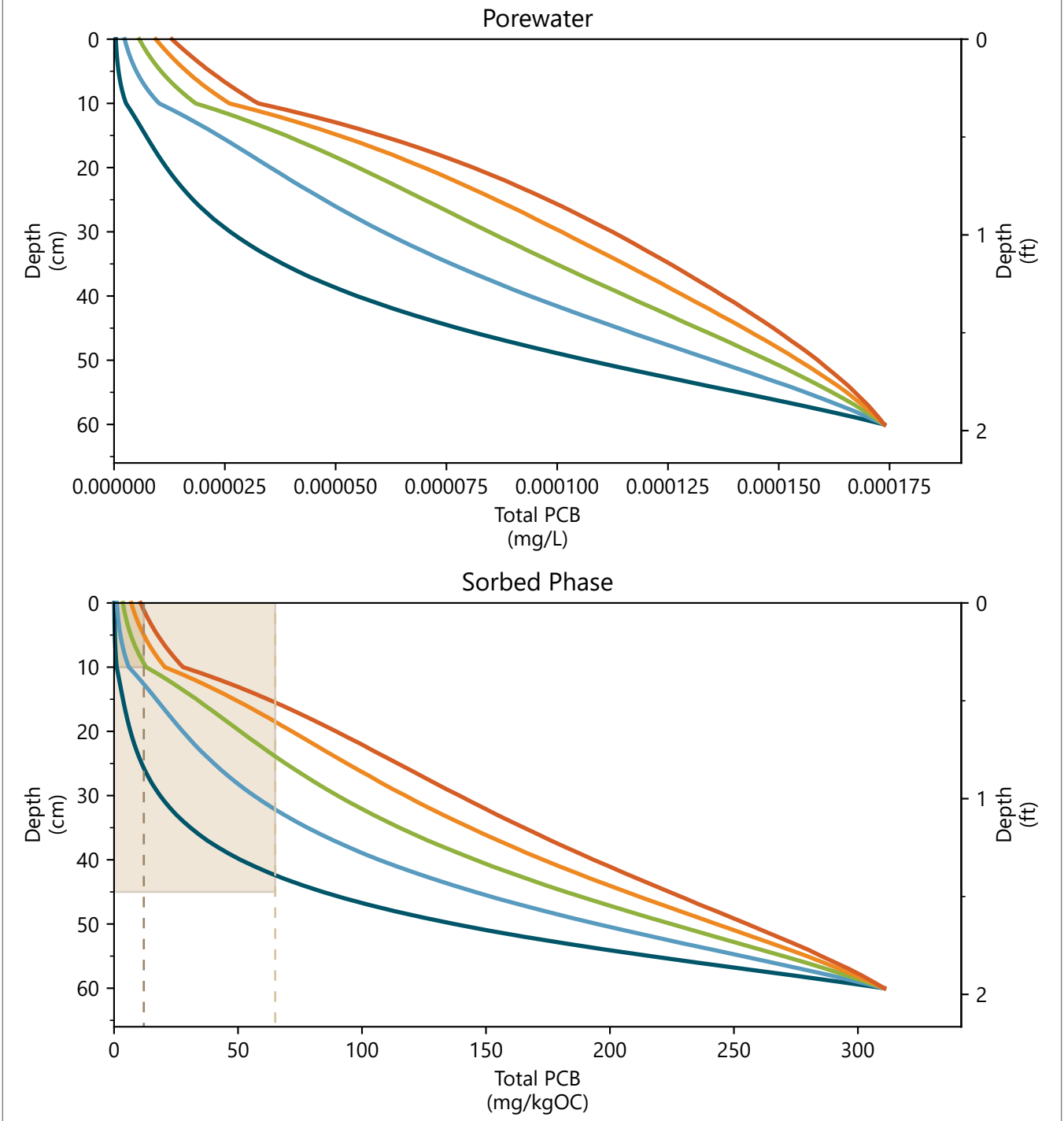
Figure H.4.2.30b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 20B Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.31a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (400 cm/yr Seepage)



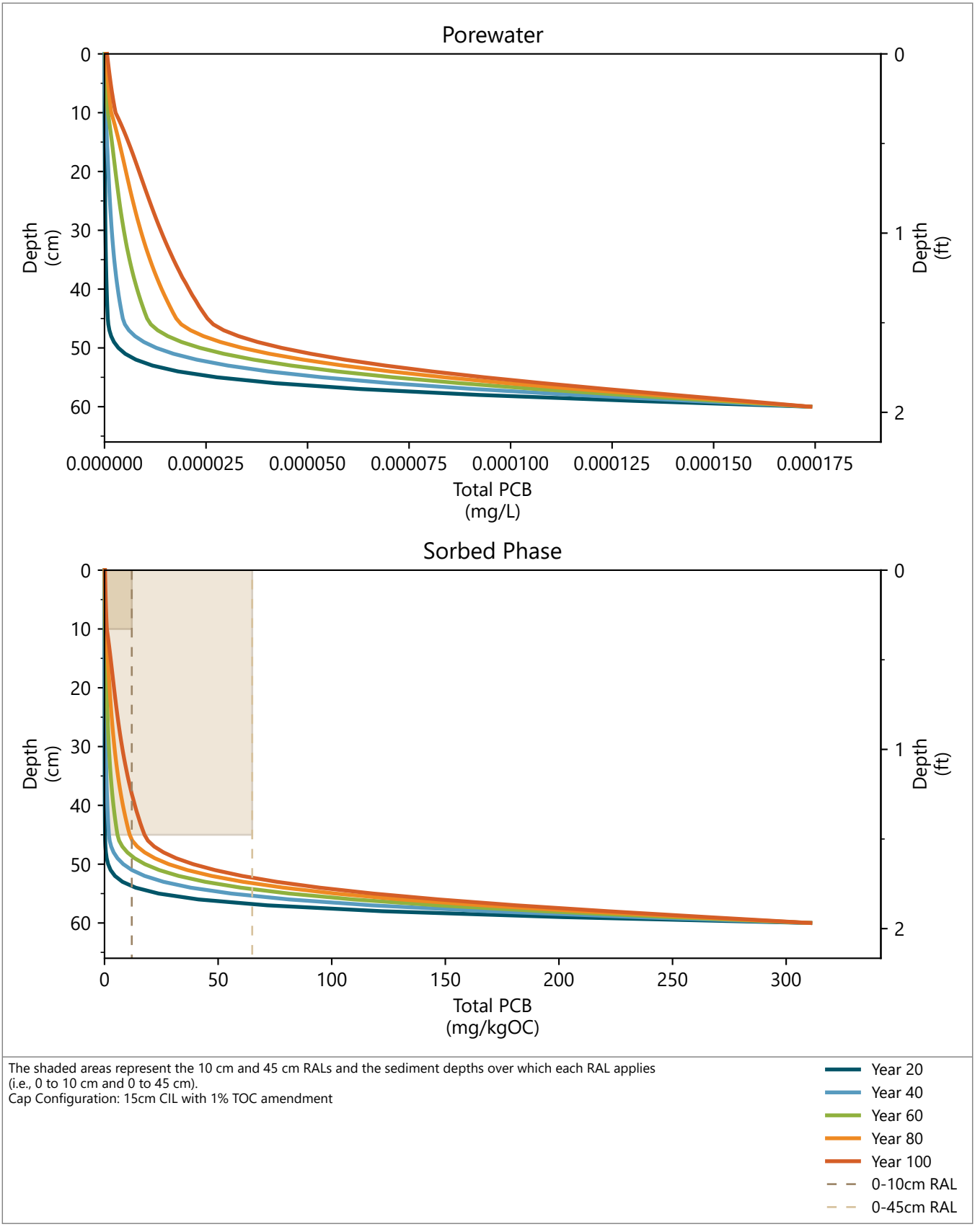
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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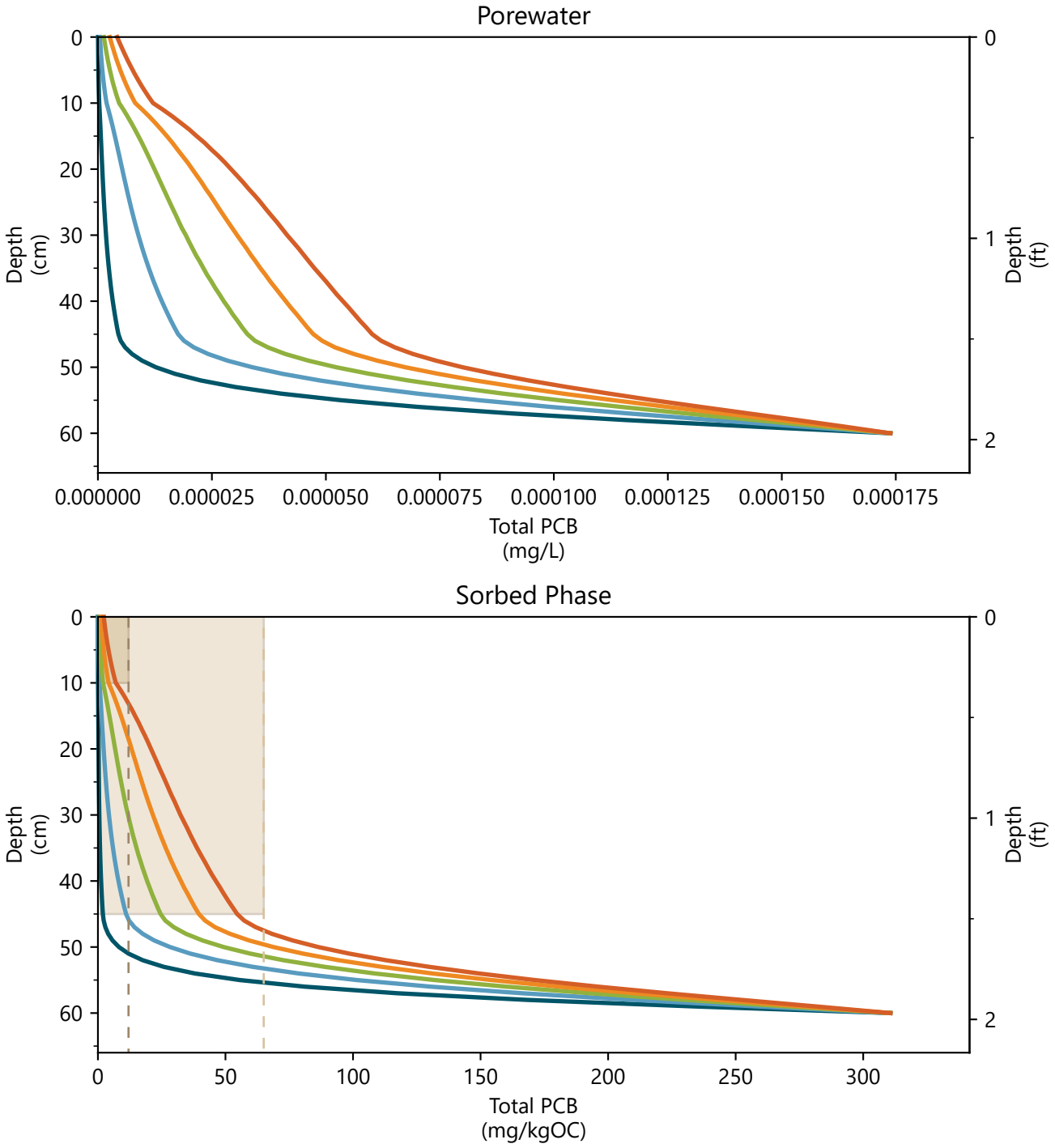
Figure H.4.2.32a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (800 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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Figure H.4.2.33a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (400 cm/yr Seepage)



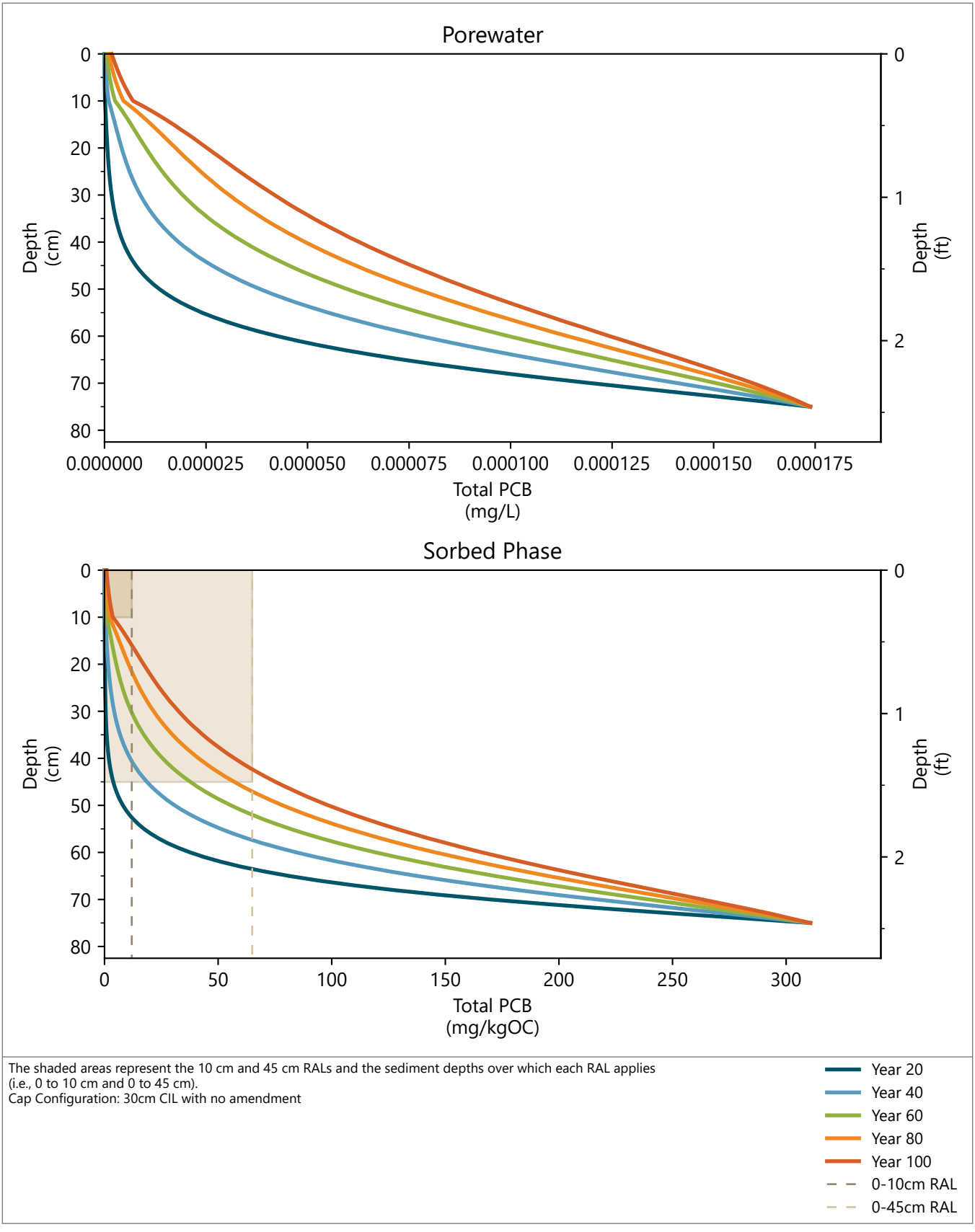
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with 1% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL
0-45cm RAL

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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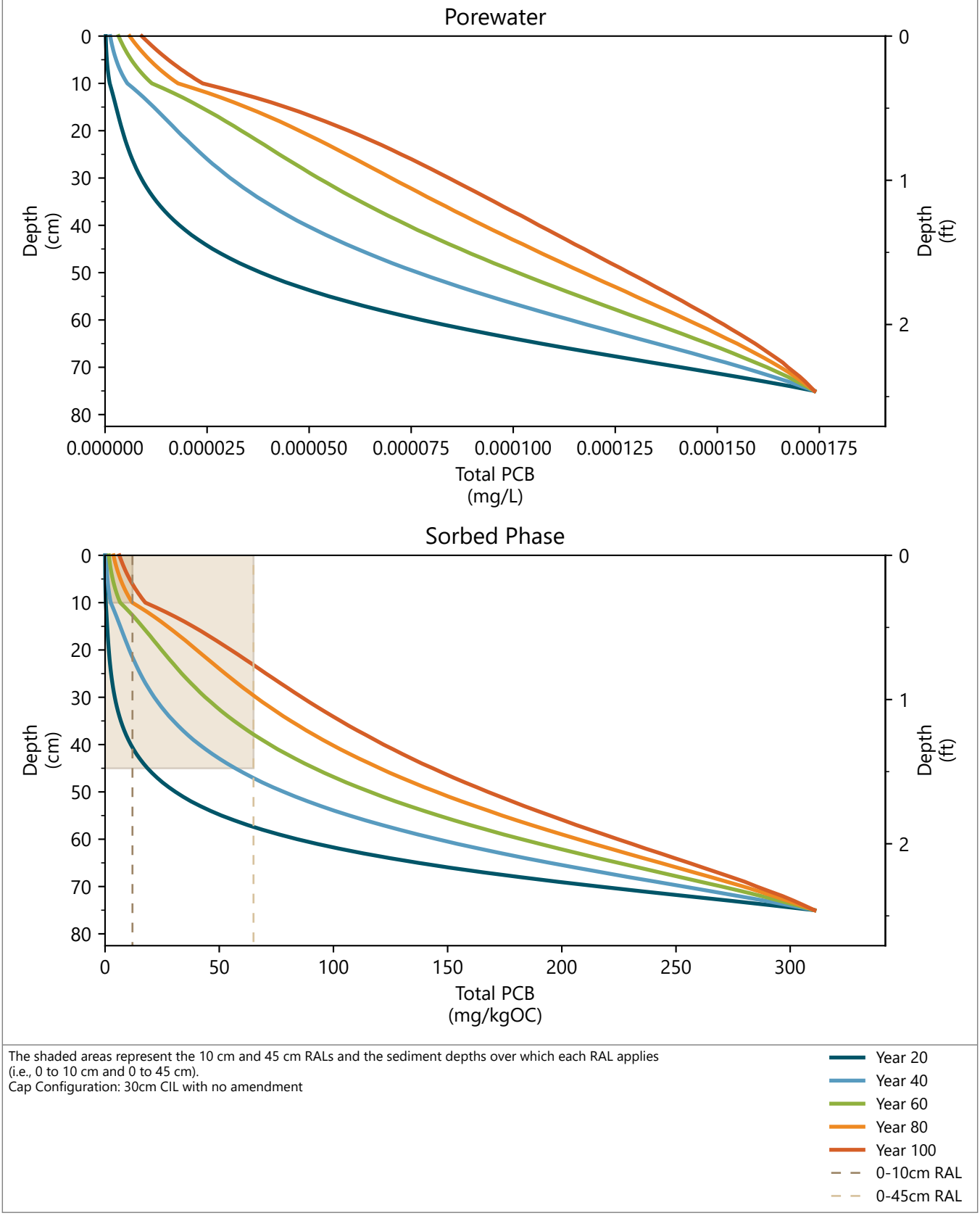
Figure H.4.2.34a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (800 cm/yr Seepage)



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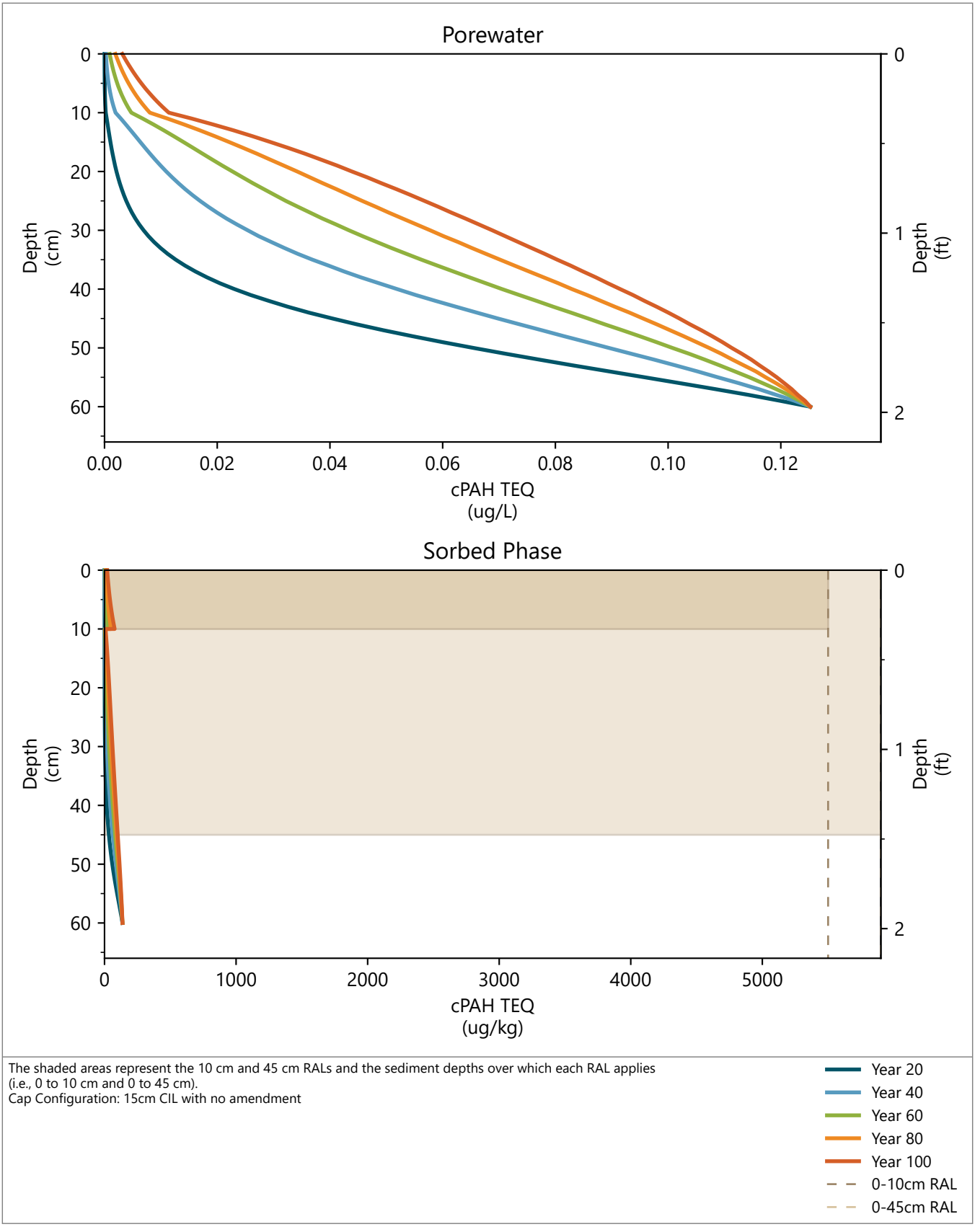
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Figure H.4.2.35a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.36a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap (800 cm/yr Seepage)

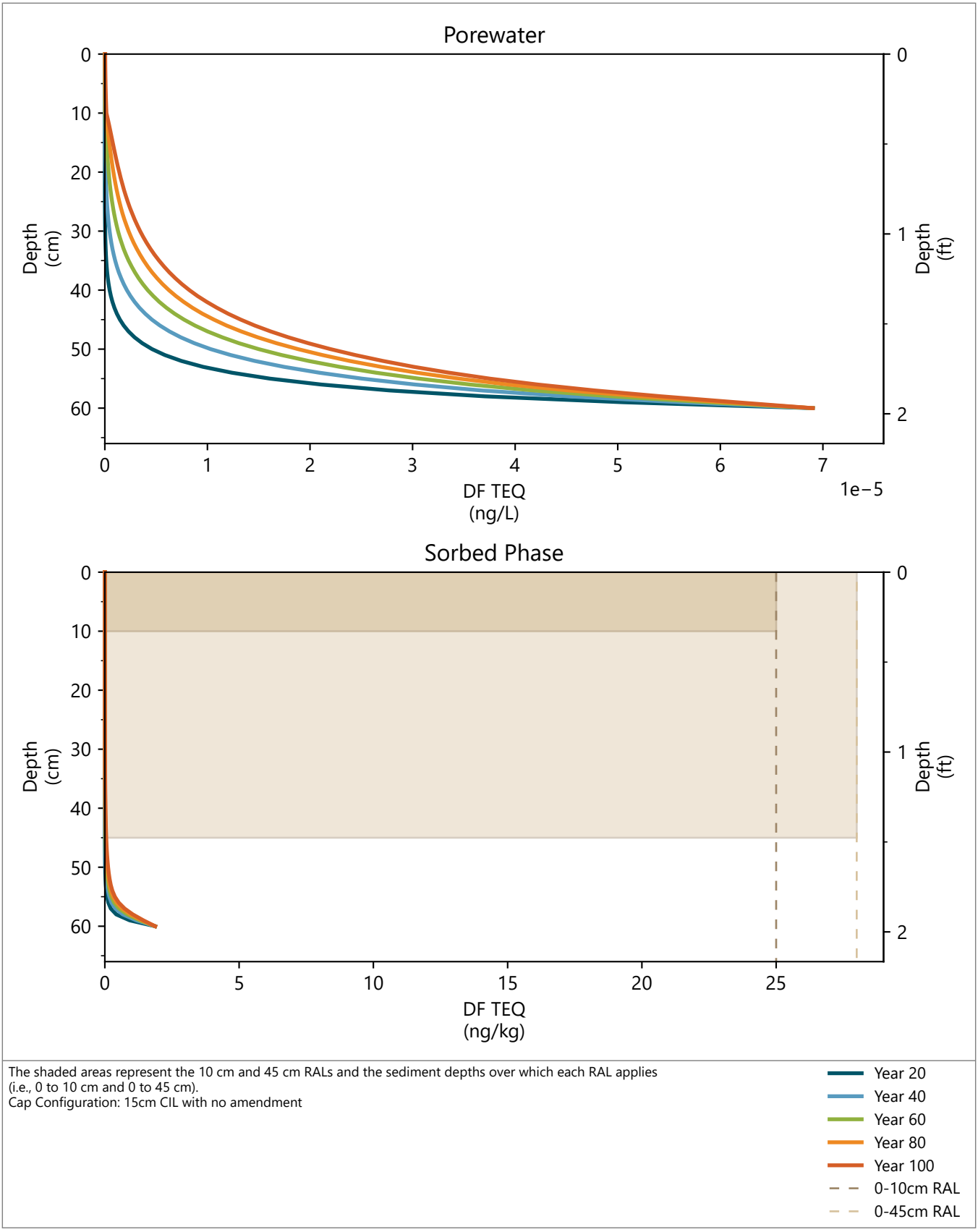


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 15cm CIL with no amendment

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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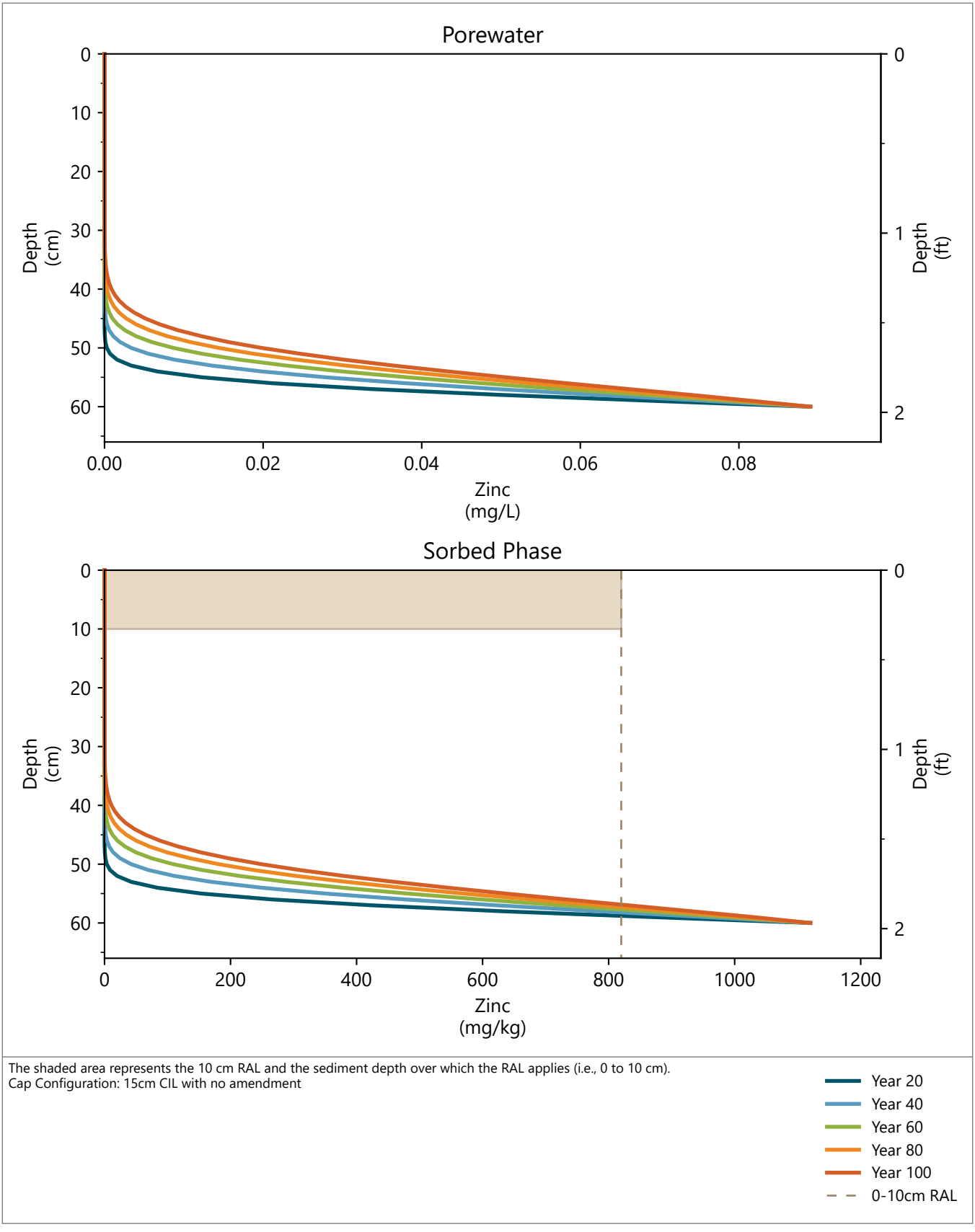
Figure H.4.2.37a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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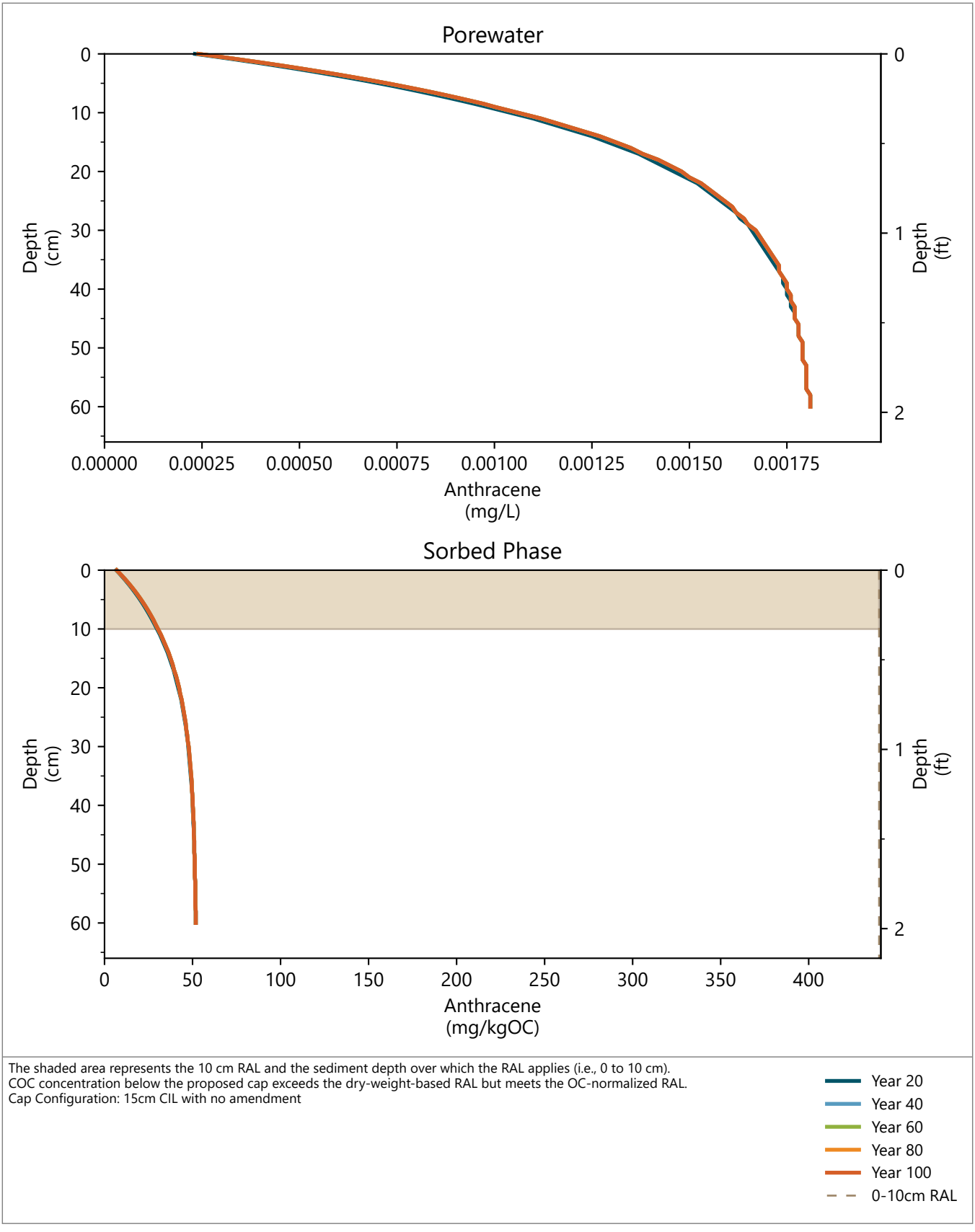
Figure H.4.2.37b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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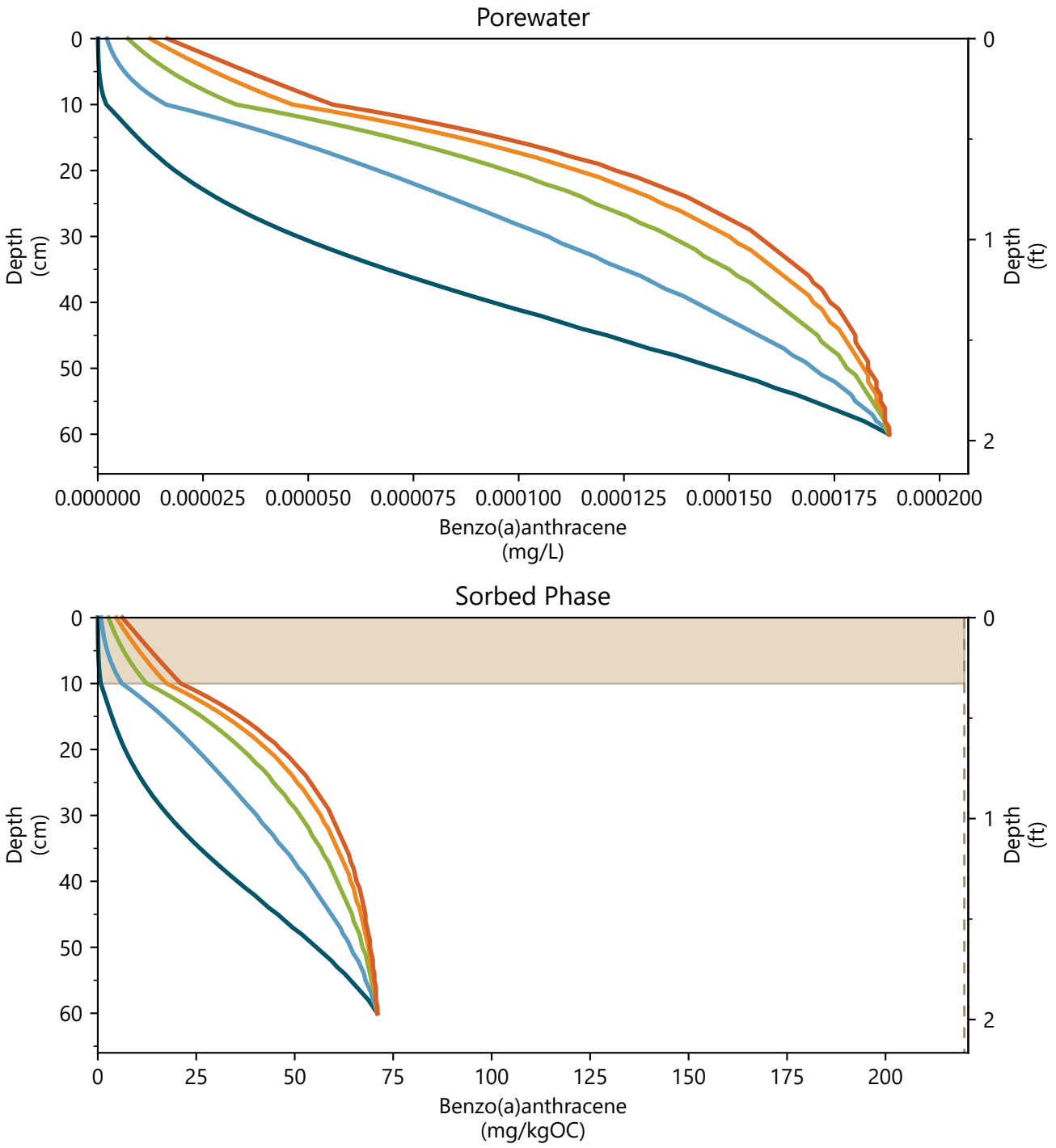
Figure H.4.2.37c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.37d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



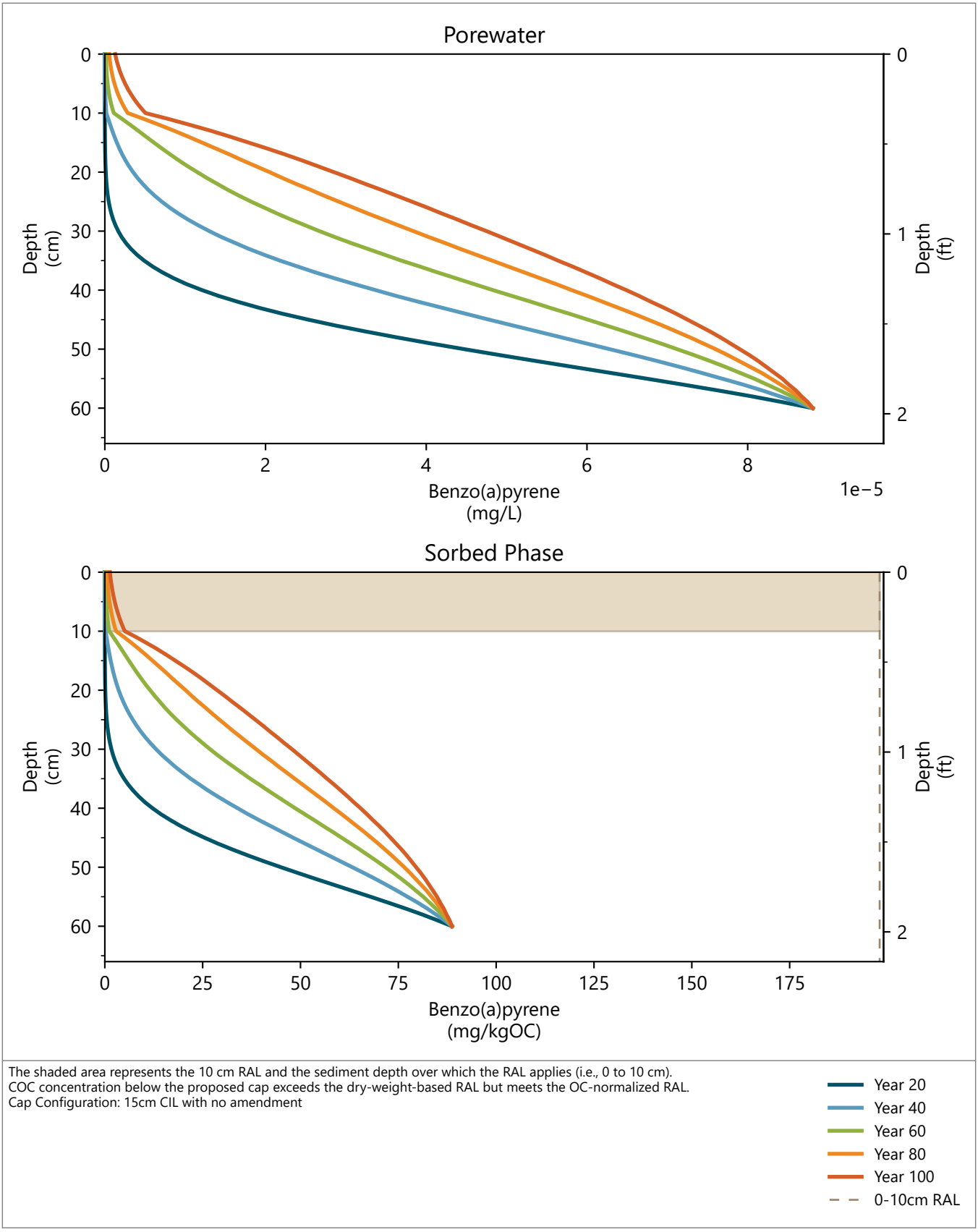
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL

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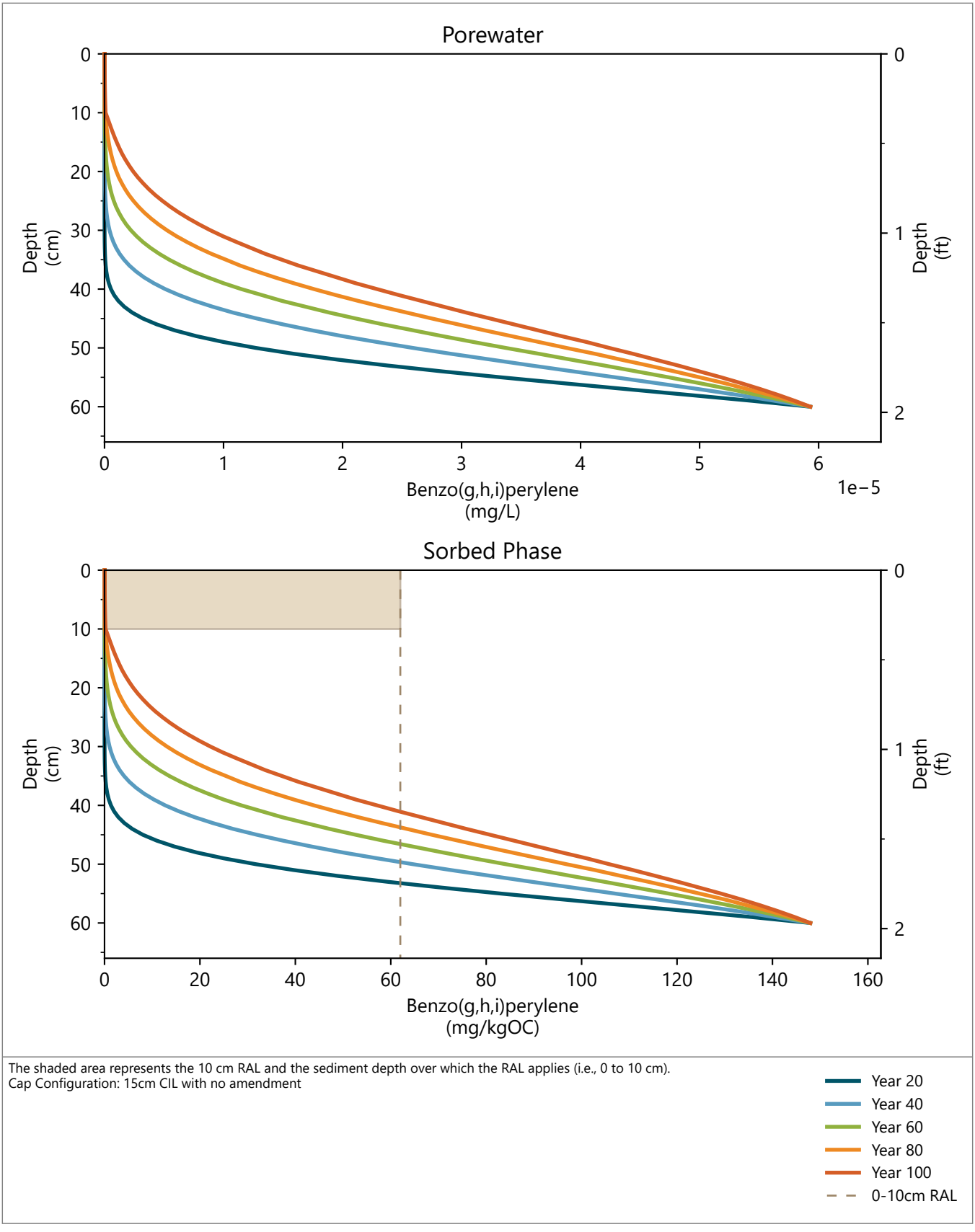
Figure H.4.2.37e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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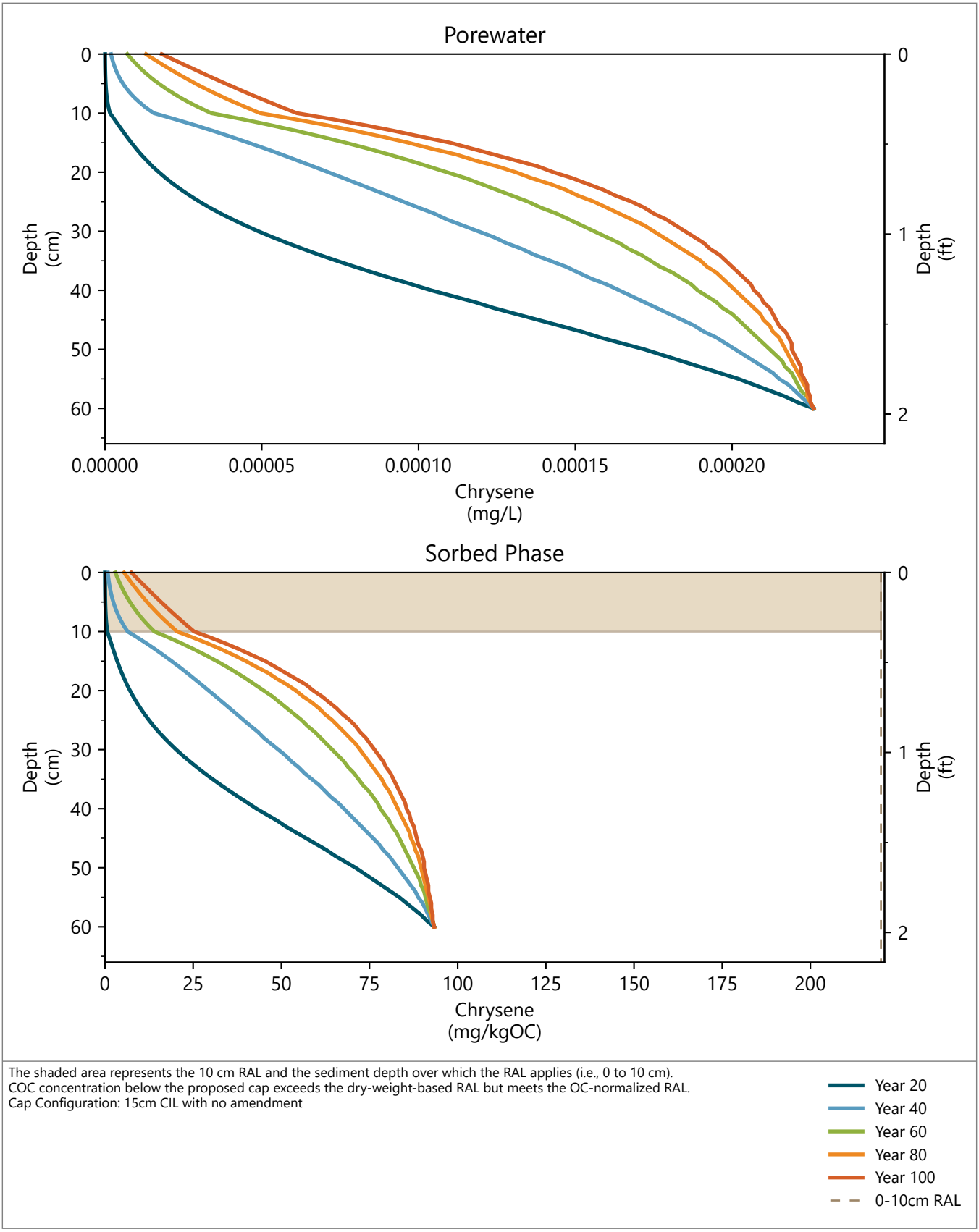
Figure H.4.2.37f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

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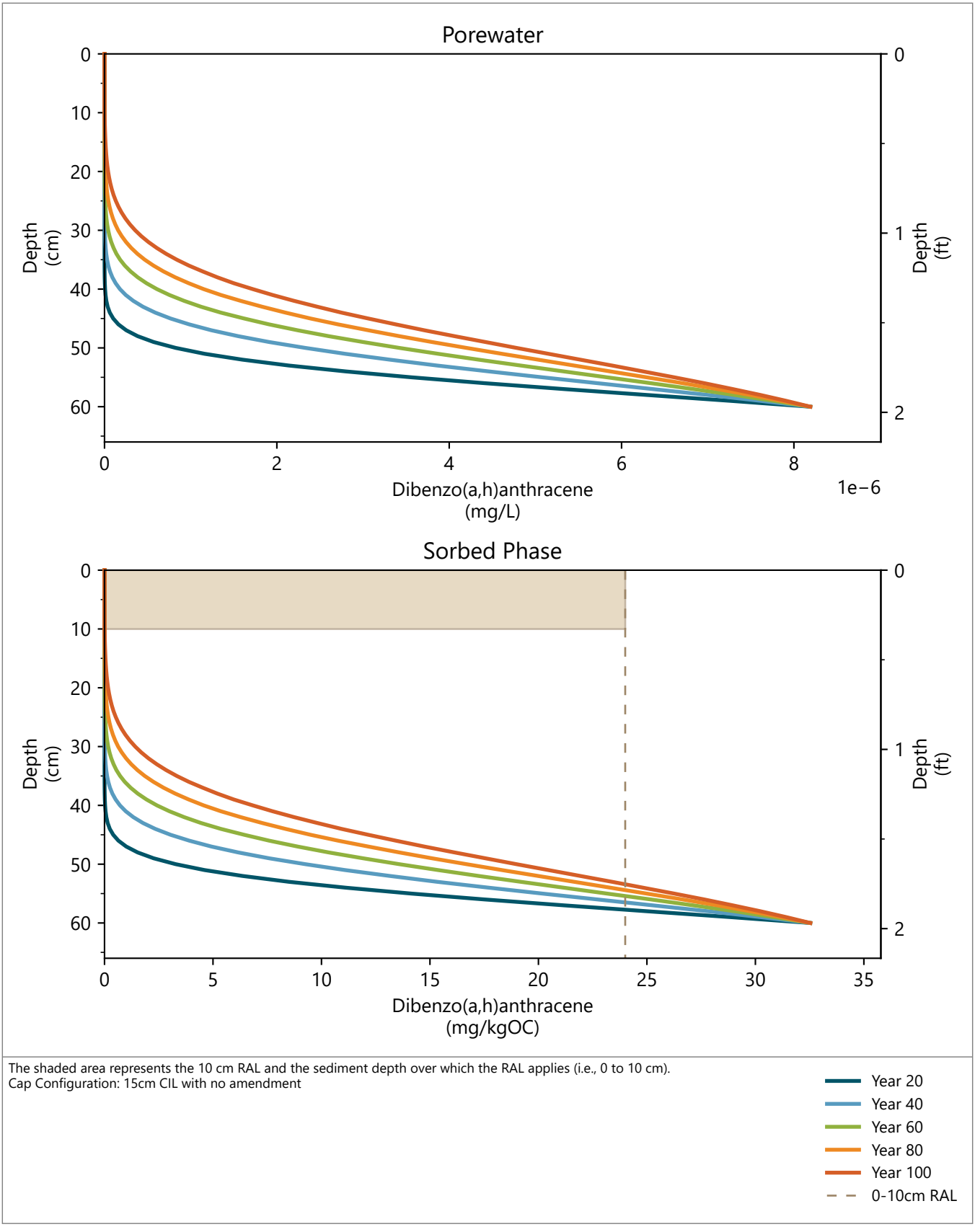
Figure H.4.2.37g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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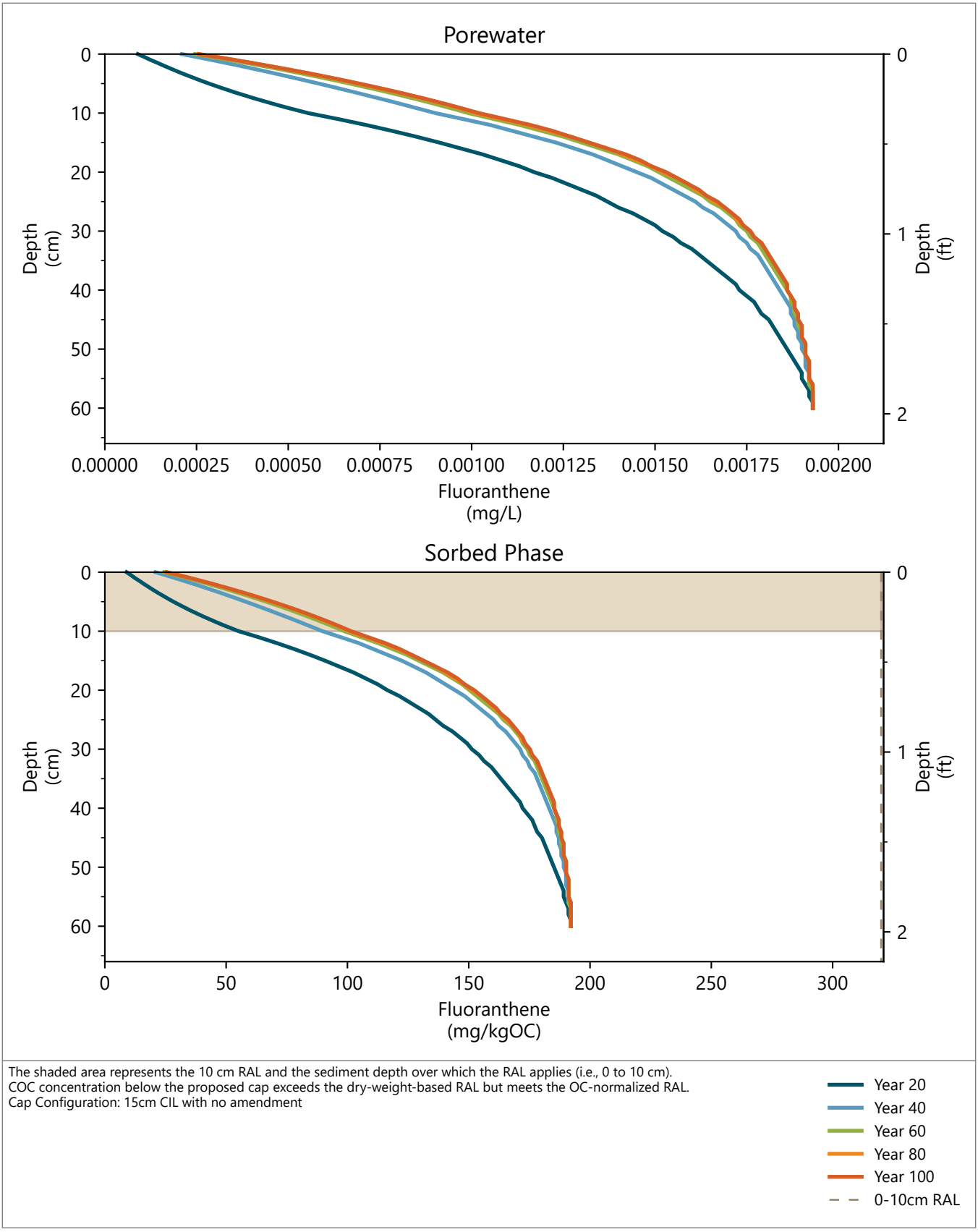
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Figure H.4.2.37h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

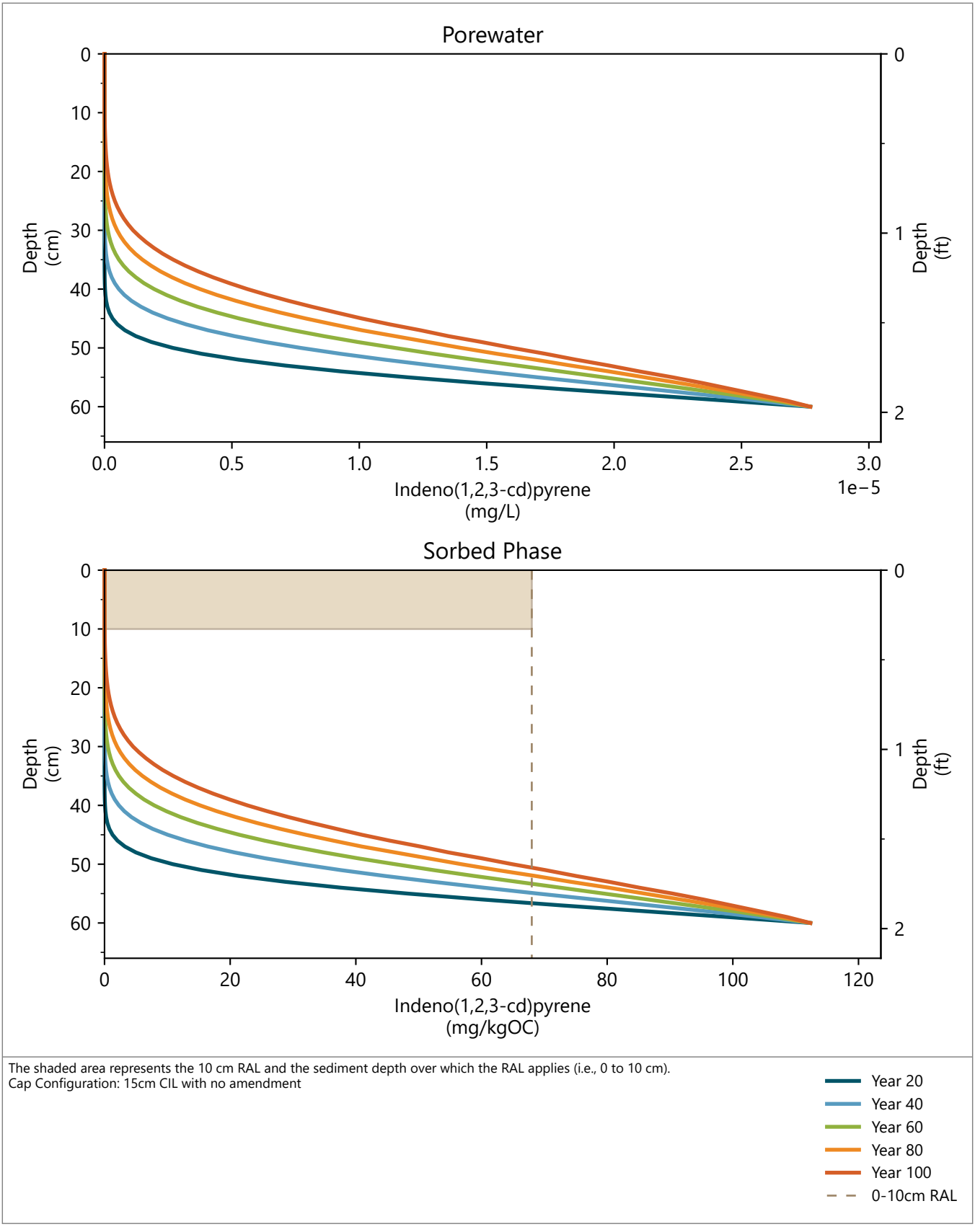
Figure H.4.2.37i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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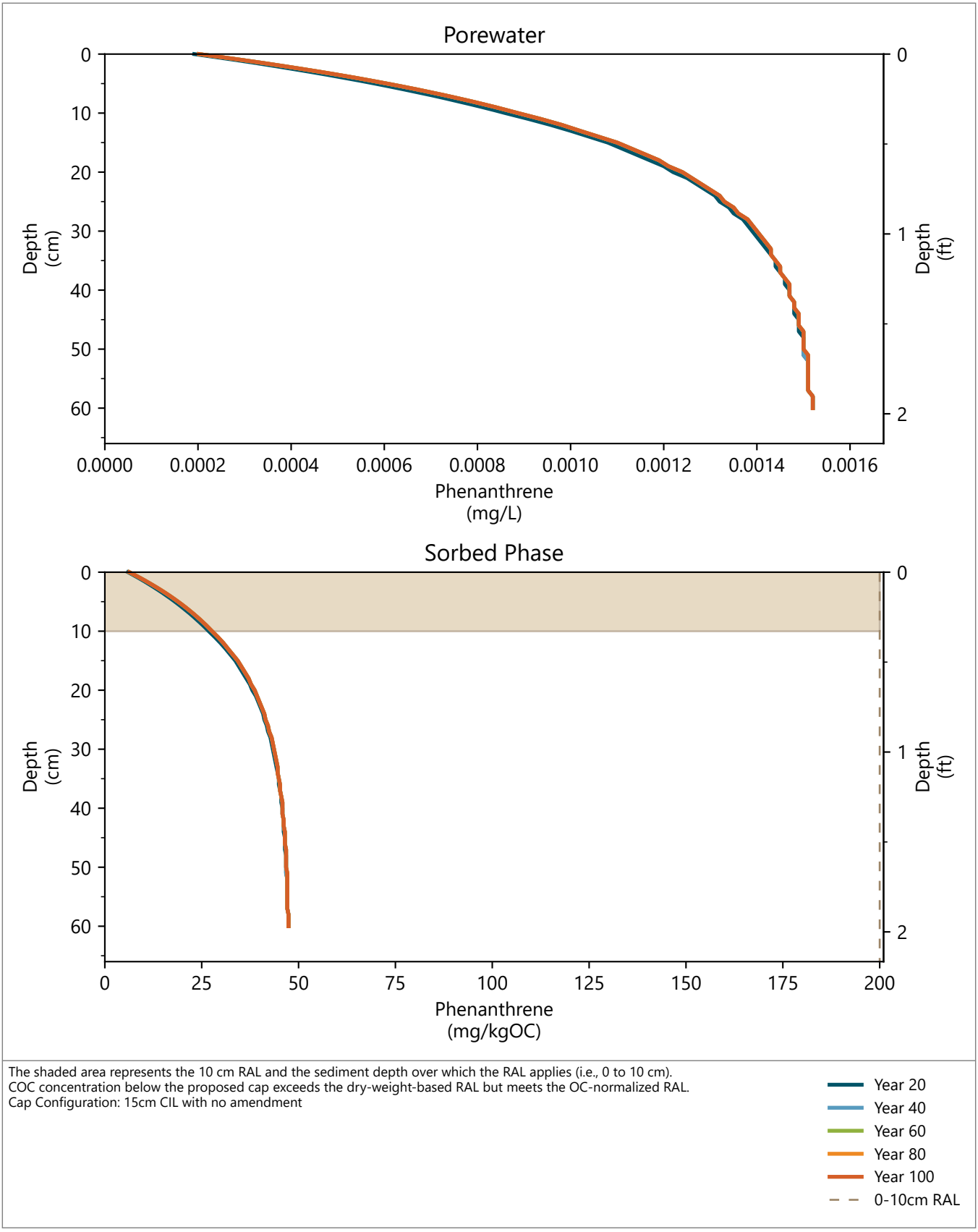
Figure H.4.2.37j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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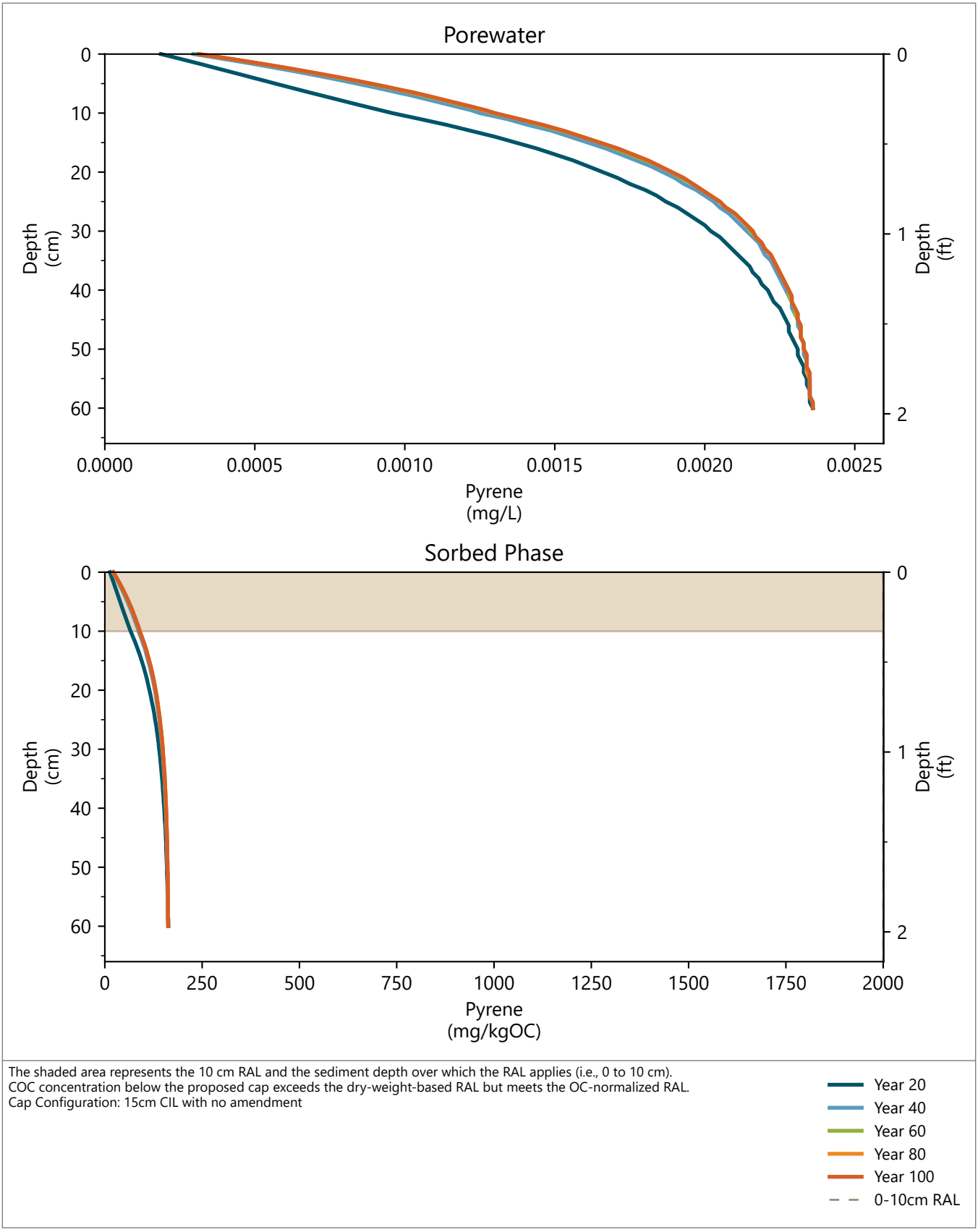
Figure H.4.2.37k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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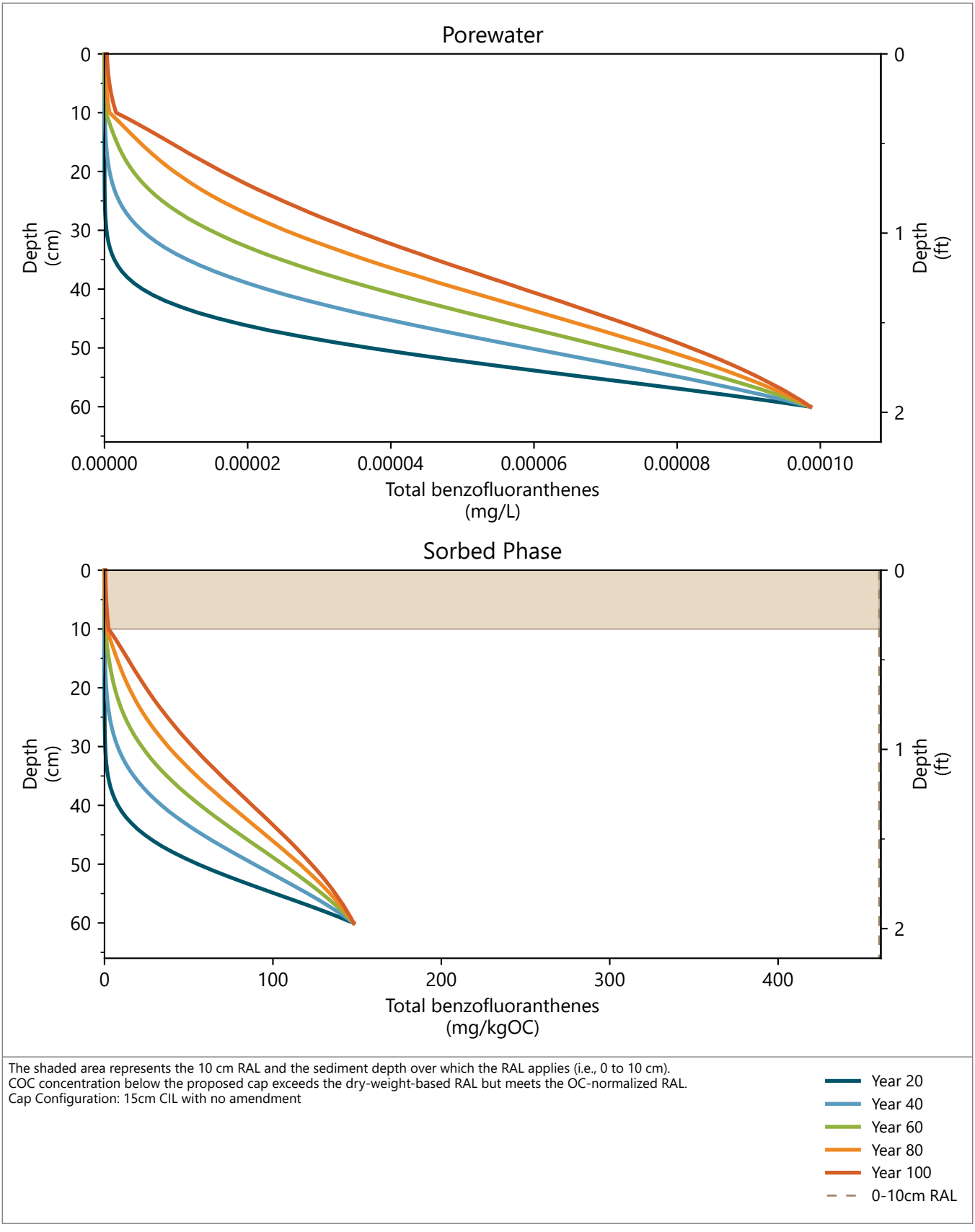
Figure H.4.2.37I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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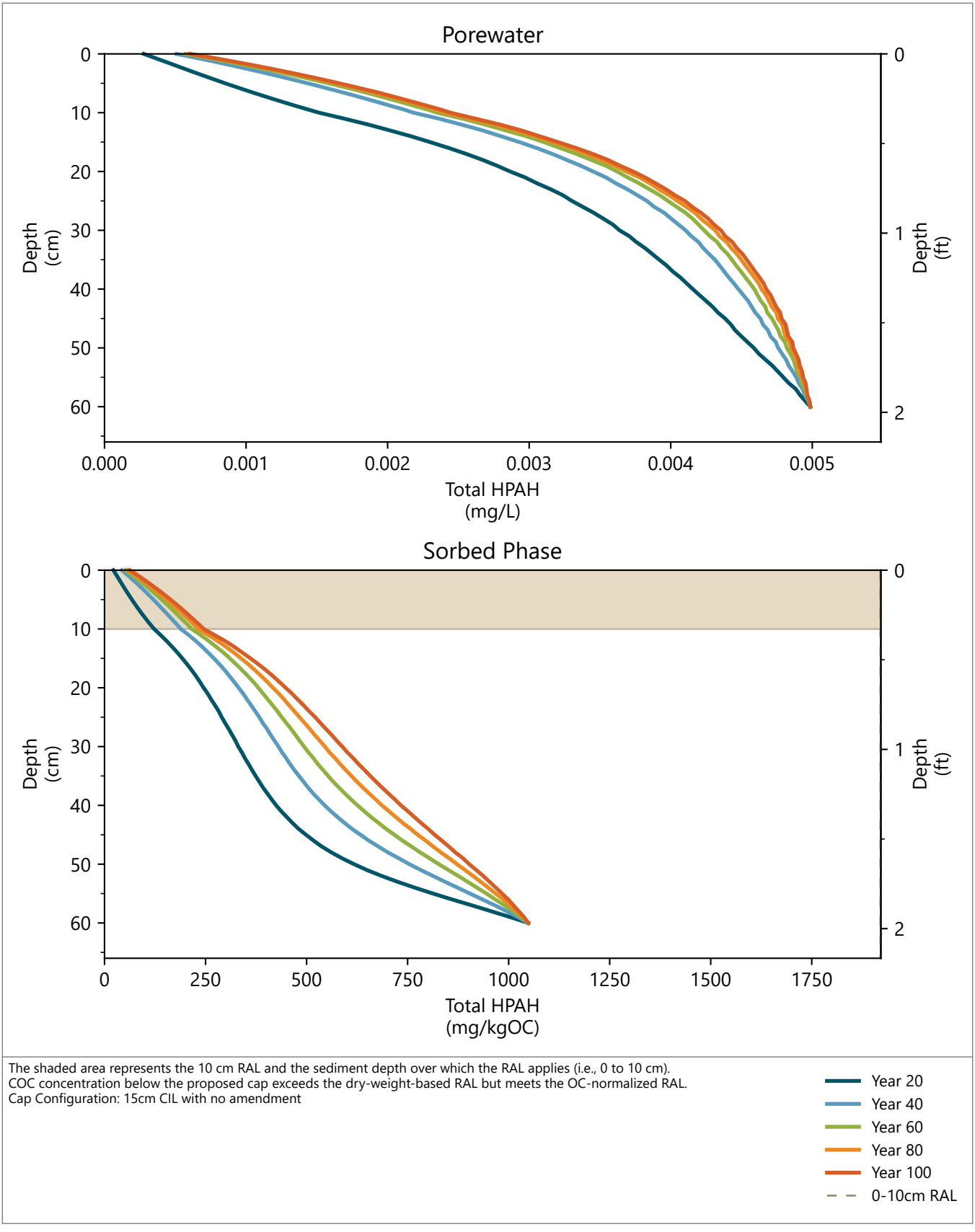
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Figure H.4.2.37m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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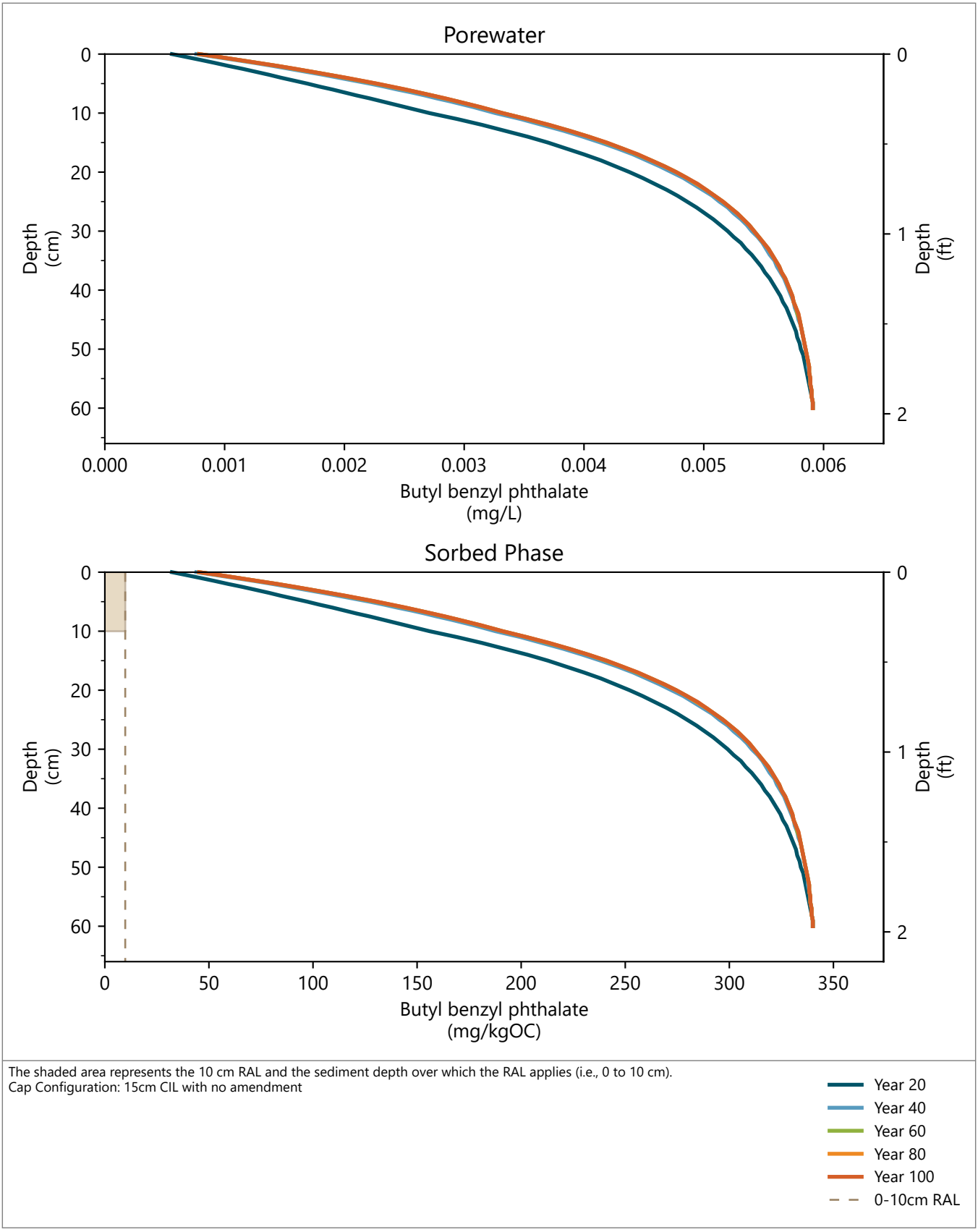
Figure H.4.2.37n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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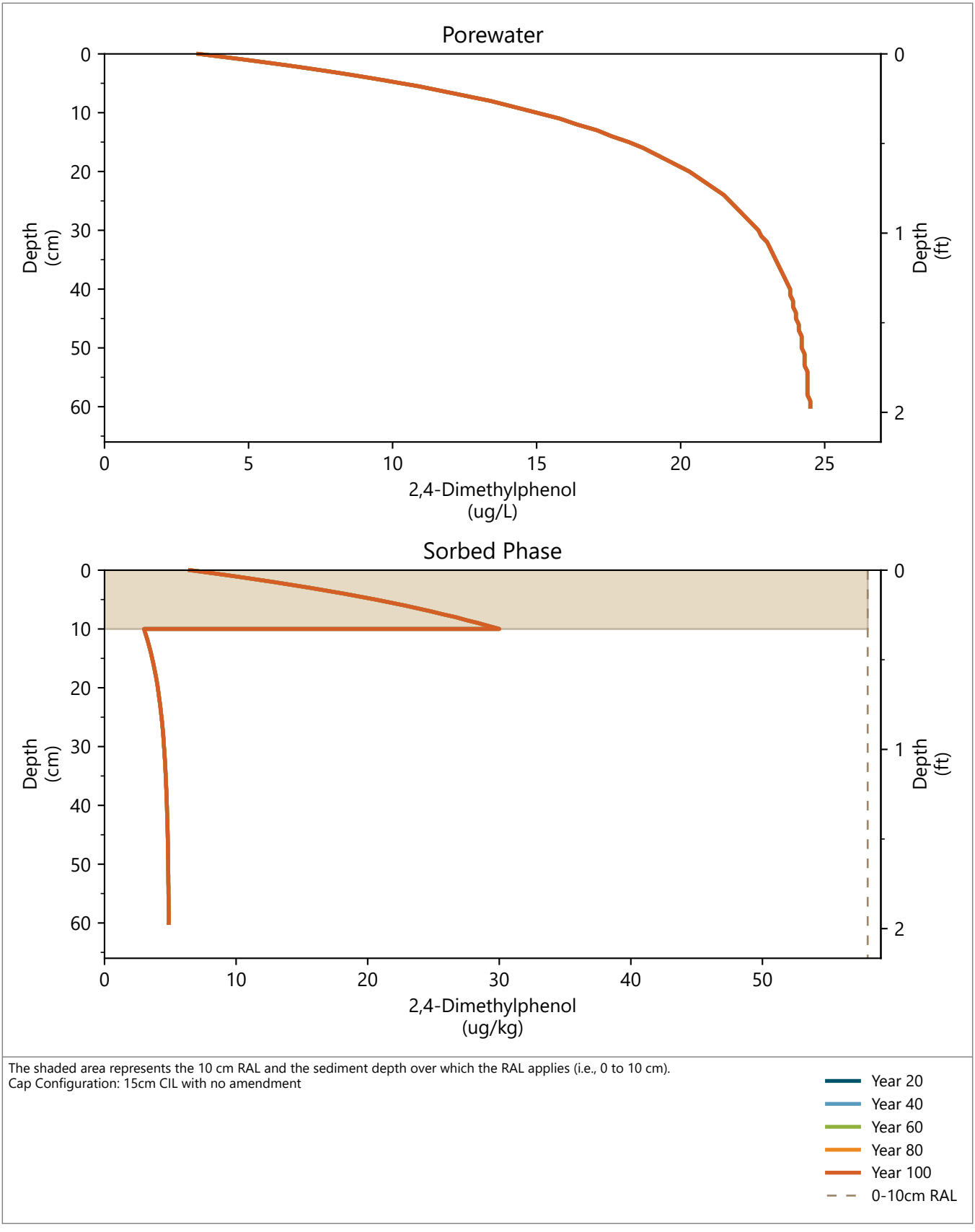
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Figure H.4.2.37o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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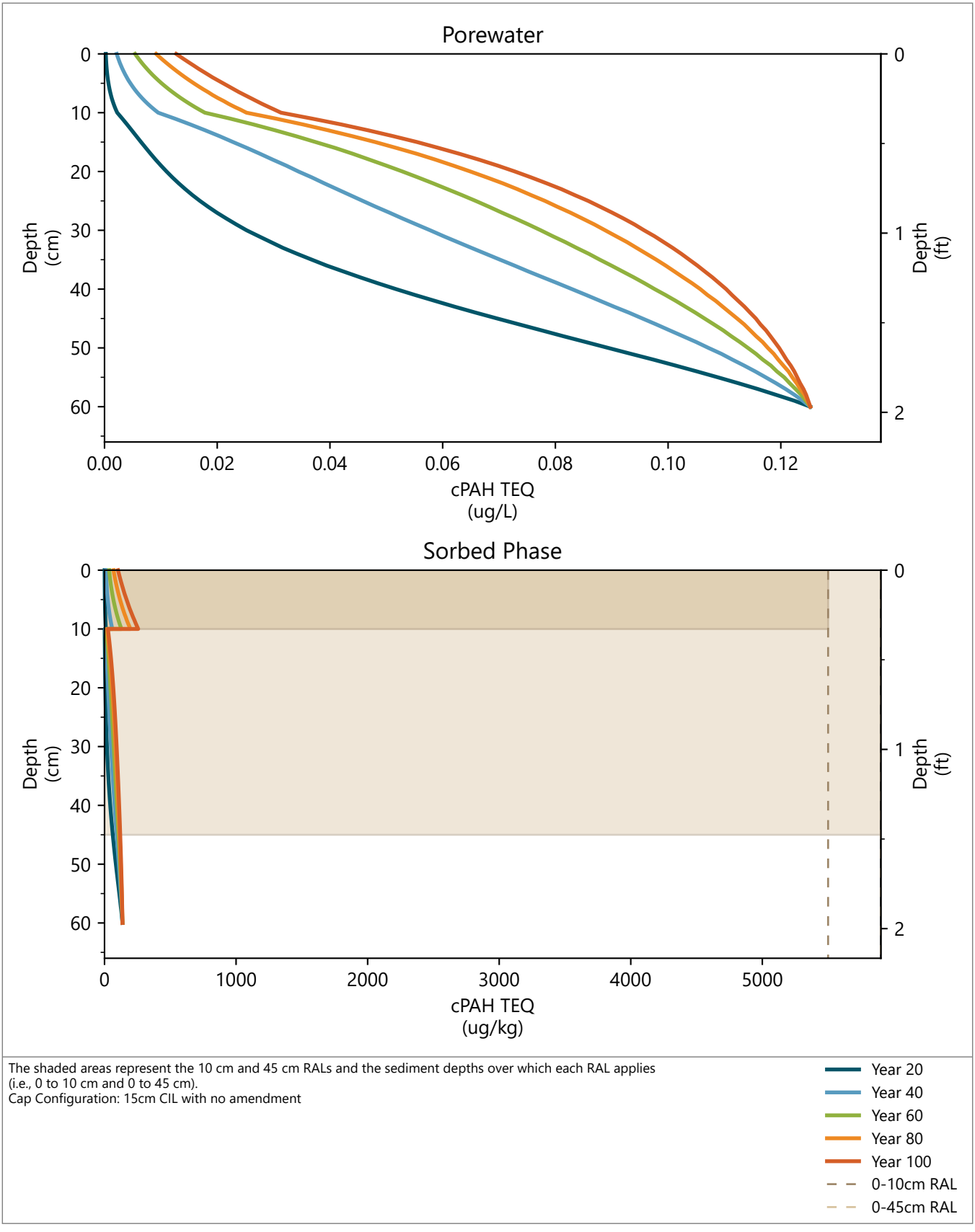
Figure H.4.2.37p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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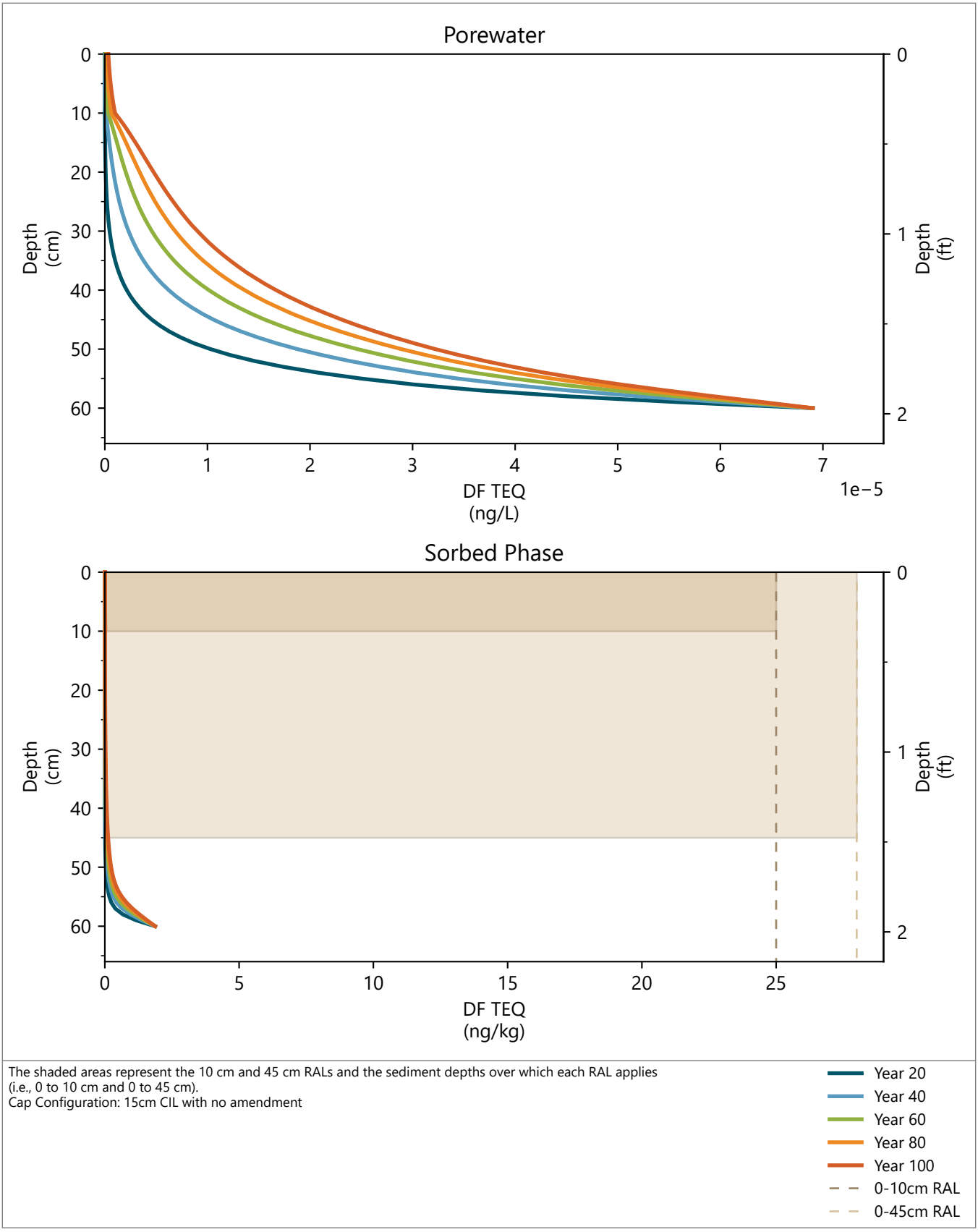
Figure H.4.2.37q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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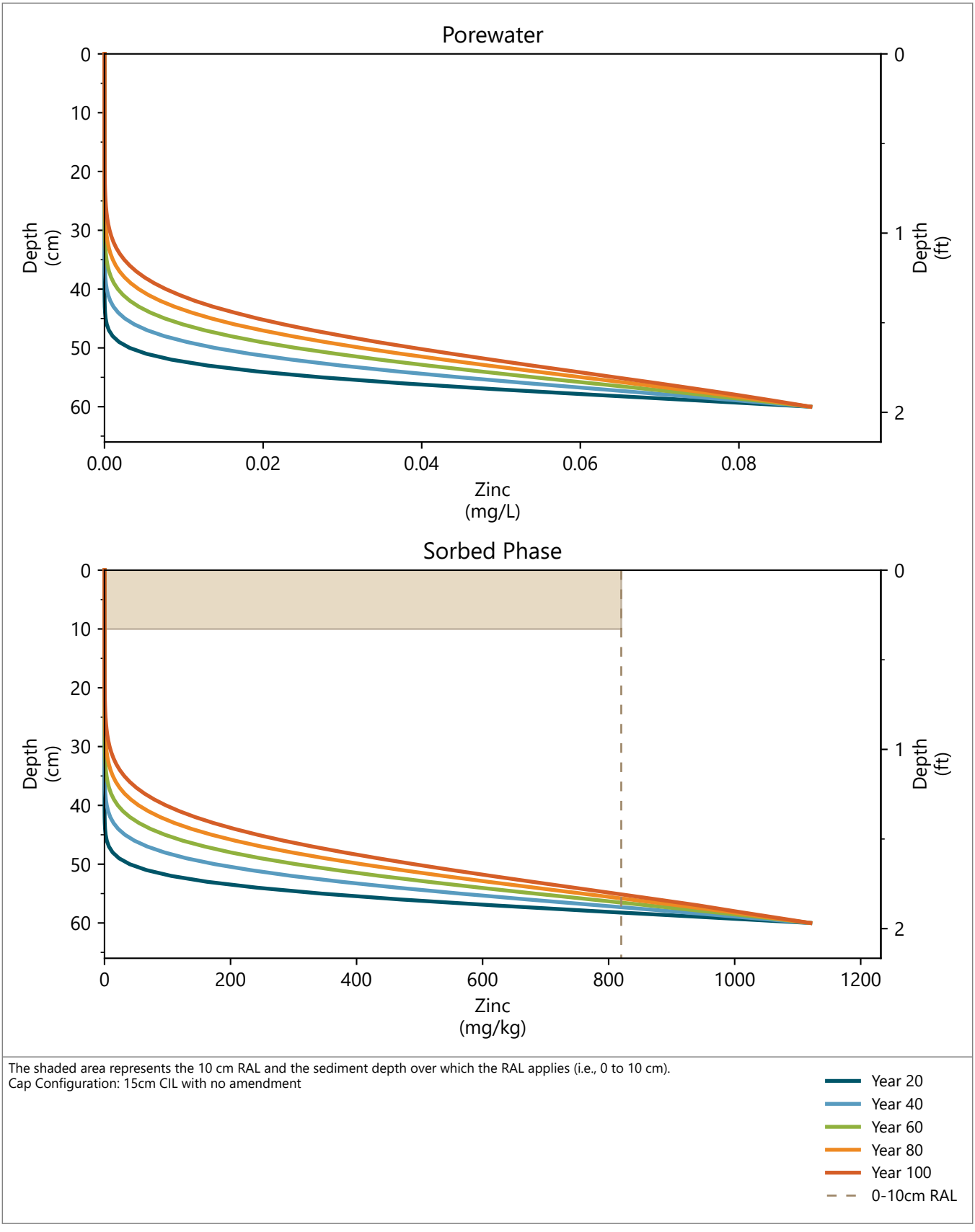
Figure H.4.2.38a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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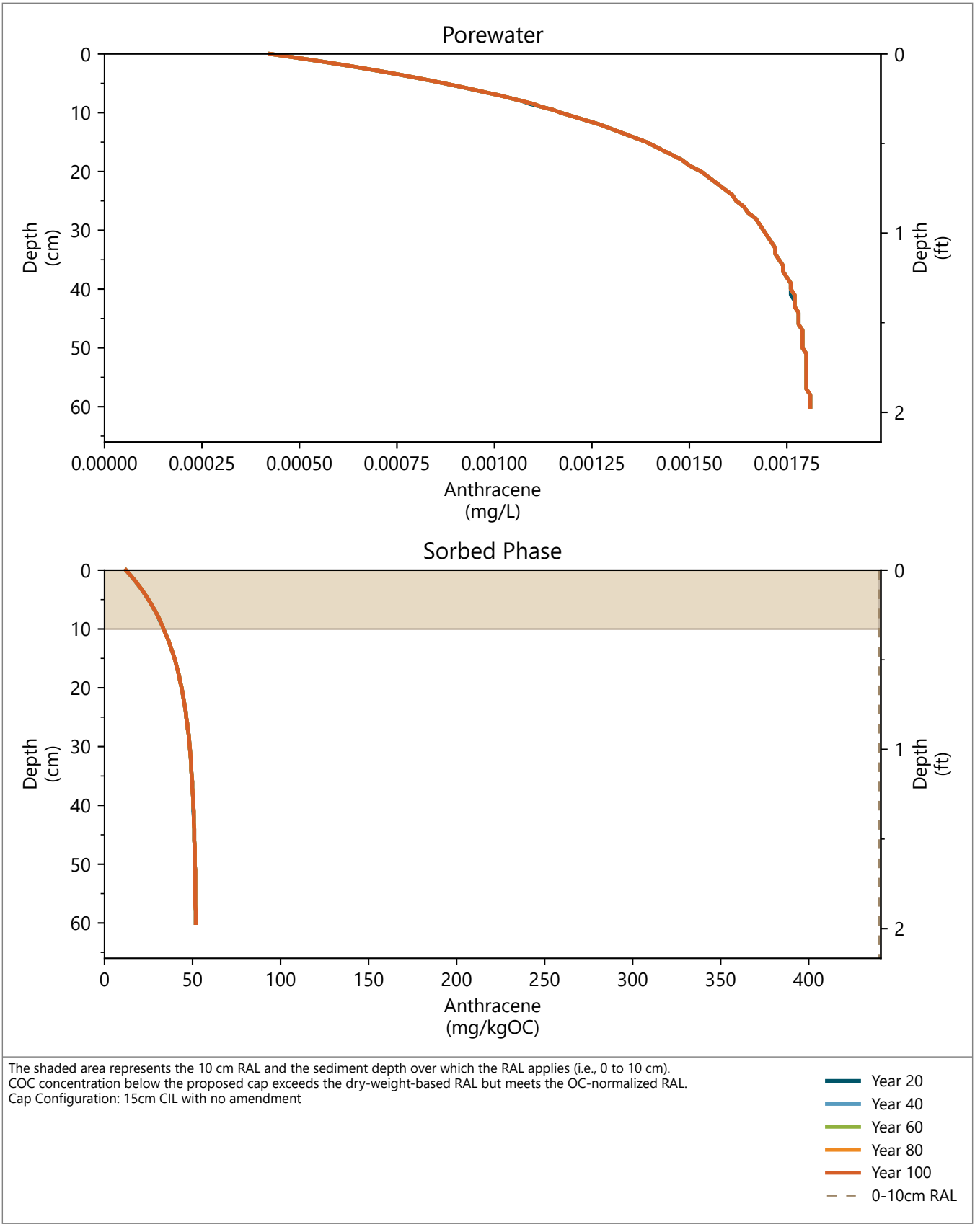
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Figure H.4.2.38b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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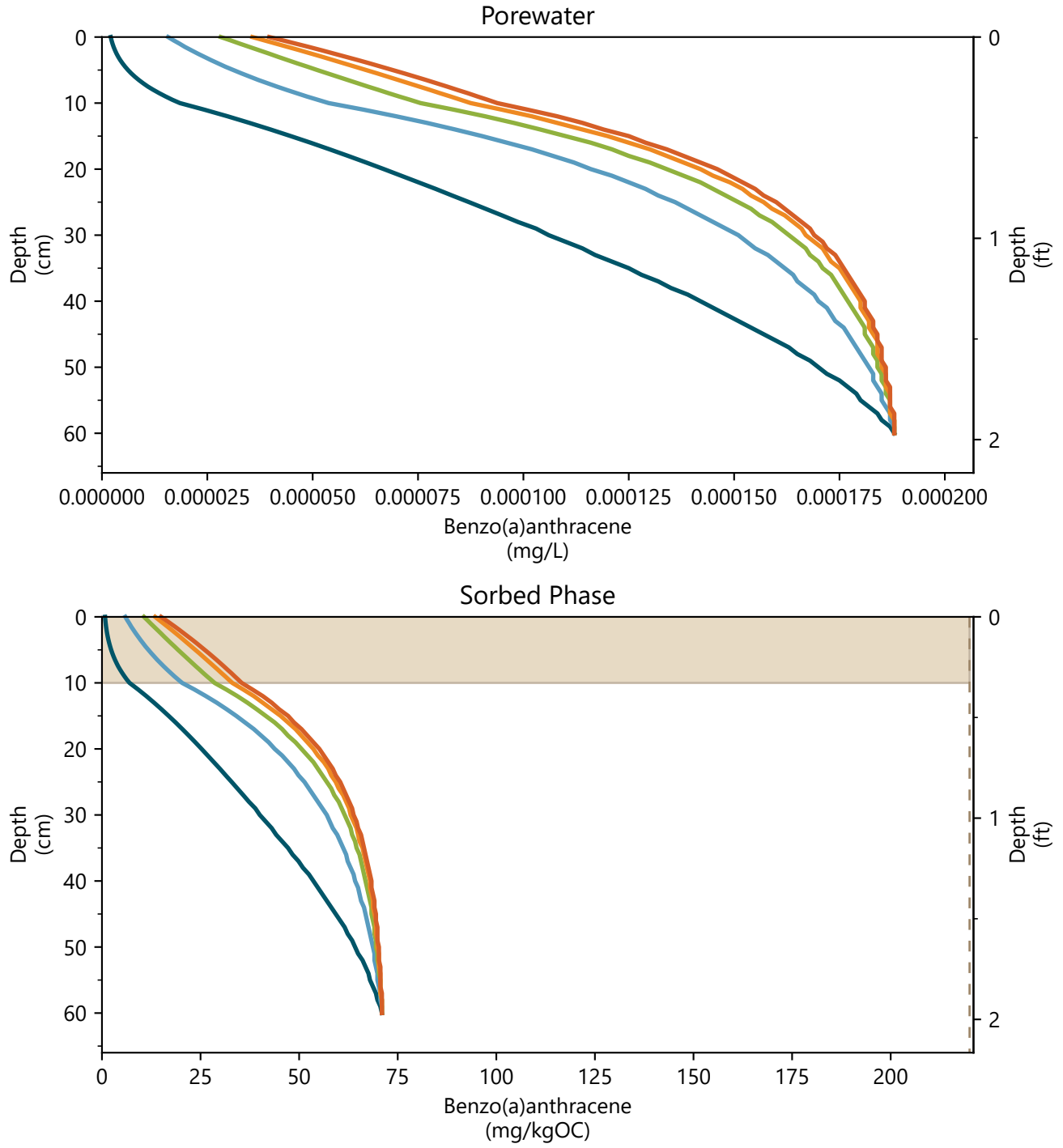
Figure H.4.2.38c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.38d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

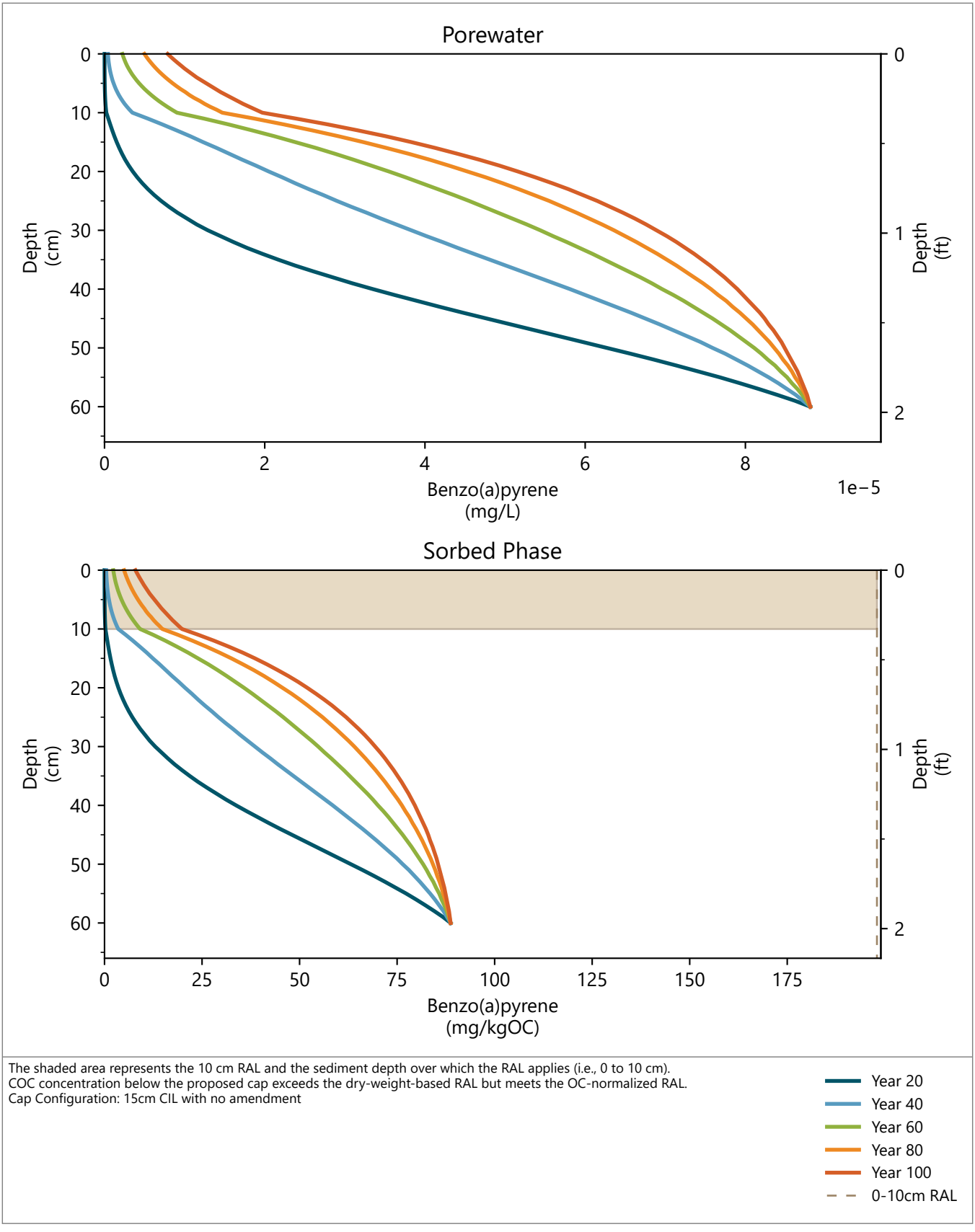


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

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Figure H.4.2.38e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

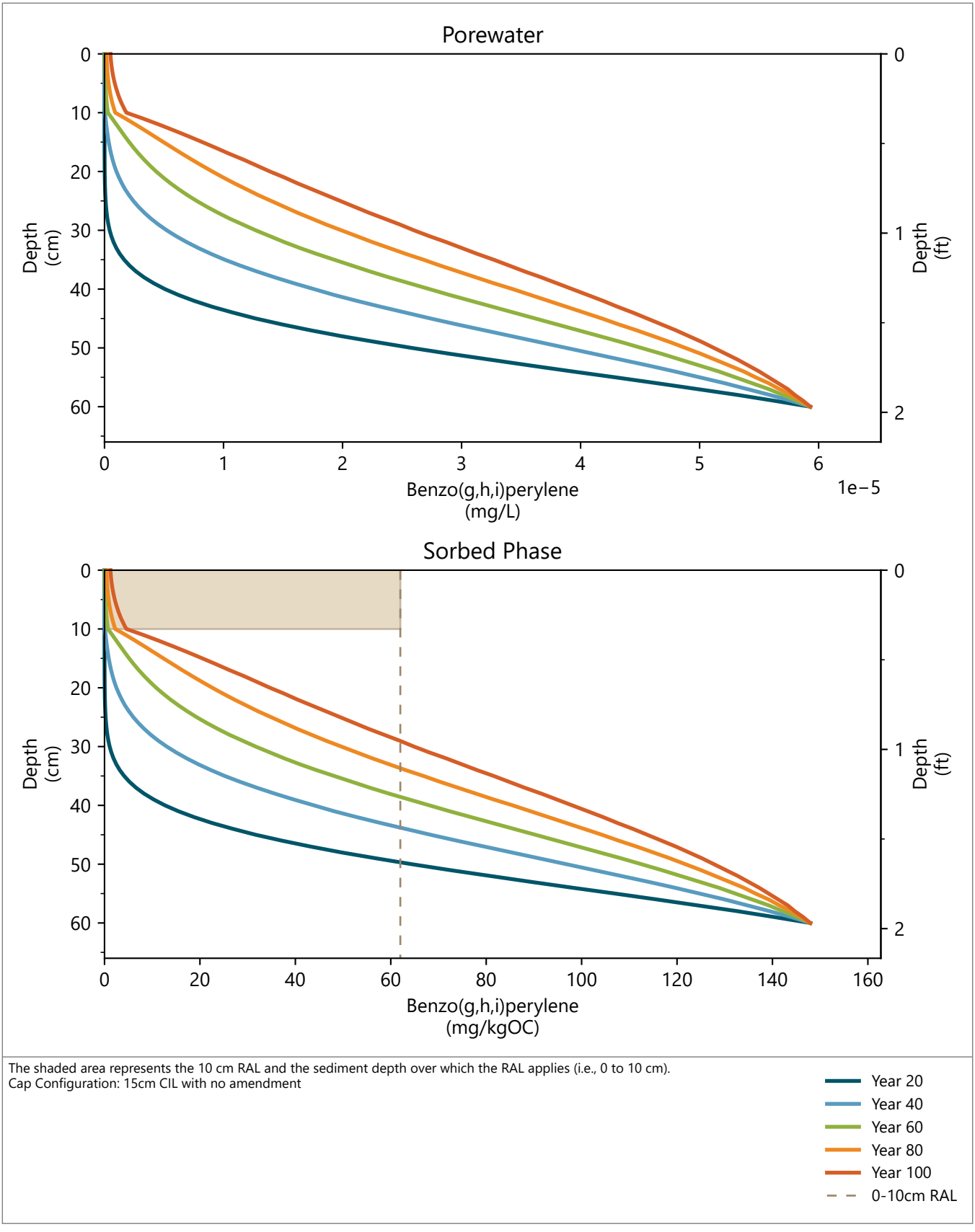


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

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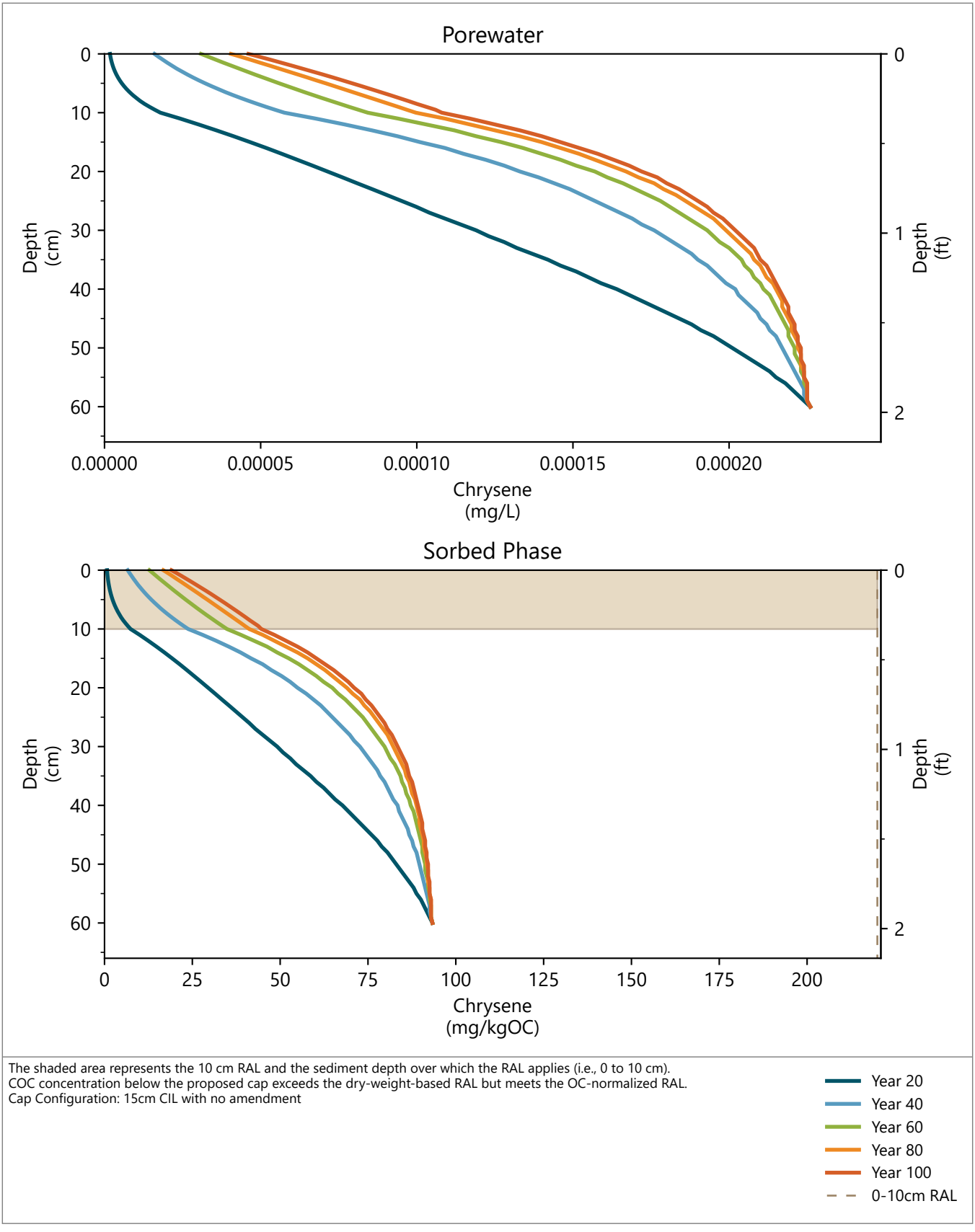
Figure H.4.2.38f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.38g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

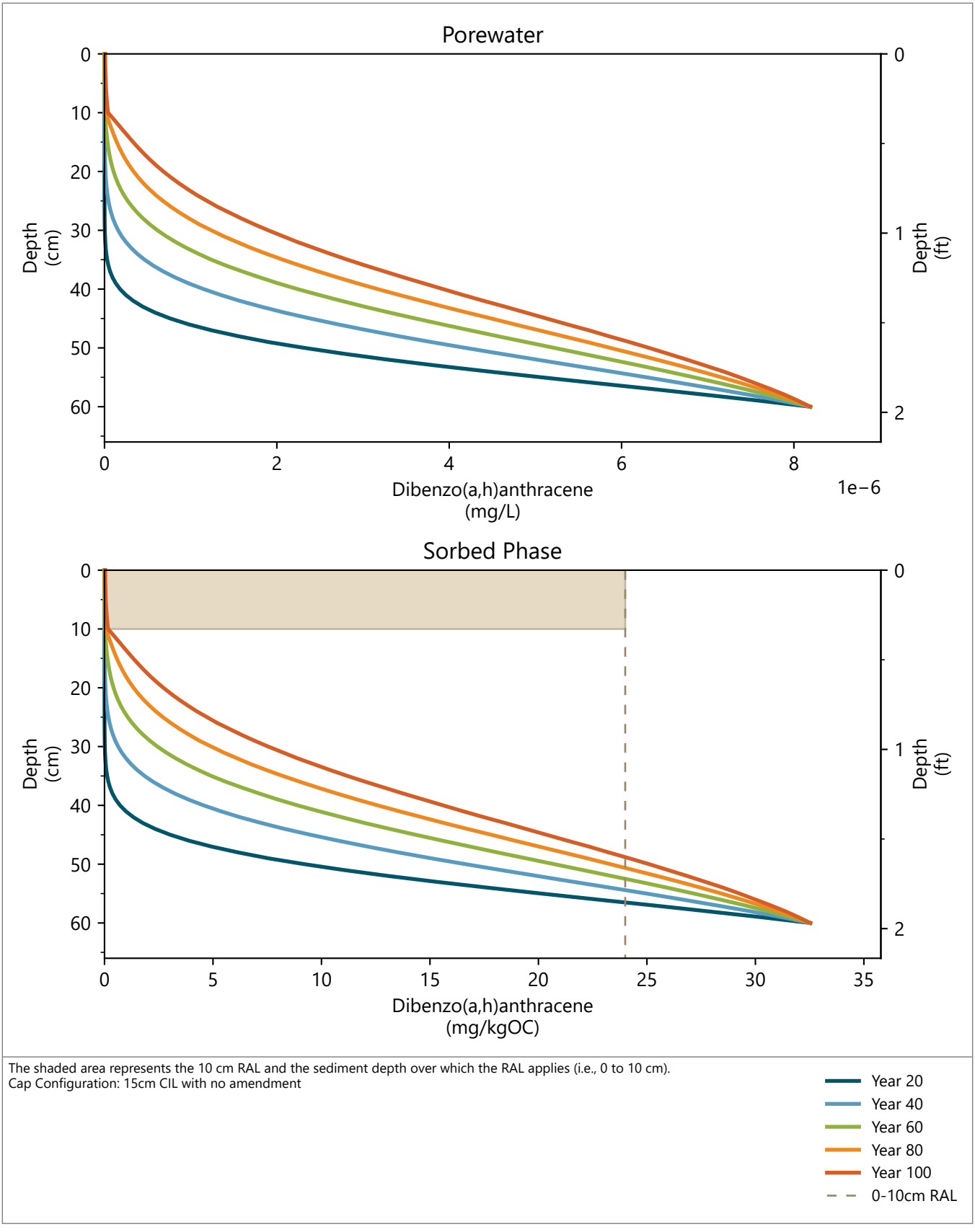


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

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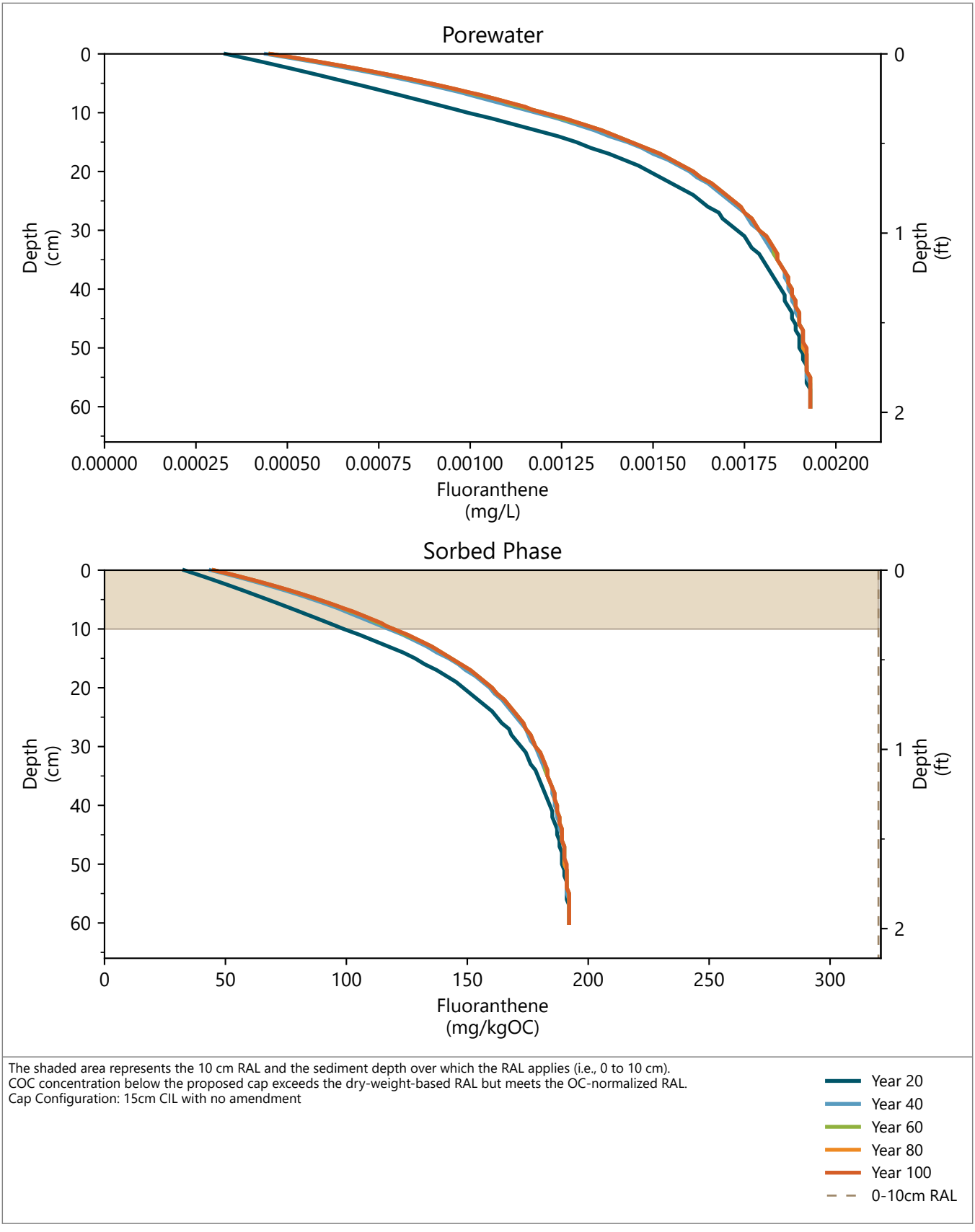
Figure H.4.2.38h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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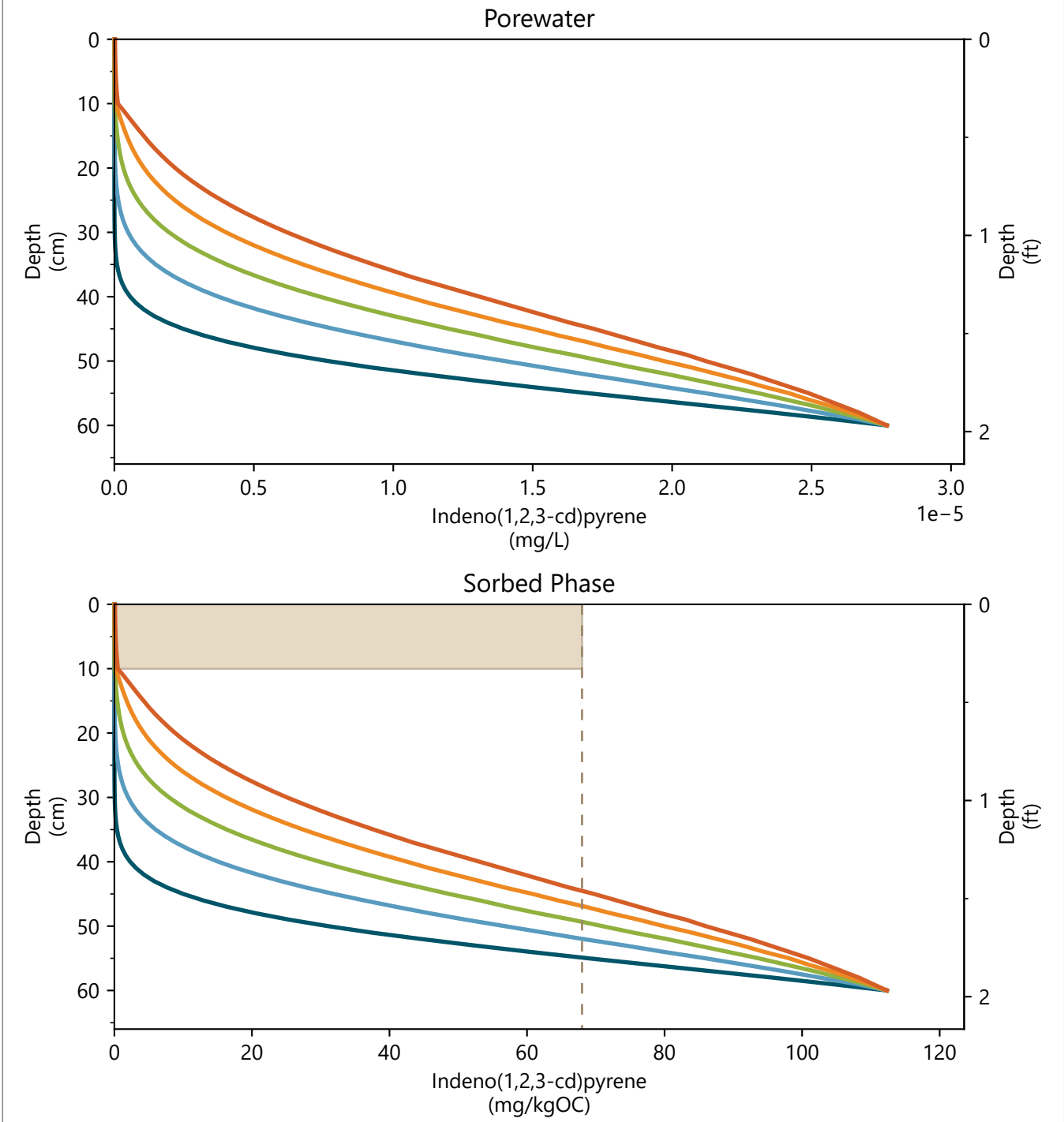
Figure H.4.2.38i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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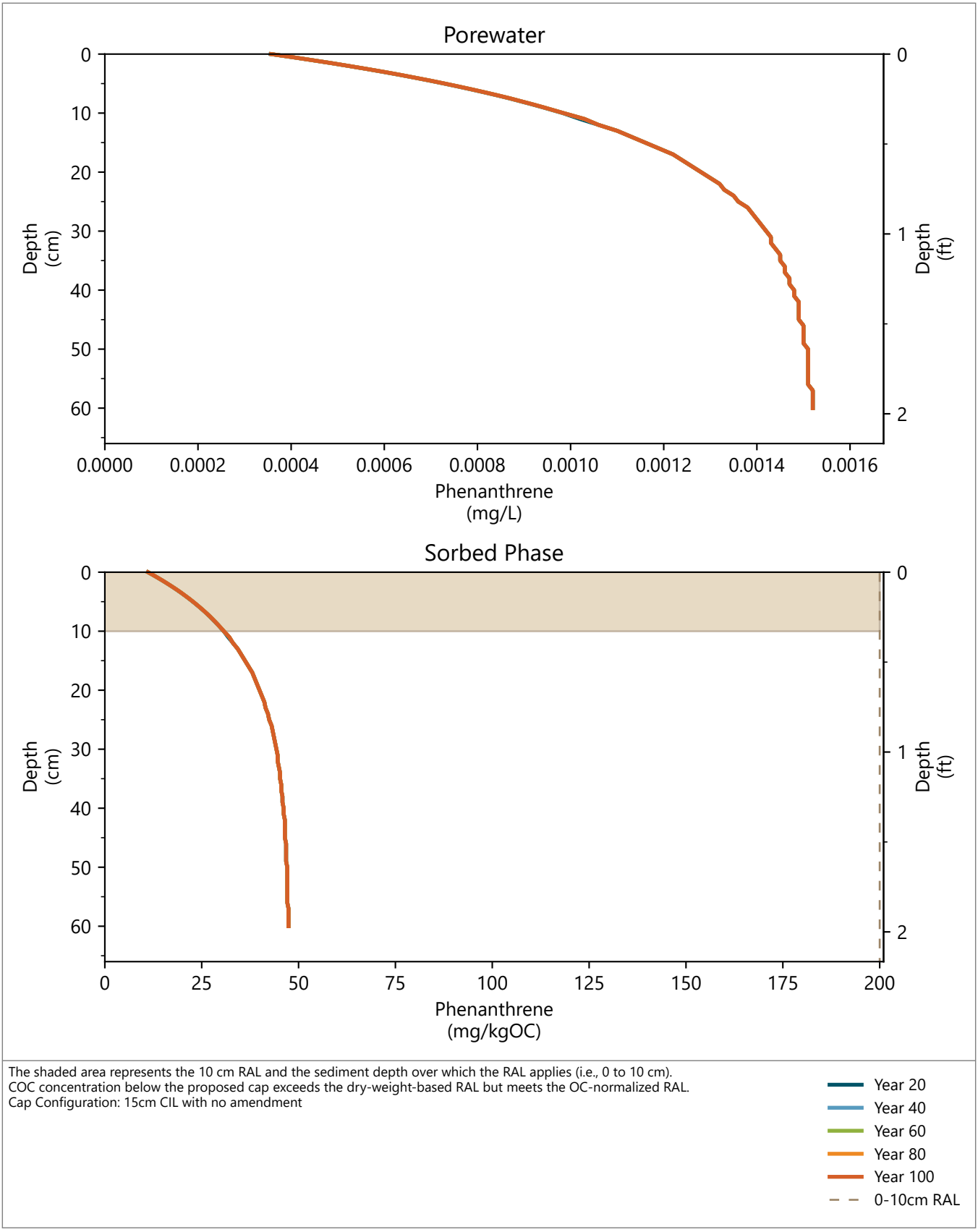
Figure H.4.2.38j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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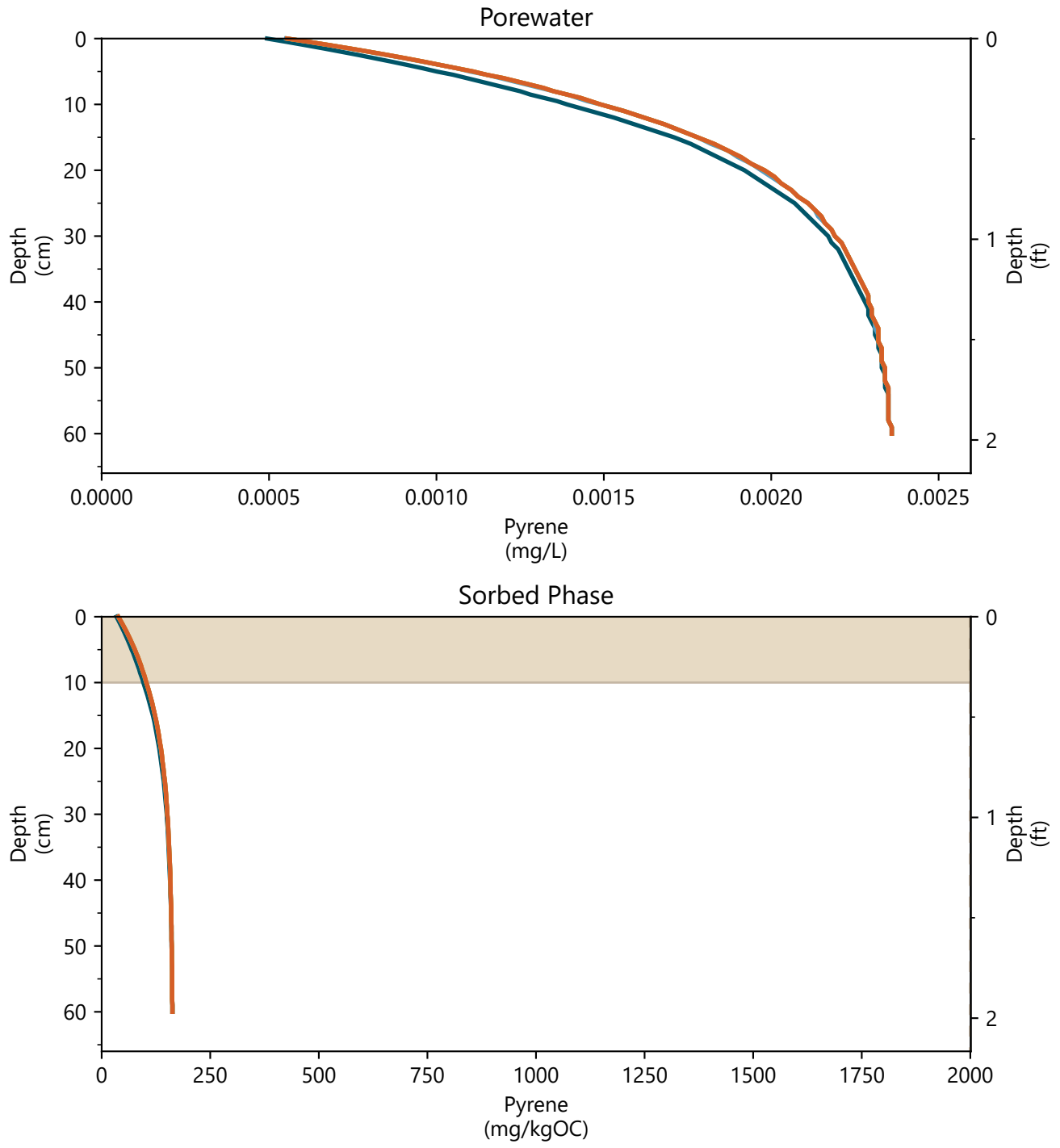
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Figure H.4.2.38k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.38I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



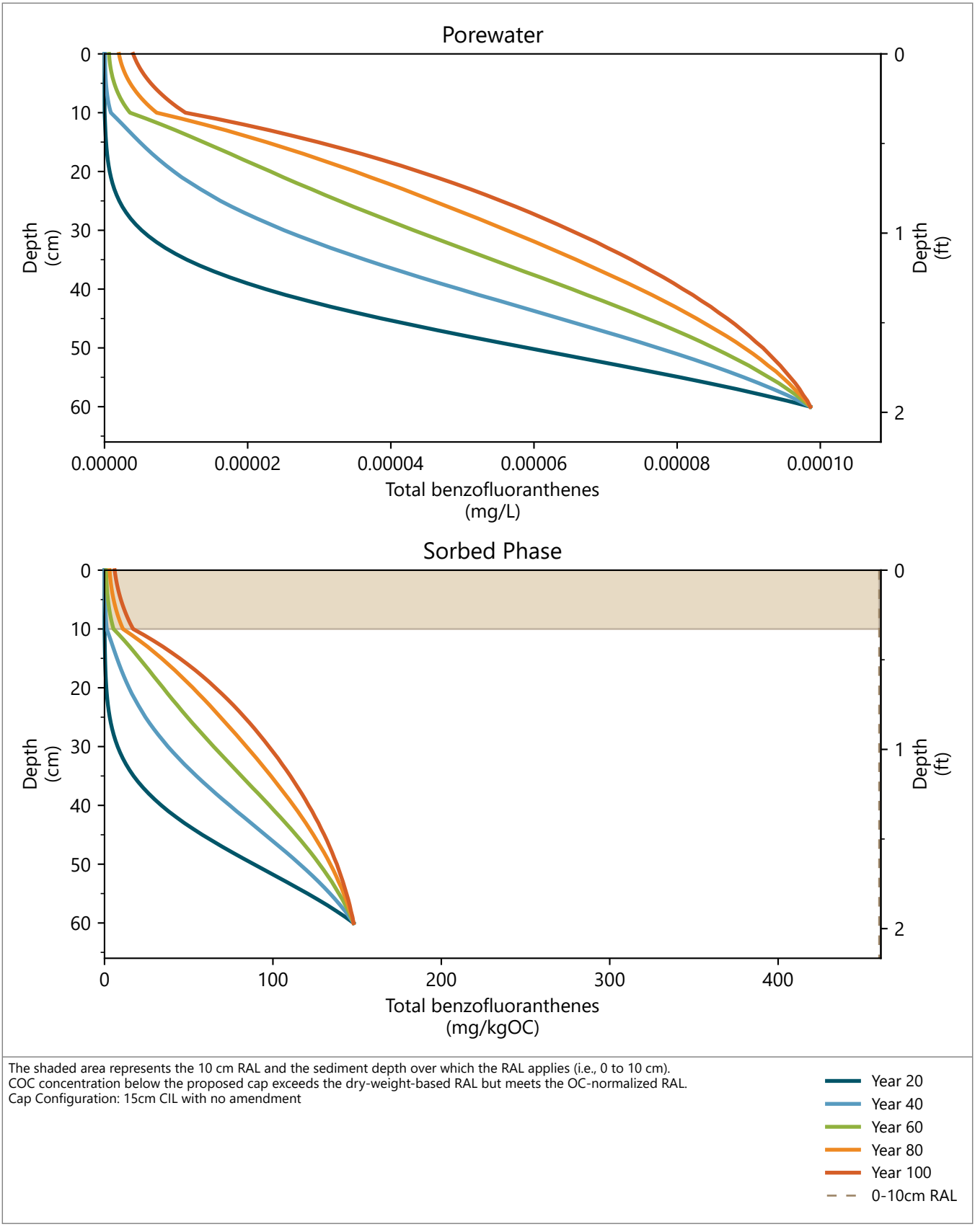
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

- Year 20
- Year 40
- Year 60
- Year 80
- Year 100
- 0-10cm RAL

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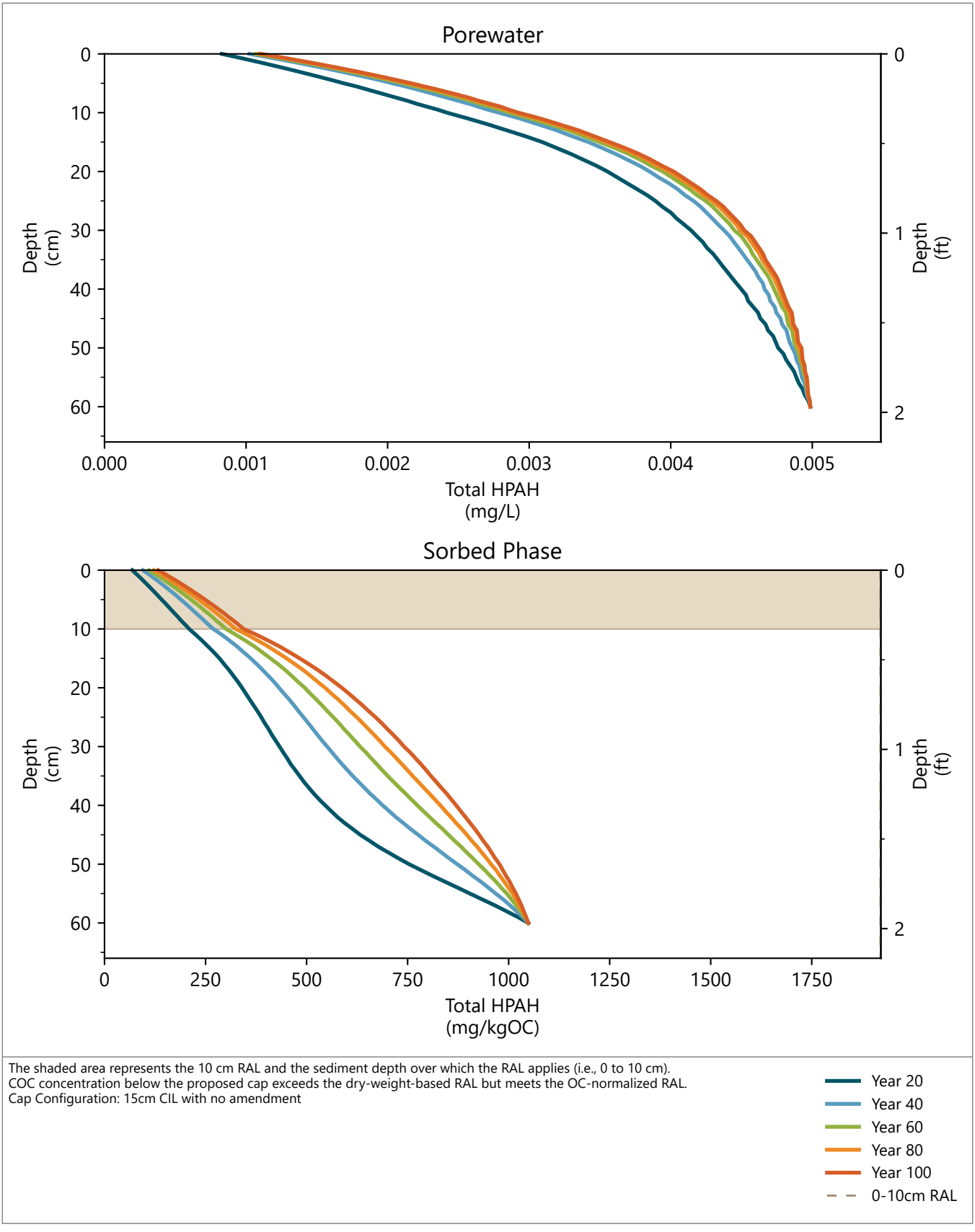
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Figure H.4.2.38m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.38n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

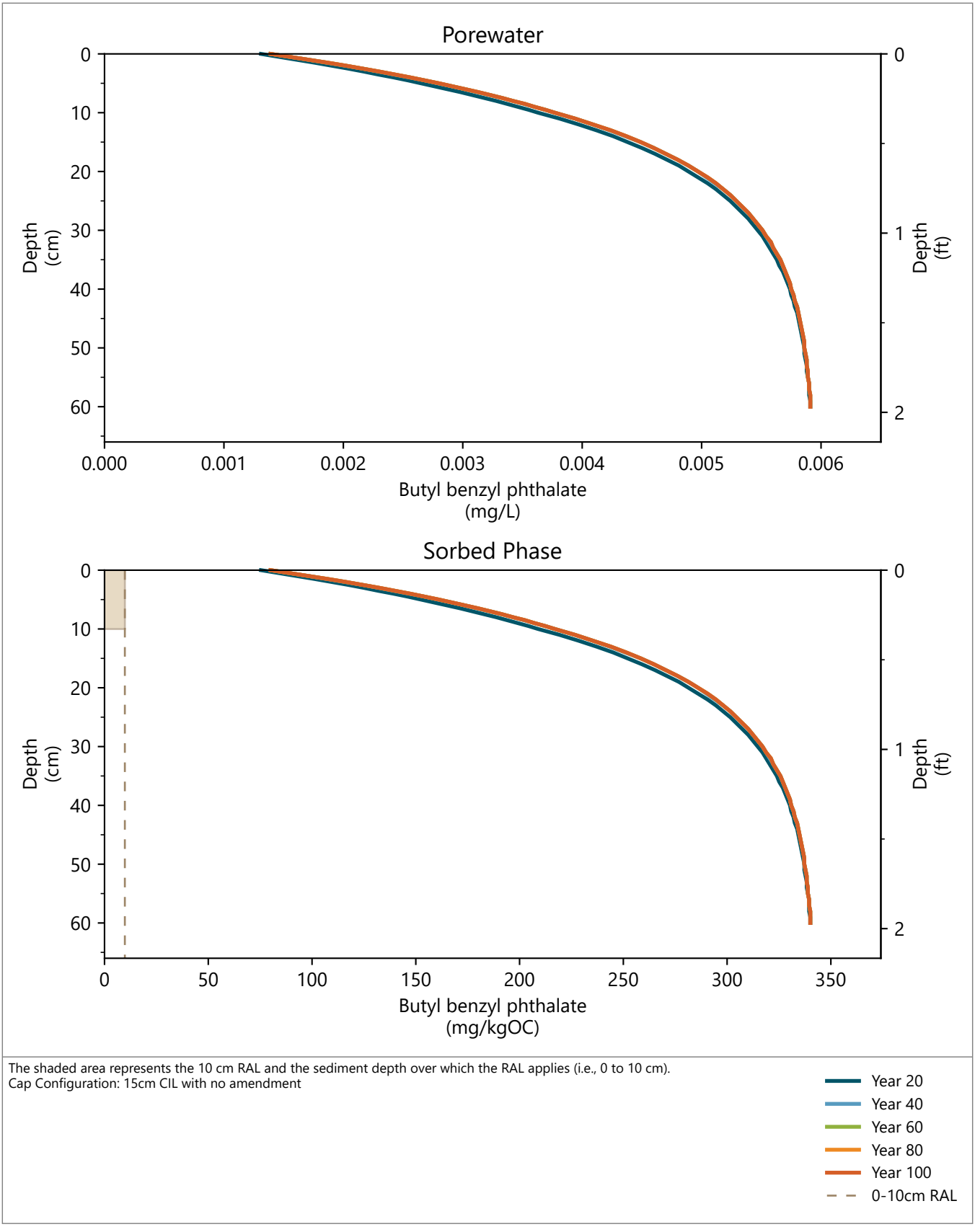


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 15cm CIL with no amendment

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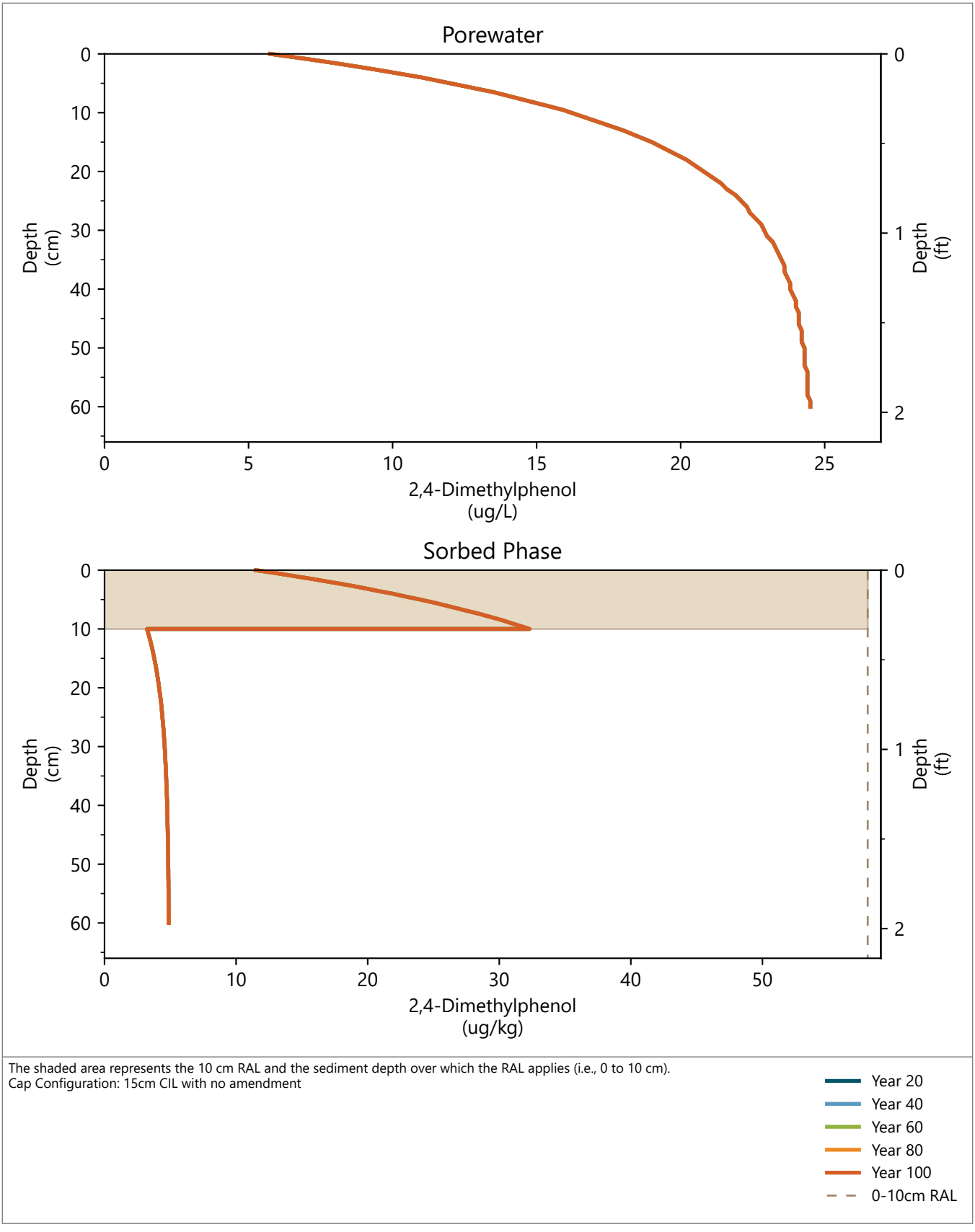
Figure H.4.2.38o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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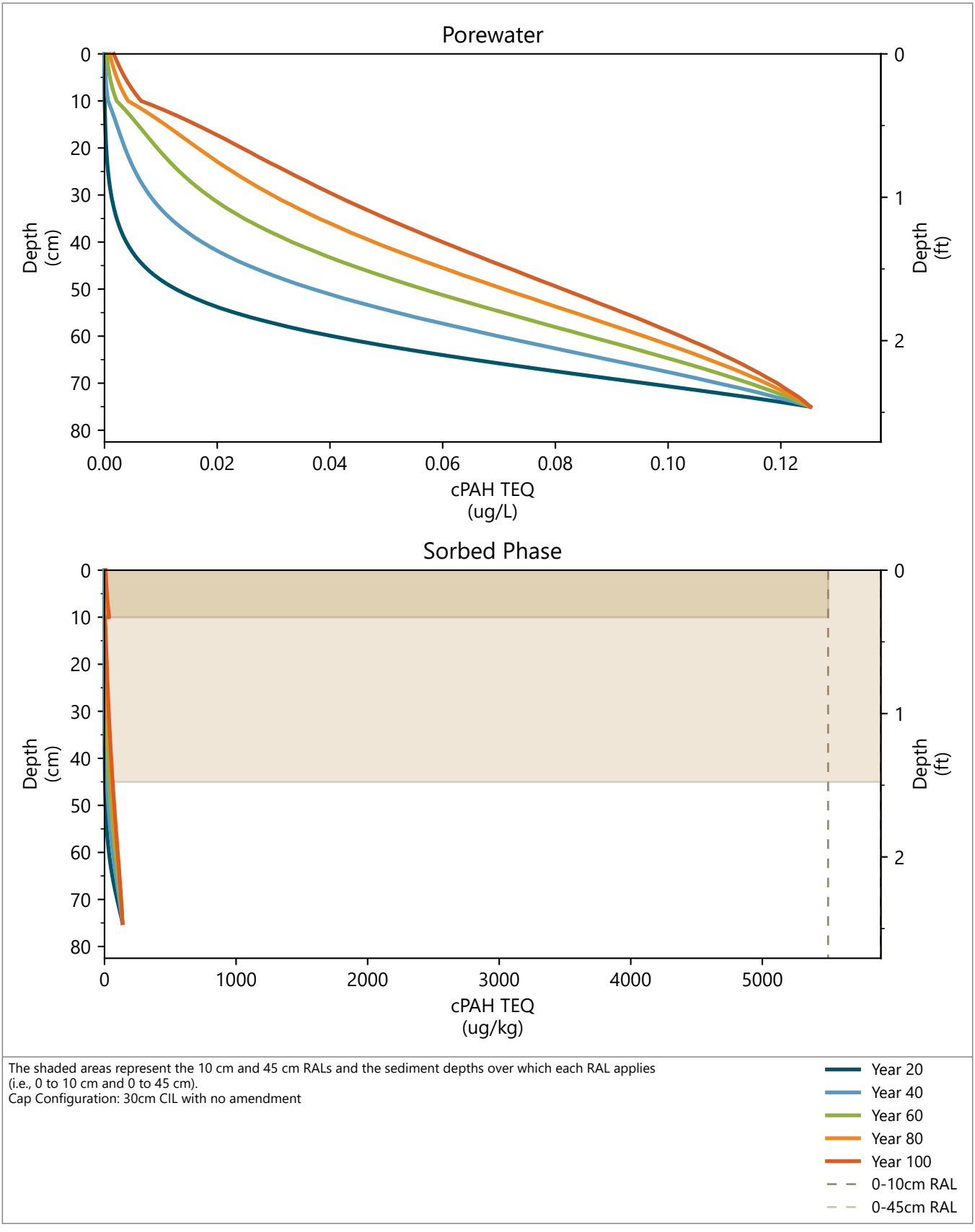
Figure H.4.2.38p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.38q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

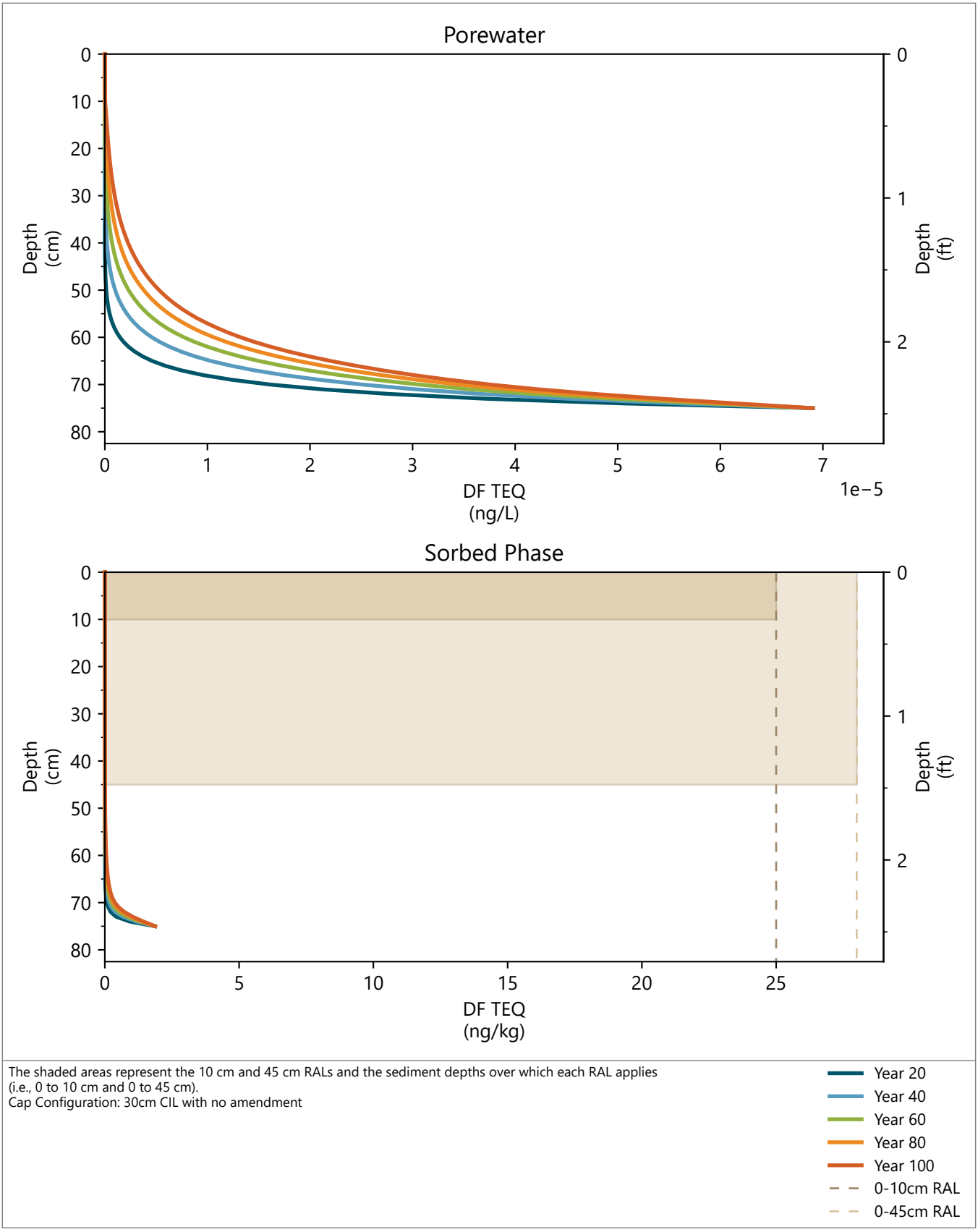


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

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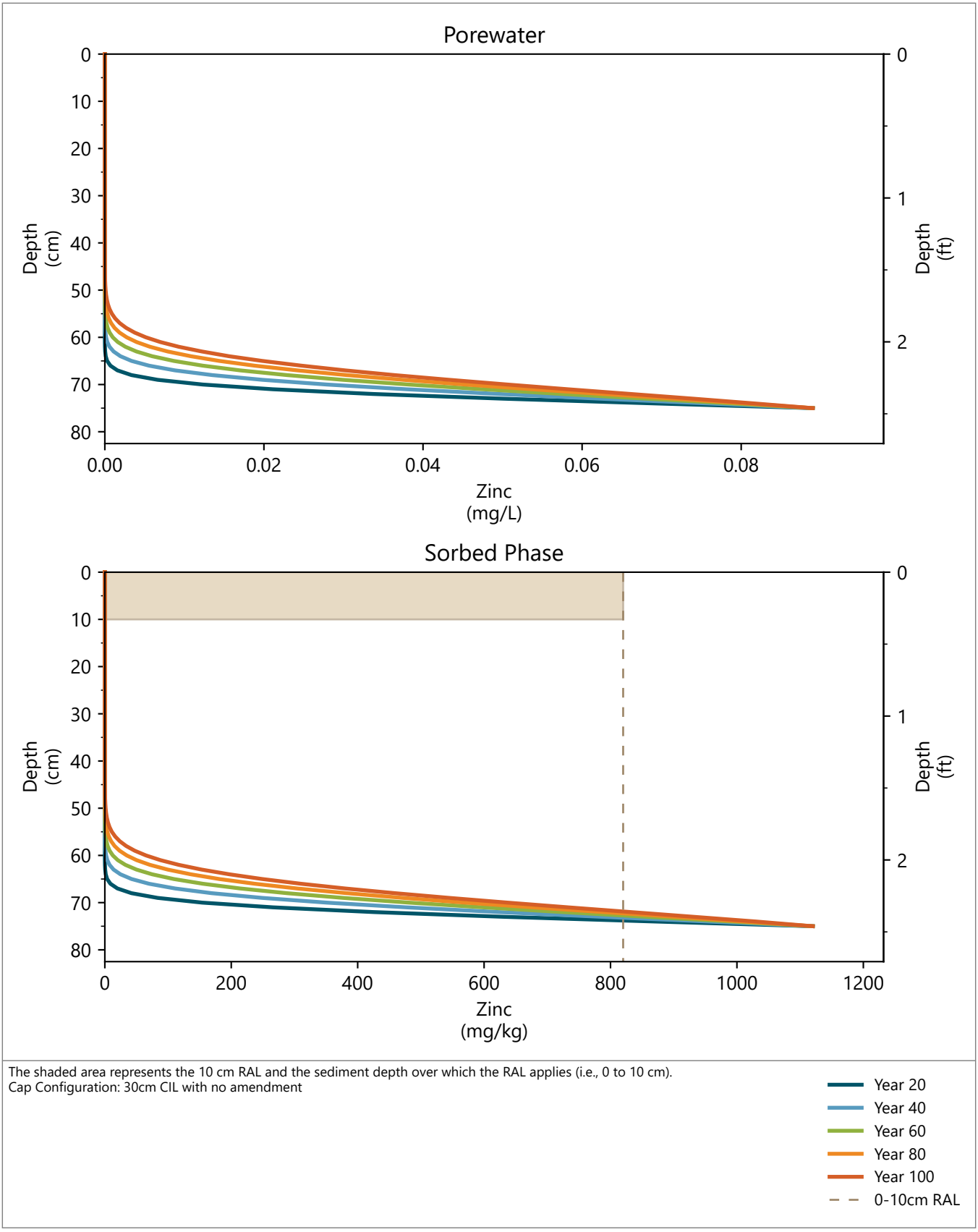
Figure H.4.2.39a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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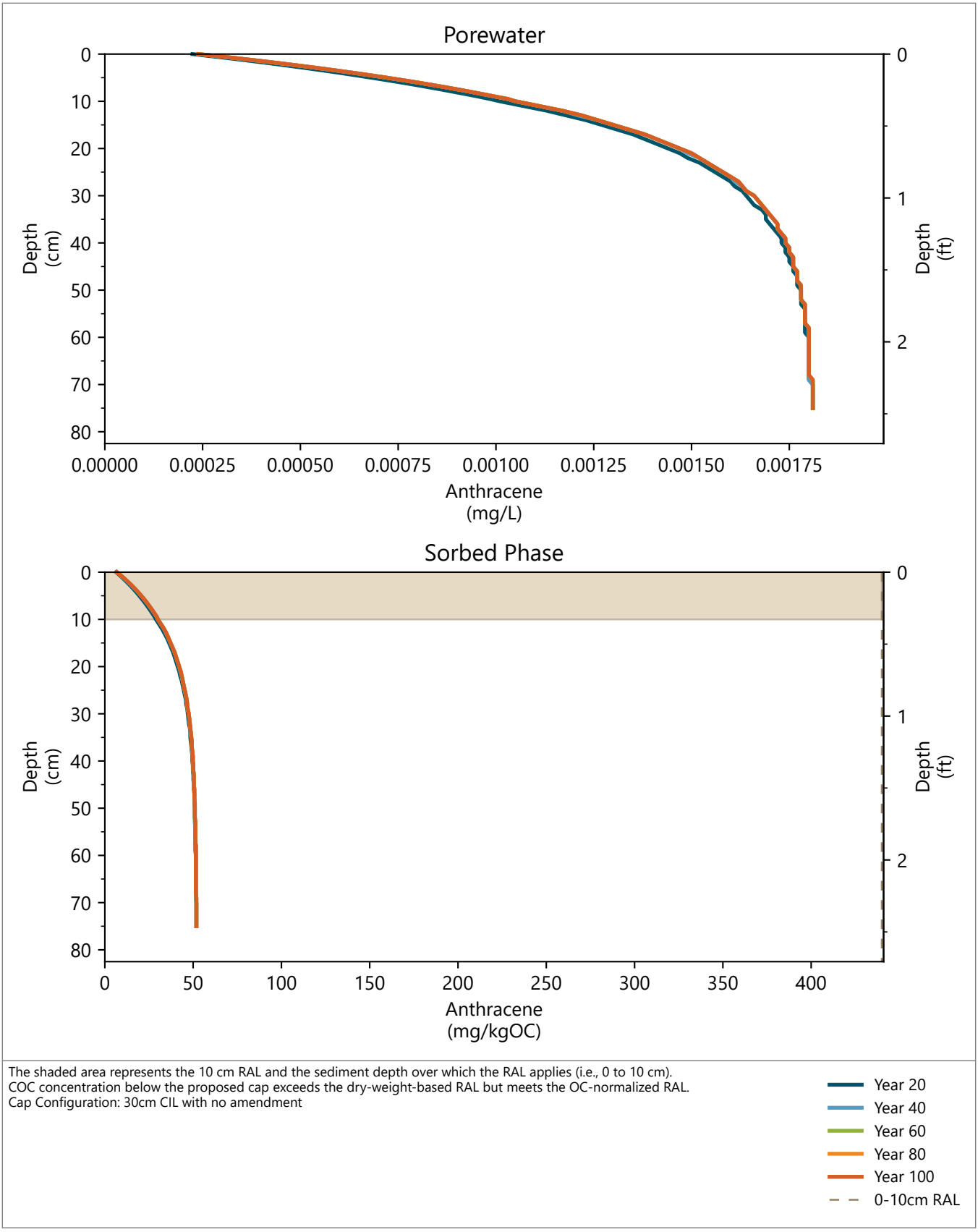
Figure H.4.2.39b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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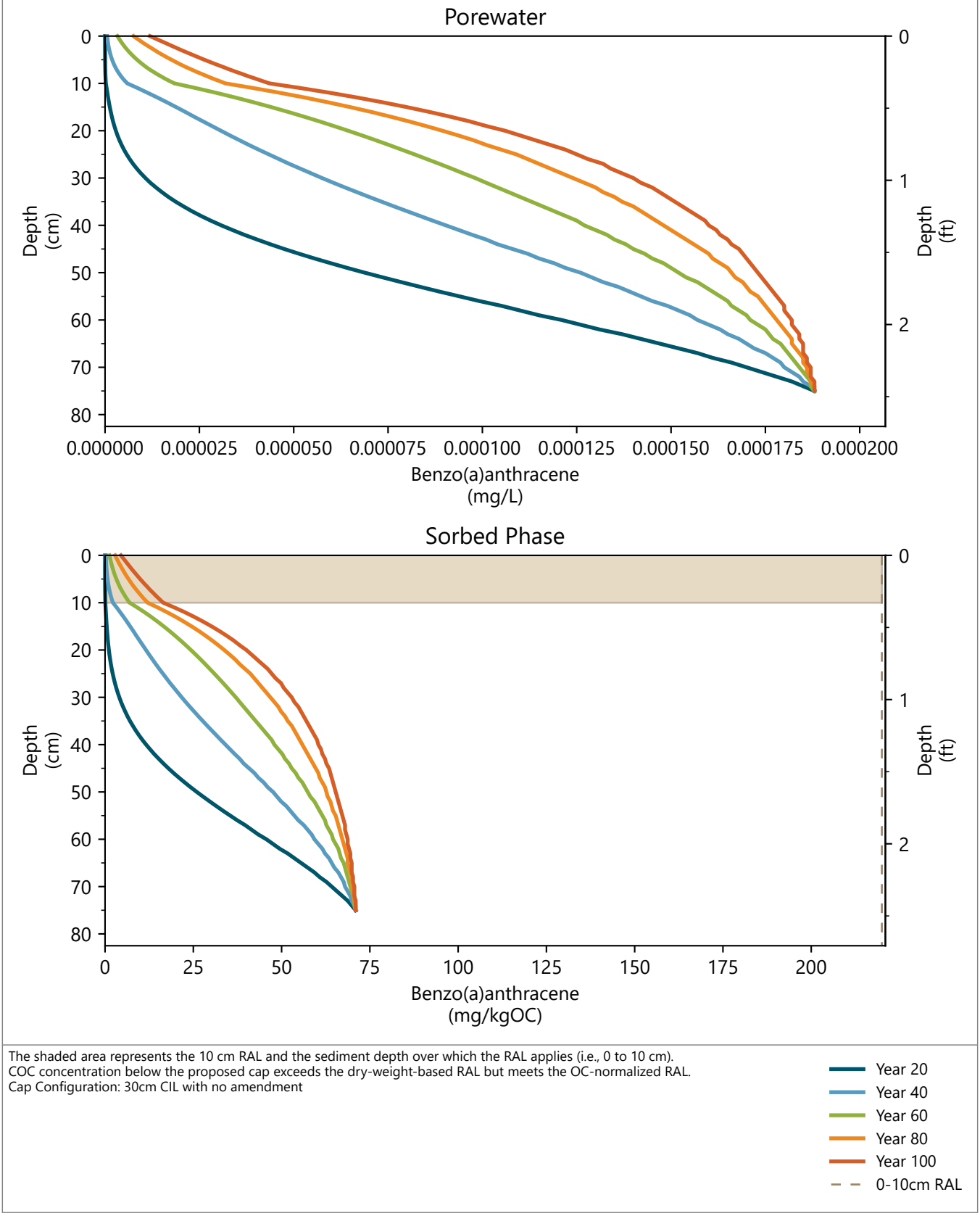
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Figure H.4.2.39c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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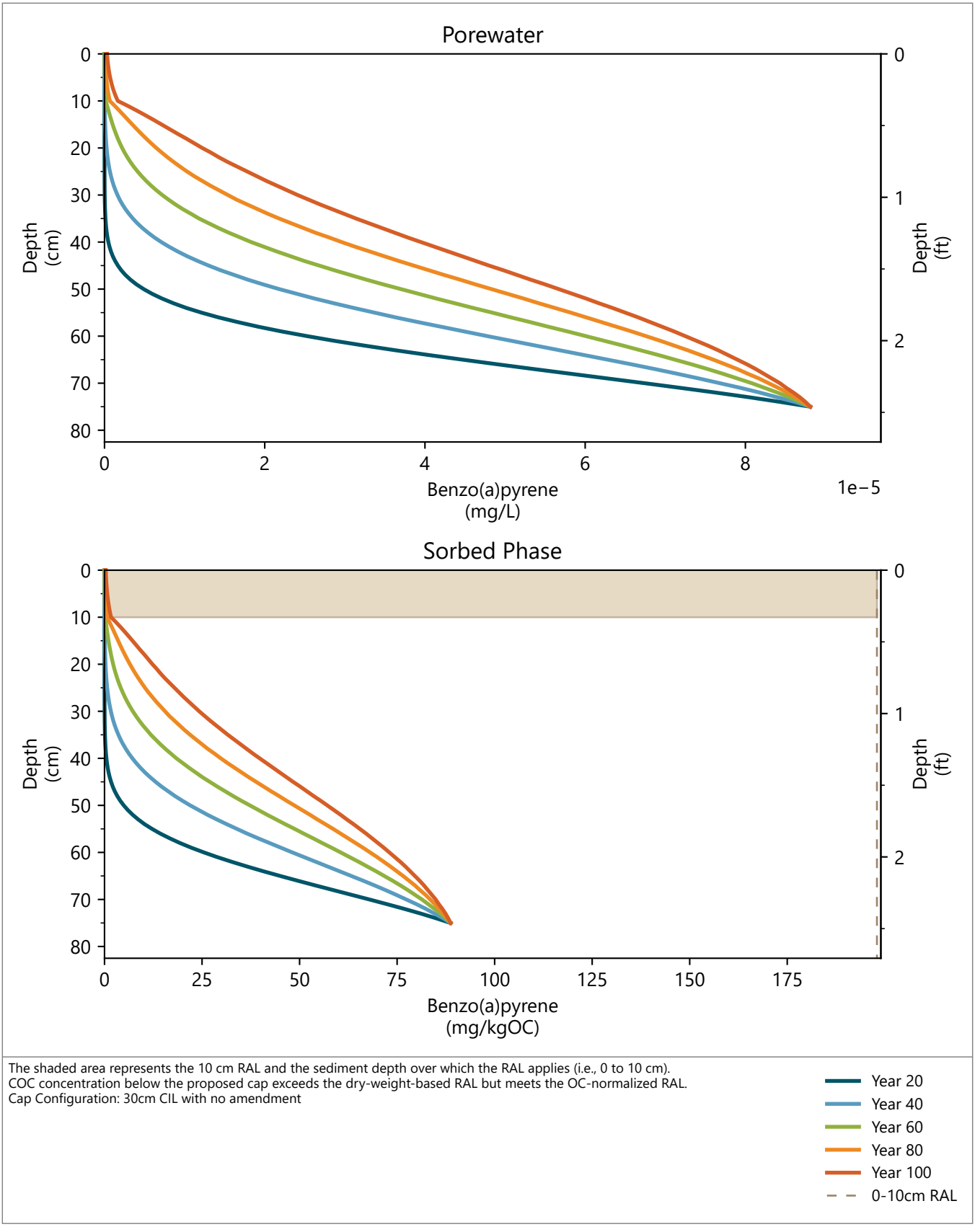
Figure H.4.2.39d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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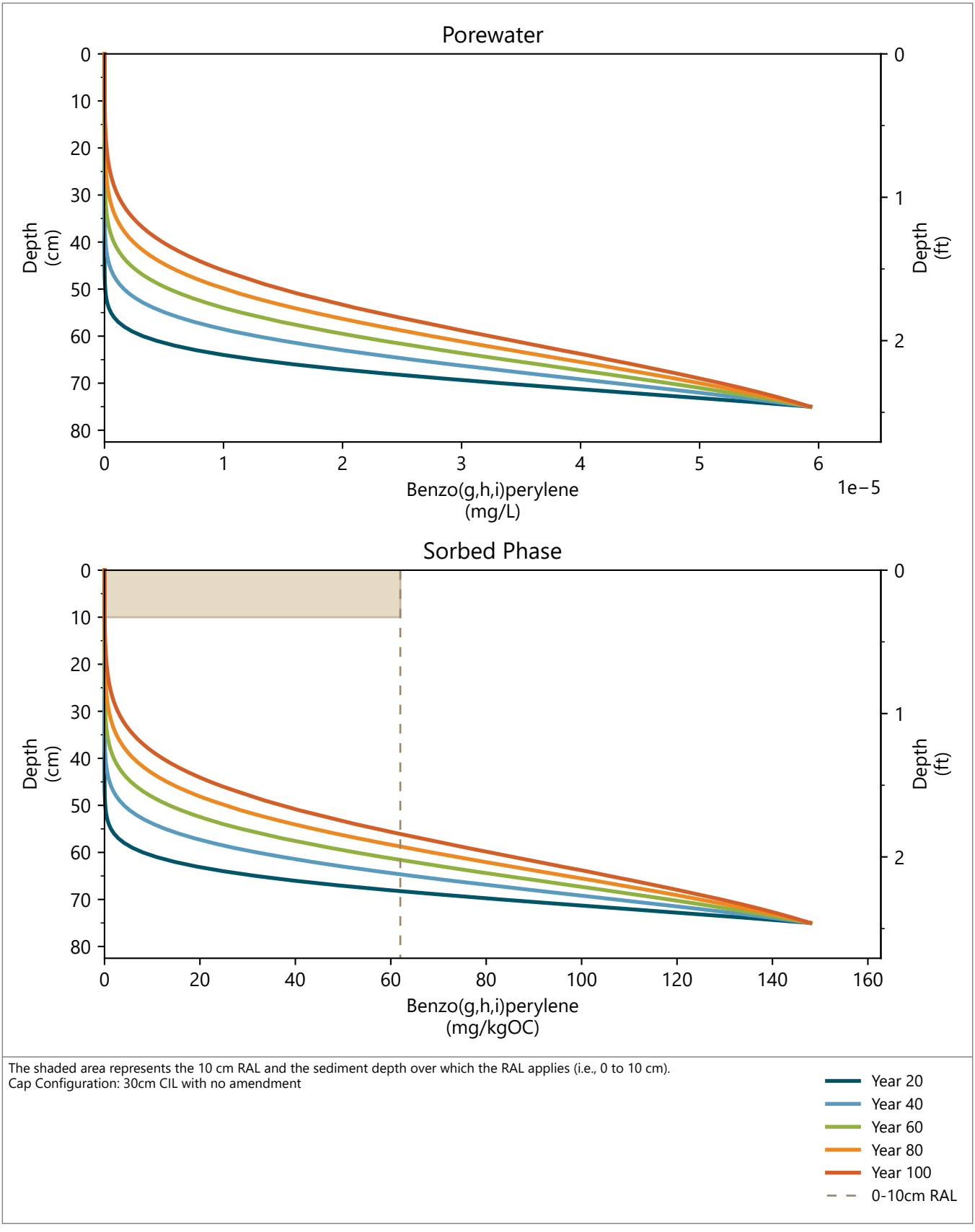
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Figure H.4.2.39e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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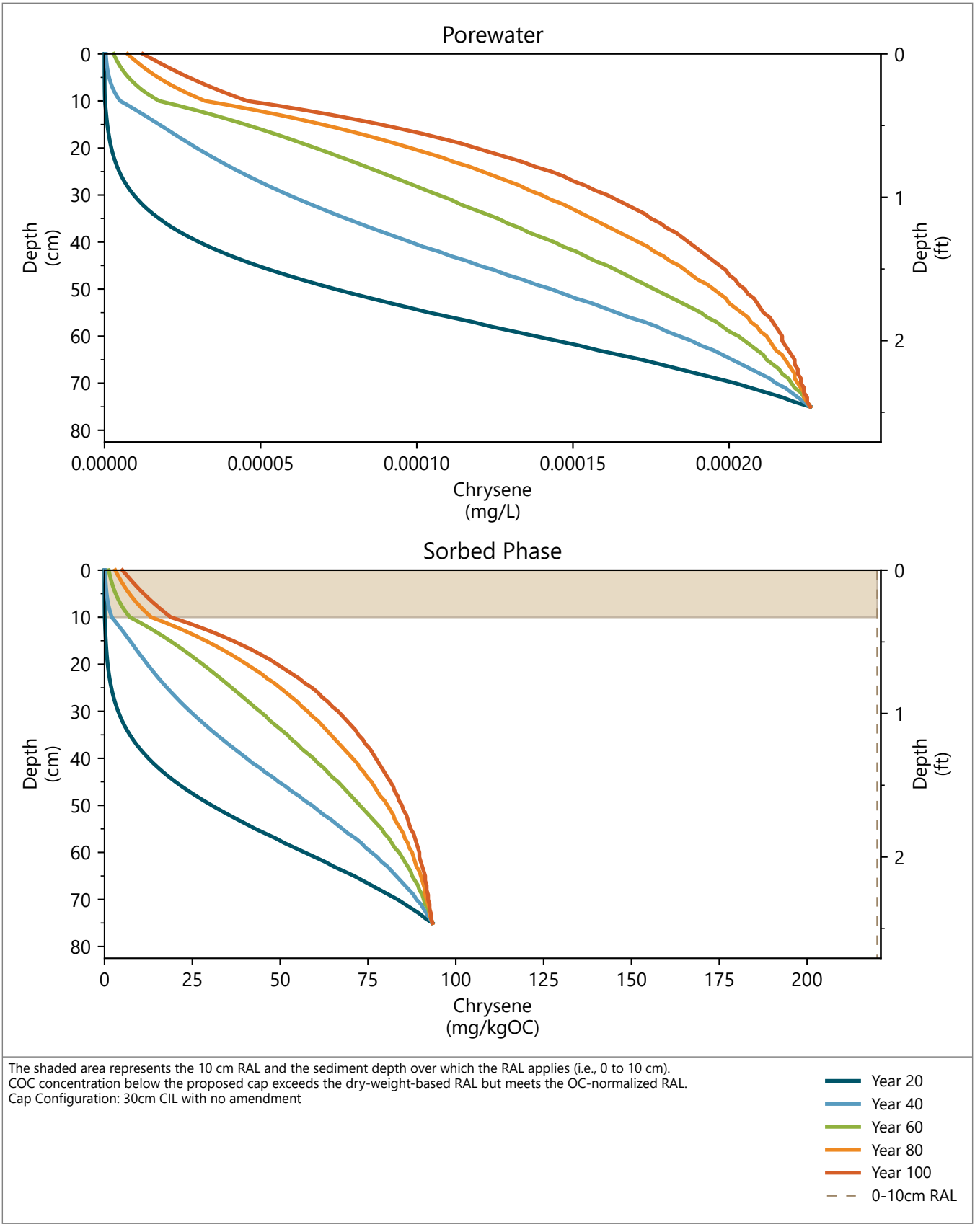
Figure H.4.2.39f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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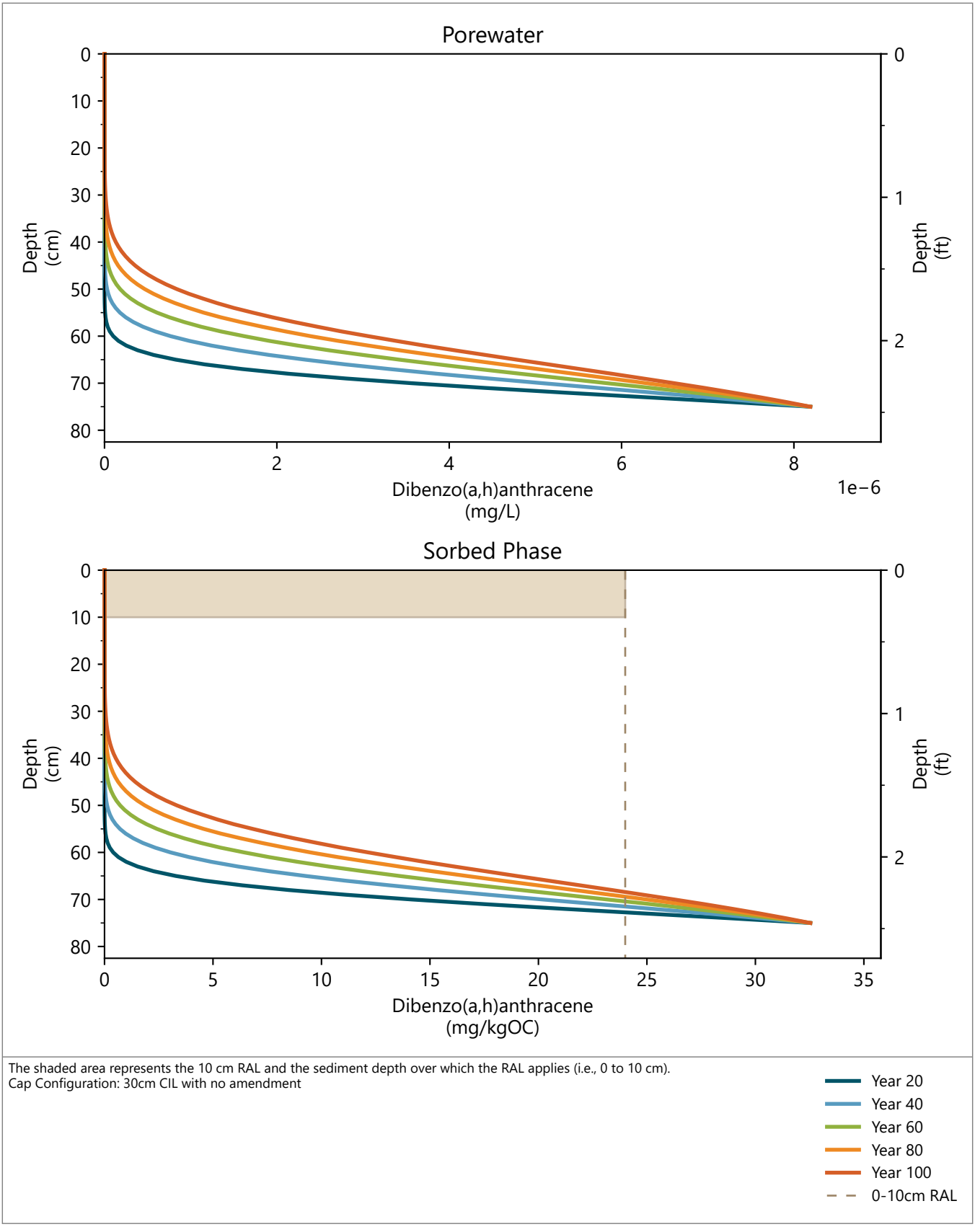
Figure H.4.2.39g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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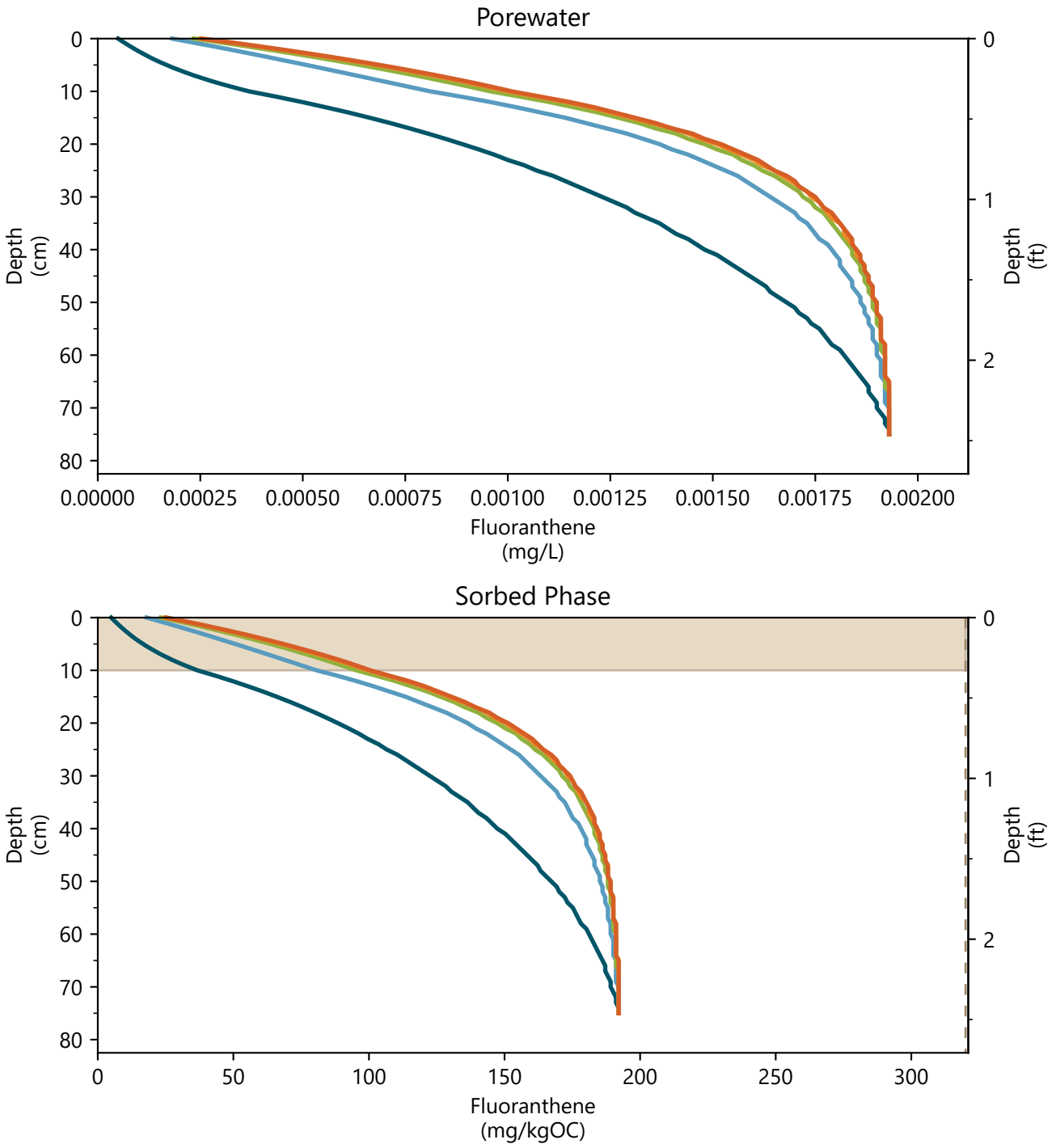
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Figure H.4.2.39h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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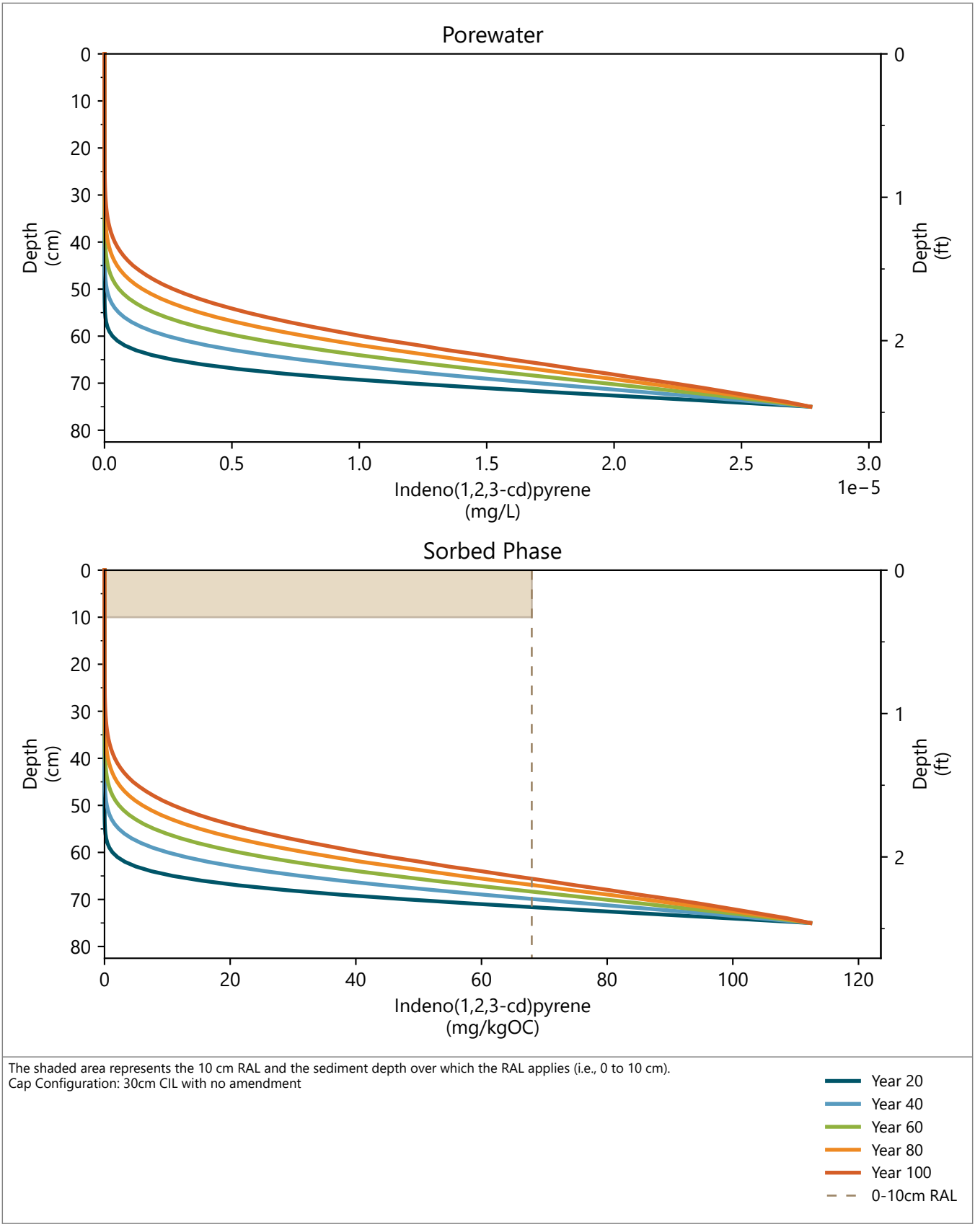
Figure H.4.2.39i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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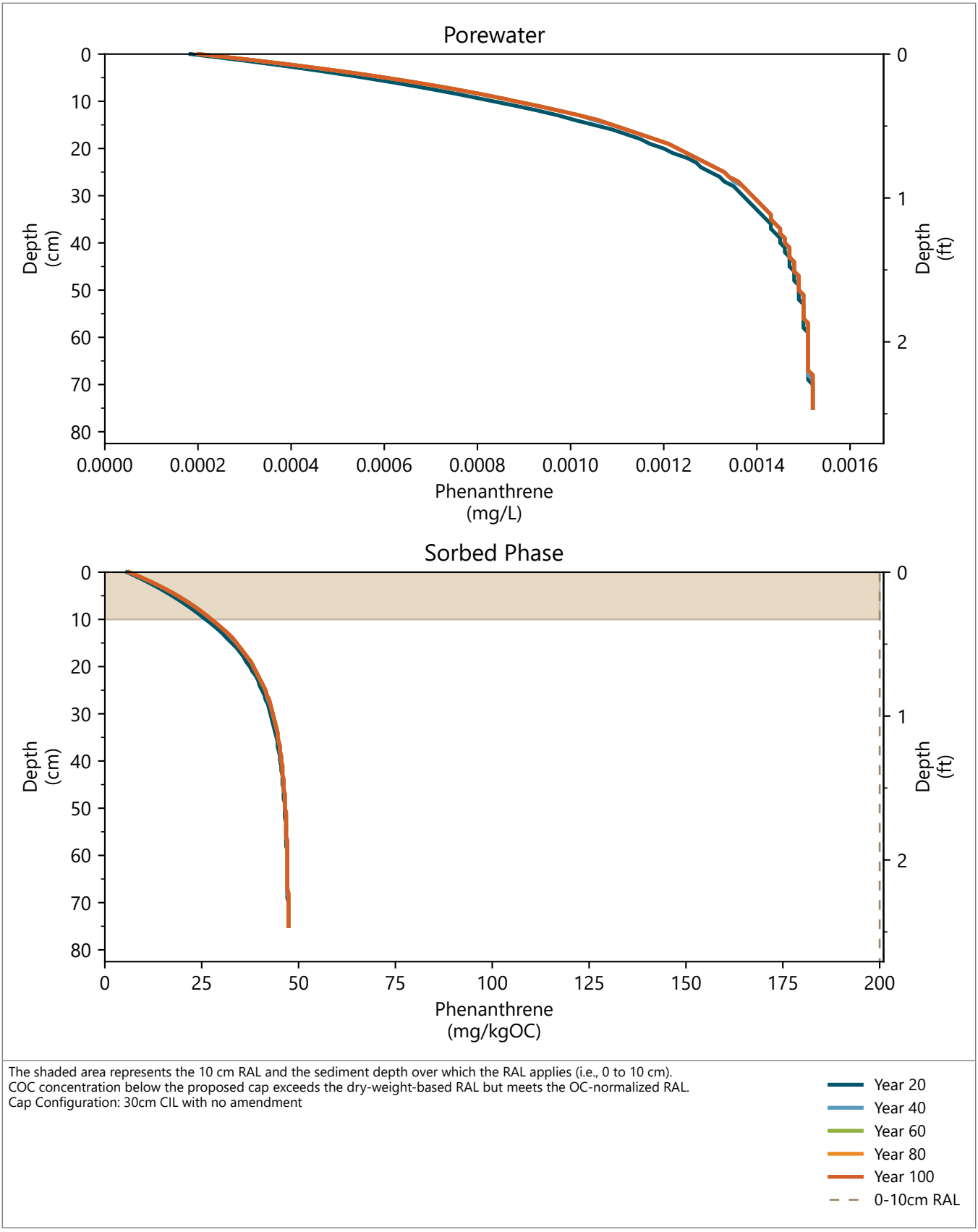
Figure H.4.2.39j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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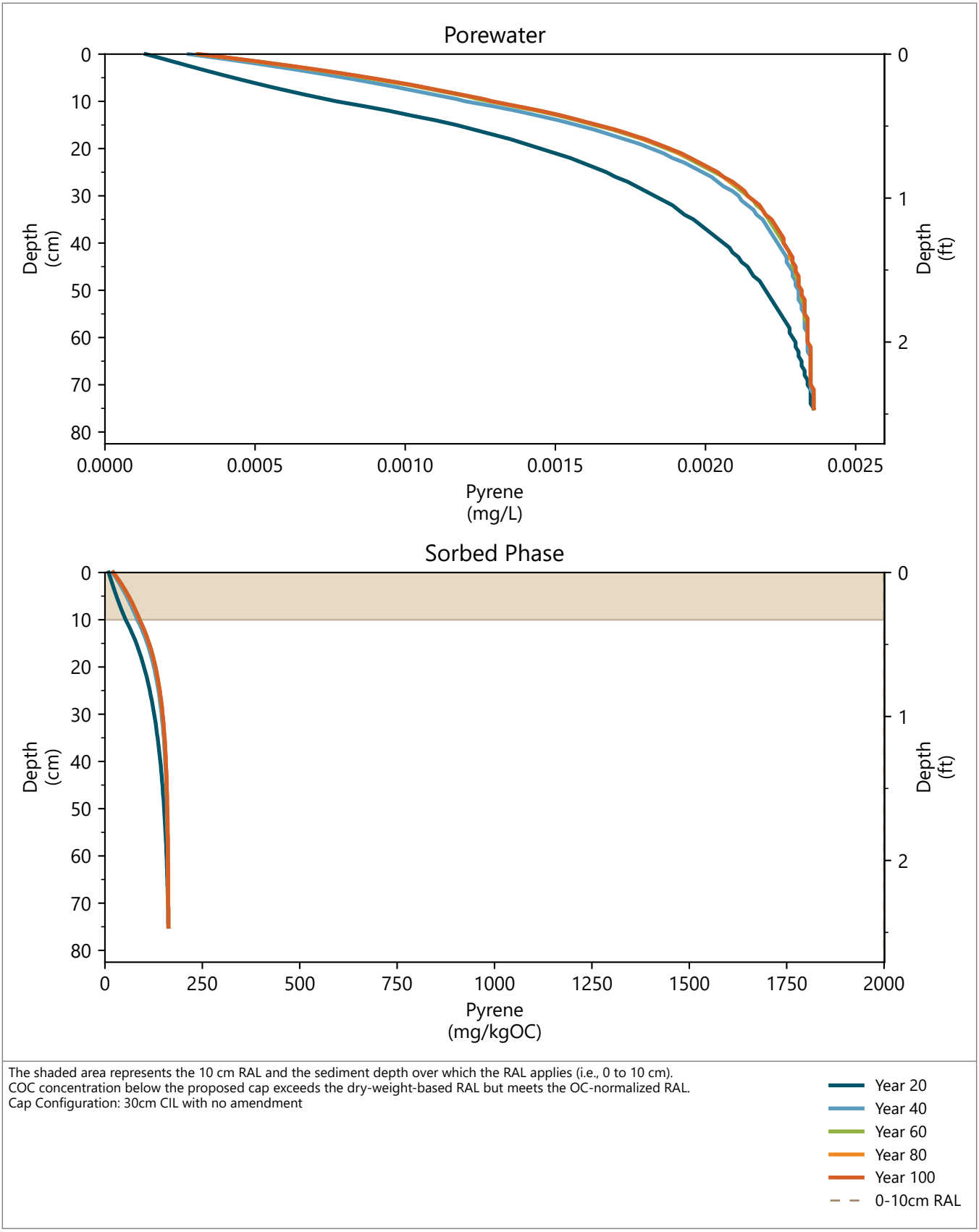
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Figure H.4.2.39k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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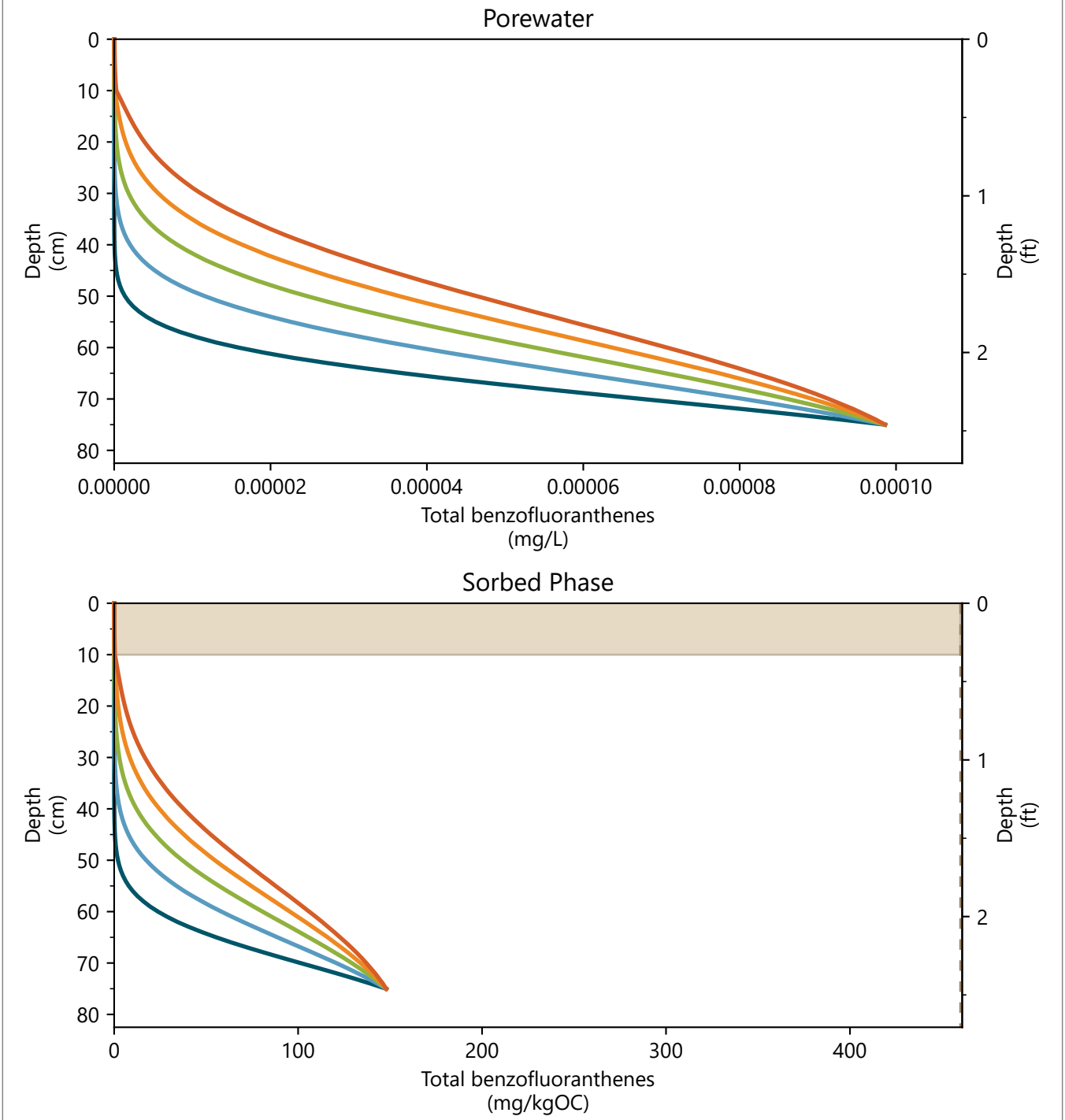
Figure H.4.2.39I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.39m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)

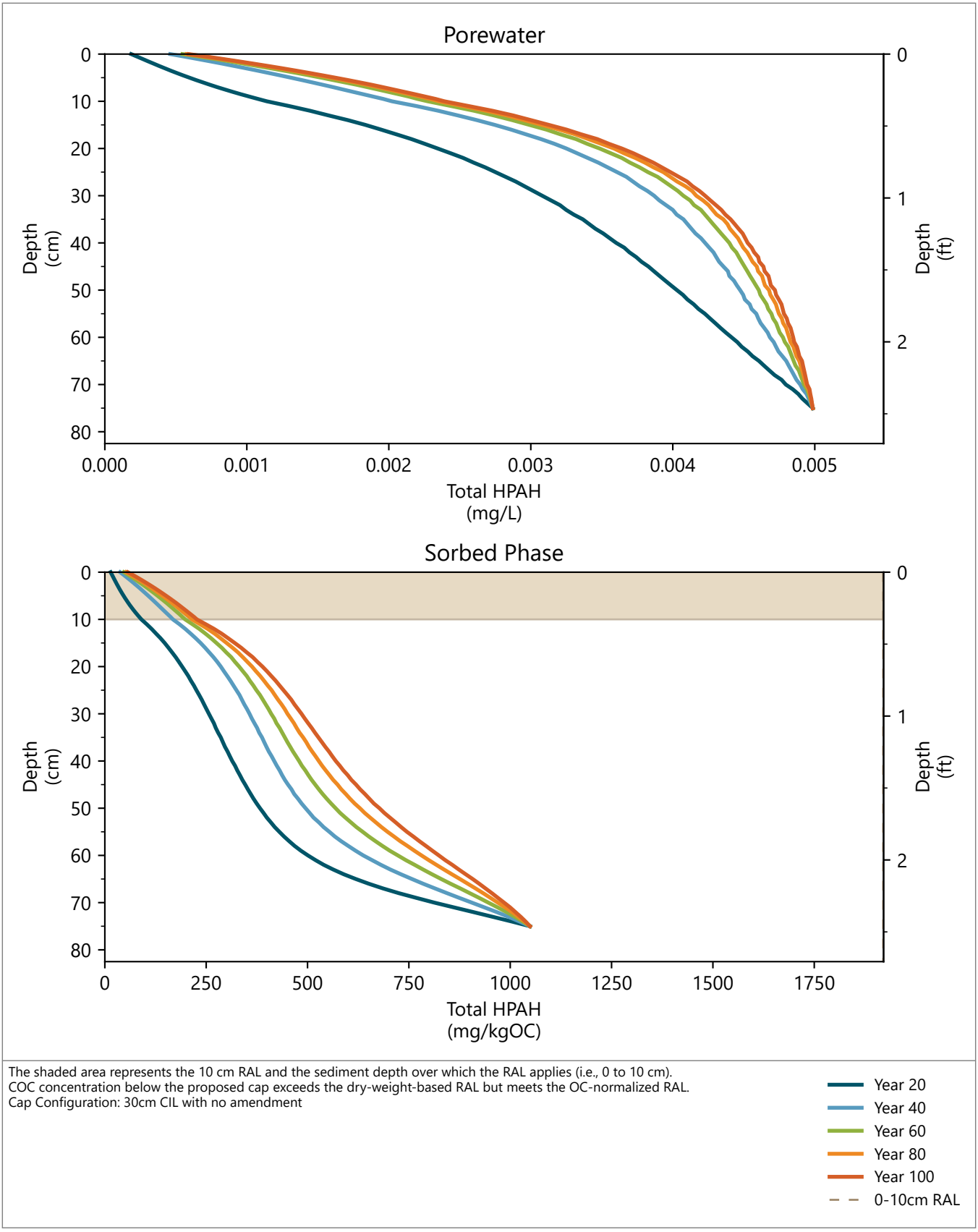


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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Figure H.4.2.39n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)

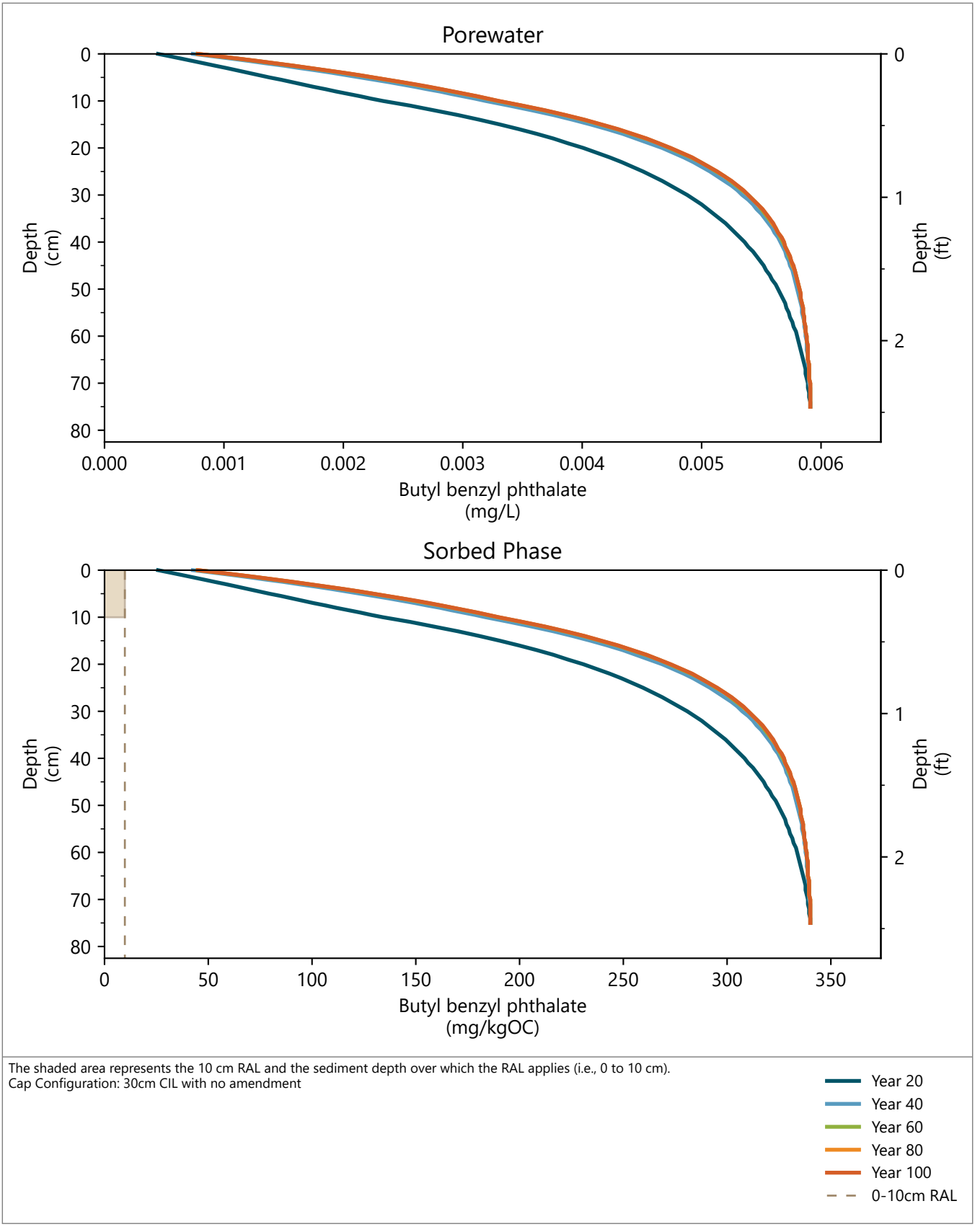


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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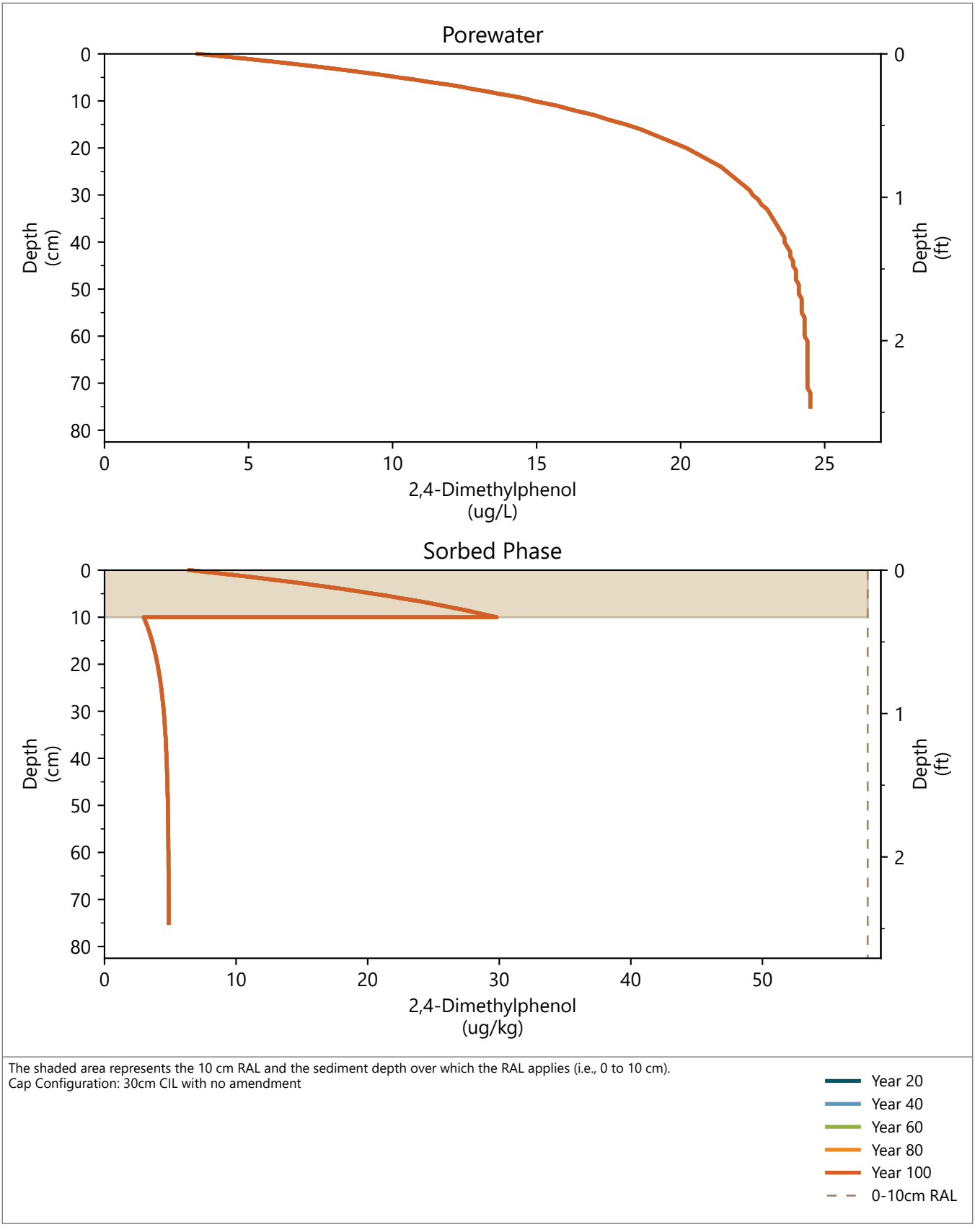
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Figure H.4.2.39o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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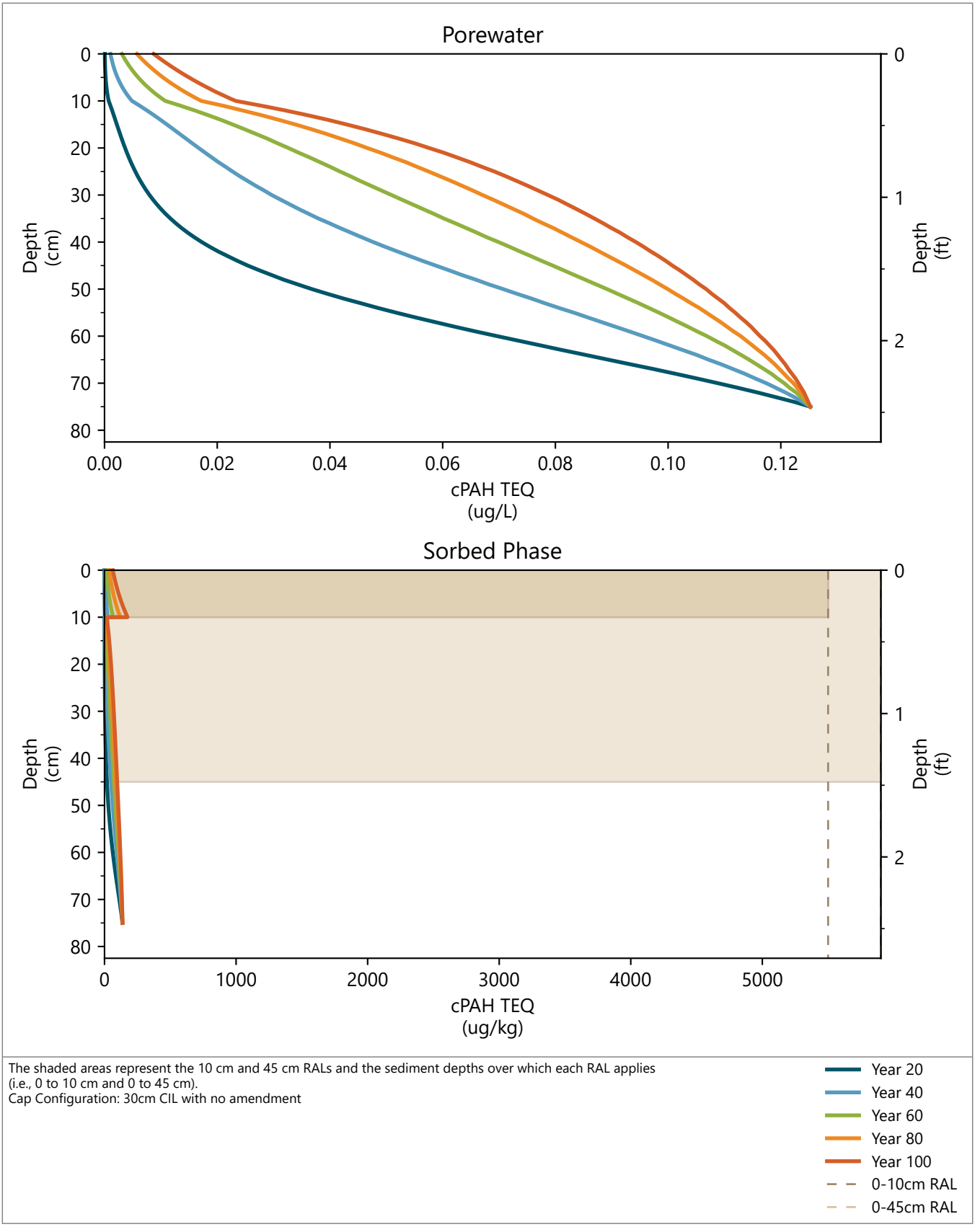
Figure H.4.2.39p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.39q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)

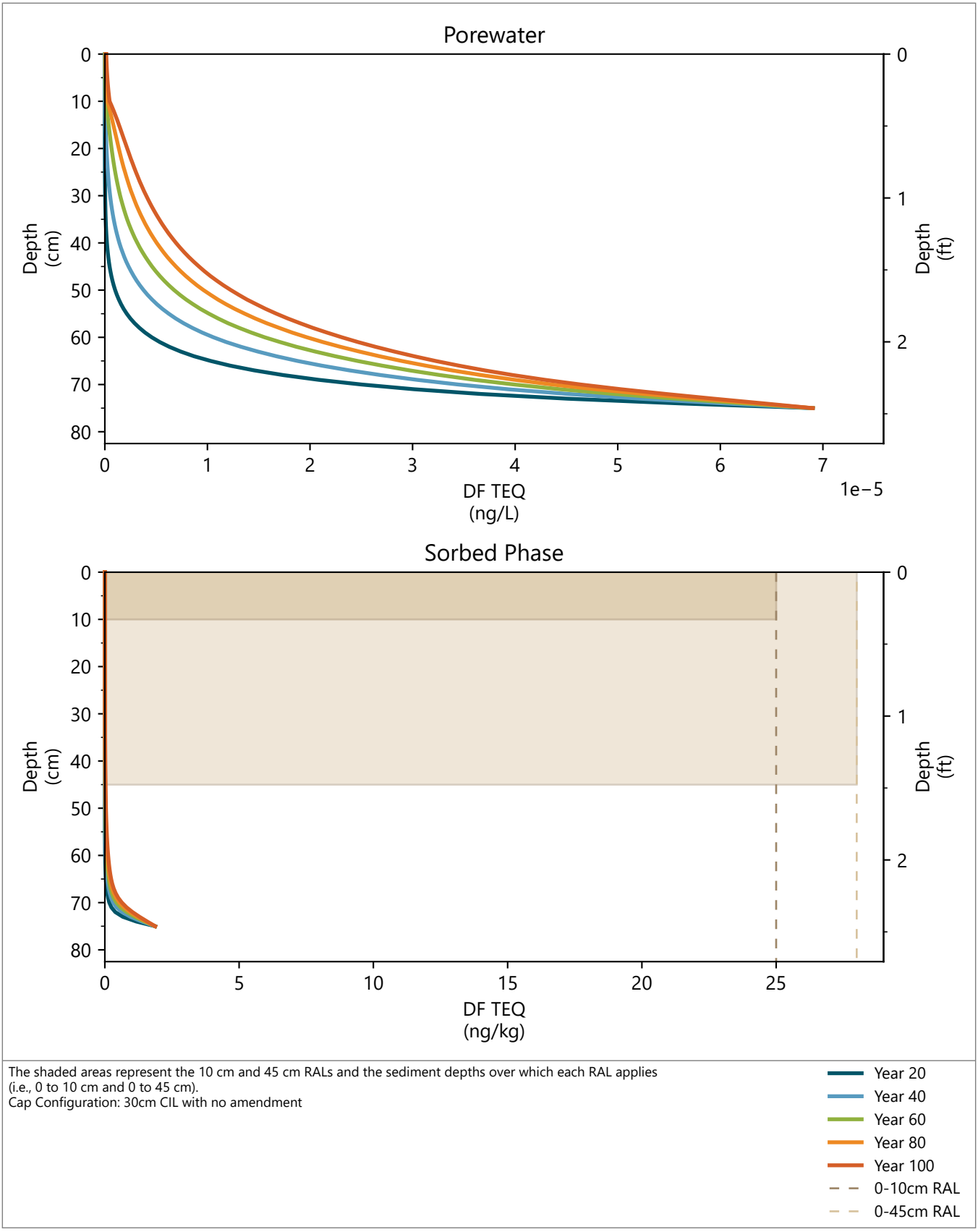


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment

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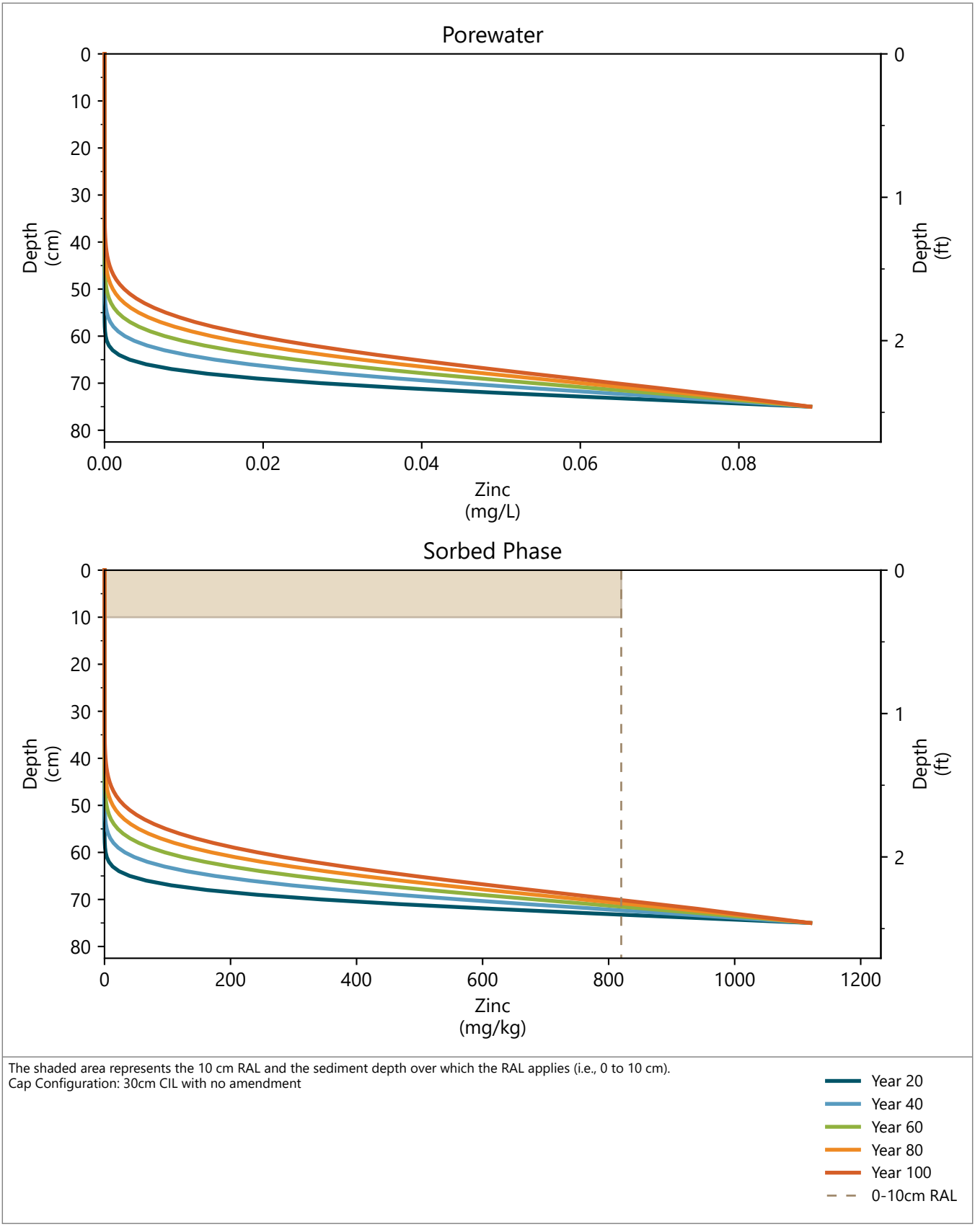
Figure H.4.2.40a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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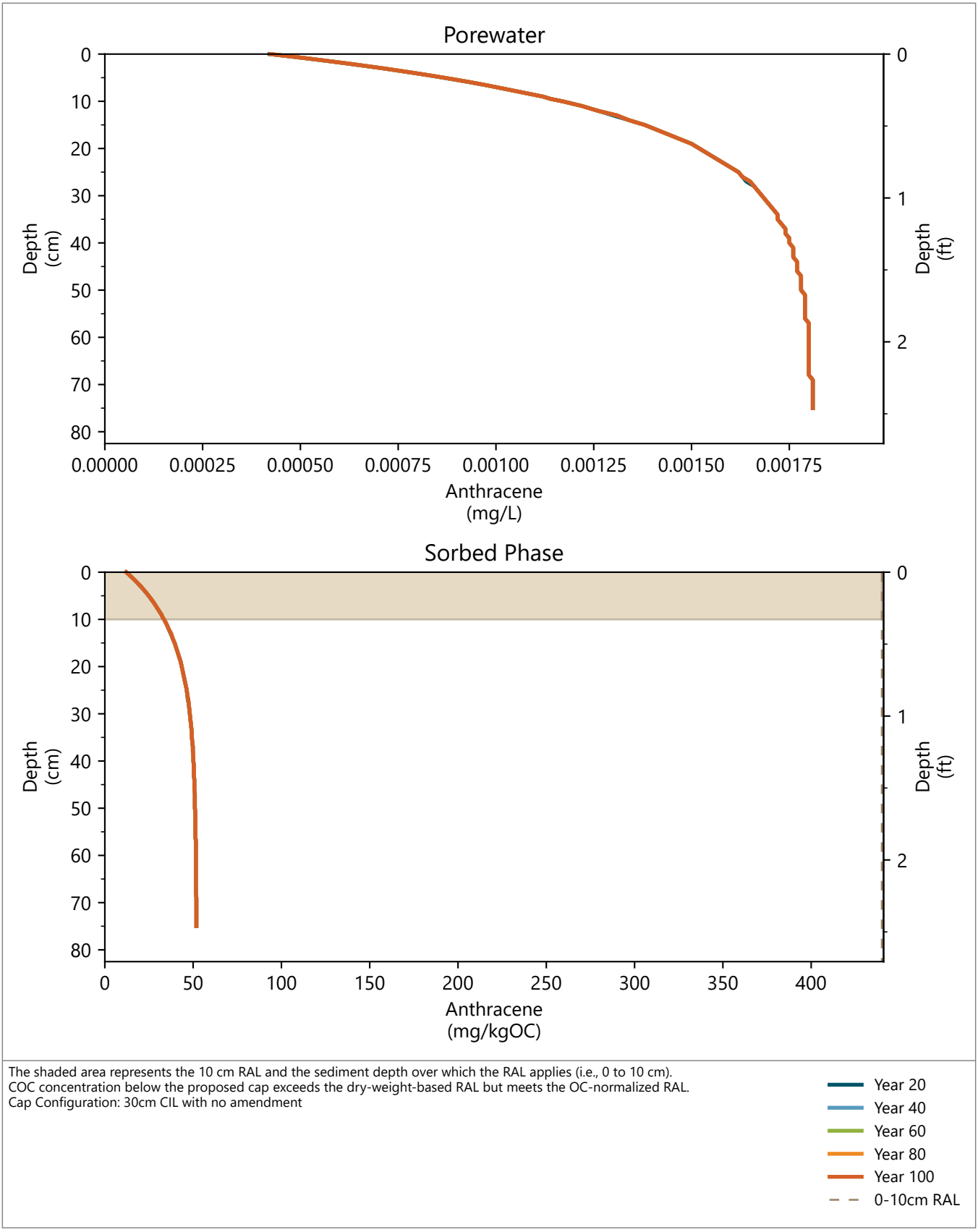
Figure H.4.2.40b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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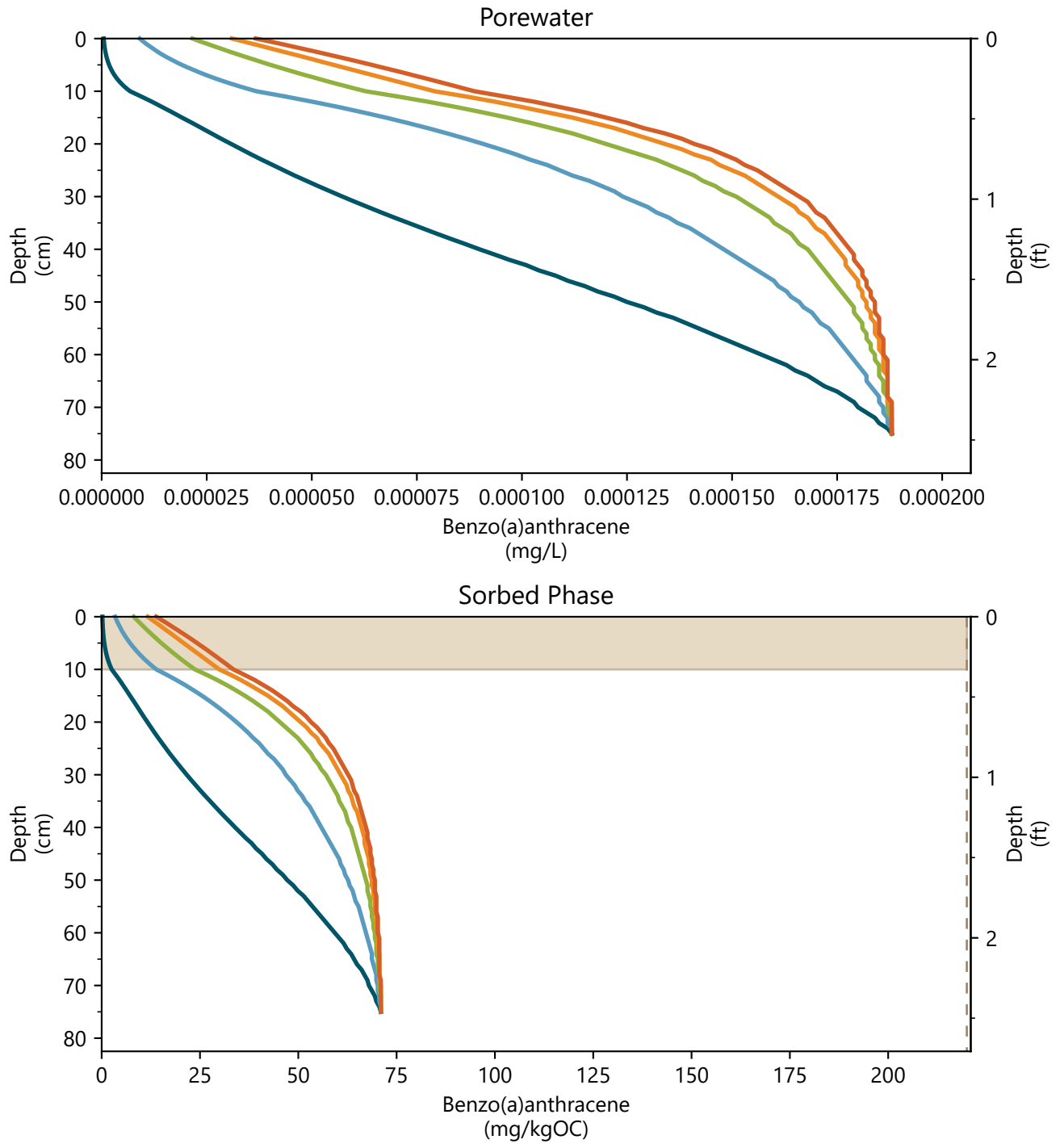
Figure H.4.2.40c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.40d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

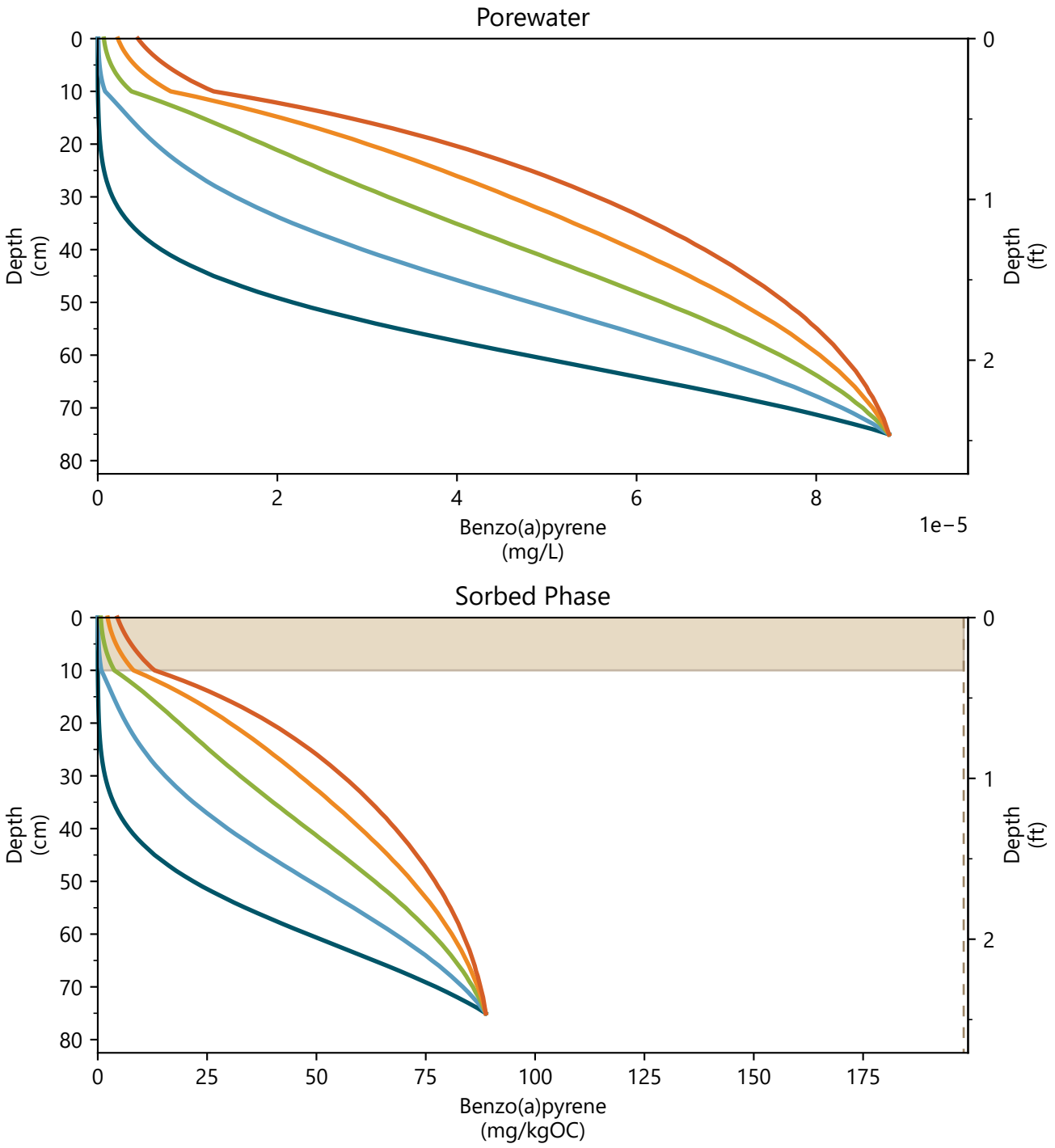


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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Figure H.4.2.40e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

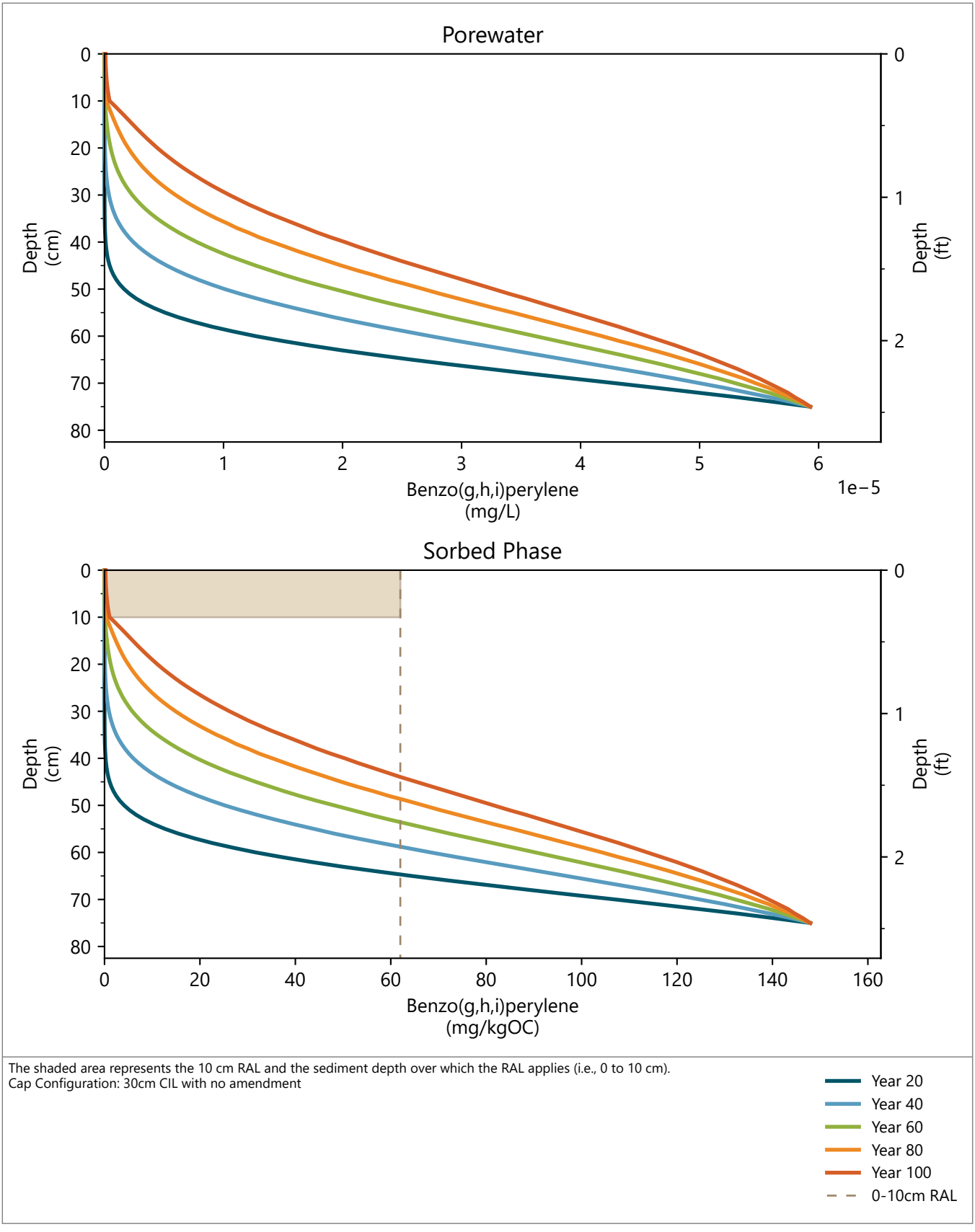


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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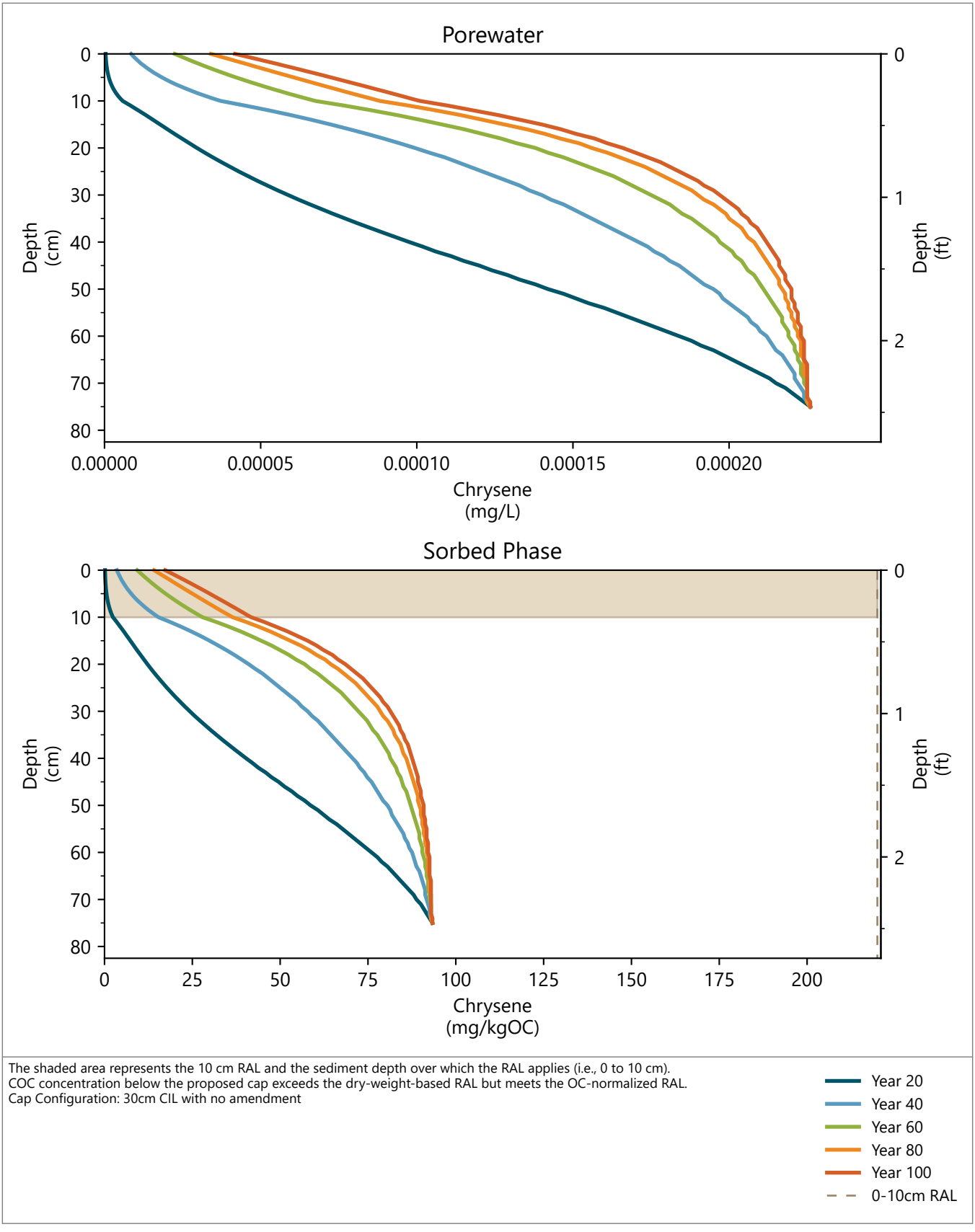
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Figure H.4.2.40f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.40g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

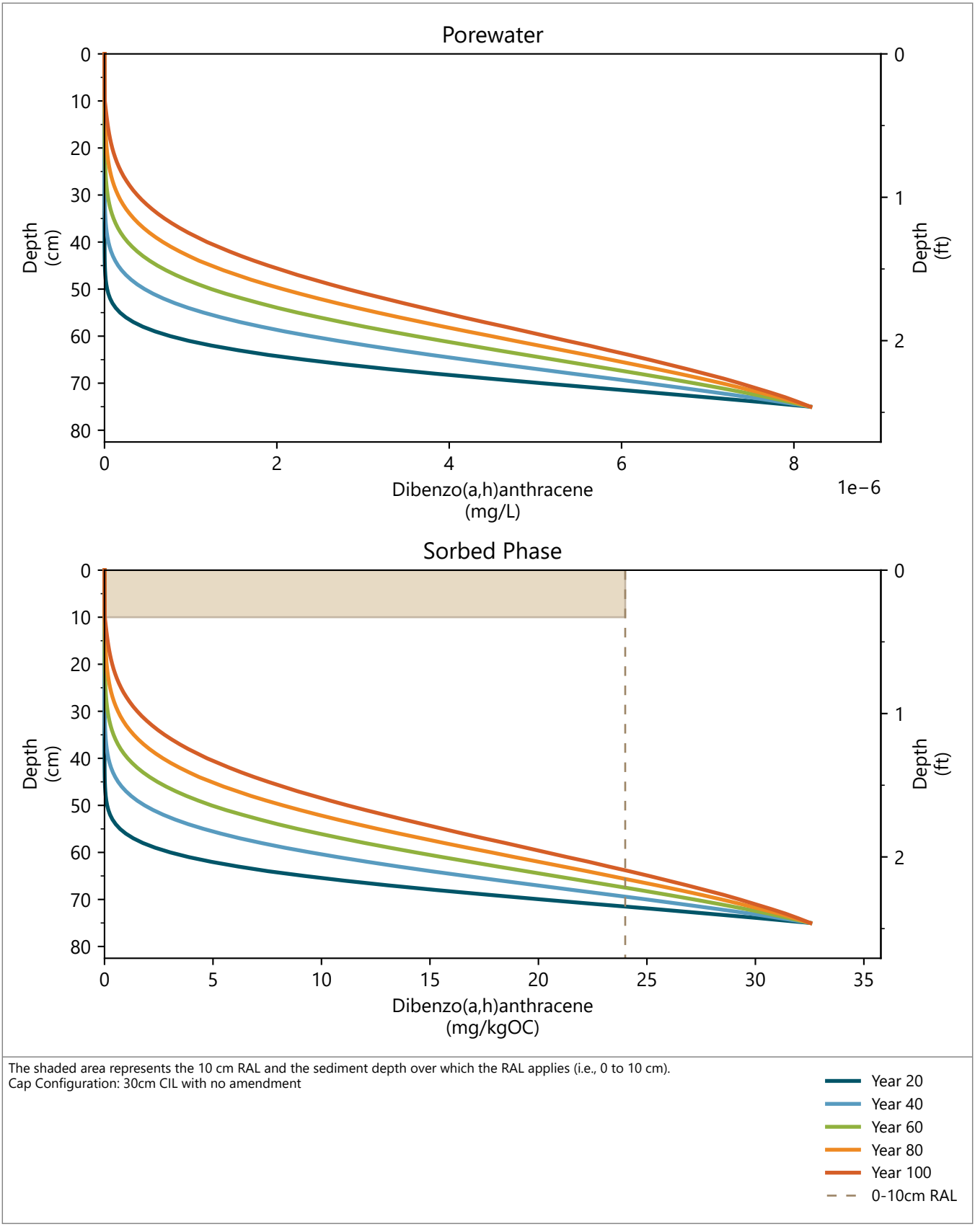


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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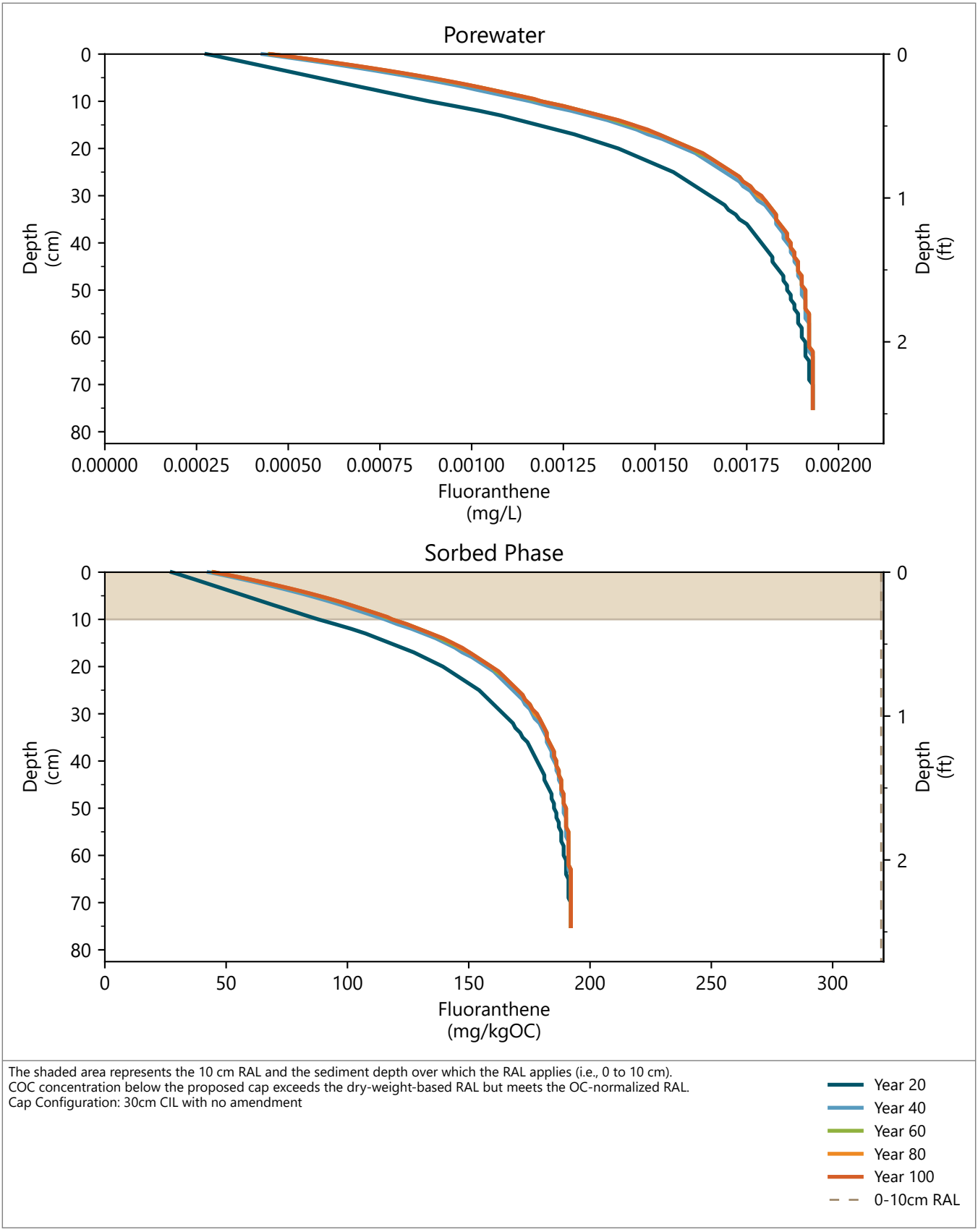
Figure H.4.2.40h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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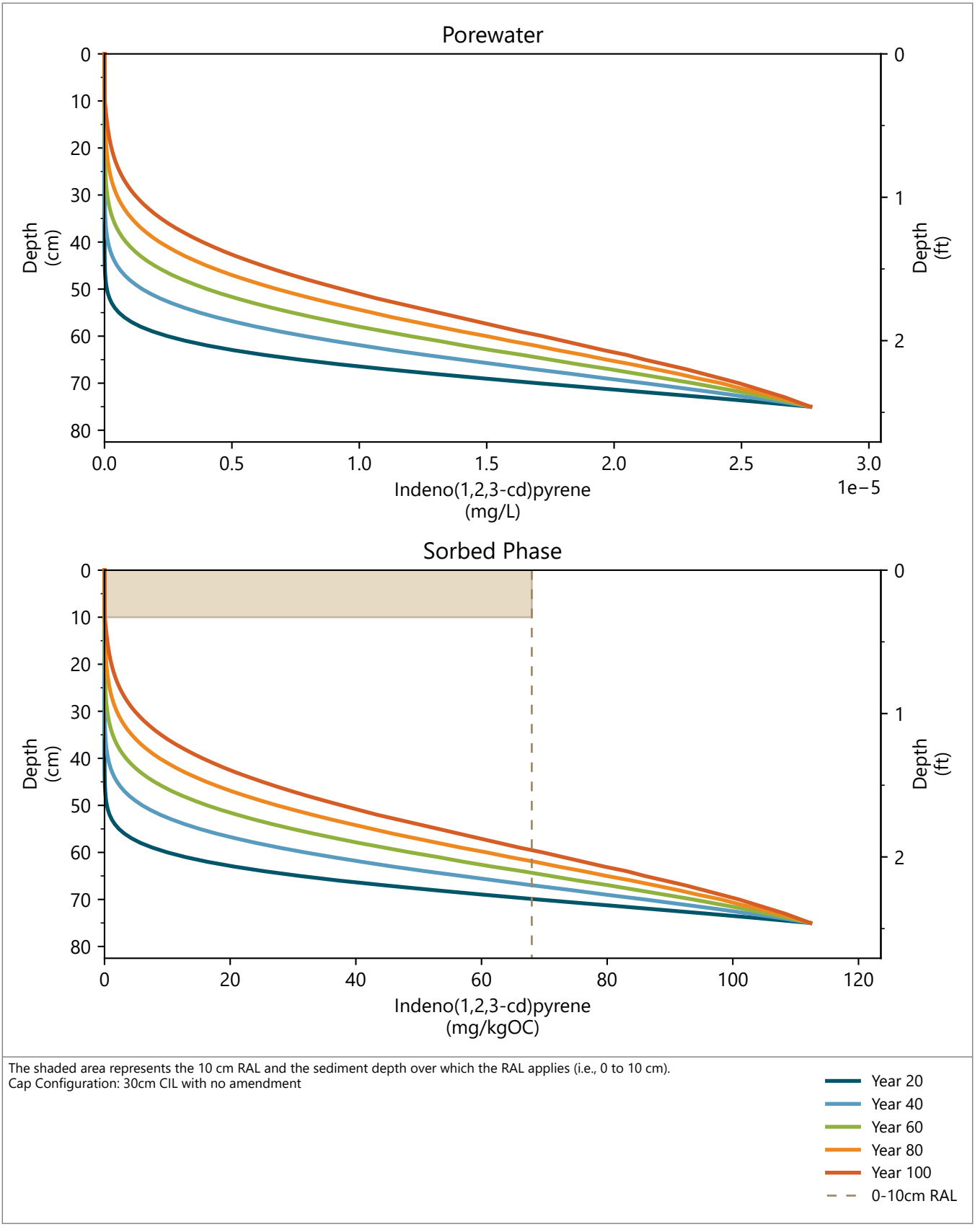
Figure H.4.2.40i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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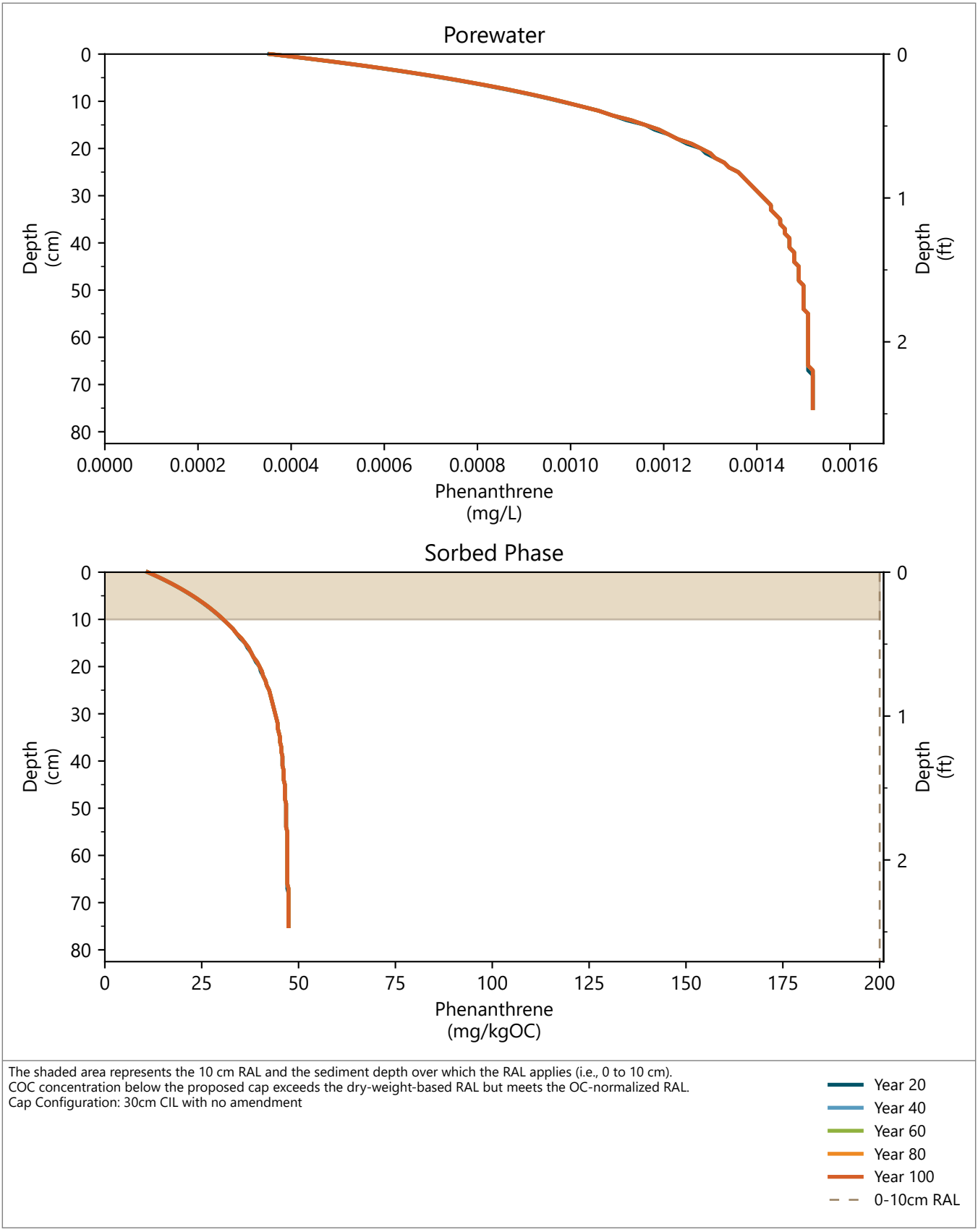
Figure H.4.2.40j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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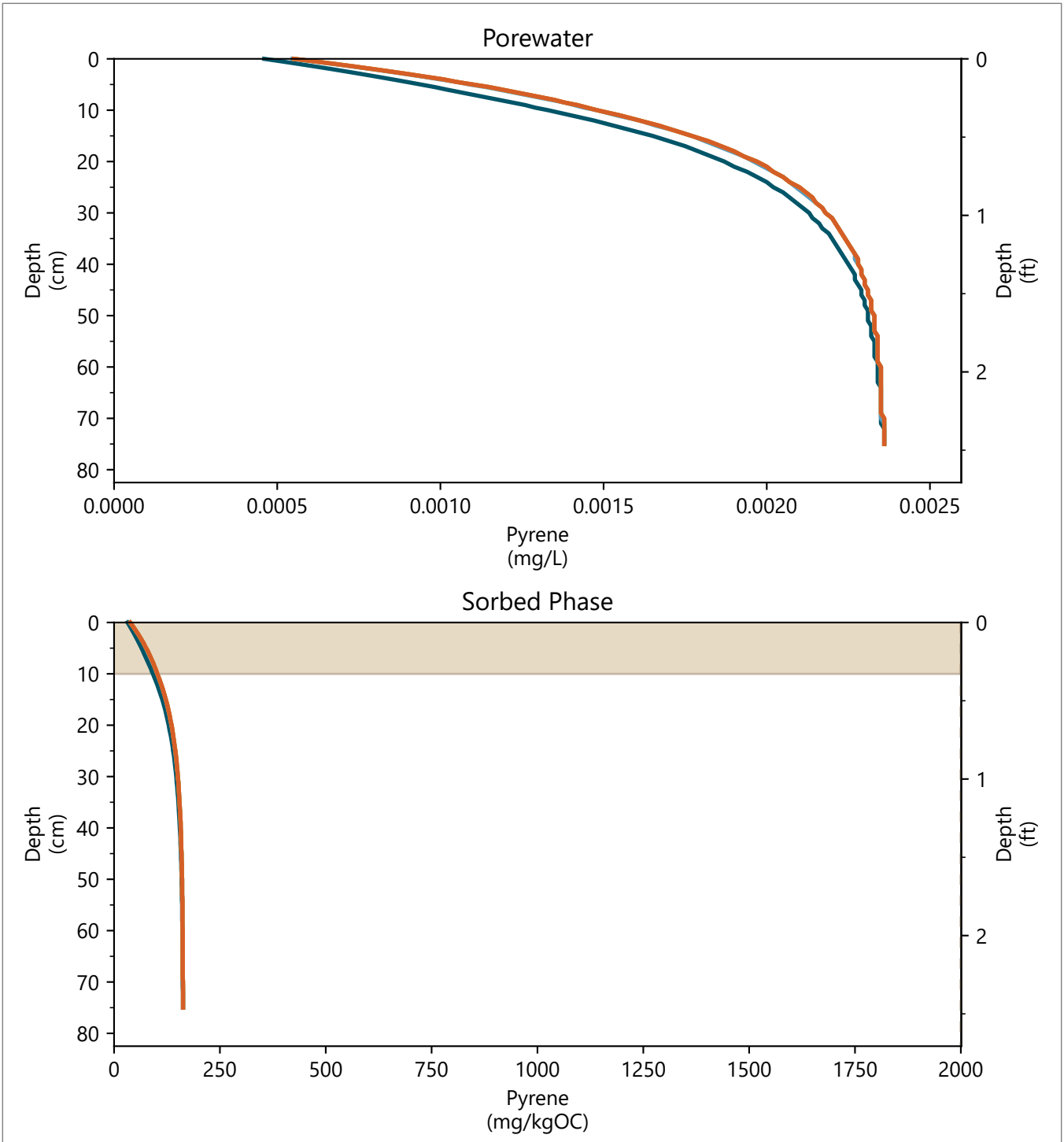
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Figure H.4.2.40k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.40I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

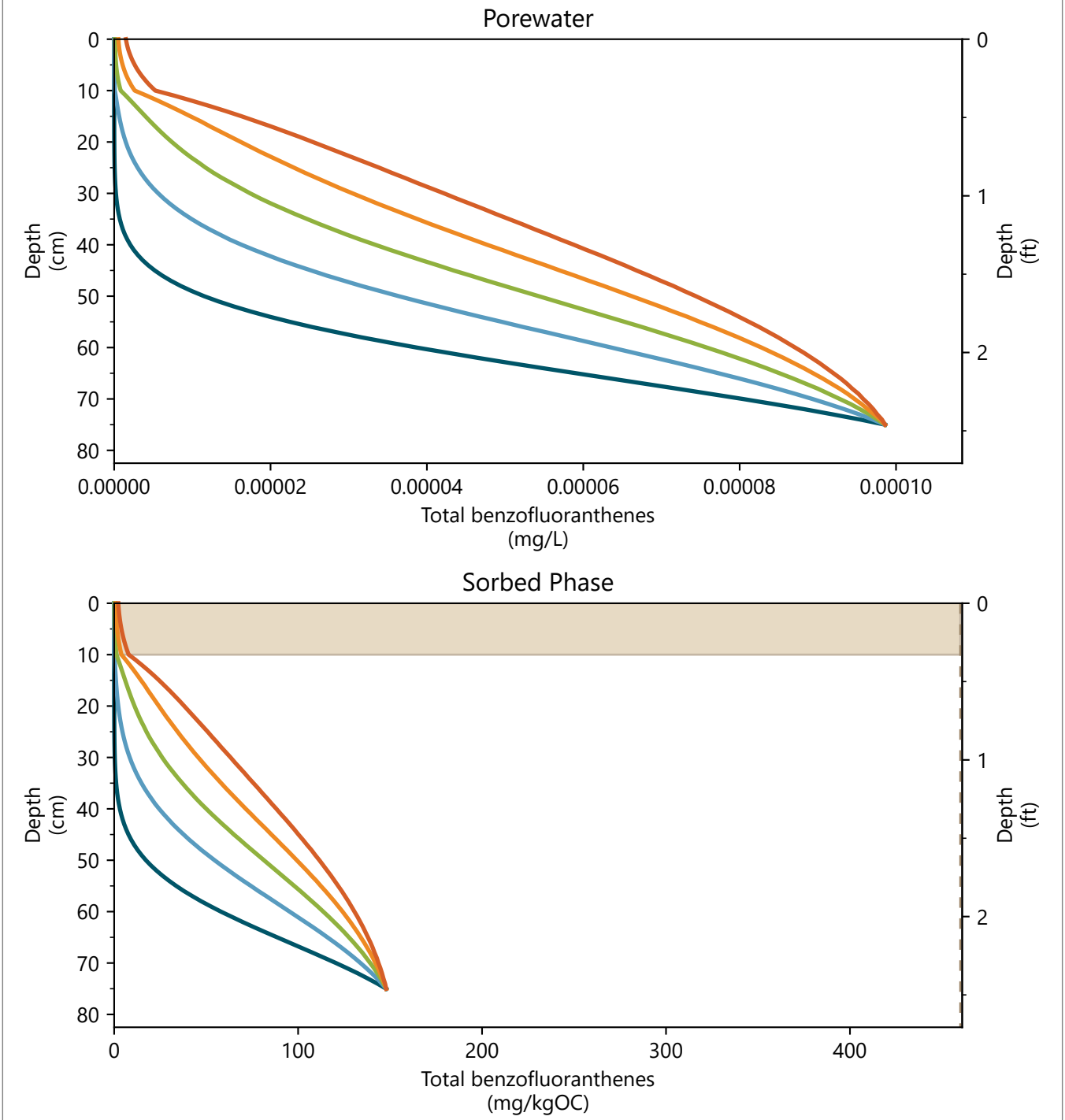


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

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Figure H.4.2.40m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



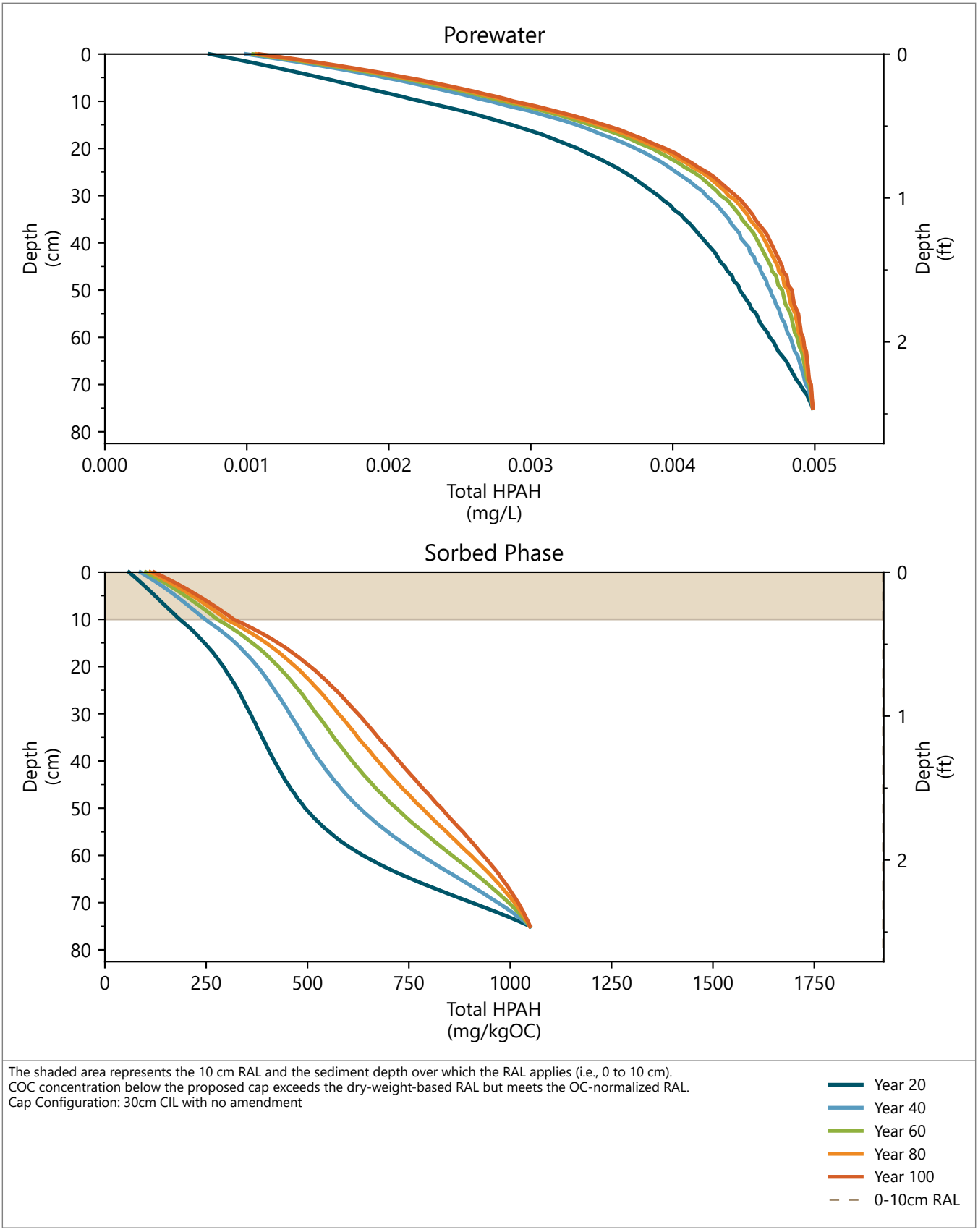
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL

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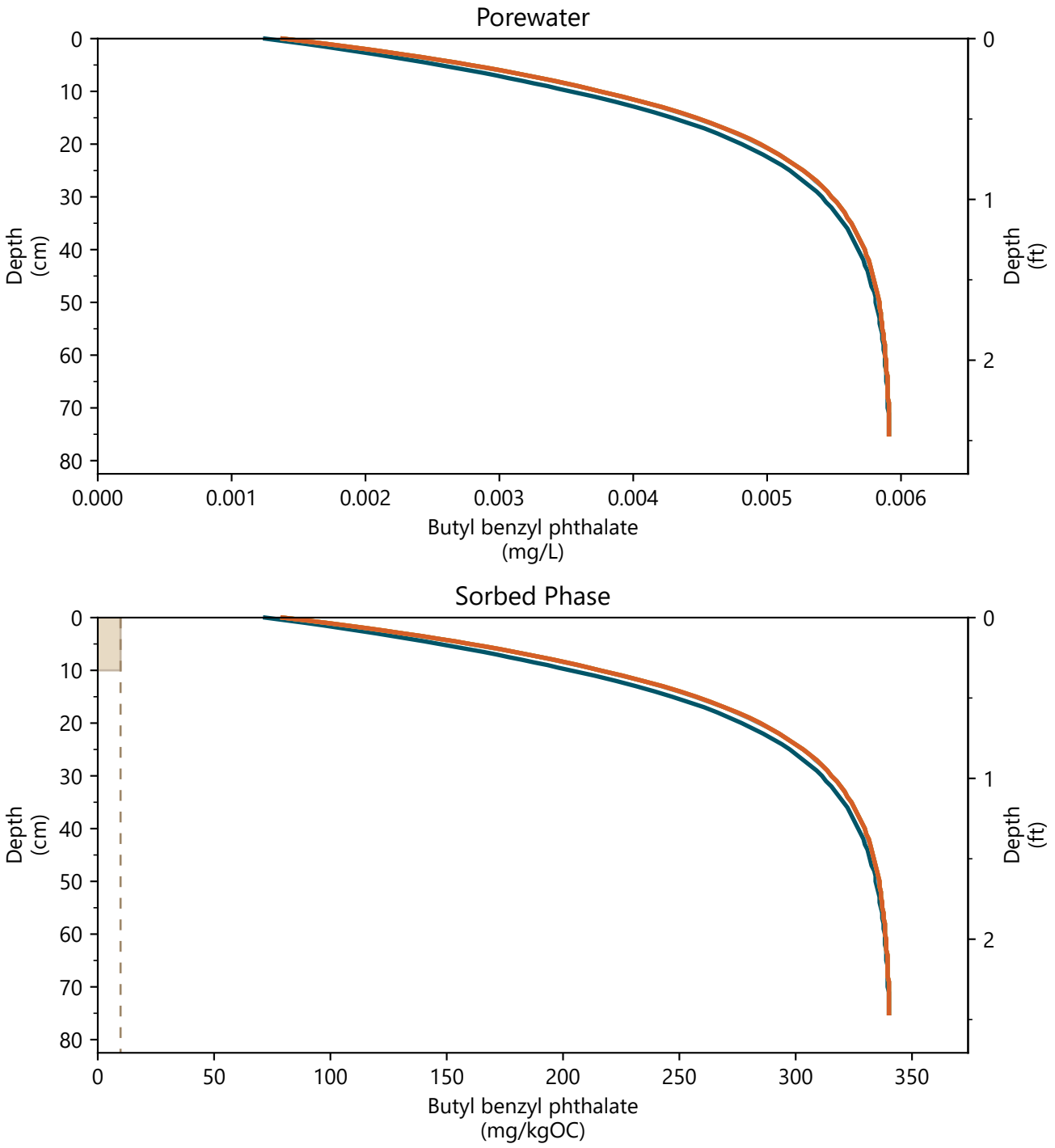
Figure H.4.2.40n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.40o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

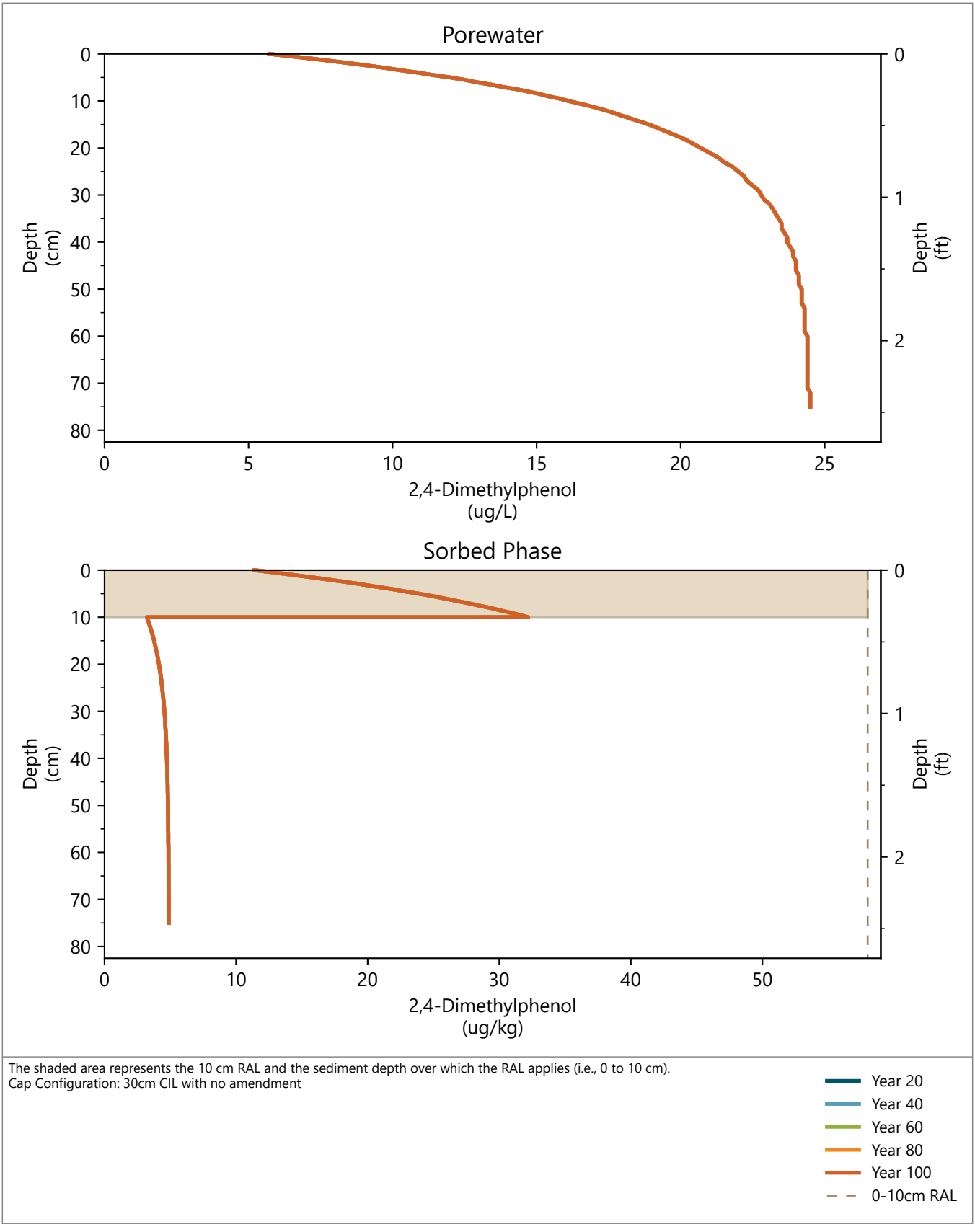


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with no amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL

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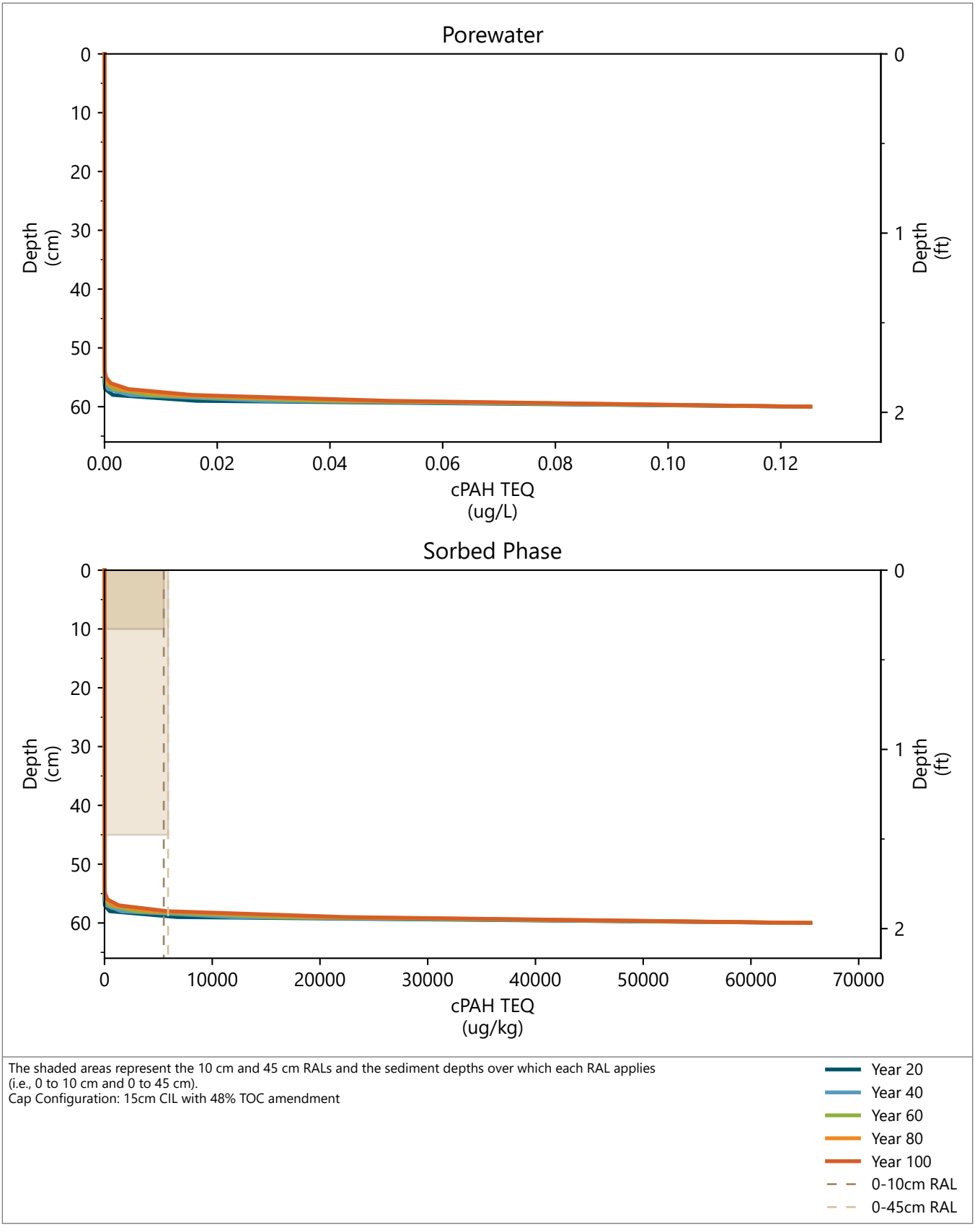
Figure H.4.2.40p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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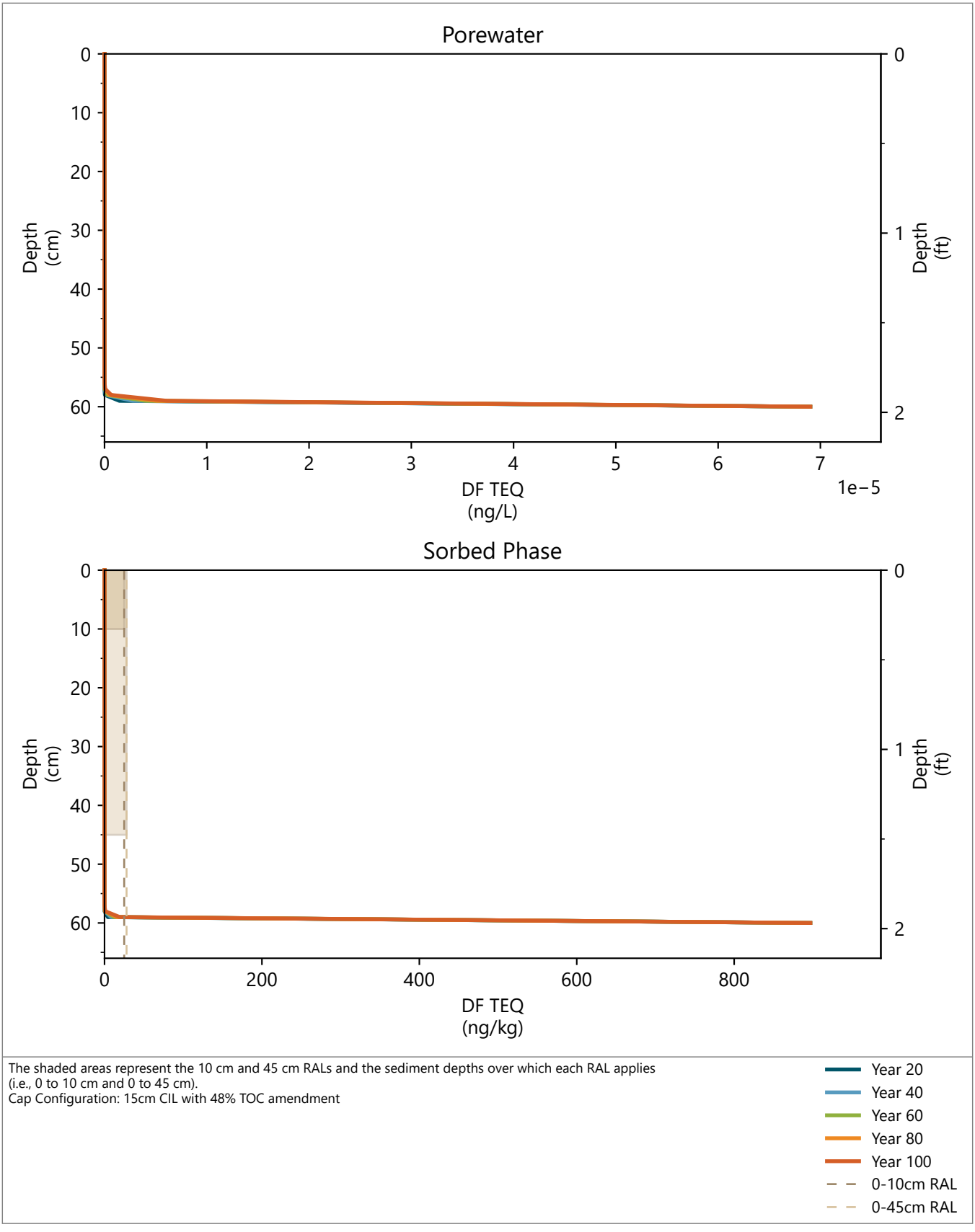
Figure H.4.2.40q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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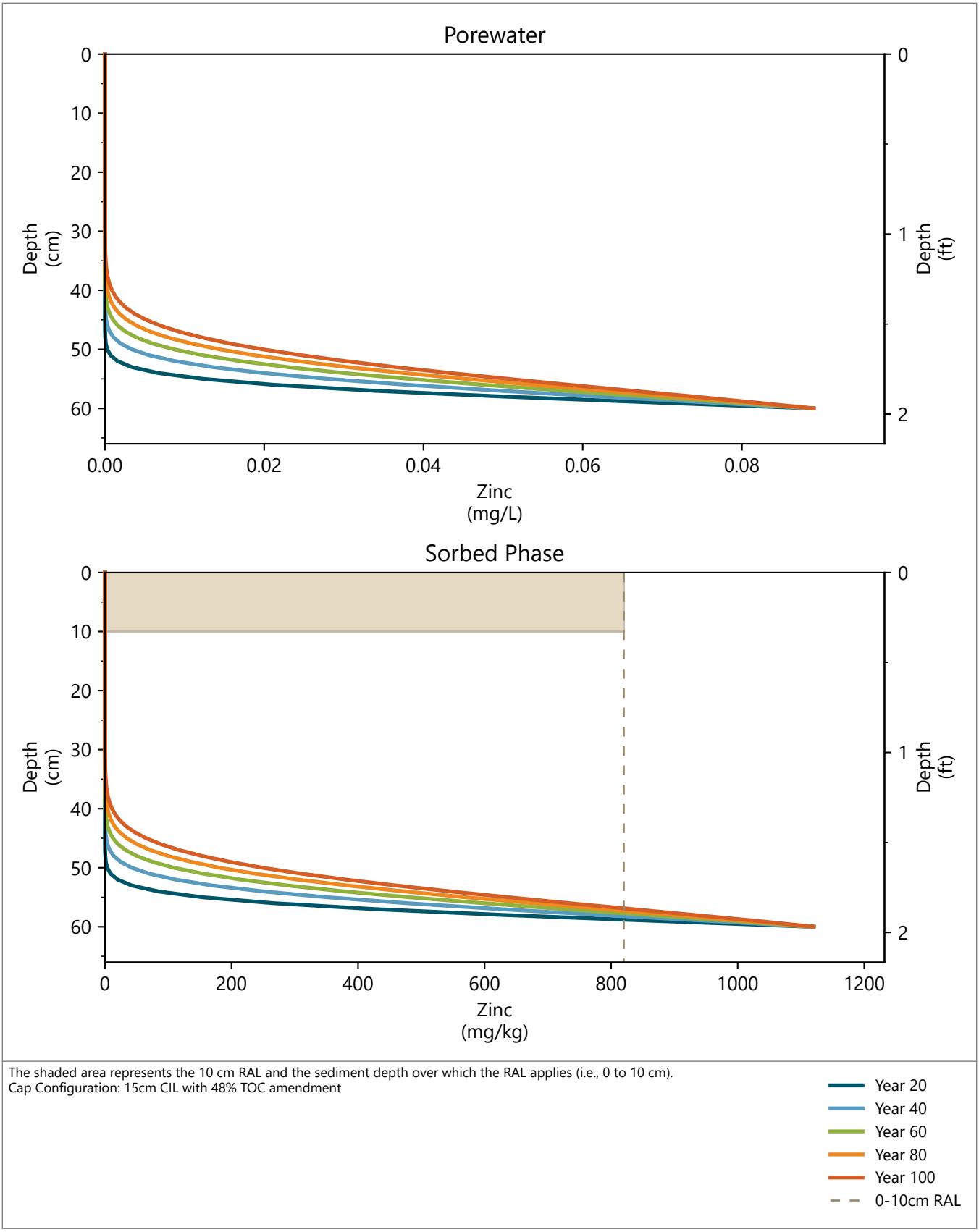
Figure H.4.2.41a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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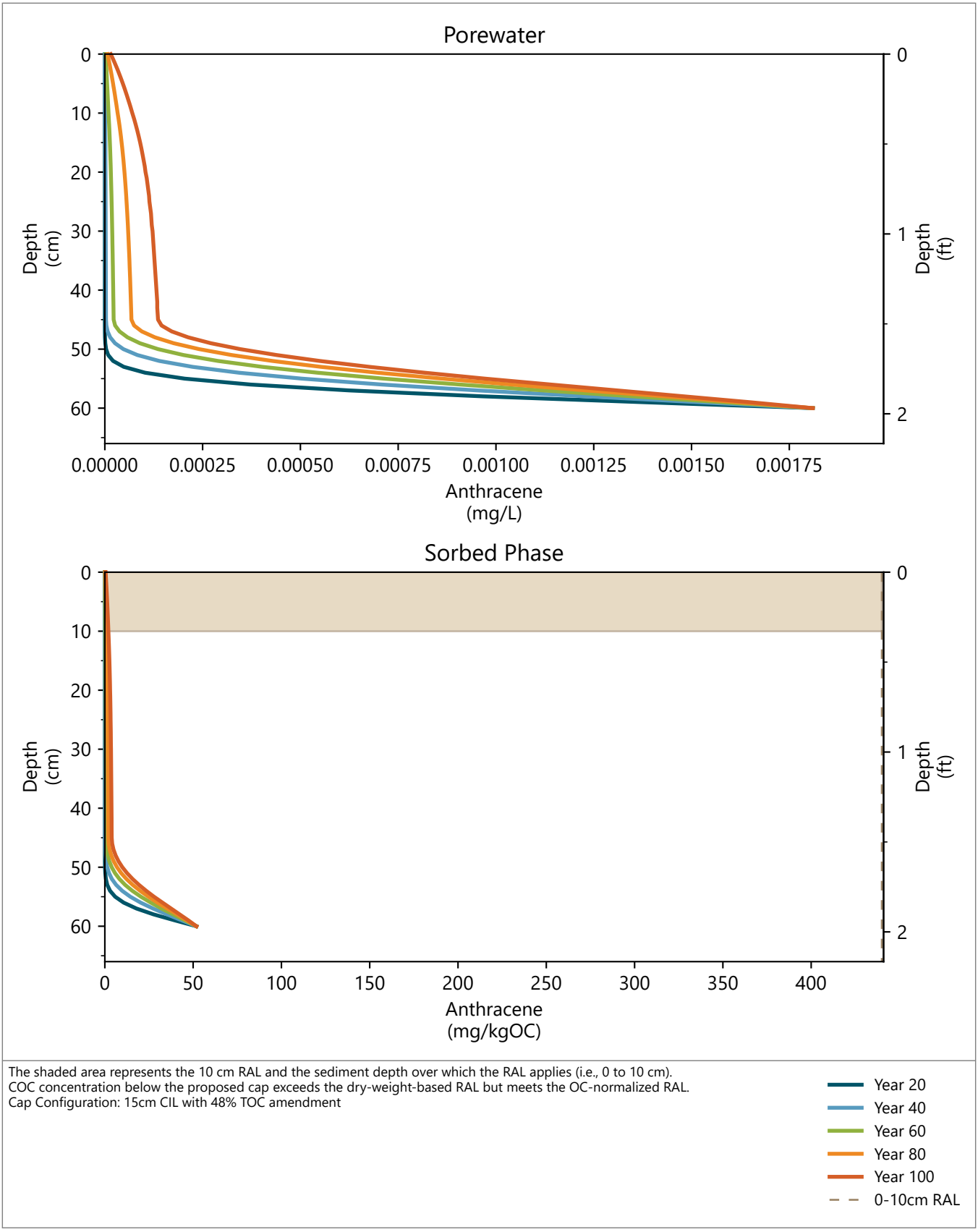
Figure H.4.2.41b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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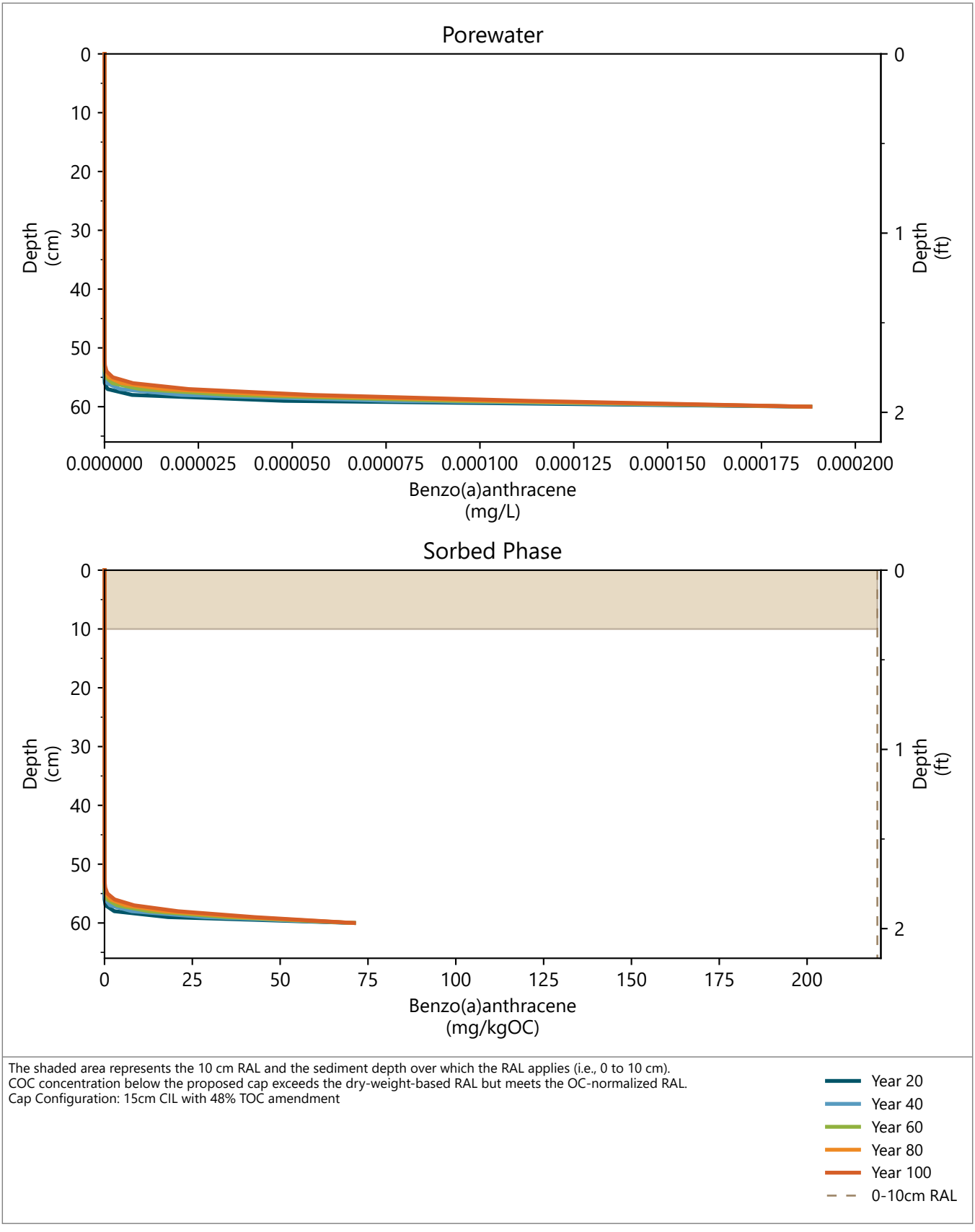
Figure H.4.2.41c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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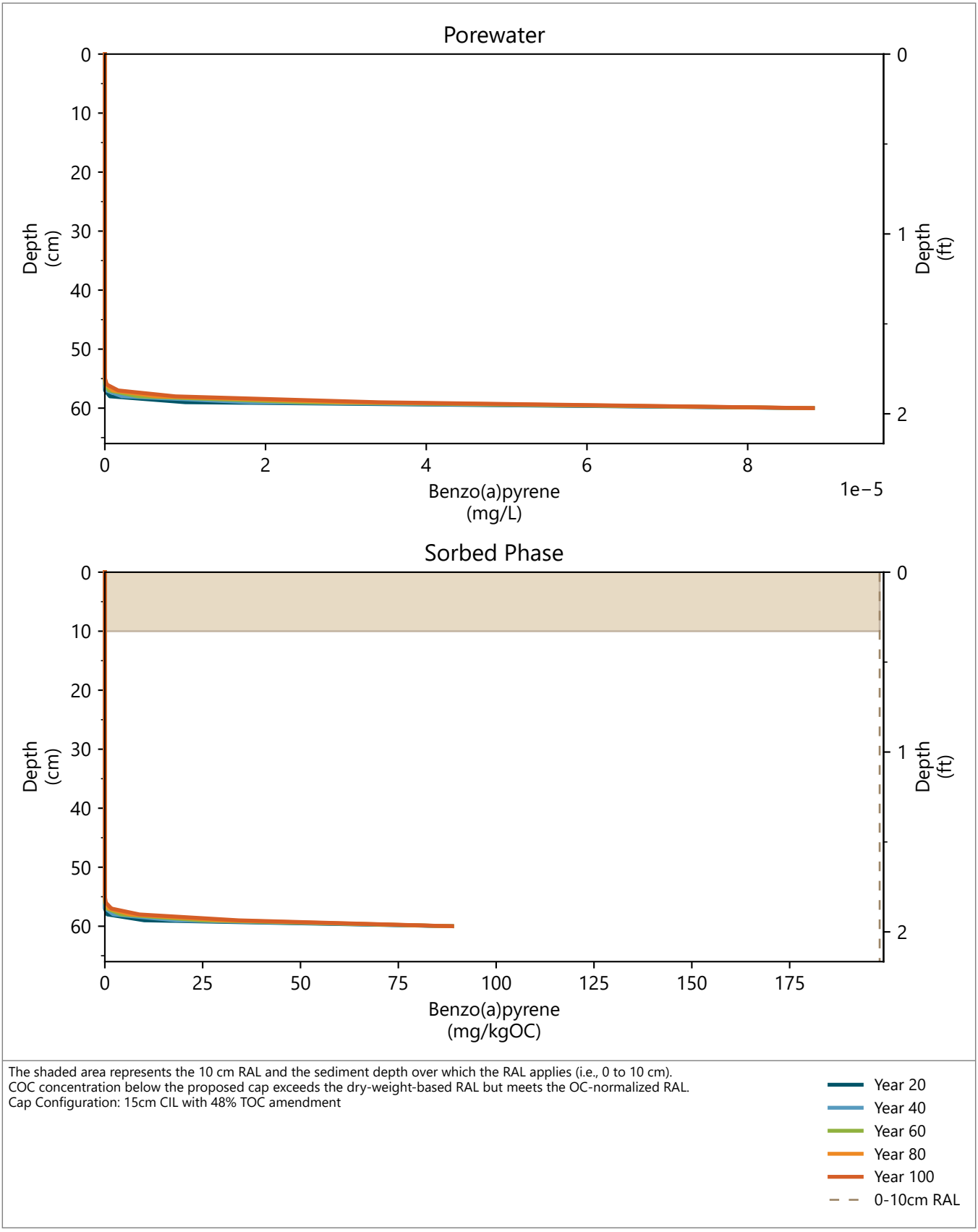
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Figure H.4.2.41d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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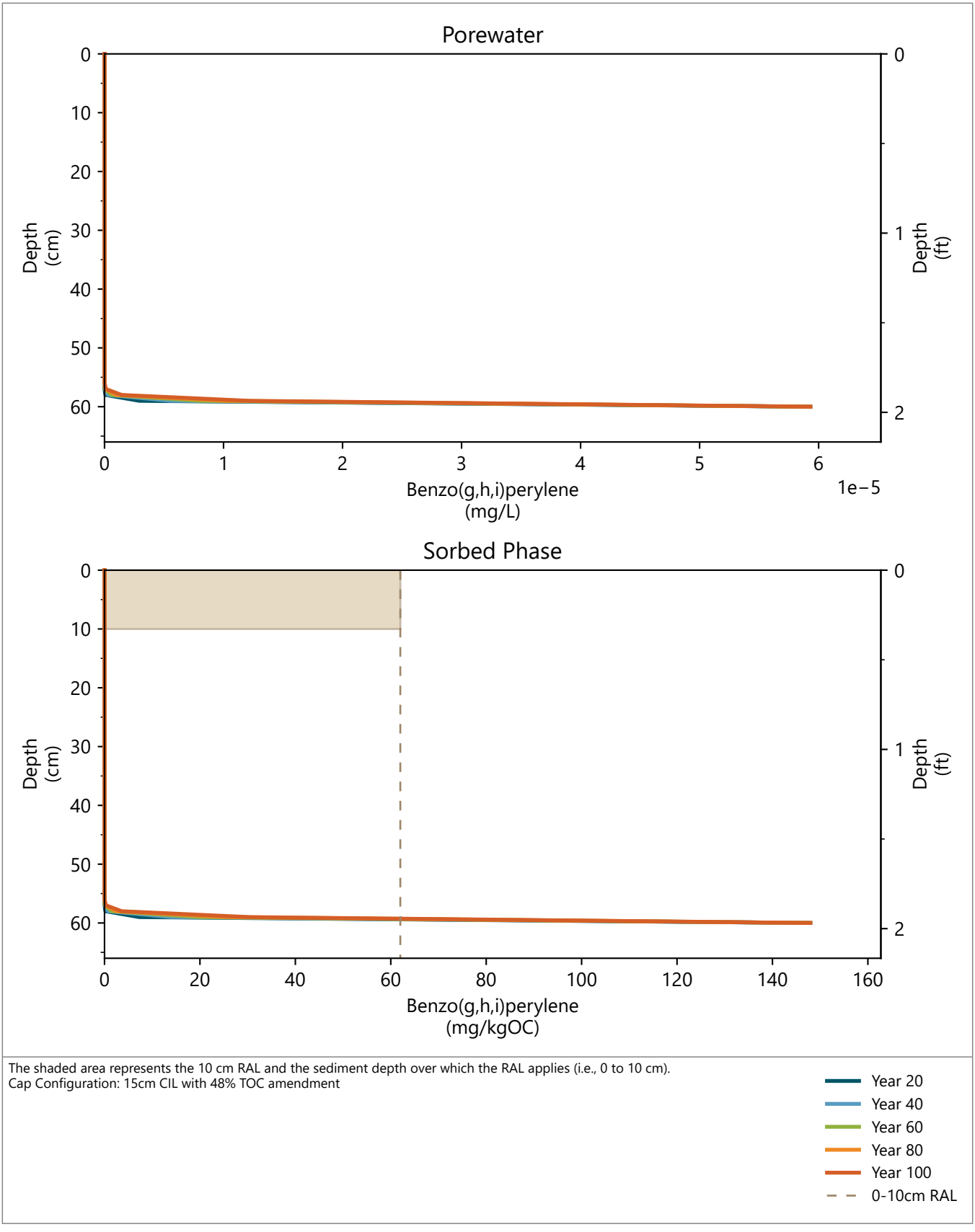
Figure H.4.2.41e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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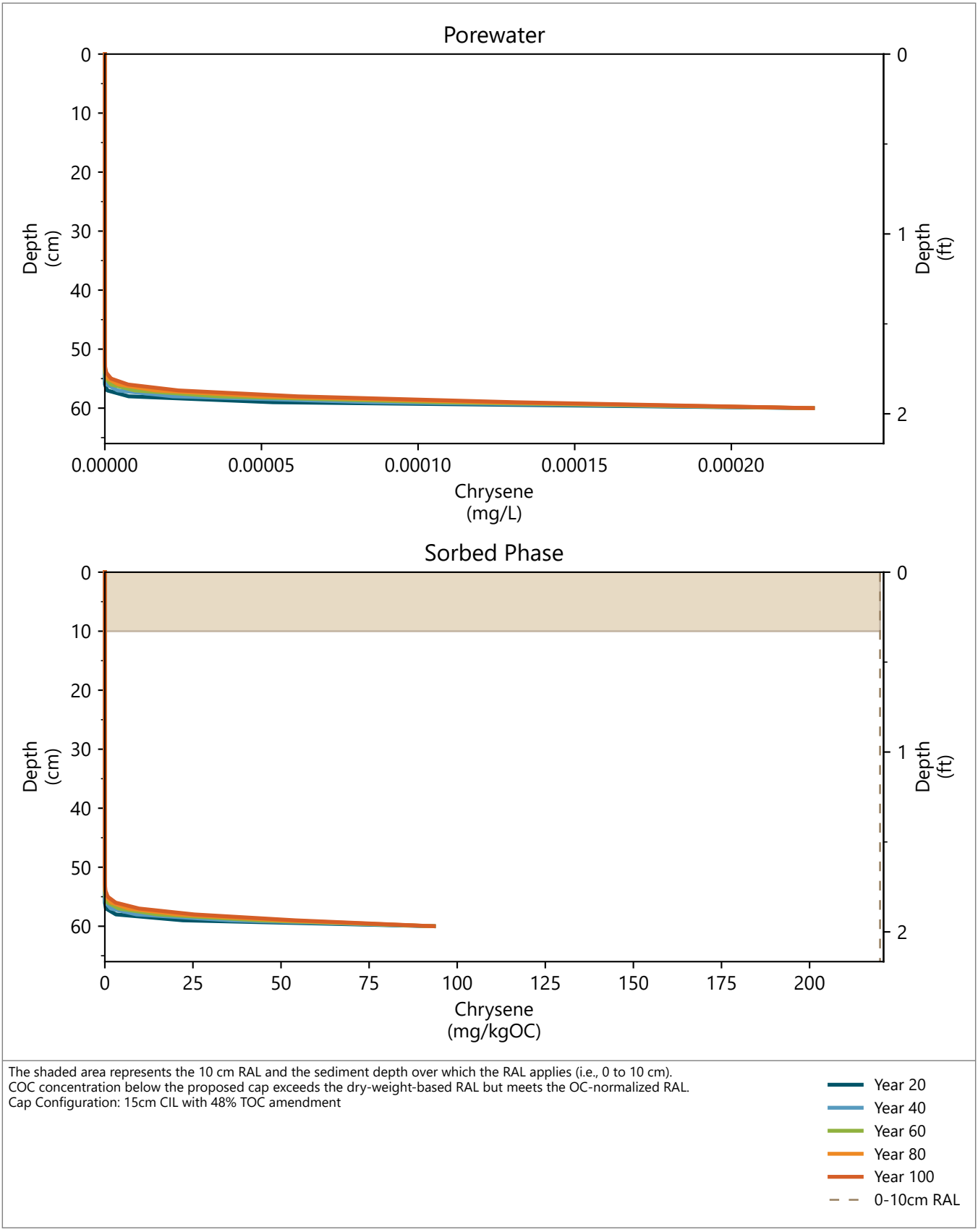
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Figure H.4.2.41f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



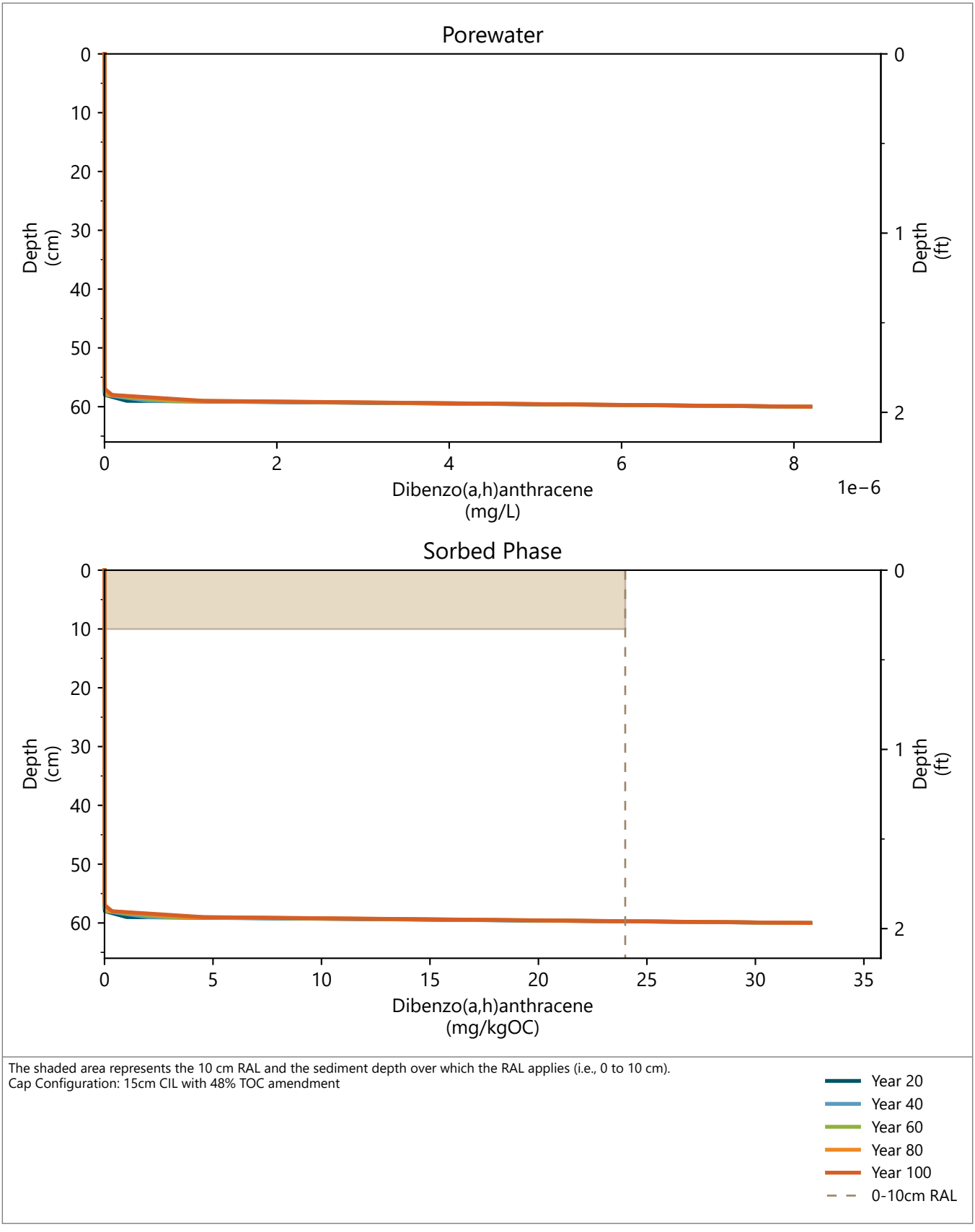
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Figure H.4.2.41g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



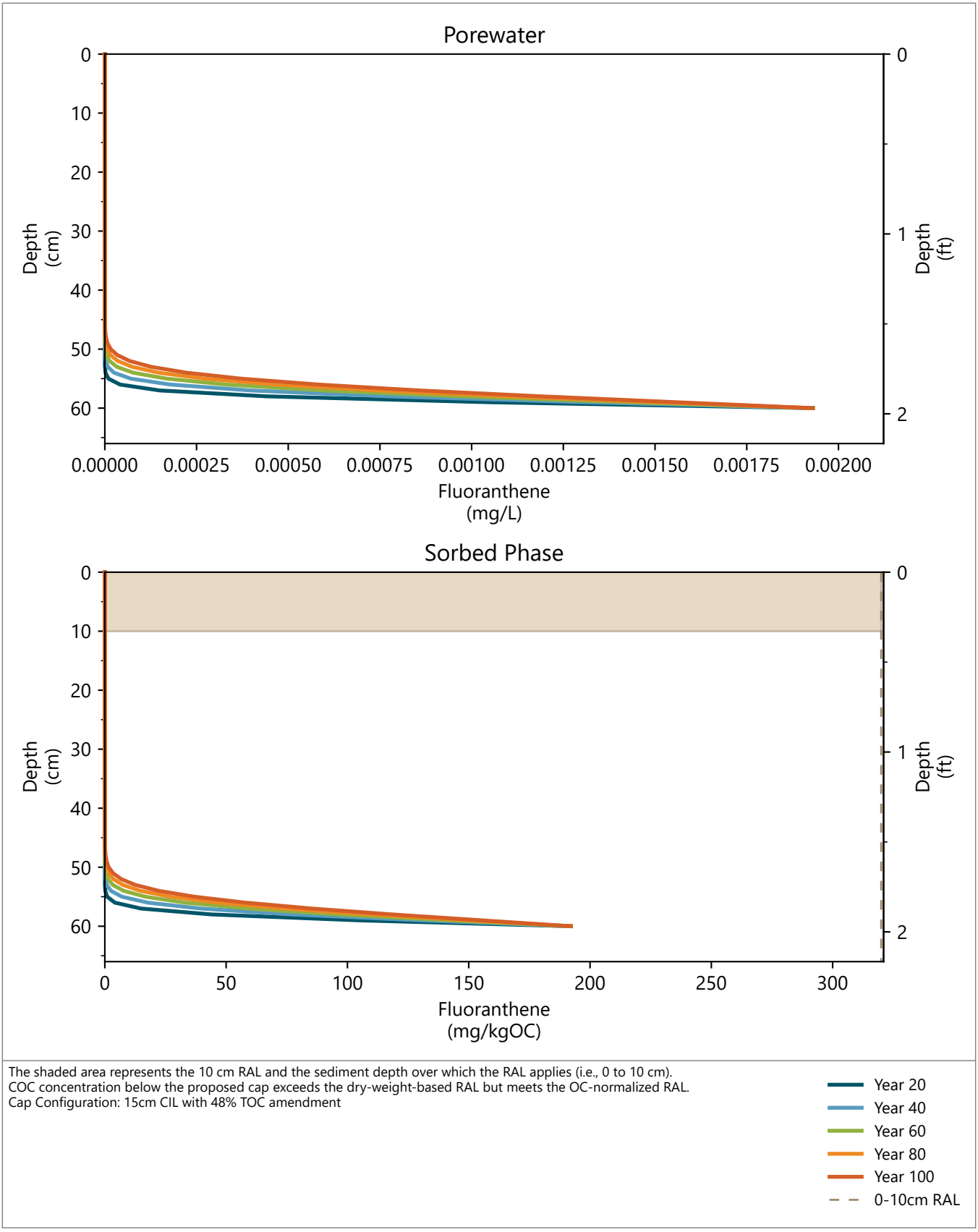
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Figure H.4.2.41h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



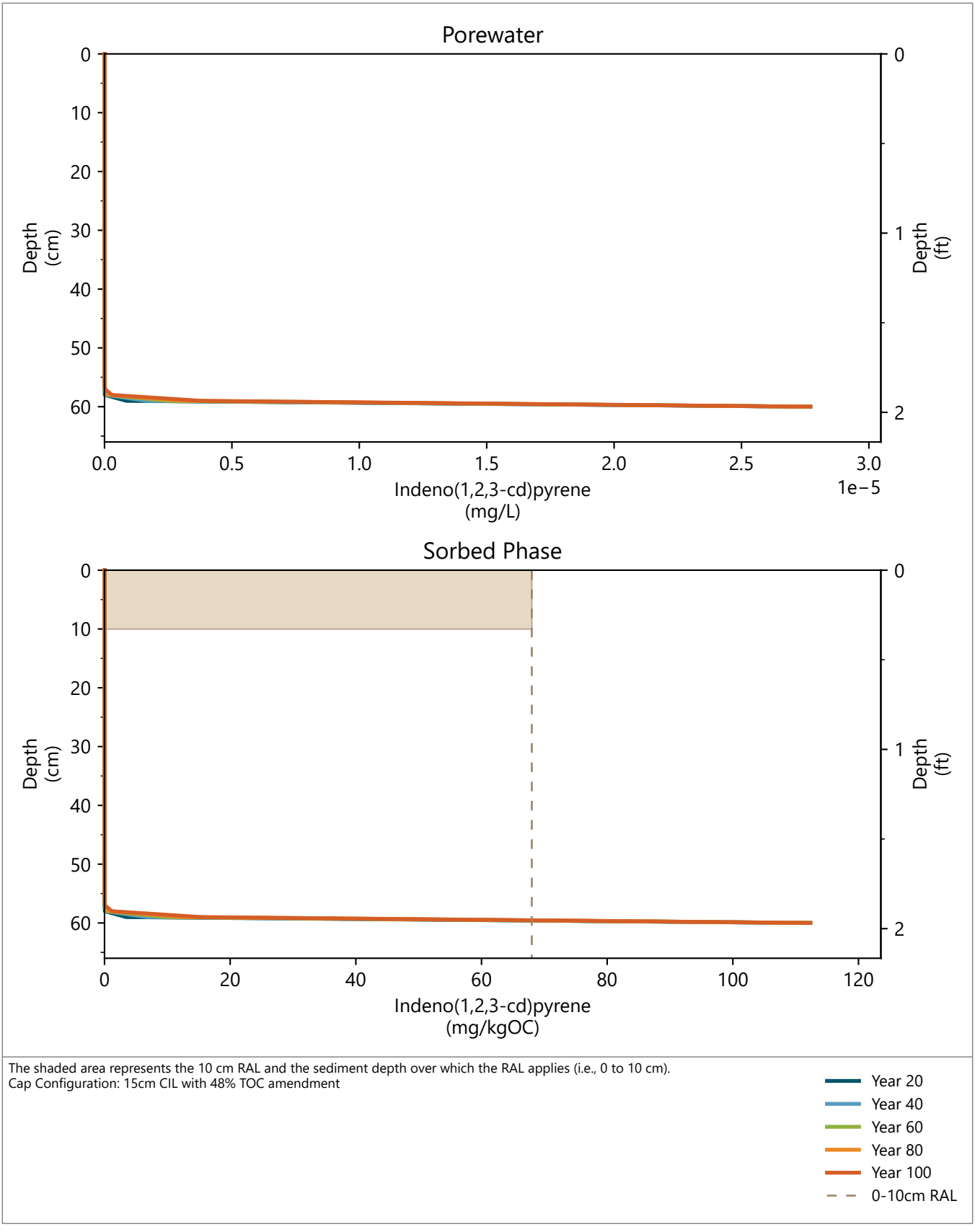
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Figure H.4.2.41i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



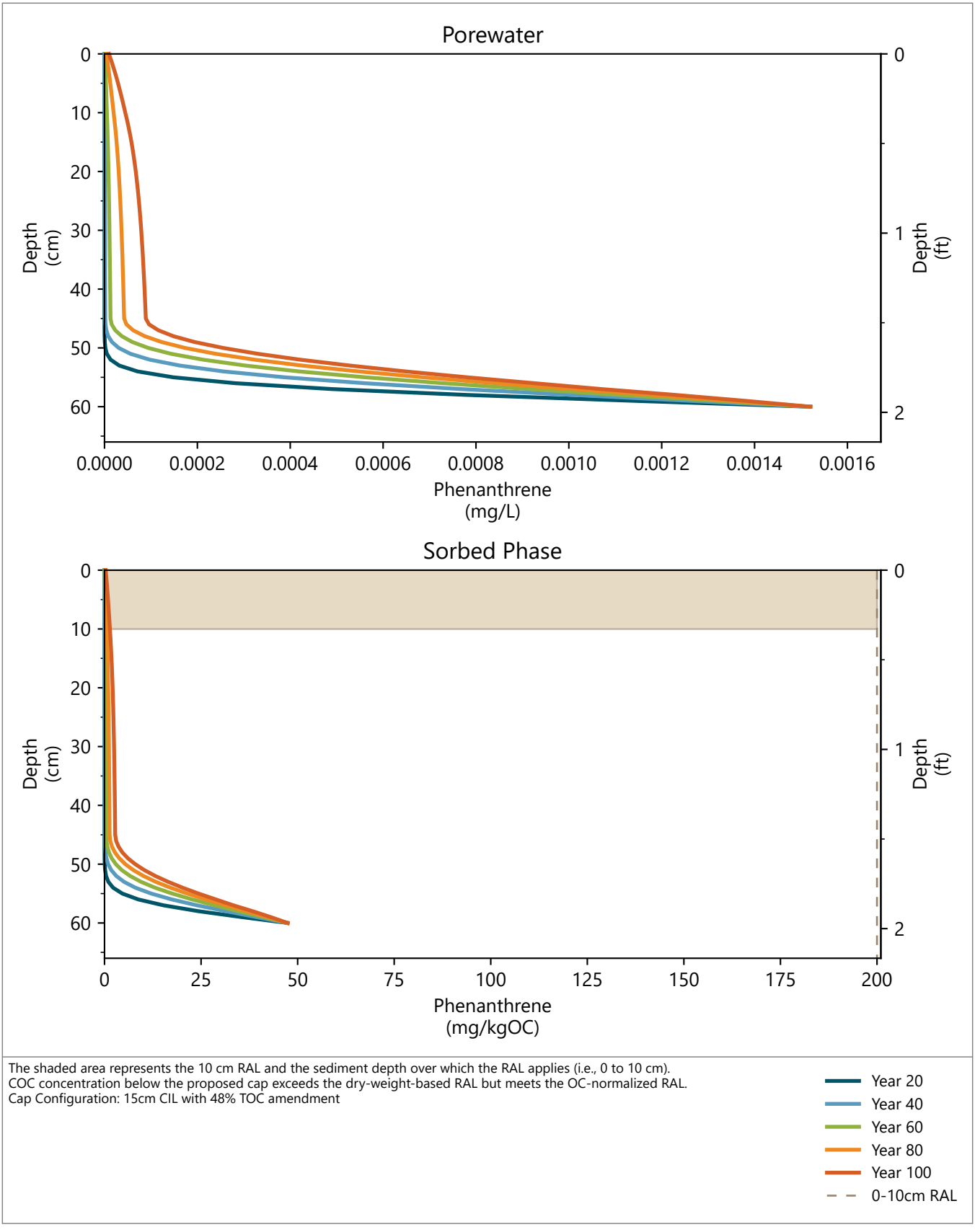
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Figure H.4.2.41j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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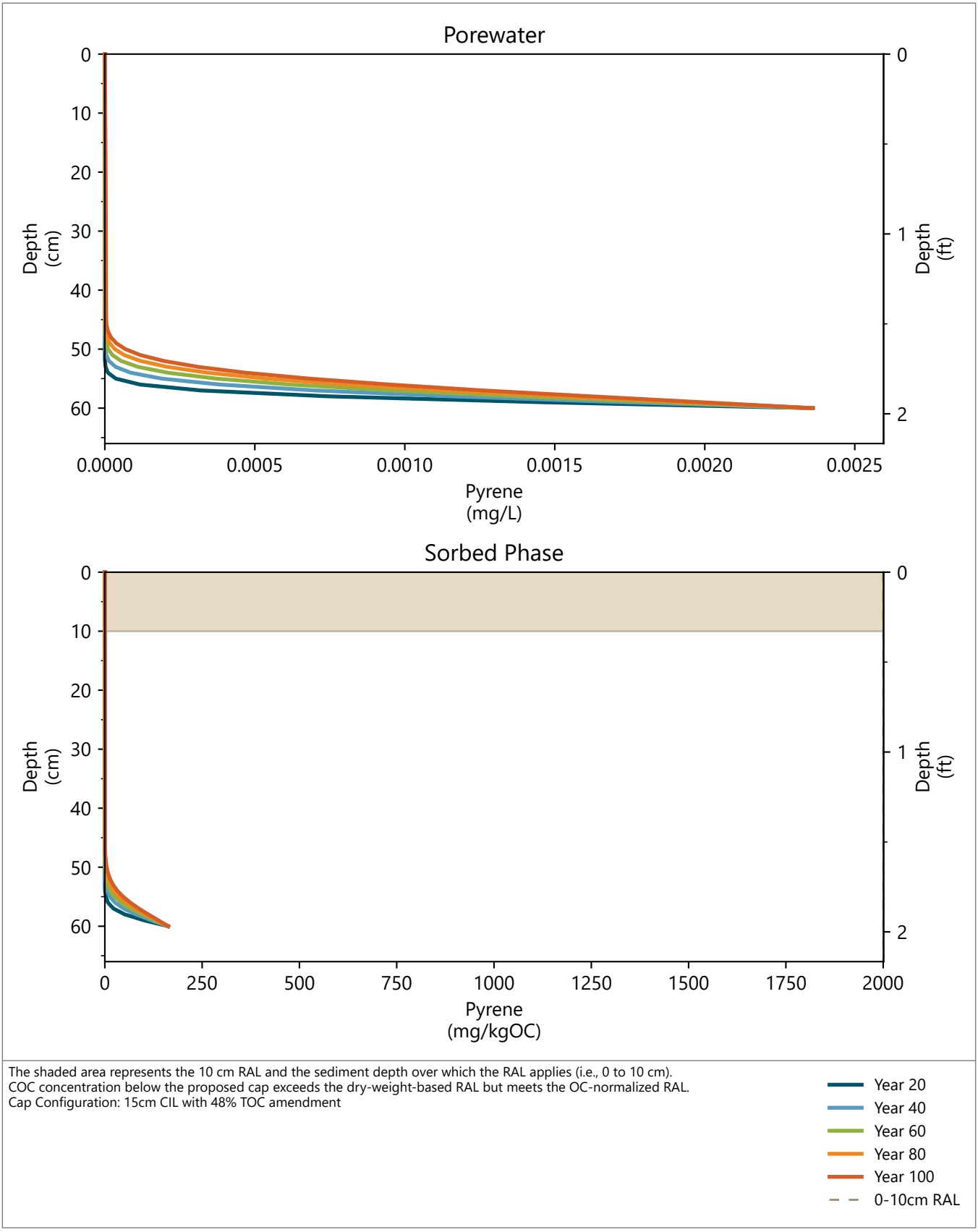
Figure H.4.2.41k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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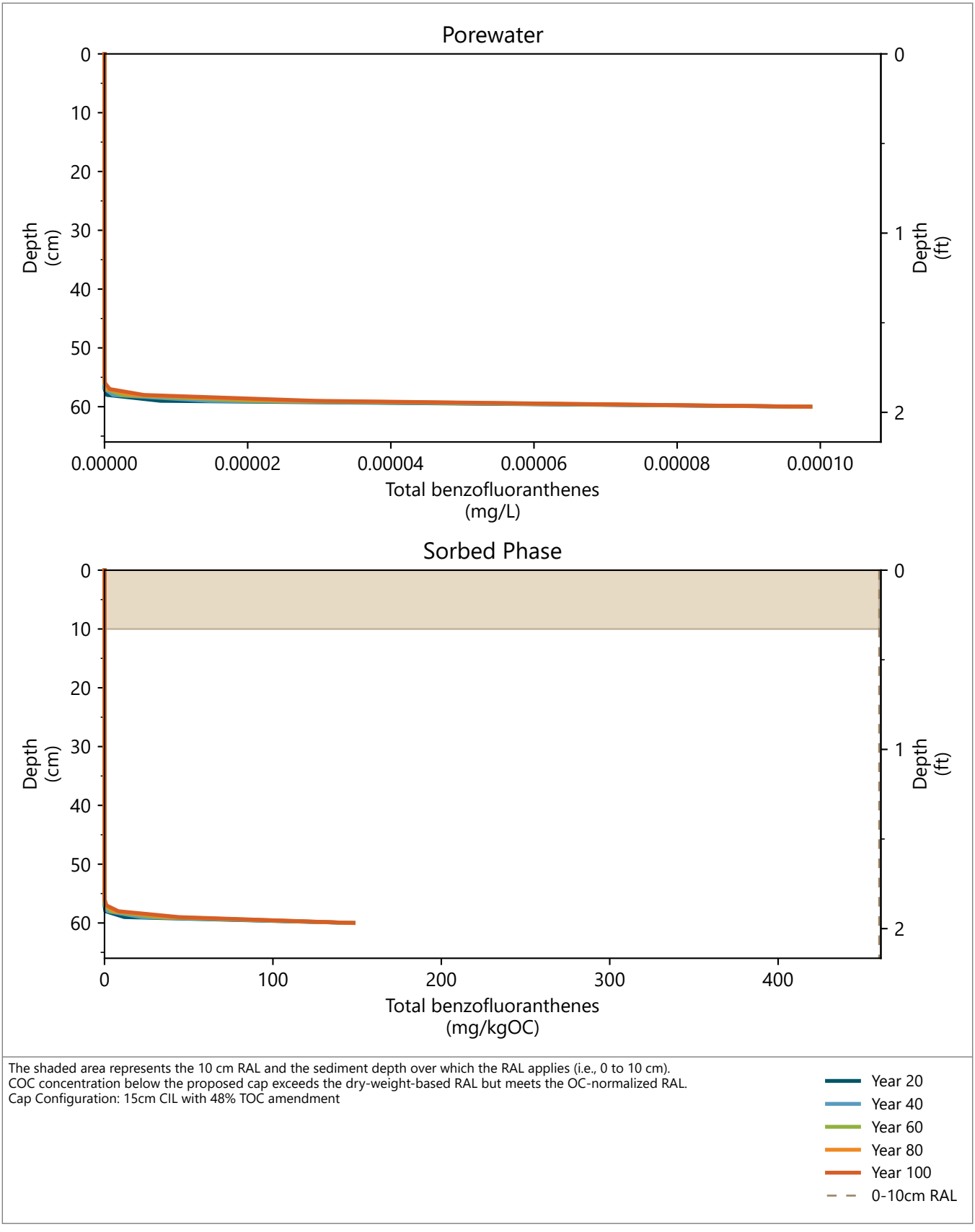
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Figure H.4.2.41l
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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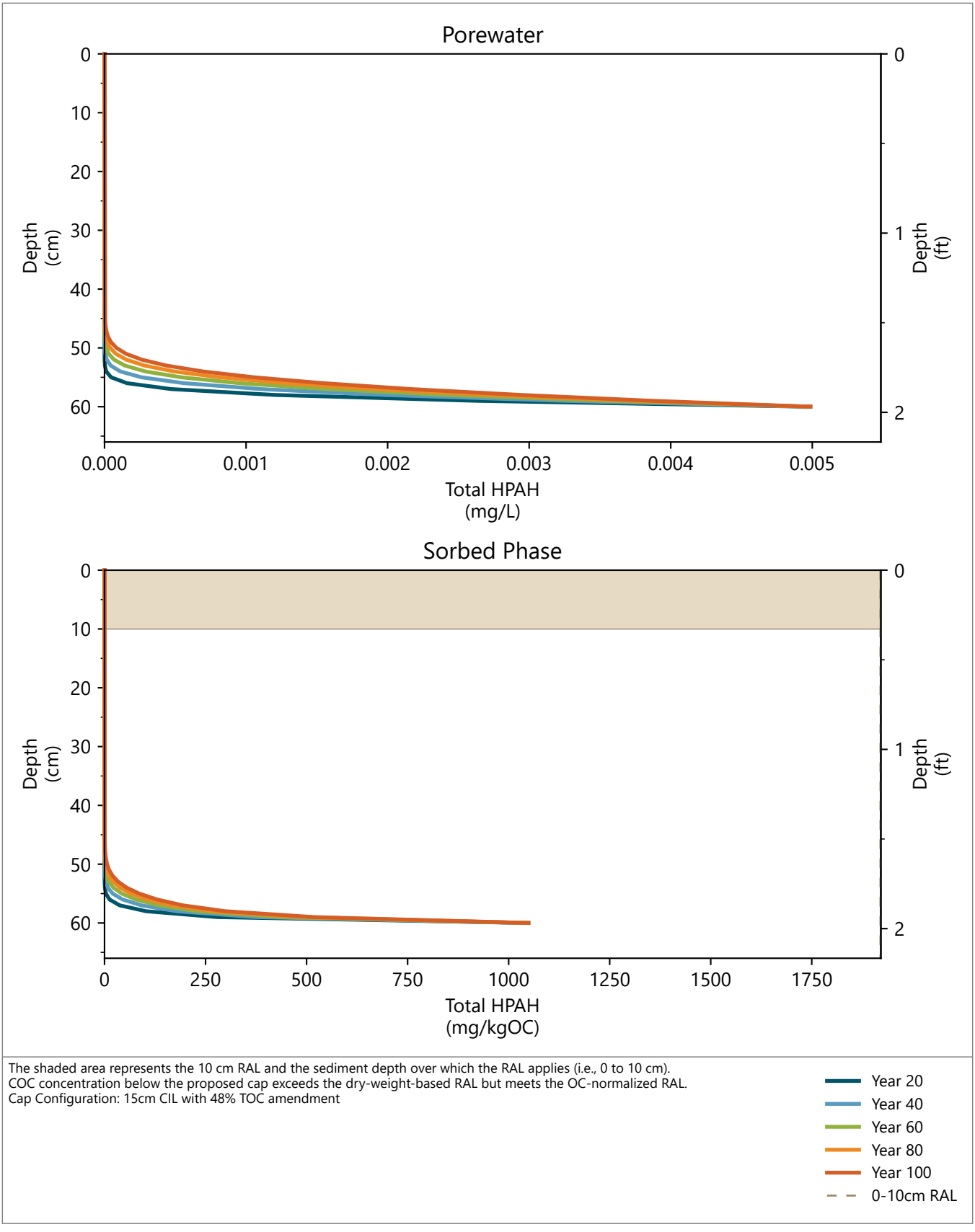
Figure H.4.2.41m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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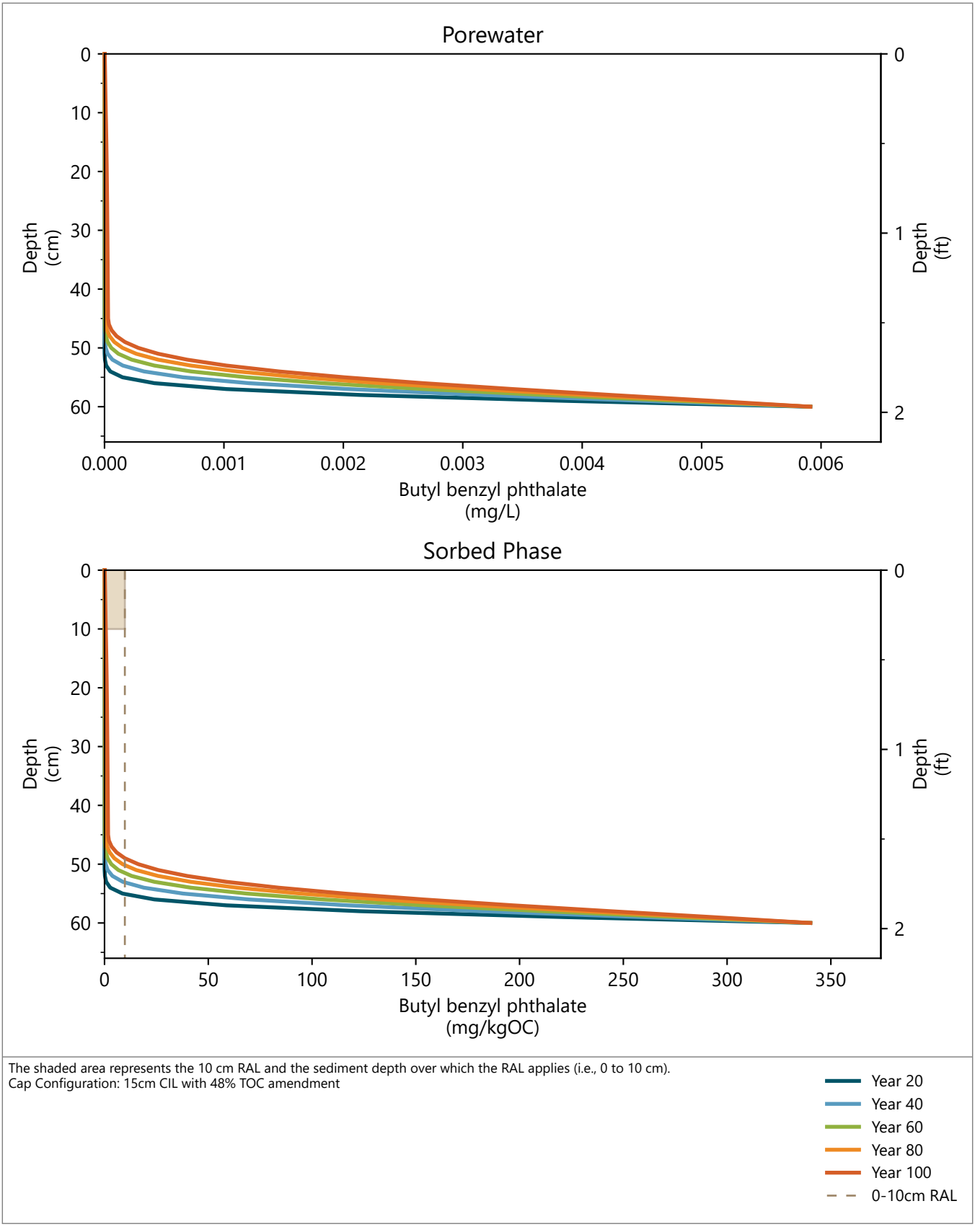
Figure H.4.2.41n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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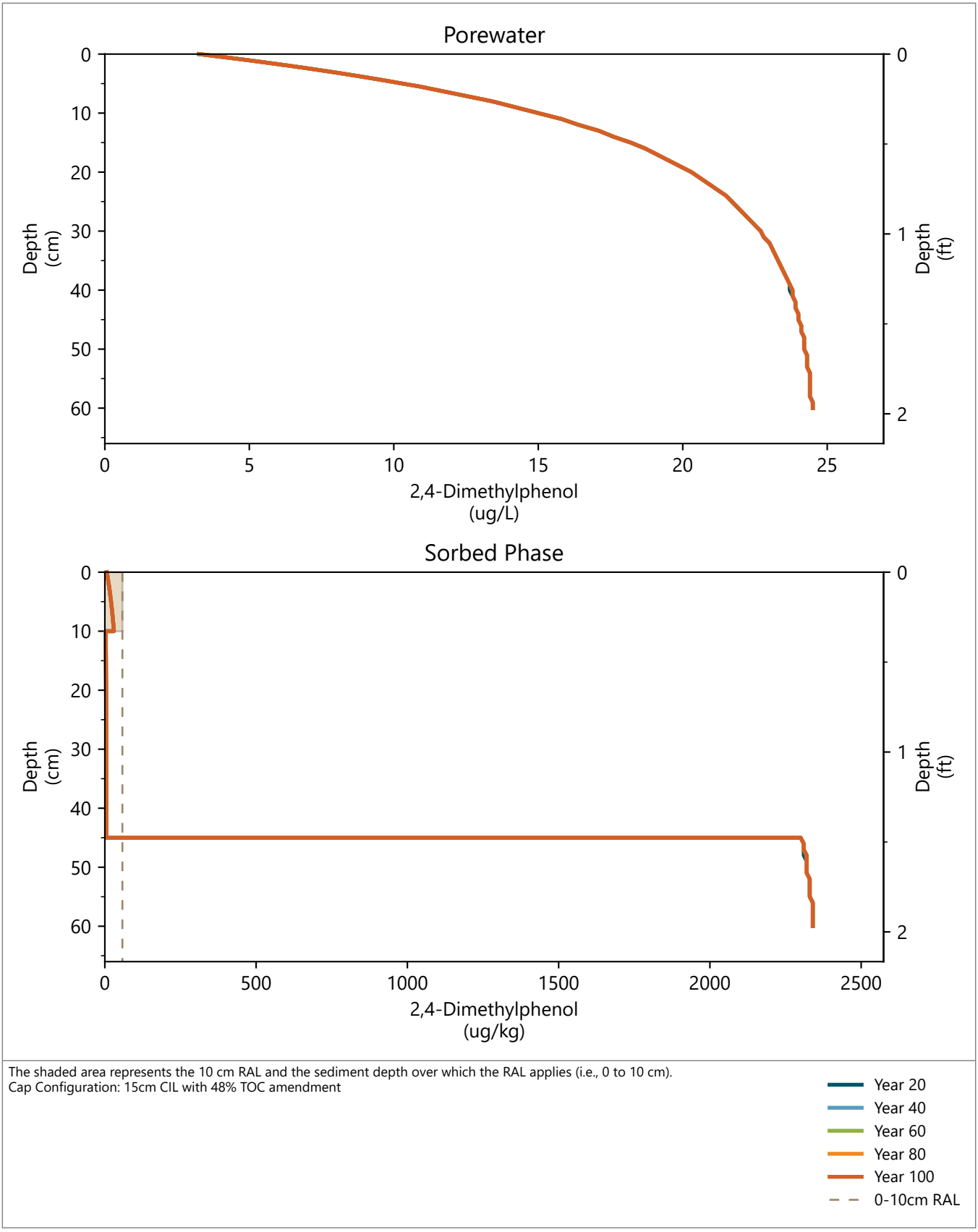
Figure H.4.2.41o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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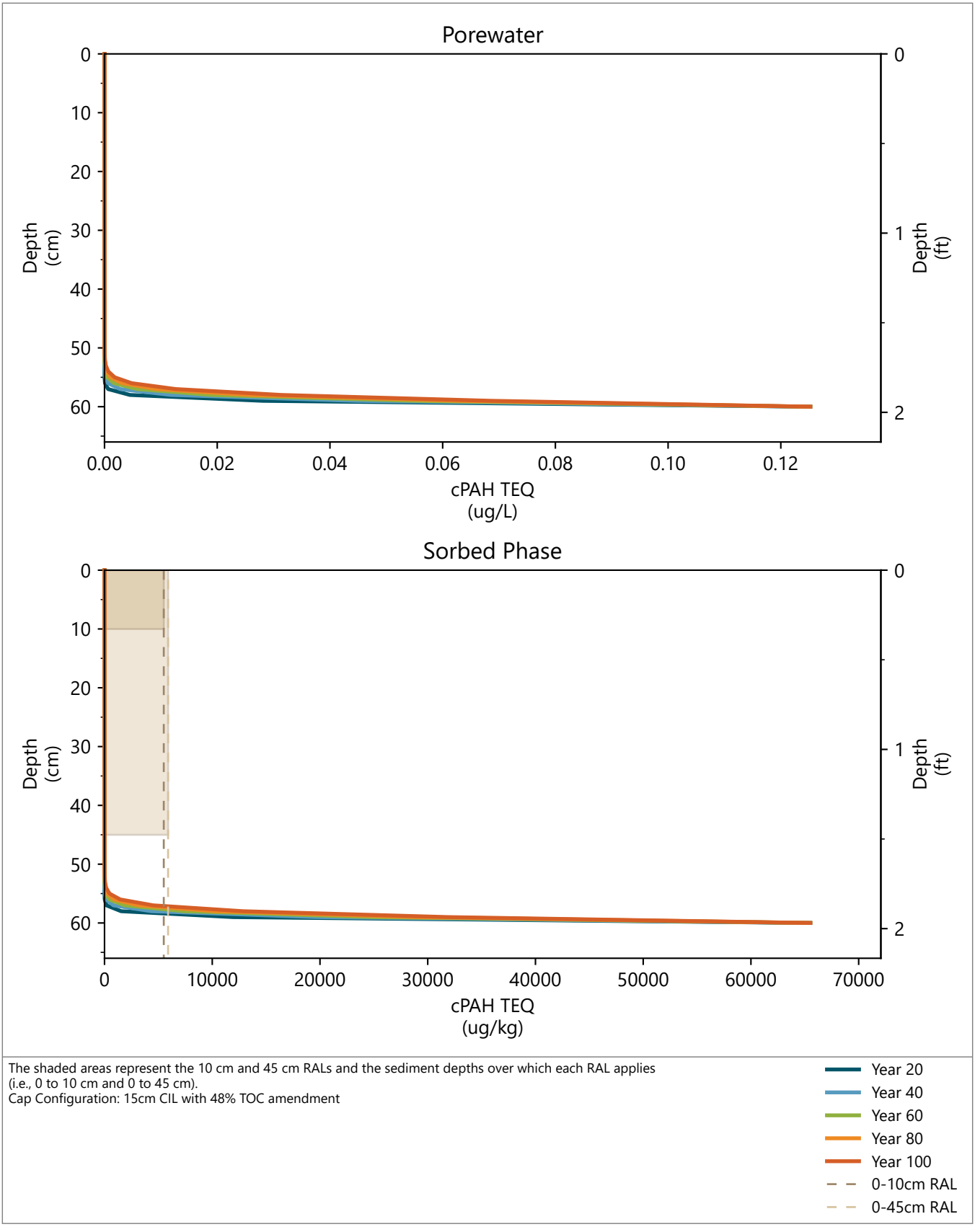
Figure H.4.2.41p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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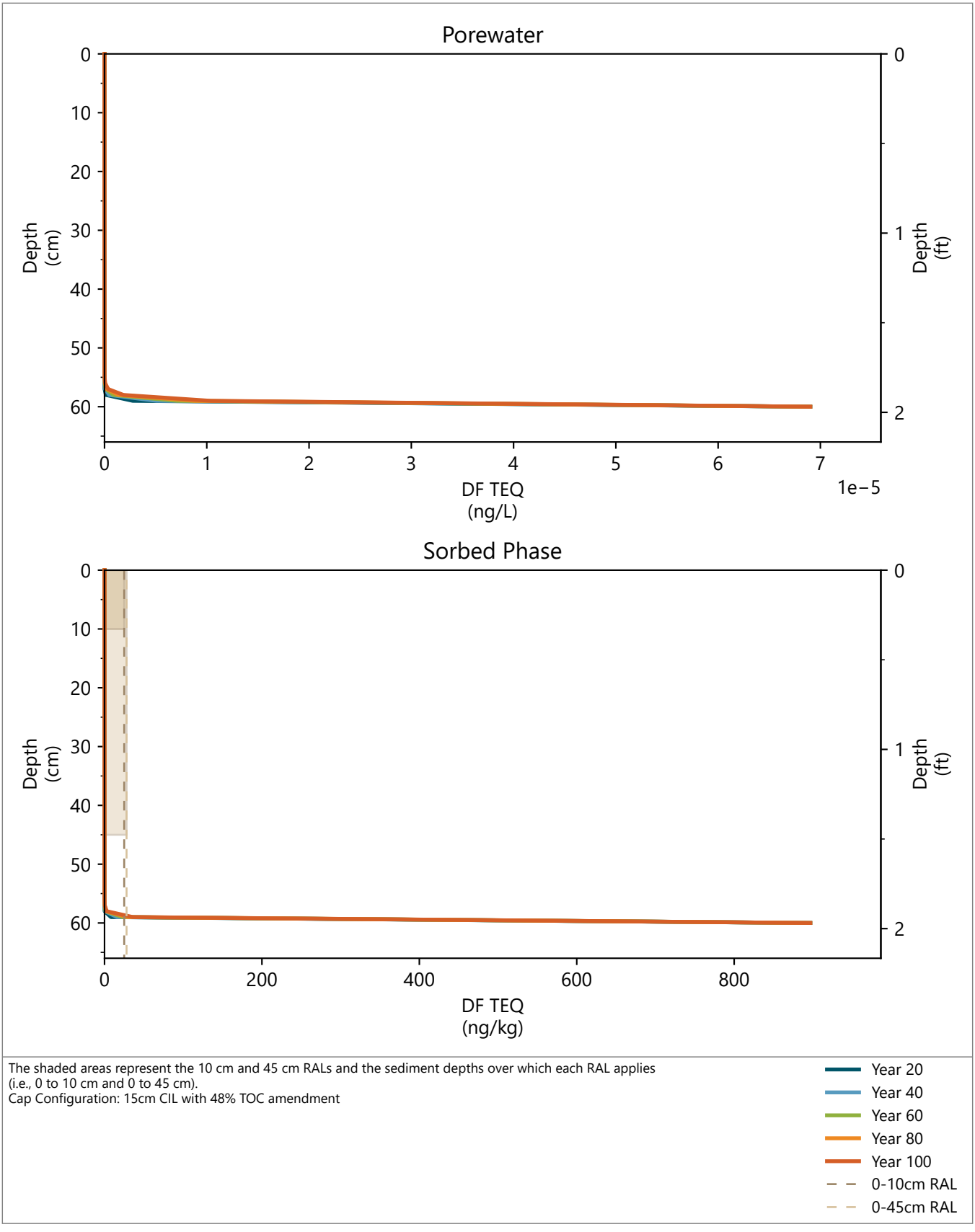
Figure H.4.2.41q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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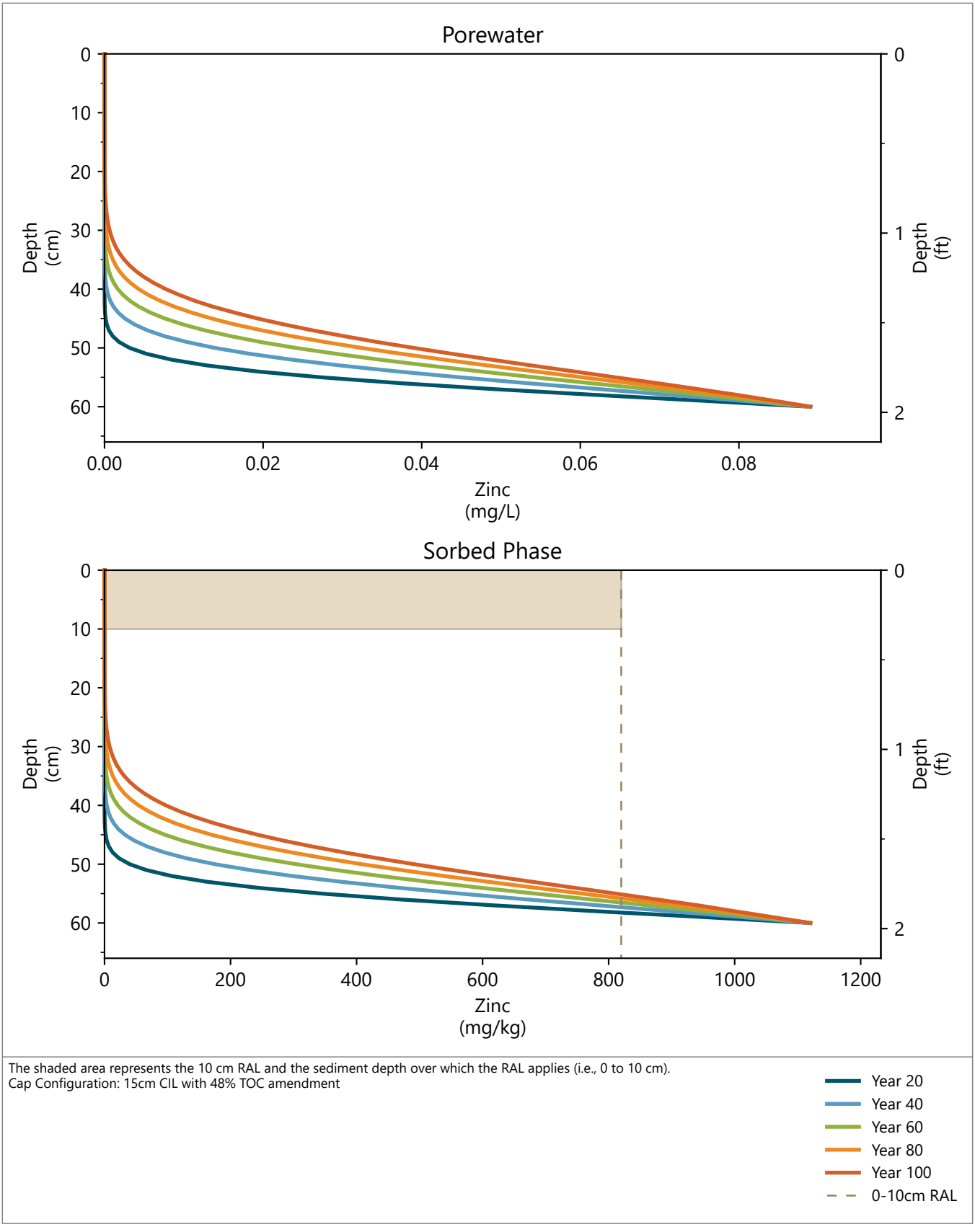
Figure H.4.2.42a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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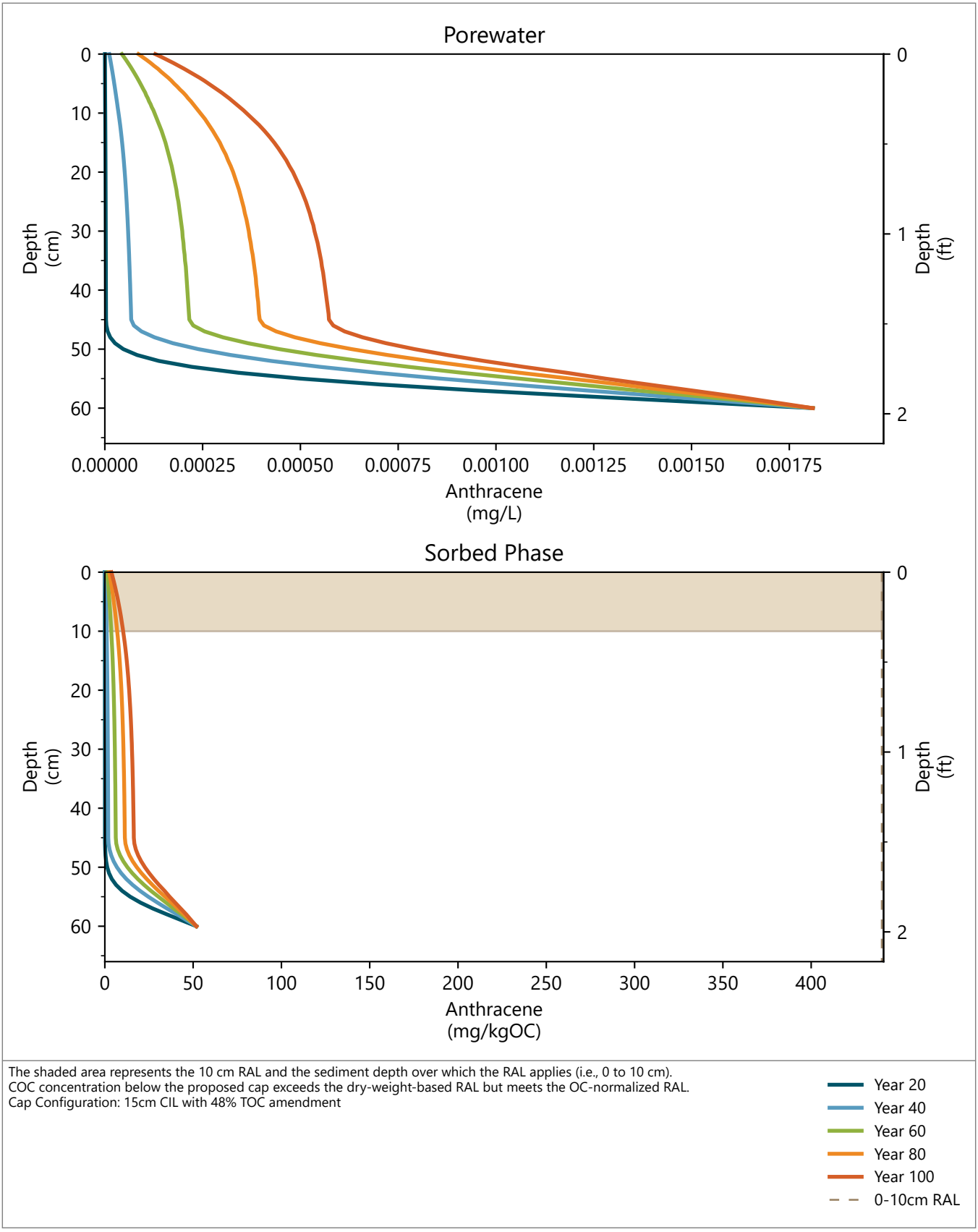
Figure H.4.2.42b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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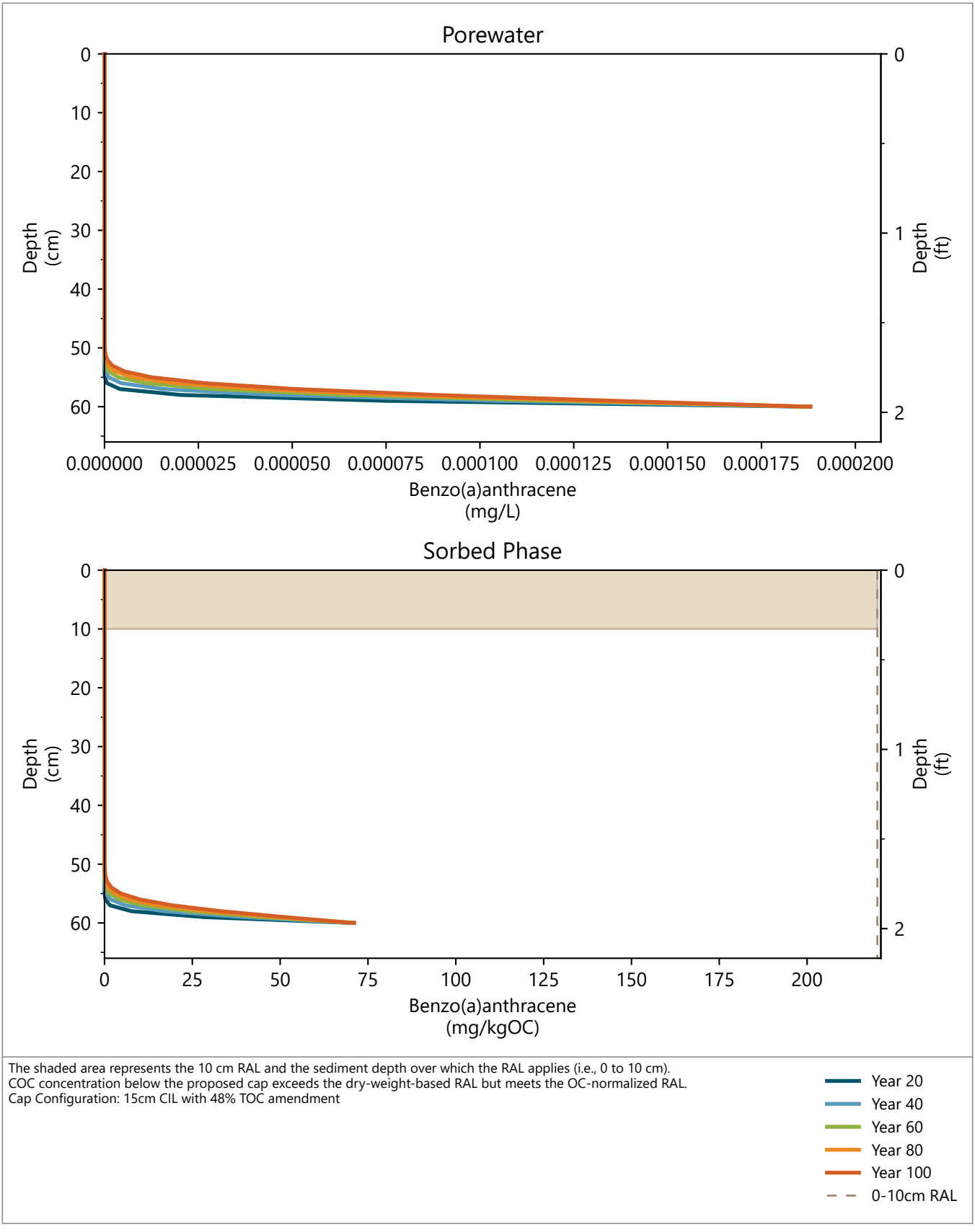
Figure H.4.2.42c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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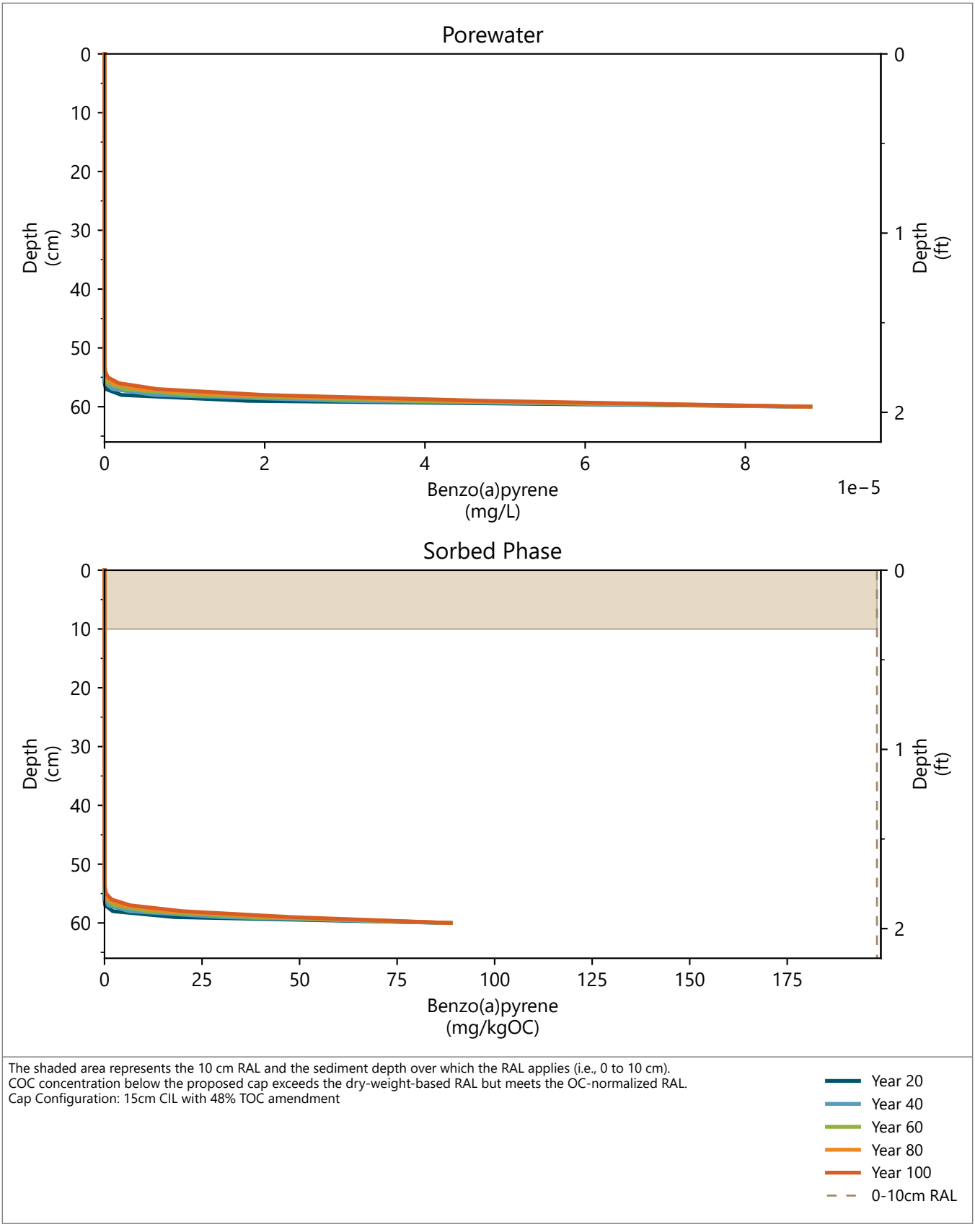
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Figure H.4.2.42d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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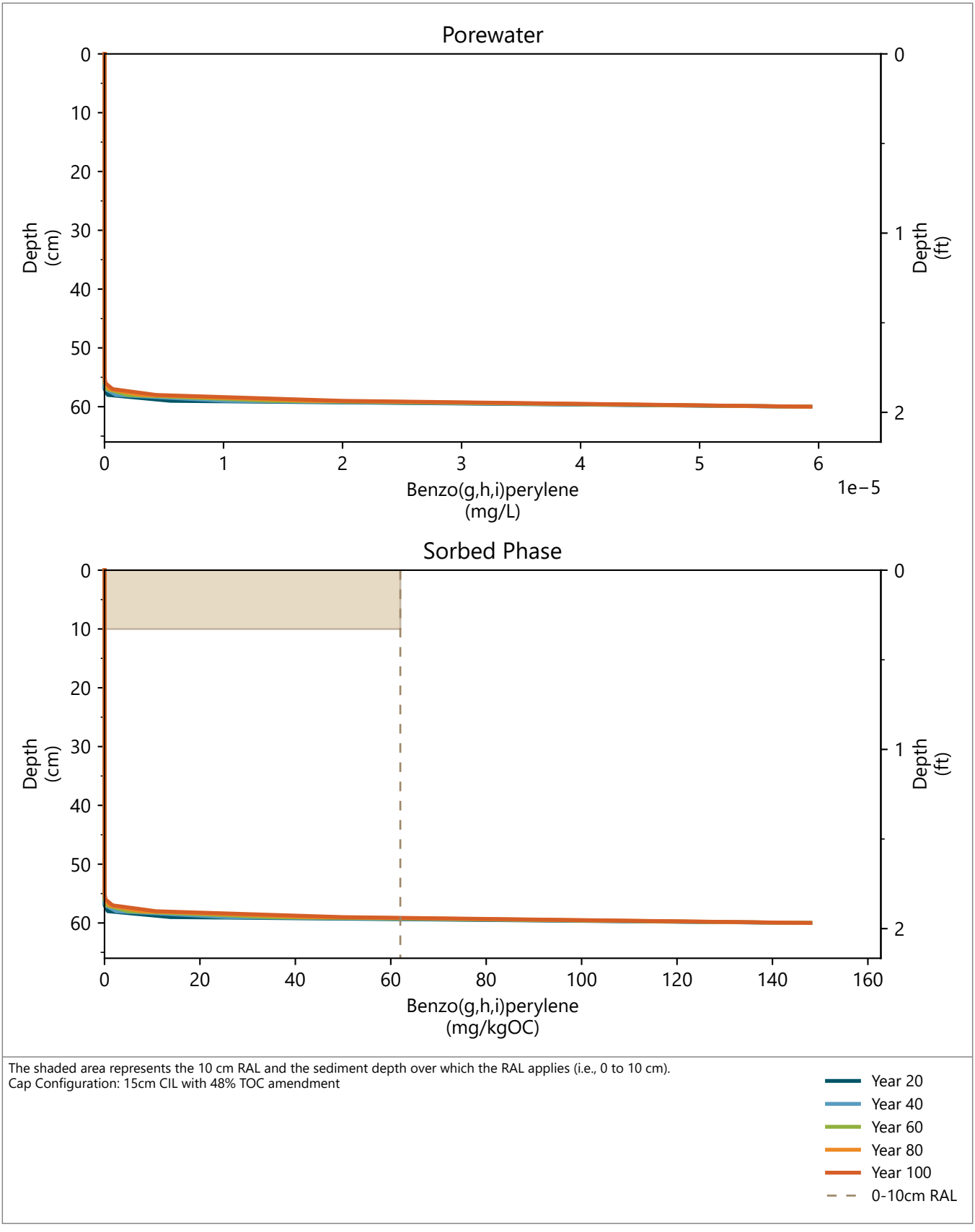
Figure H.4.2.42e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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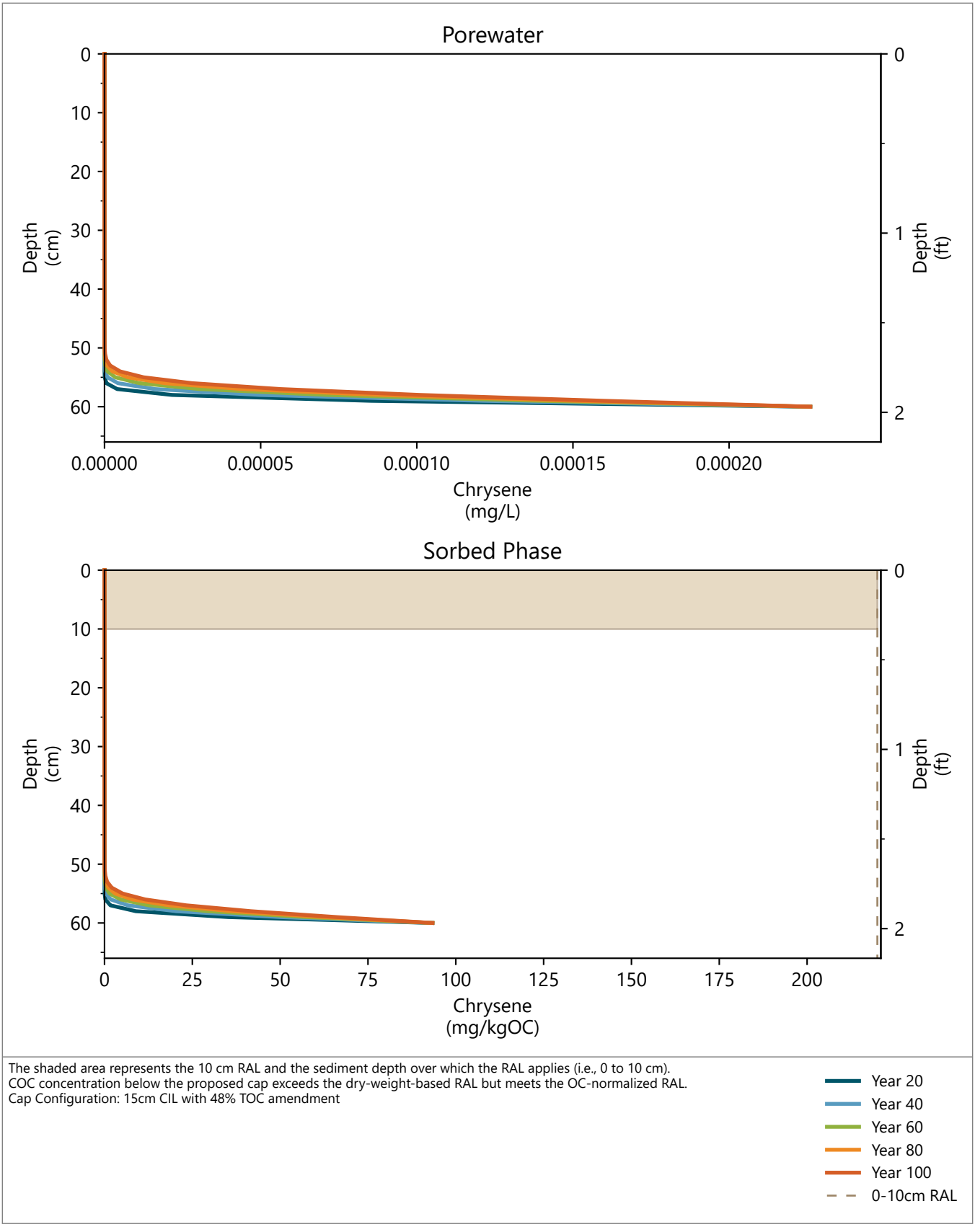
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Figure H.4.2.42f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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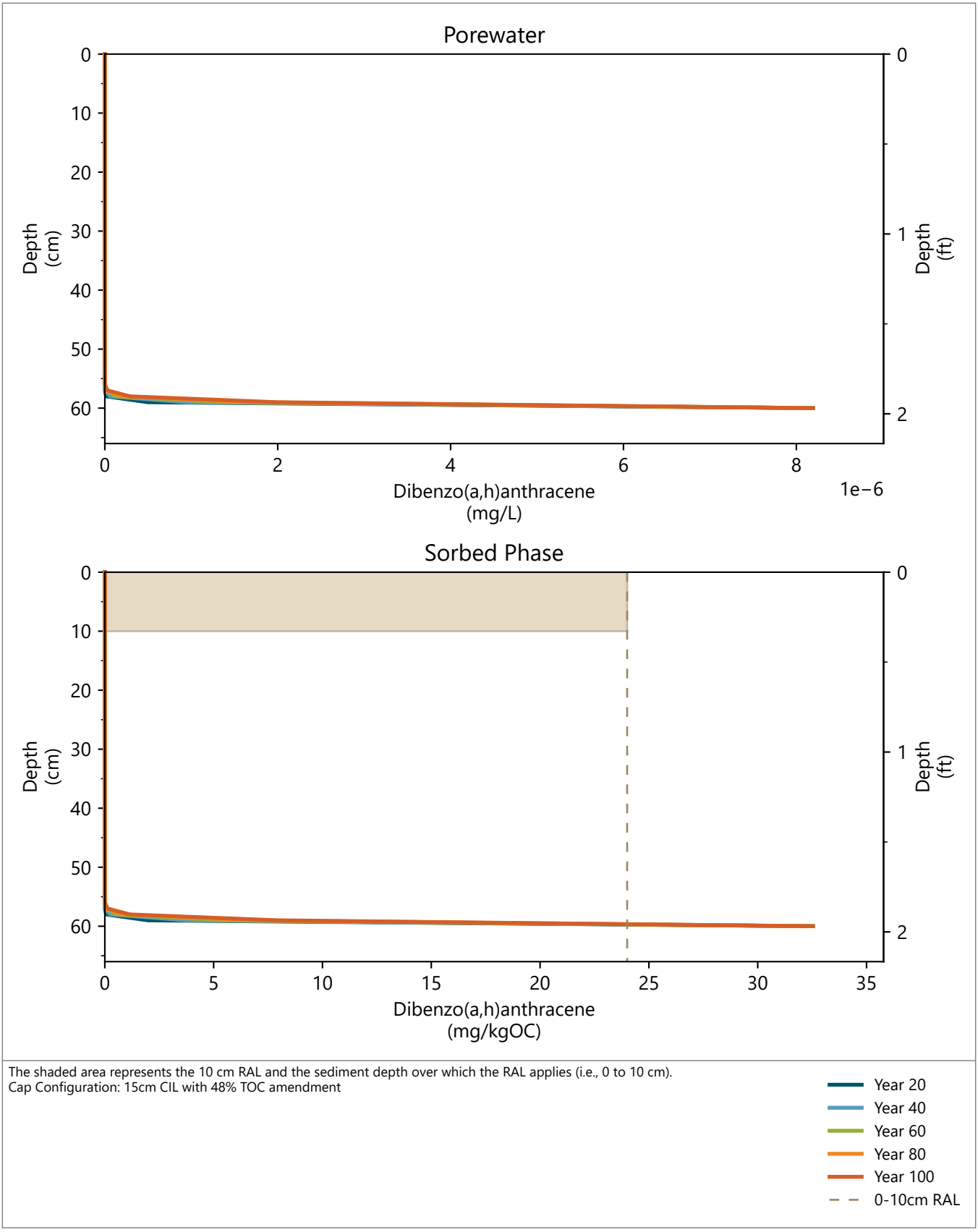
Figure H.4.2.42g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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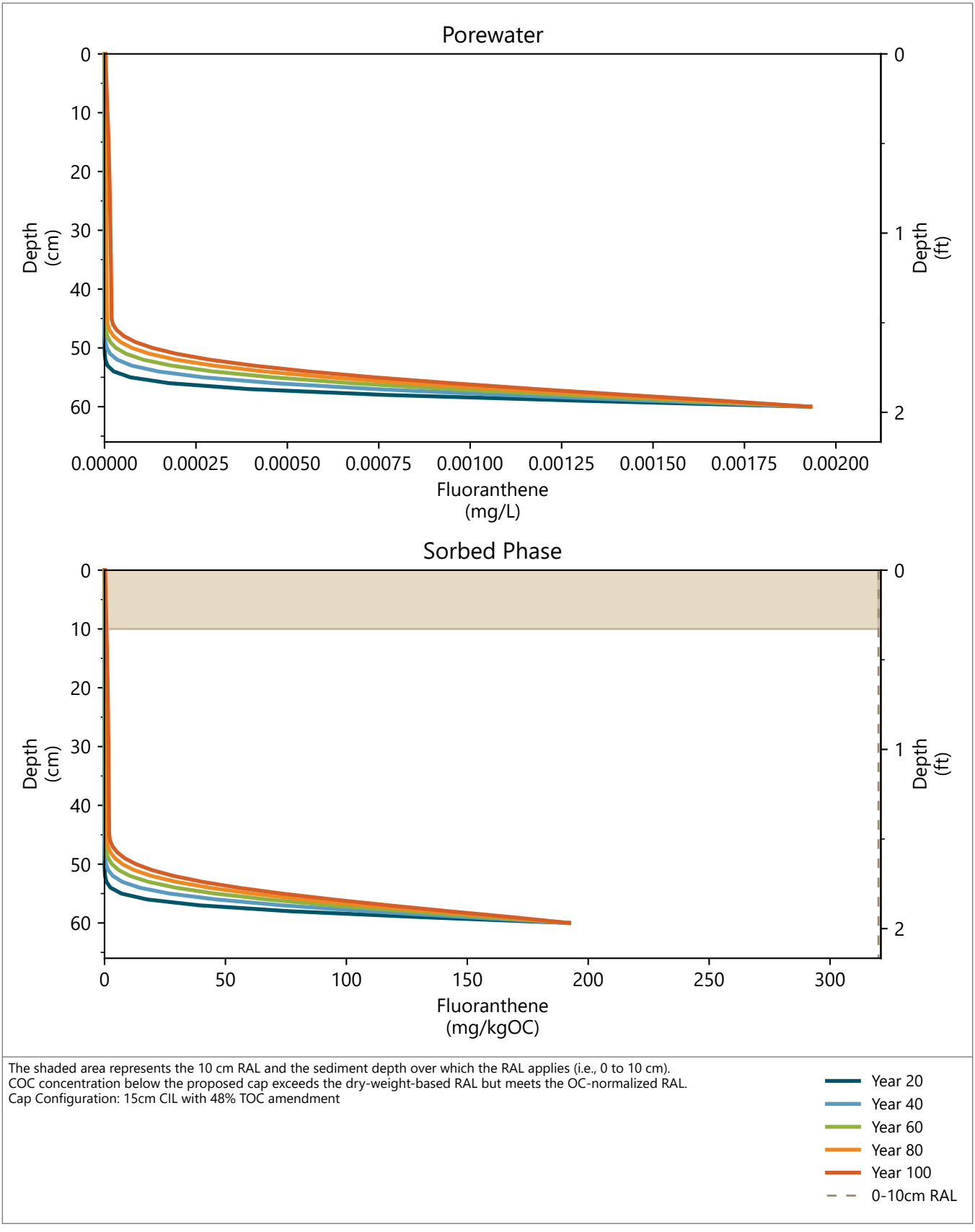
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Figure H.4.2.42h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



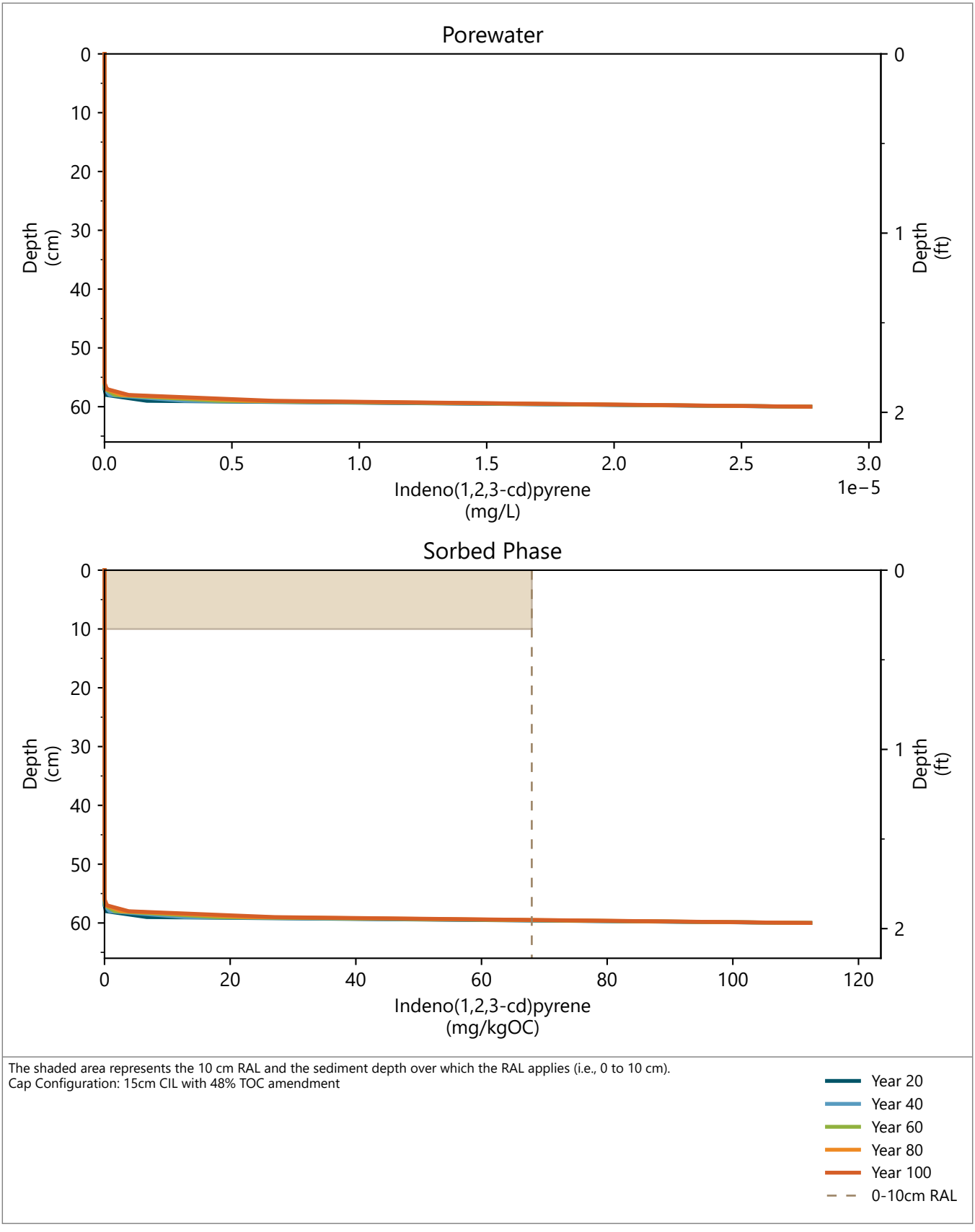
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Figure H.4.2.42i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



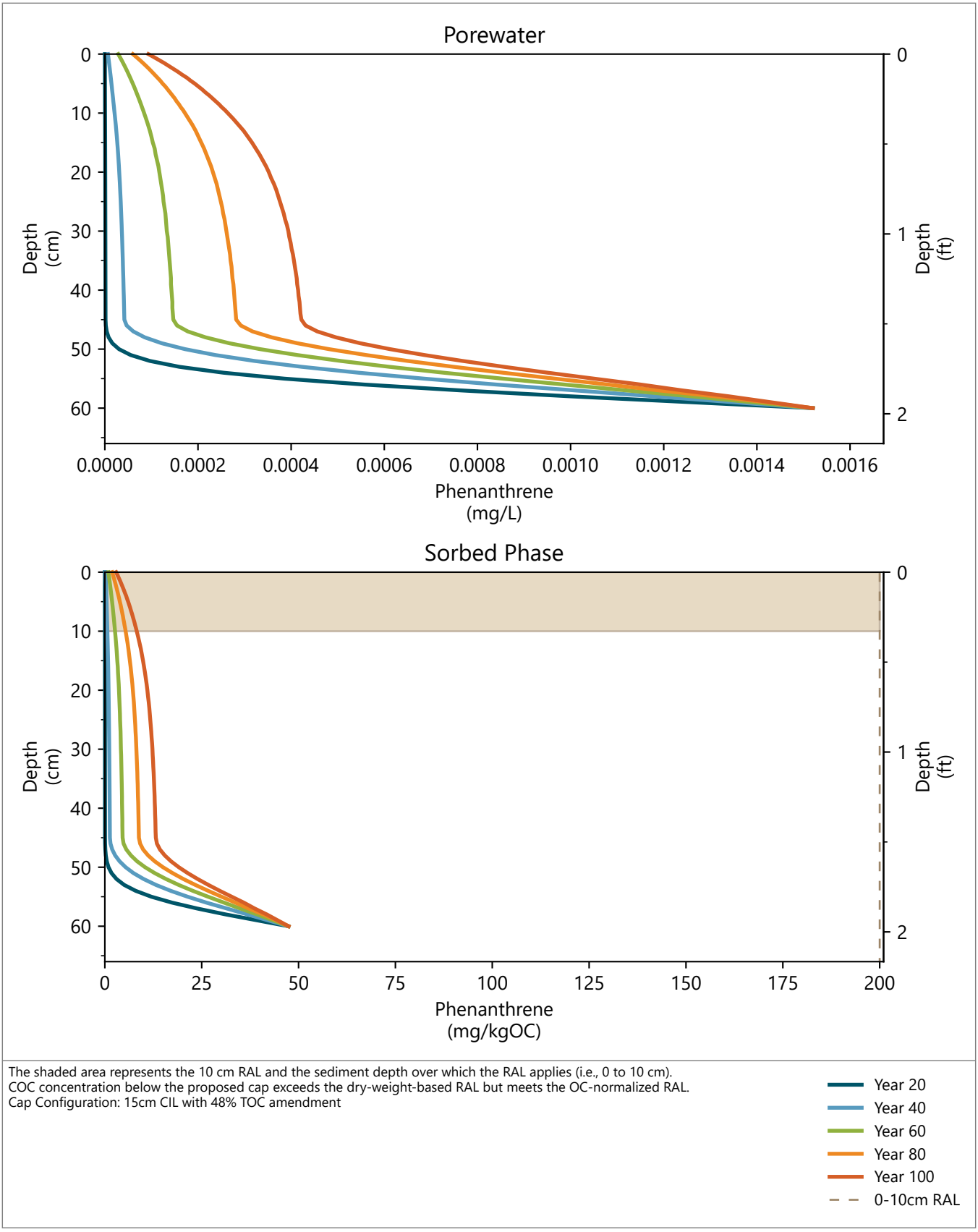
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Figure H.4.2.42j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



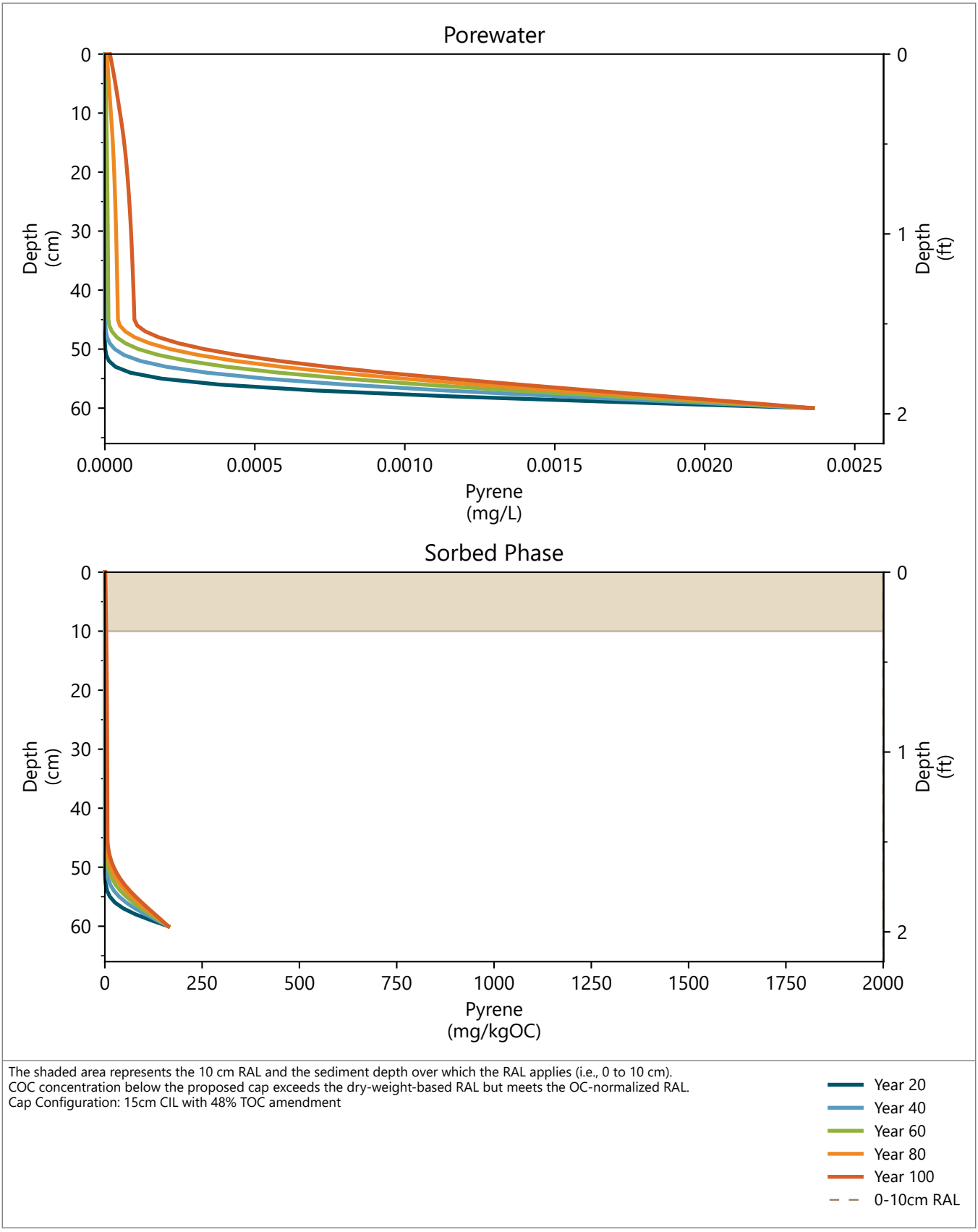
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Figure H.4.2.42k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



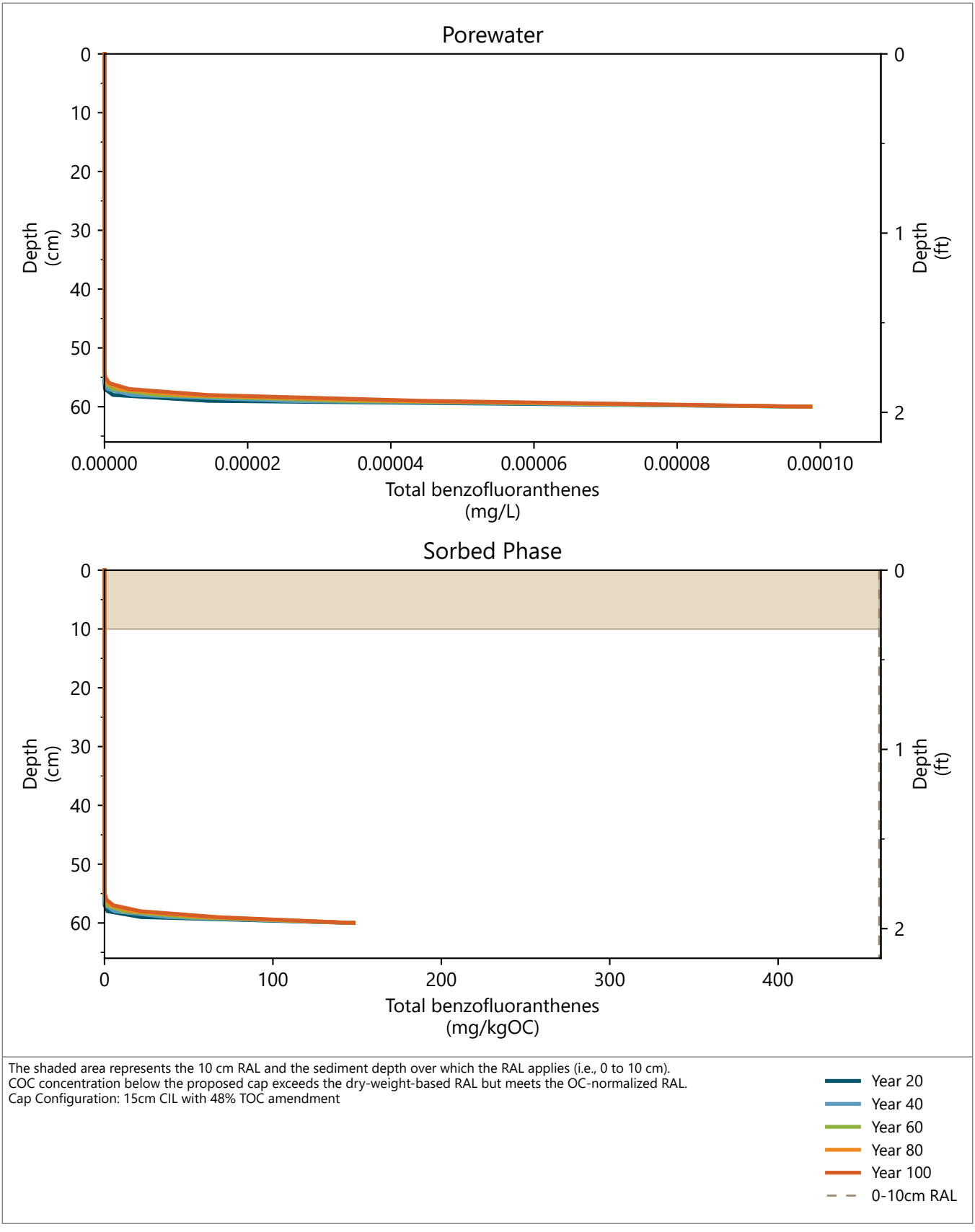
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Figure H.4.2.42I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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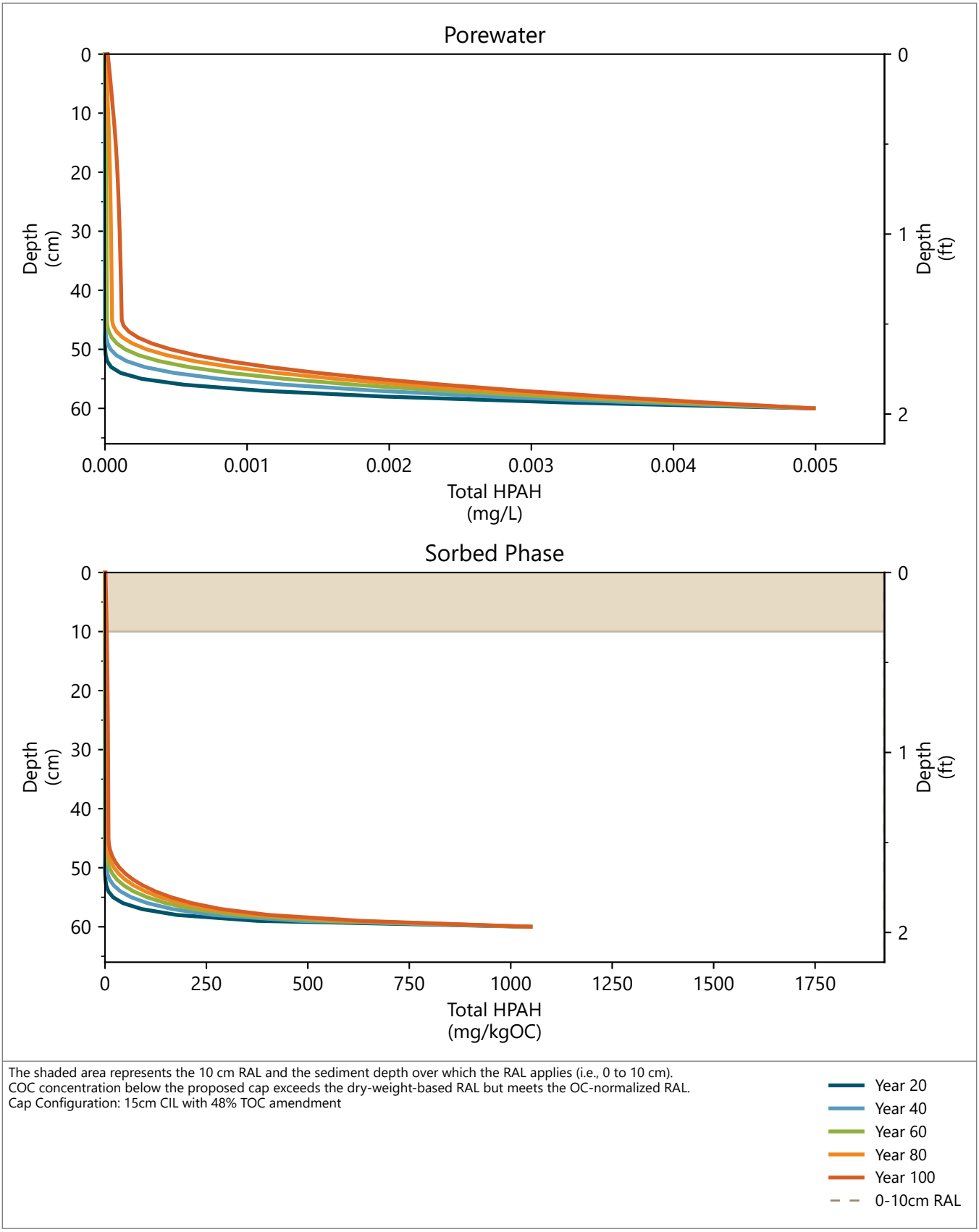
Figure H.4.2.42m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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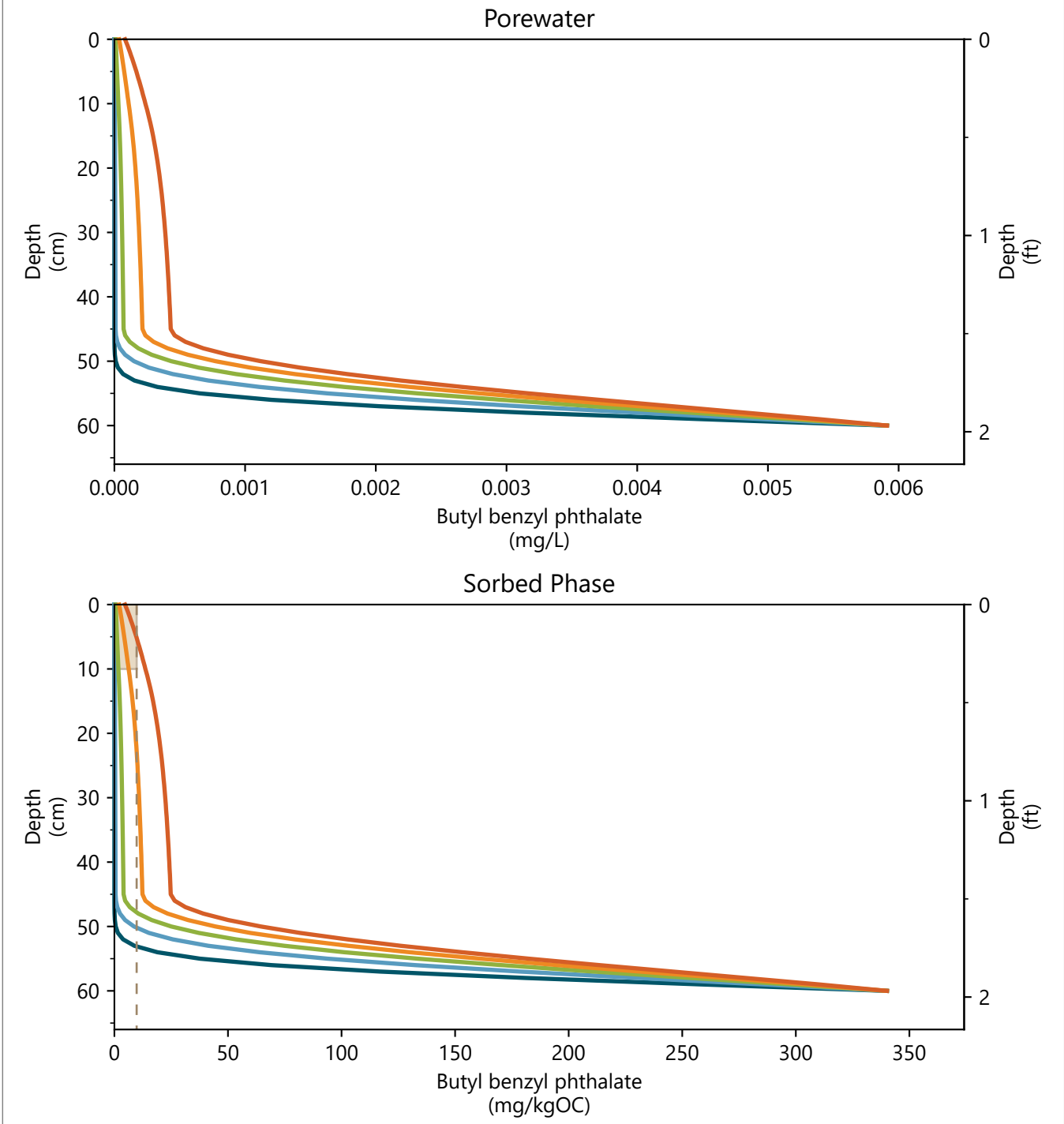
Figure H.4.2.42n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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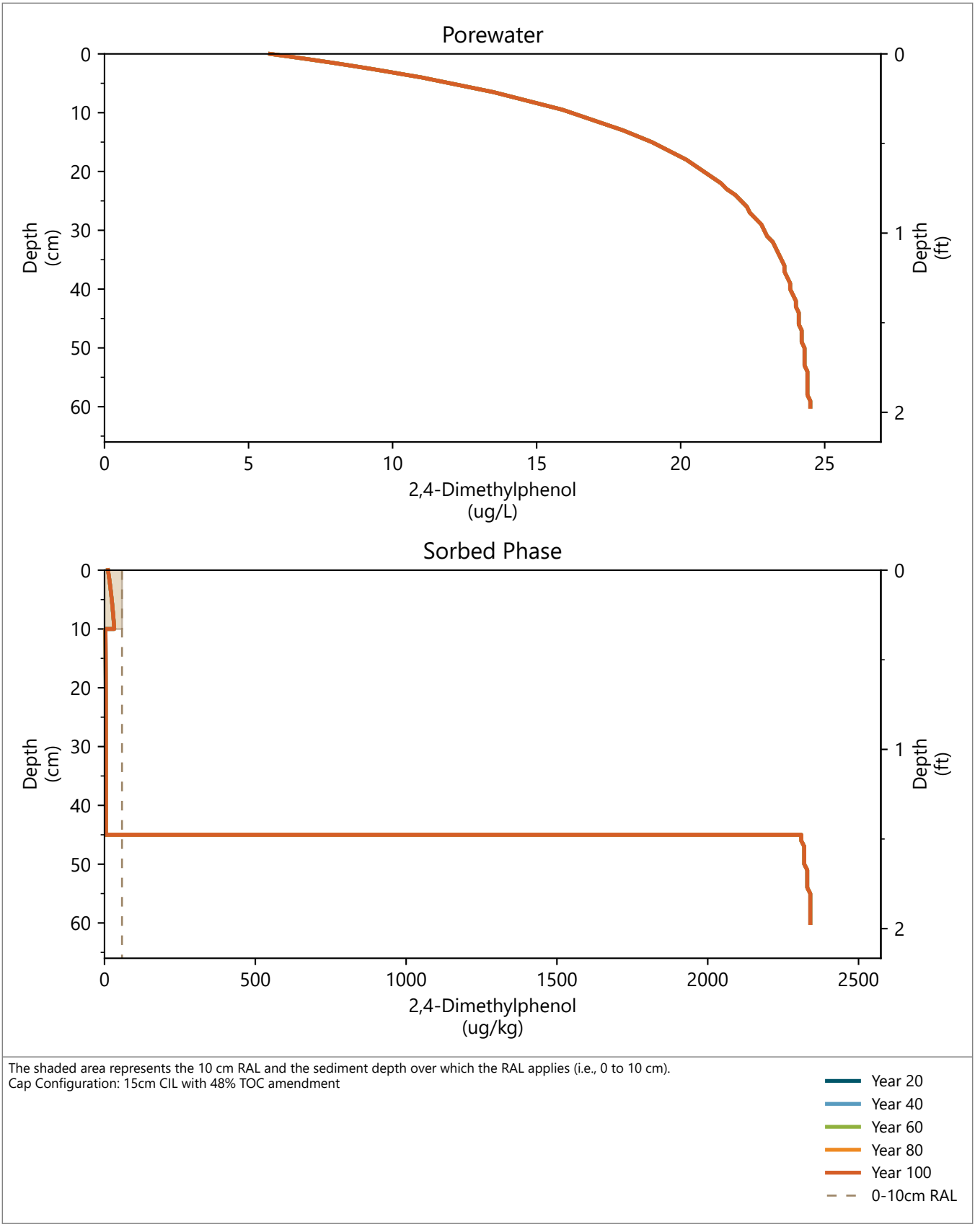
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Figure H.4.2.42o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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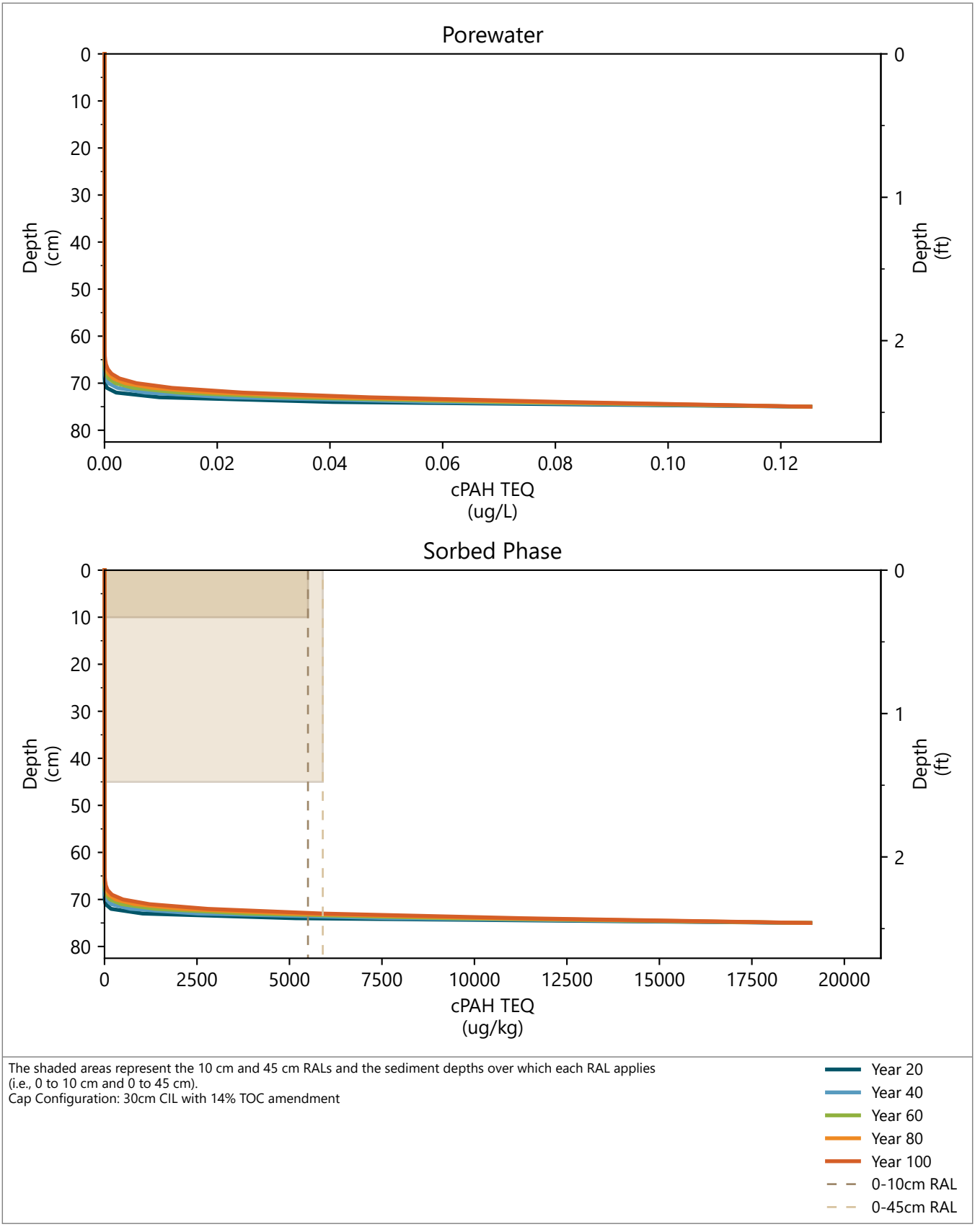
Figure H.4.2.42p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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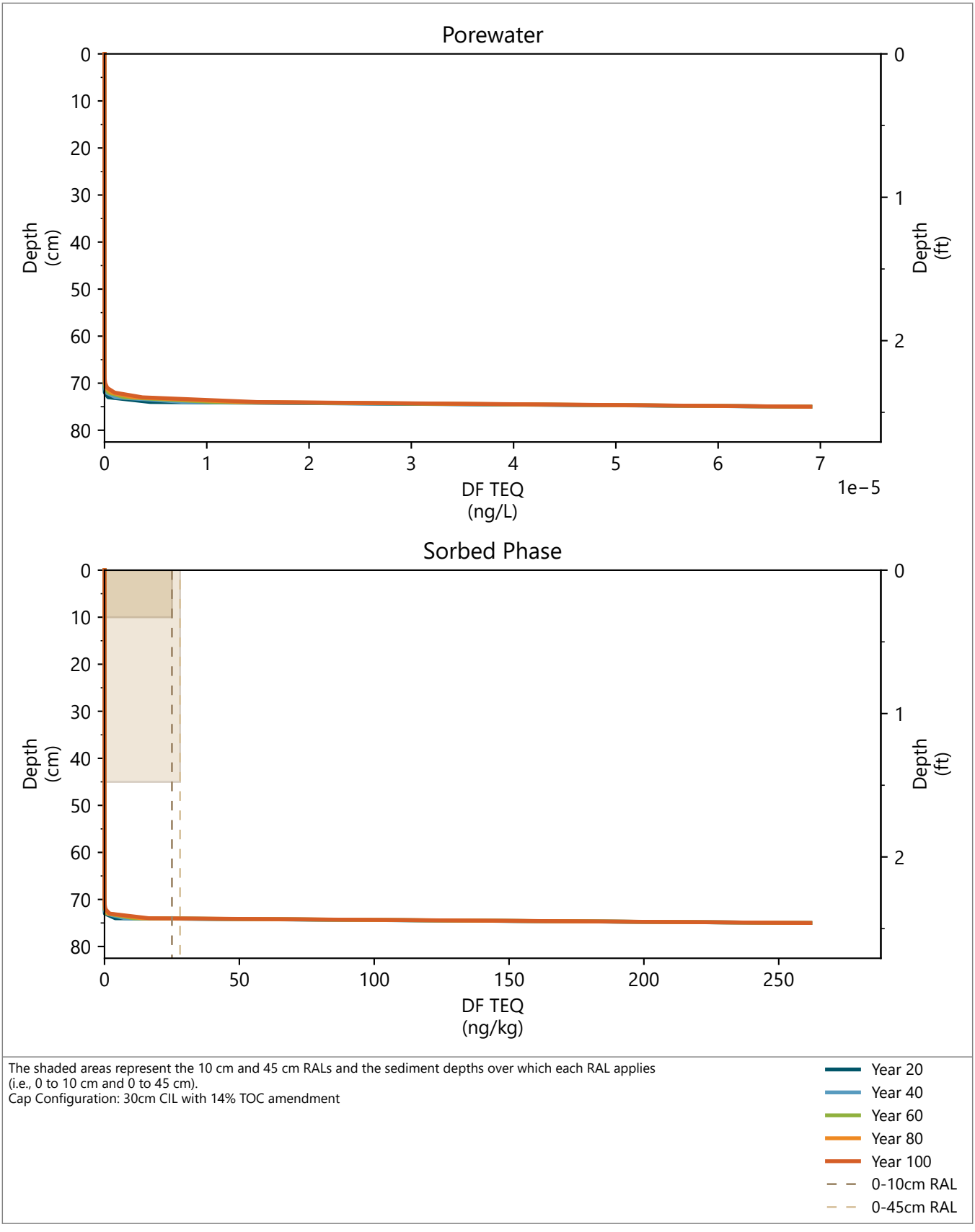
Figure H.4.2.42q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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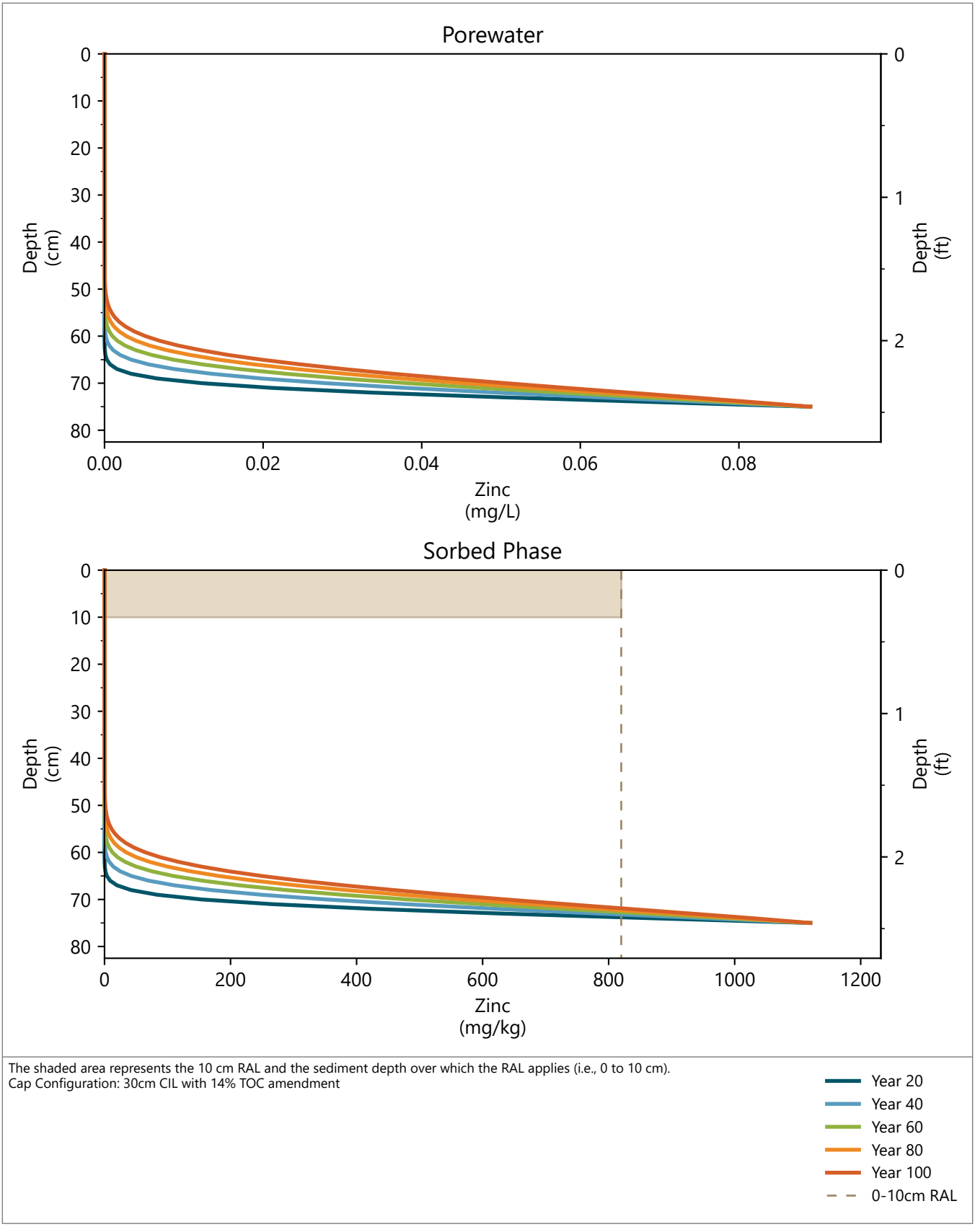
Figure H.4.2.43a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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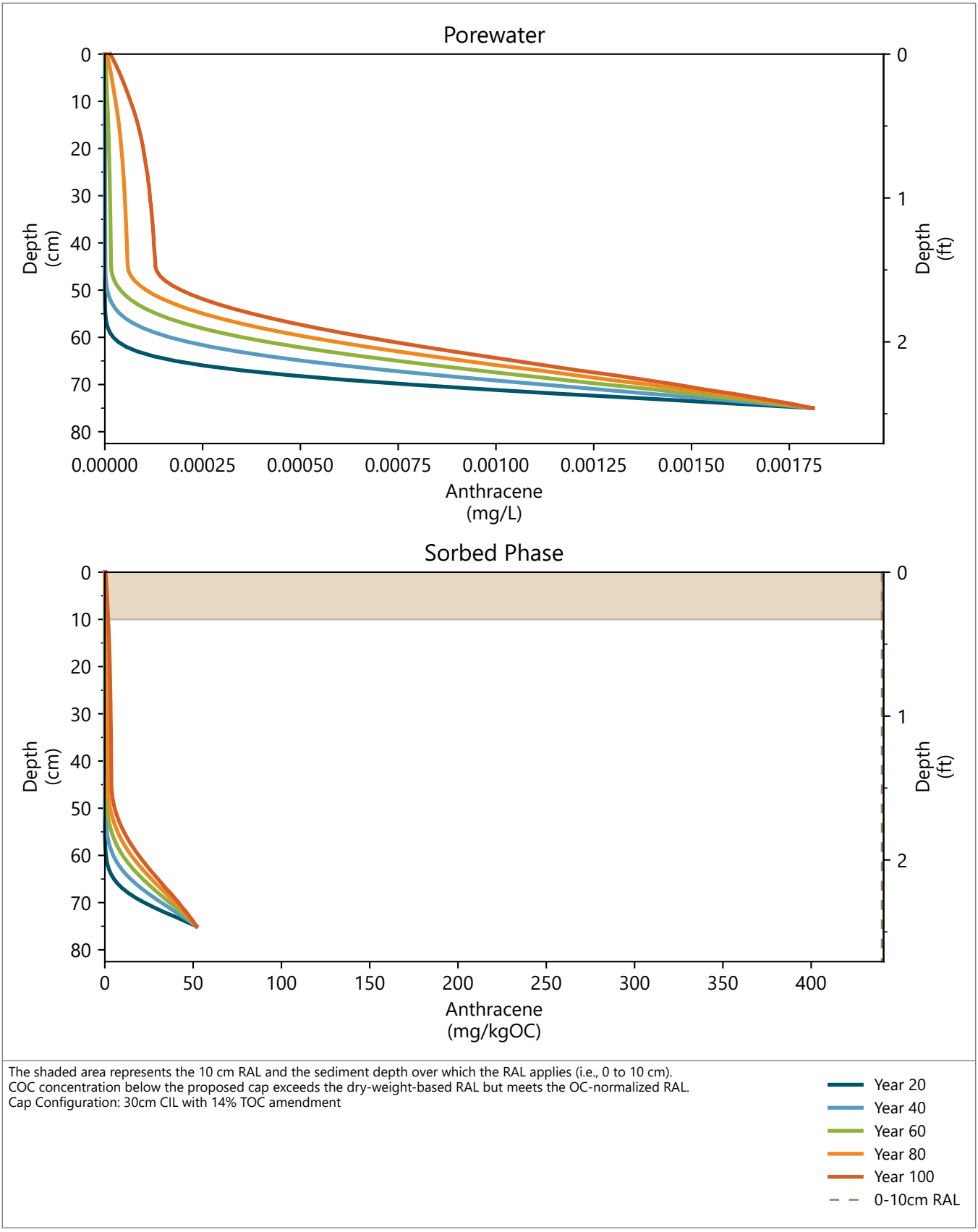
Figure H.4.2.43b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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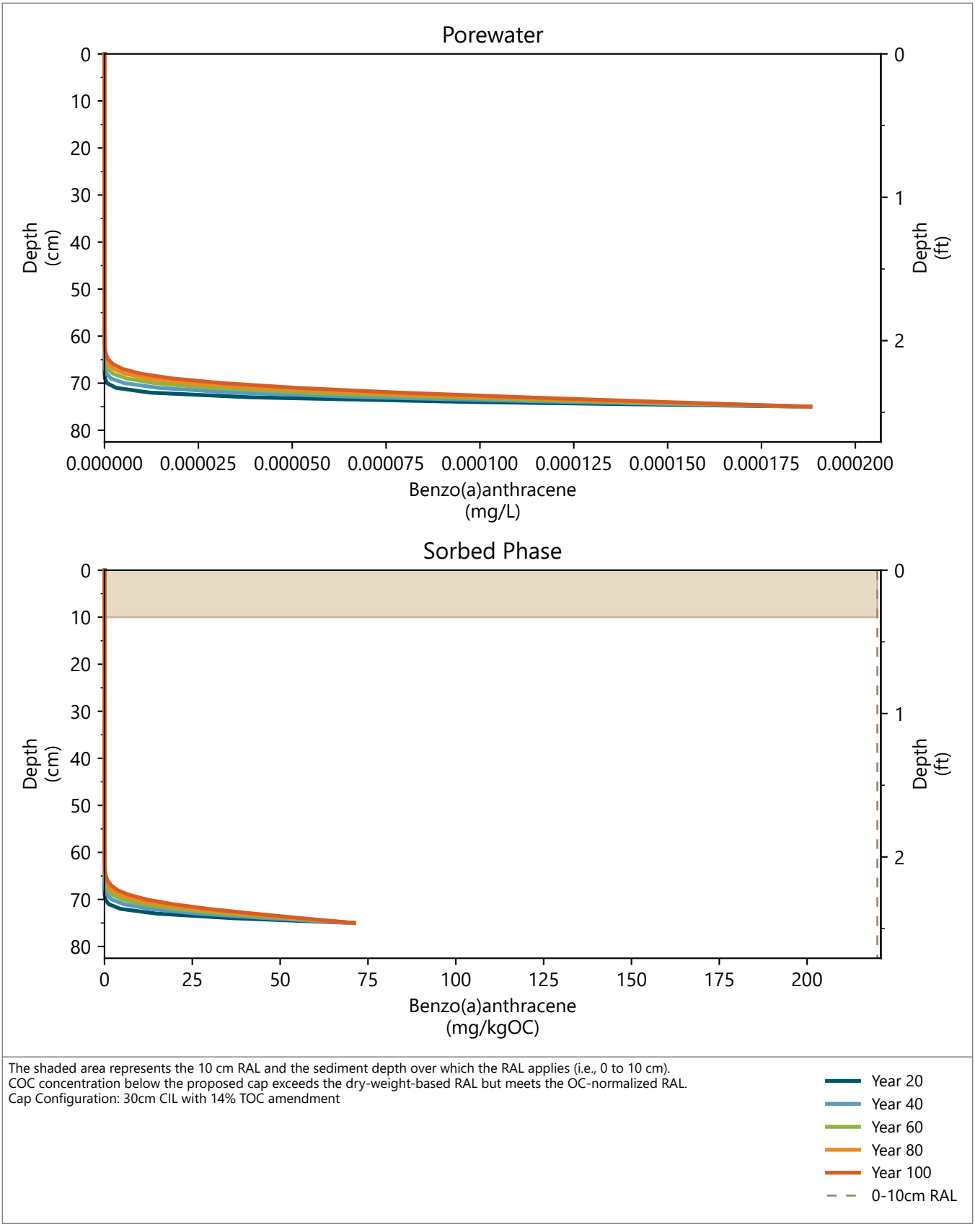
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Figure H.4.2.43c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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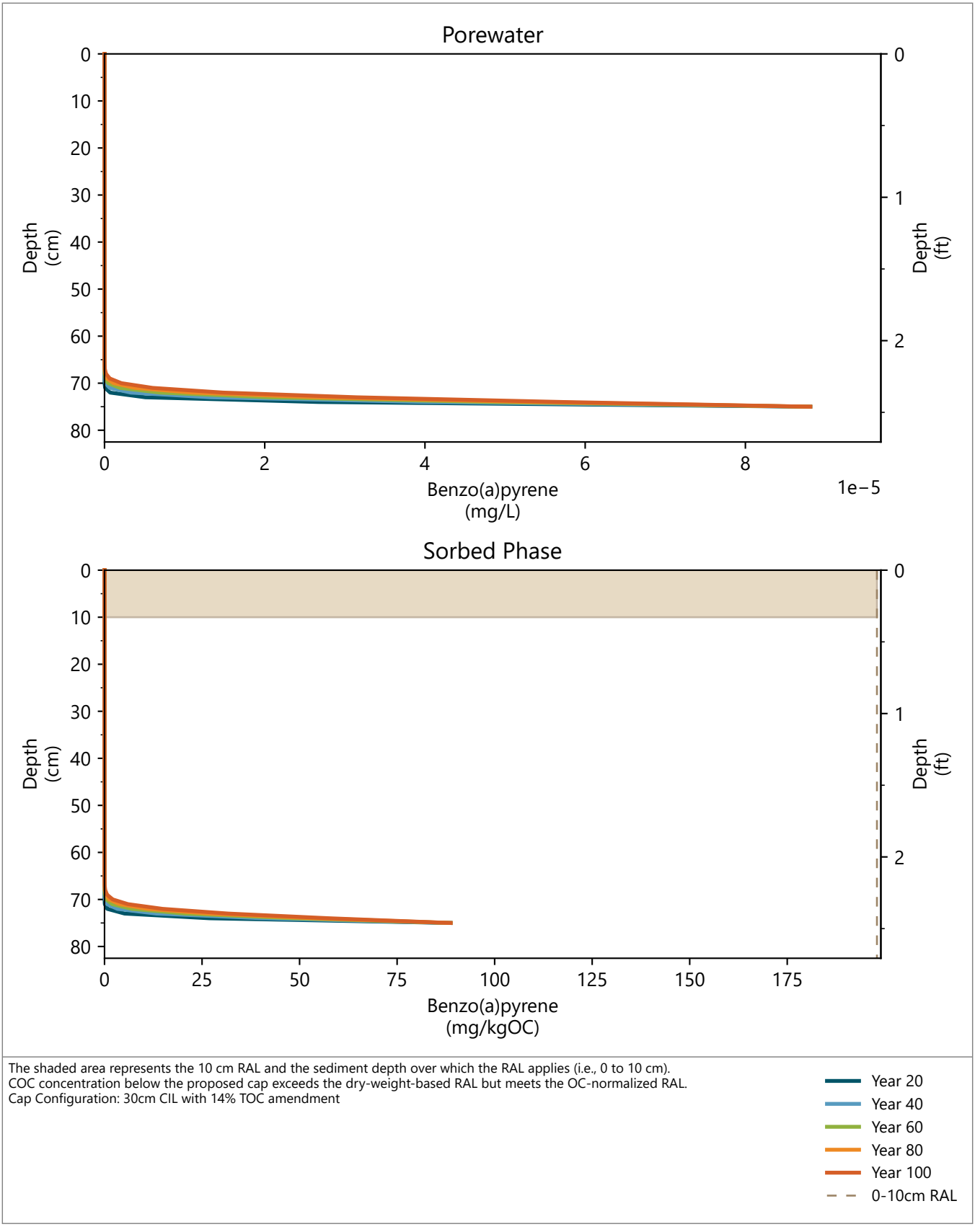
Figure H.4.2.43d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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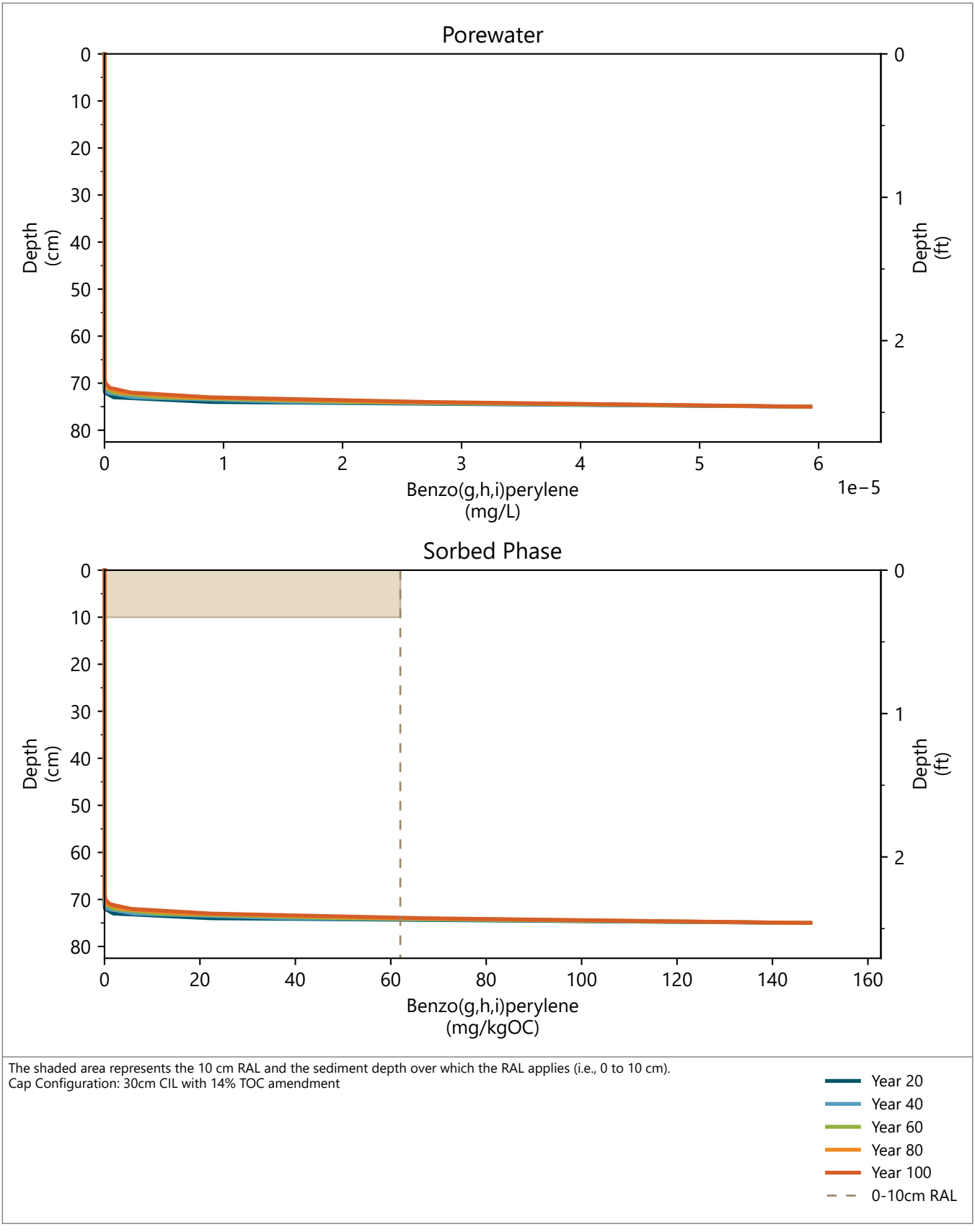
Figure H.4.2.43e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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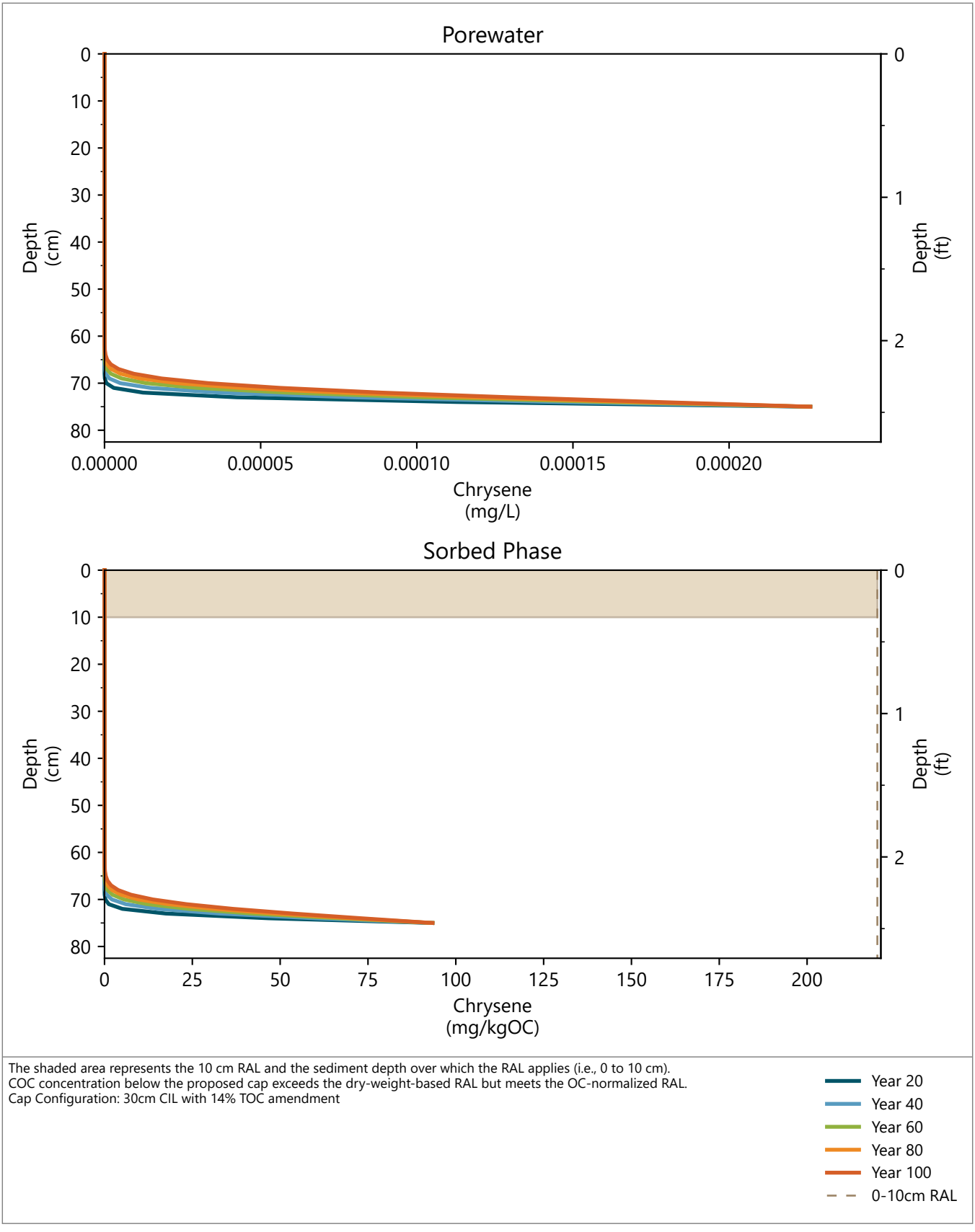
Figure H.4.2.43f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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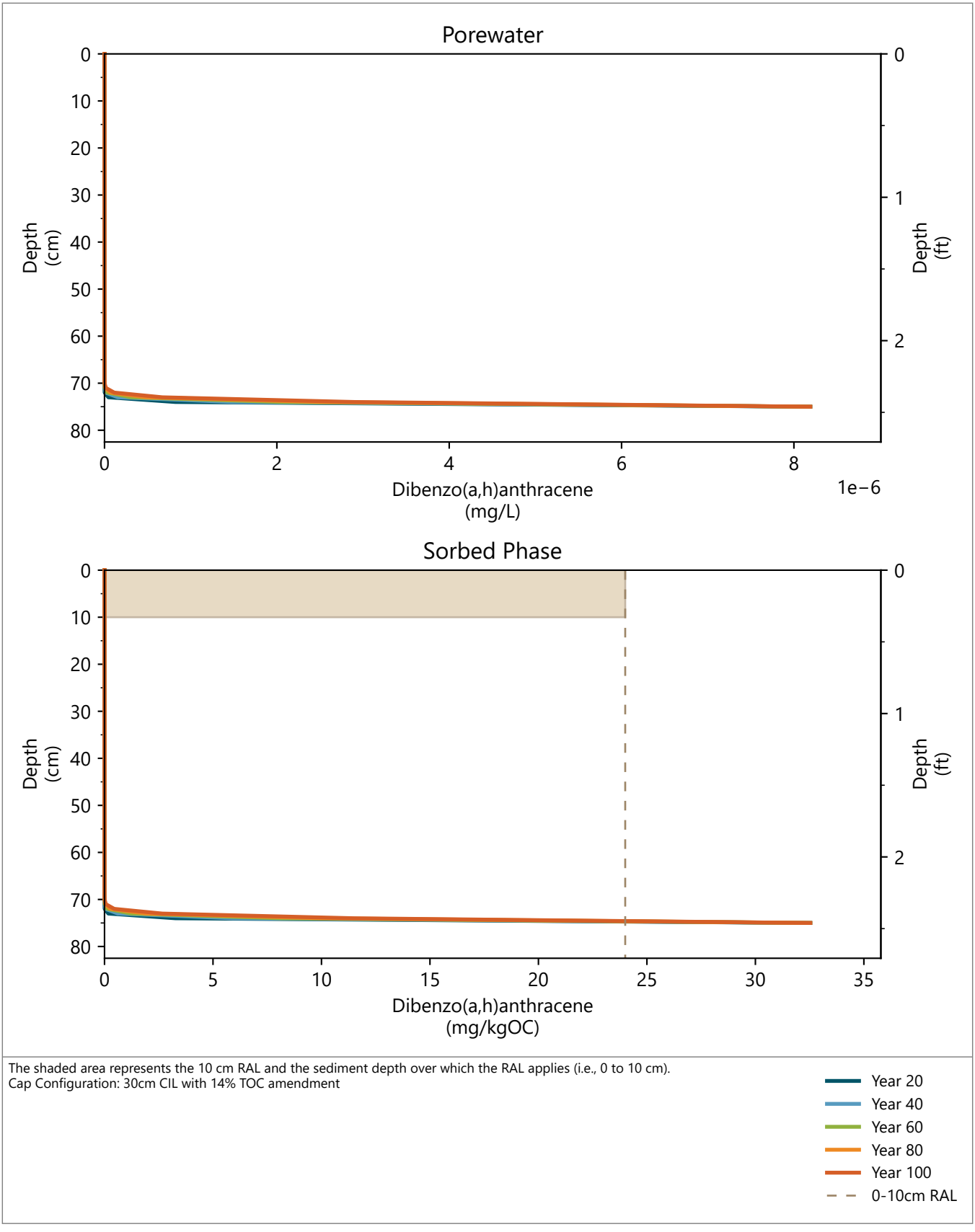
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Figure H.4.2.43g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



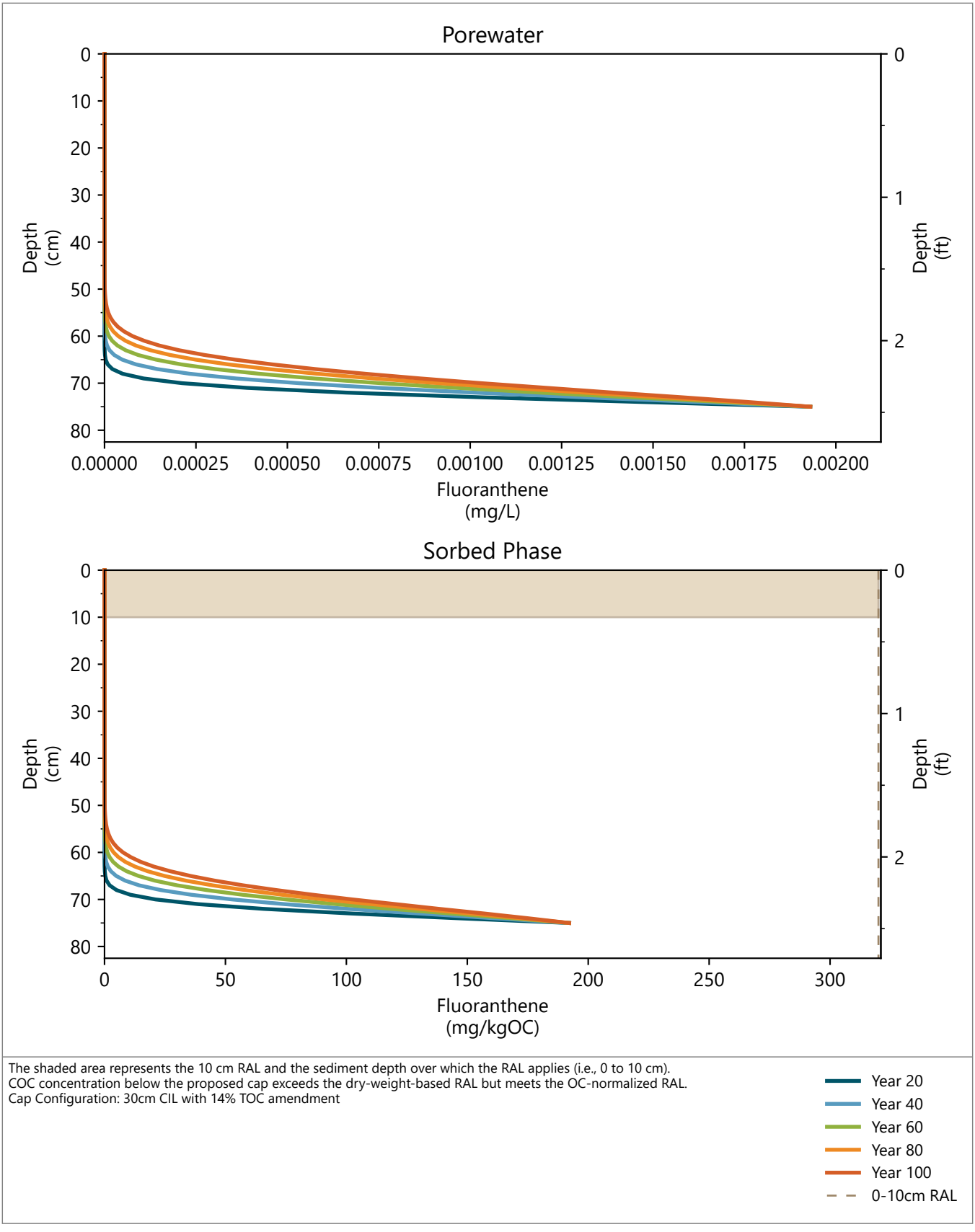
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Figure H.4.2.43h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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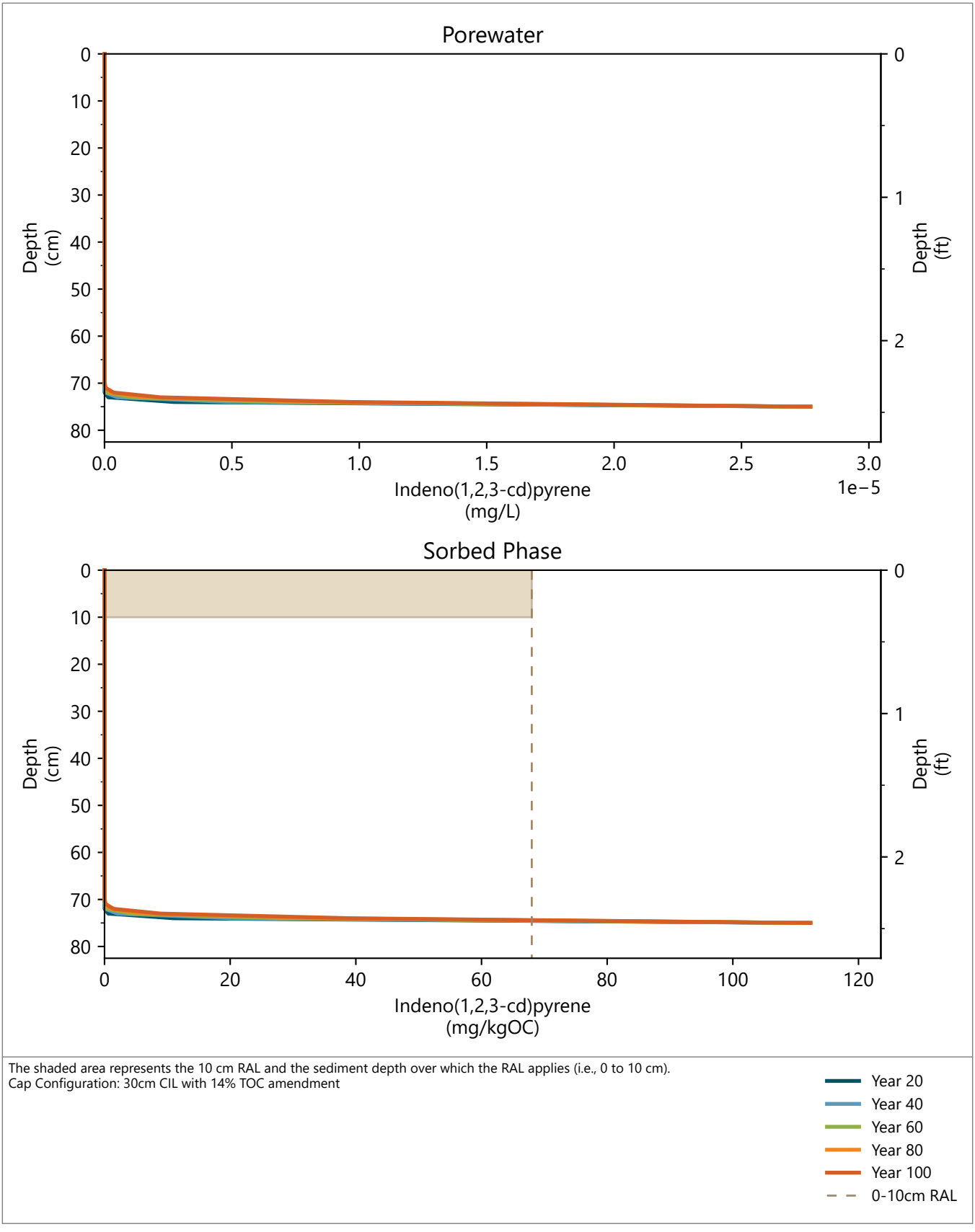
Figure H.4.2.43i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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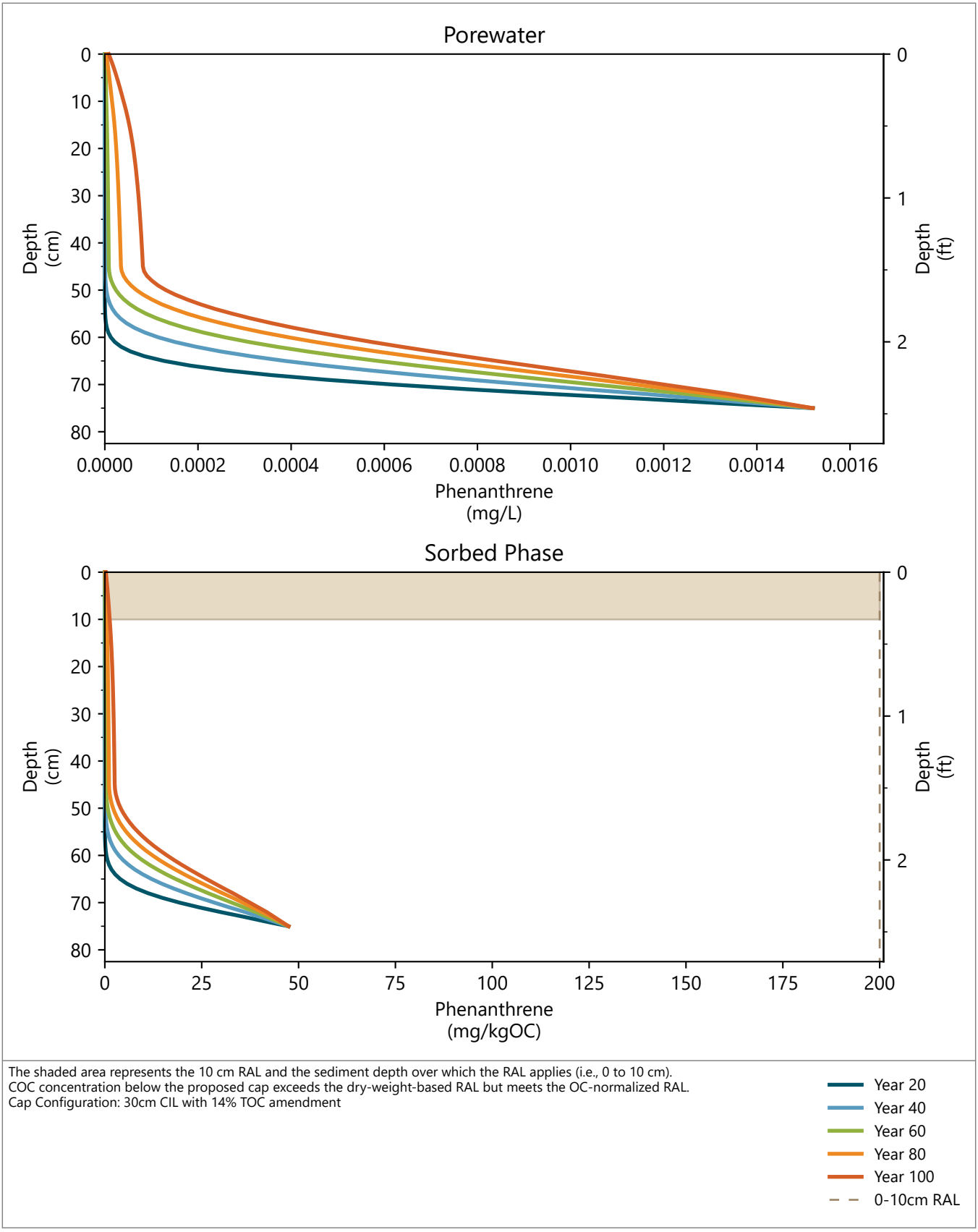
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Figure H.4.2.43j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



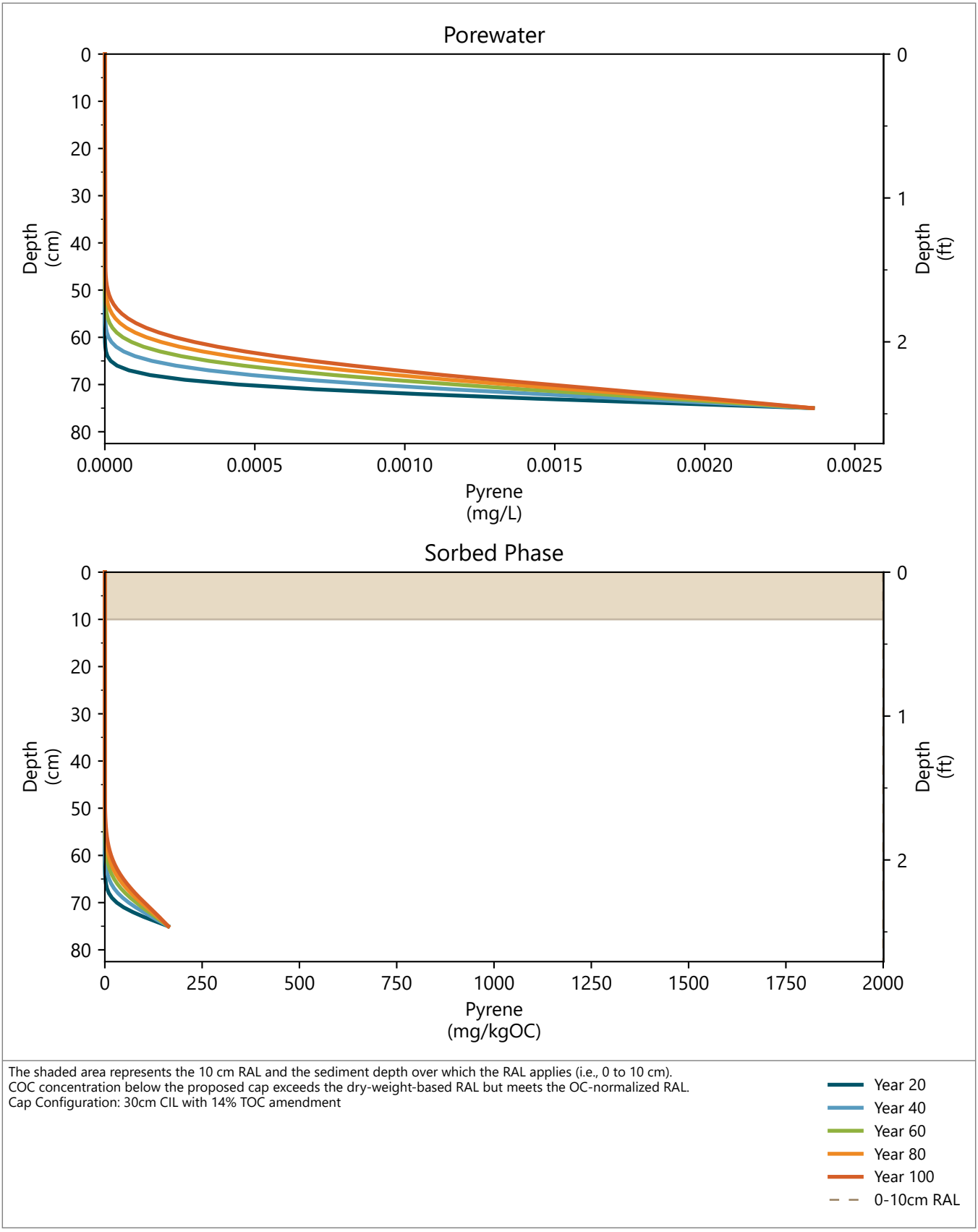
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Figure H.4.2.43k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



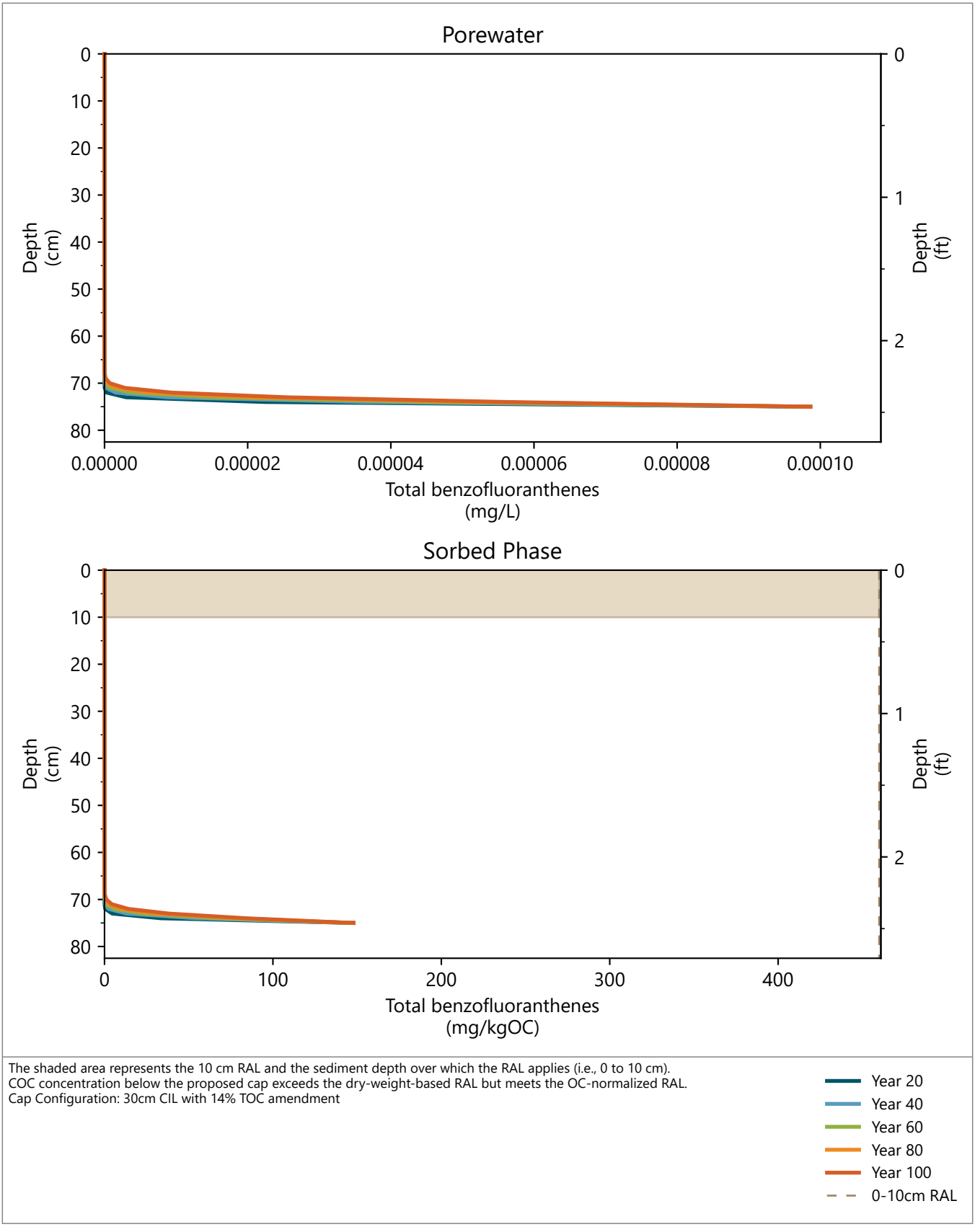
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Figure H.4.2.43I
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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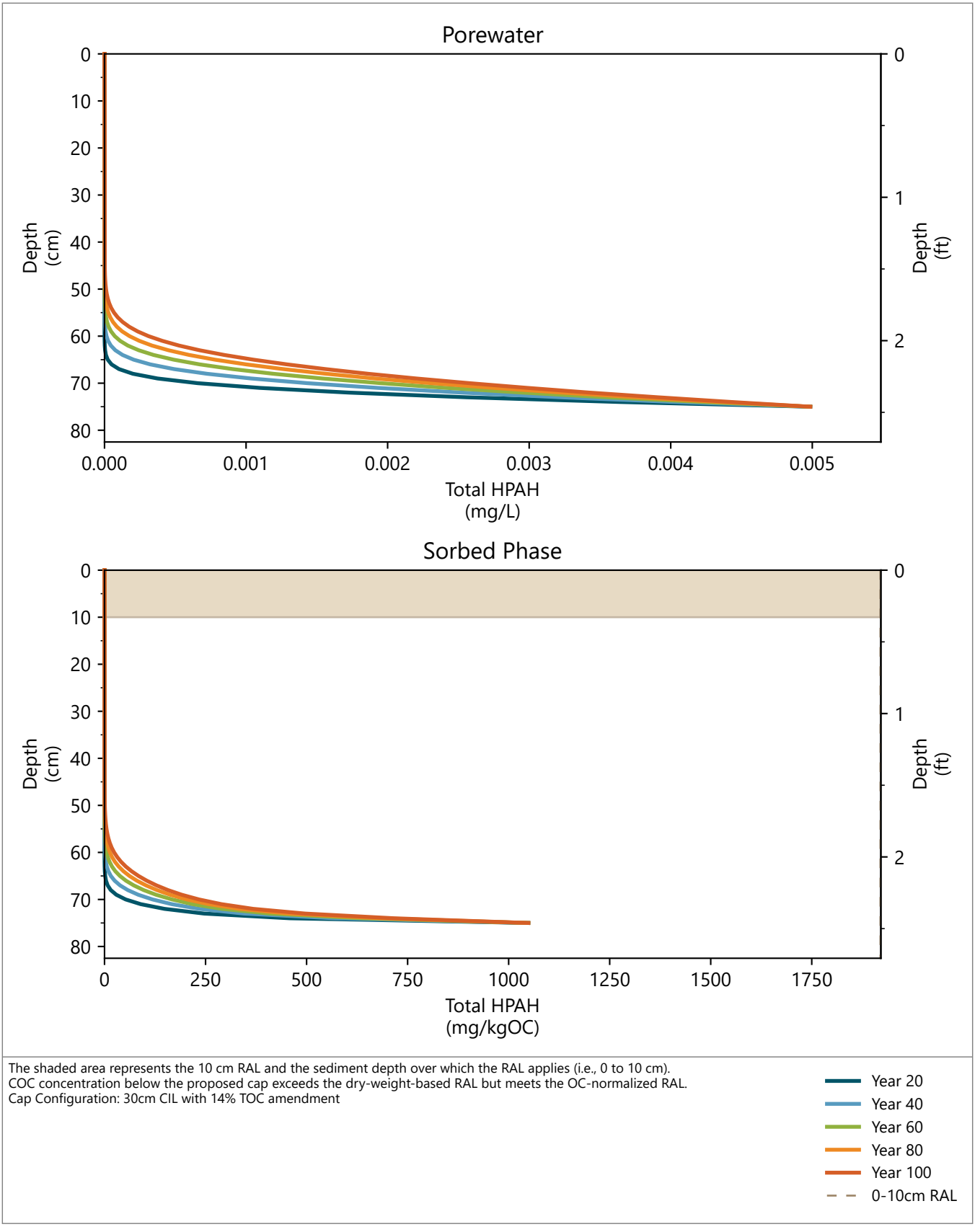
Figure H.4.2.43m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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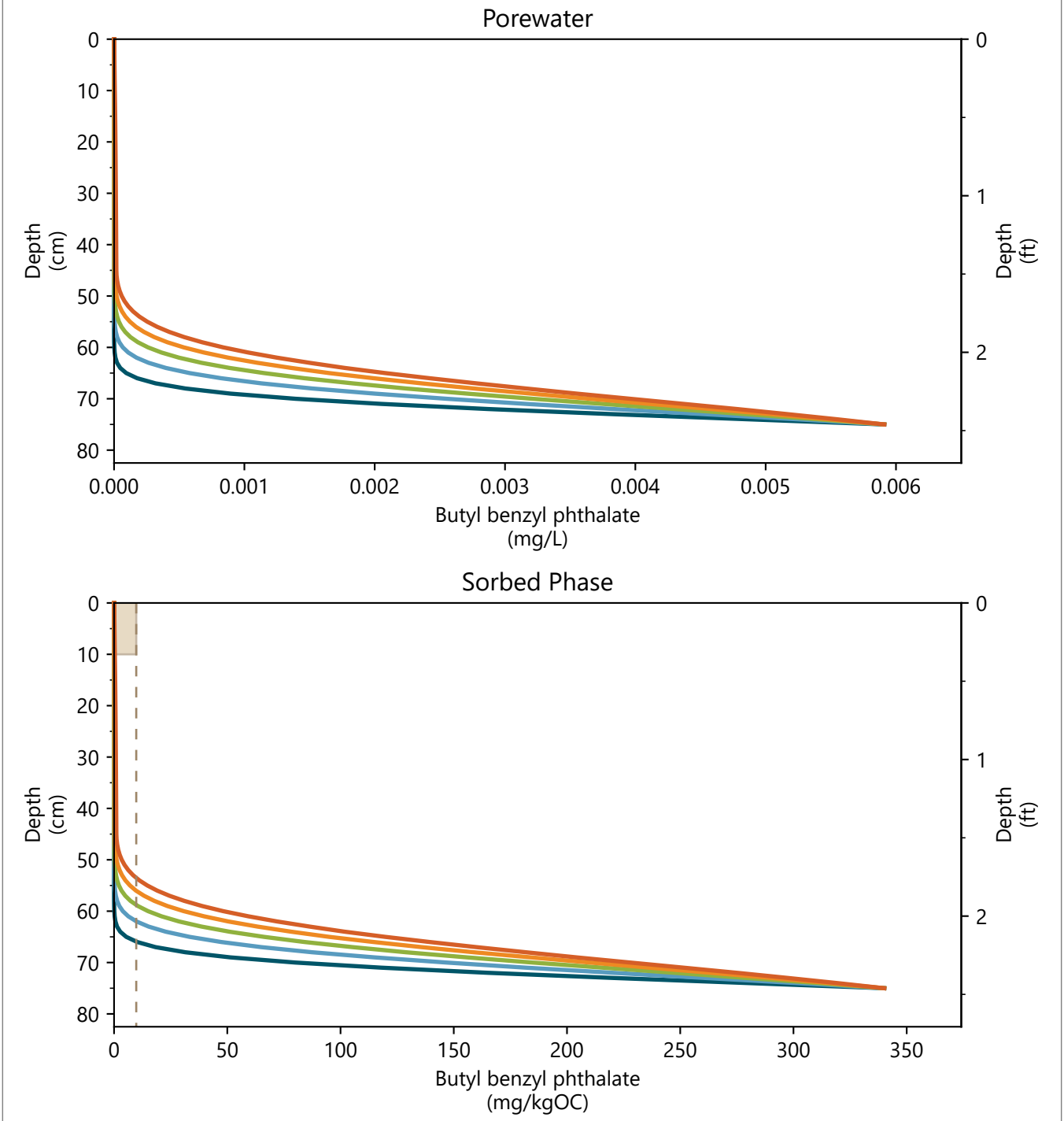
Figure H.4.2.43n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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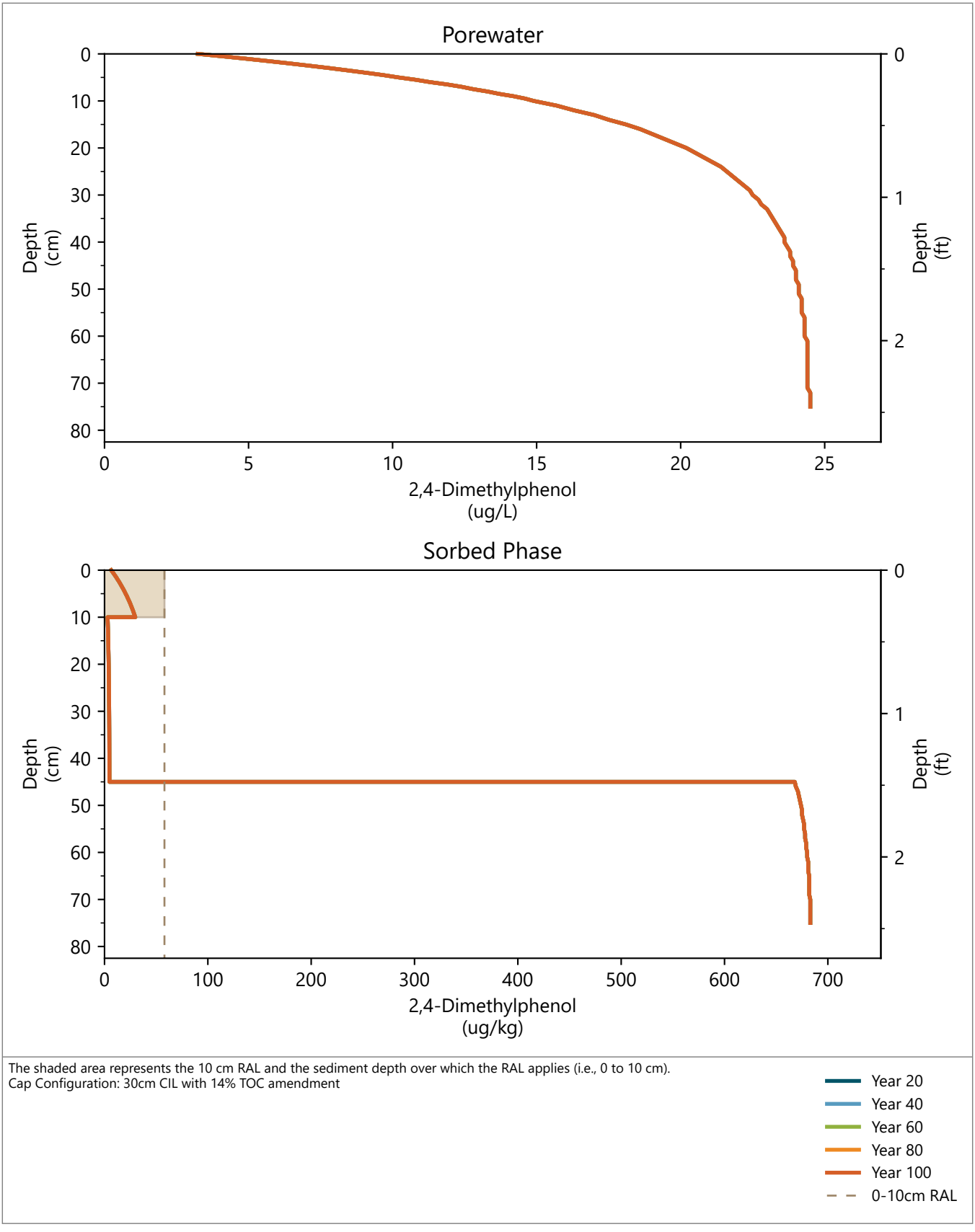
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Figure H.4.2.43o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



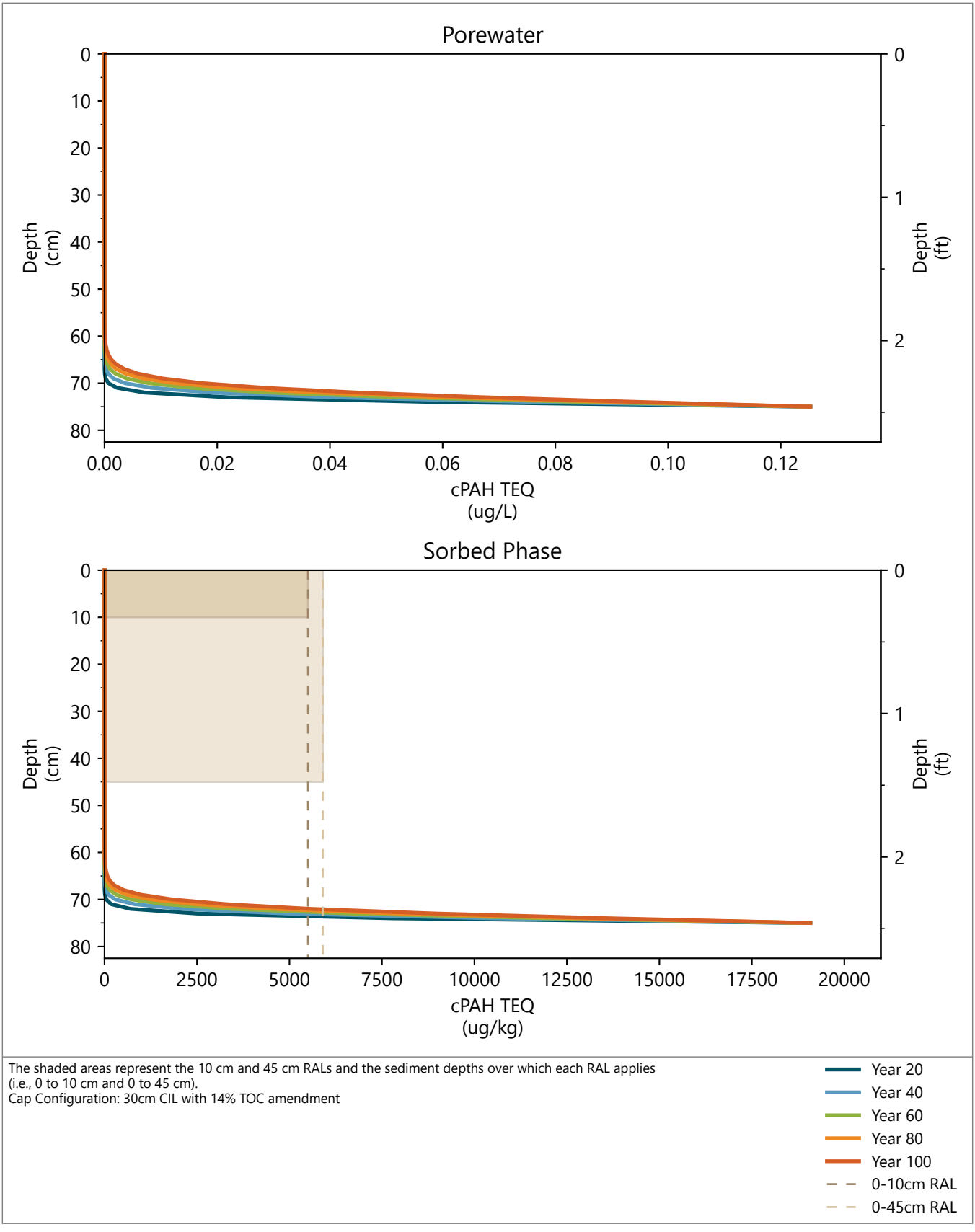
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Figure H.4.2.43p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)



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Figure H.4.2.43q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (400 cm/yr Seepage)

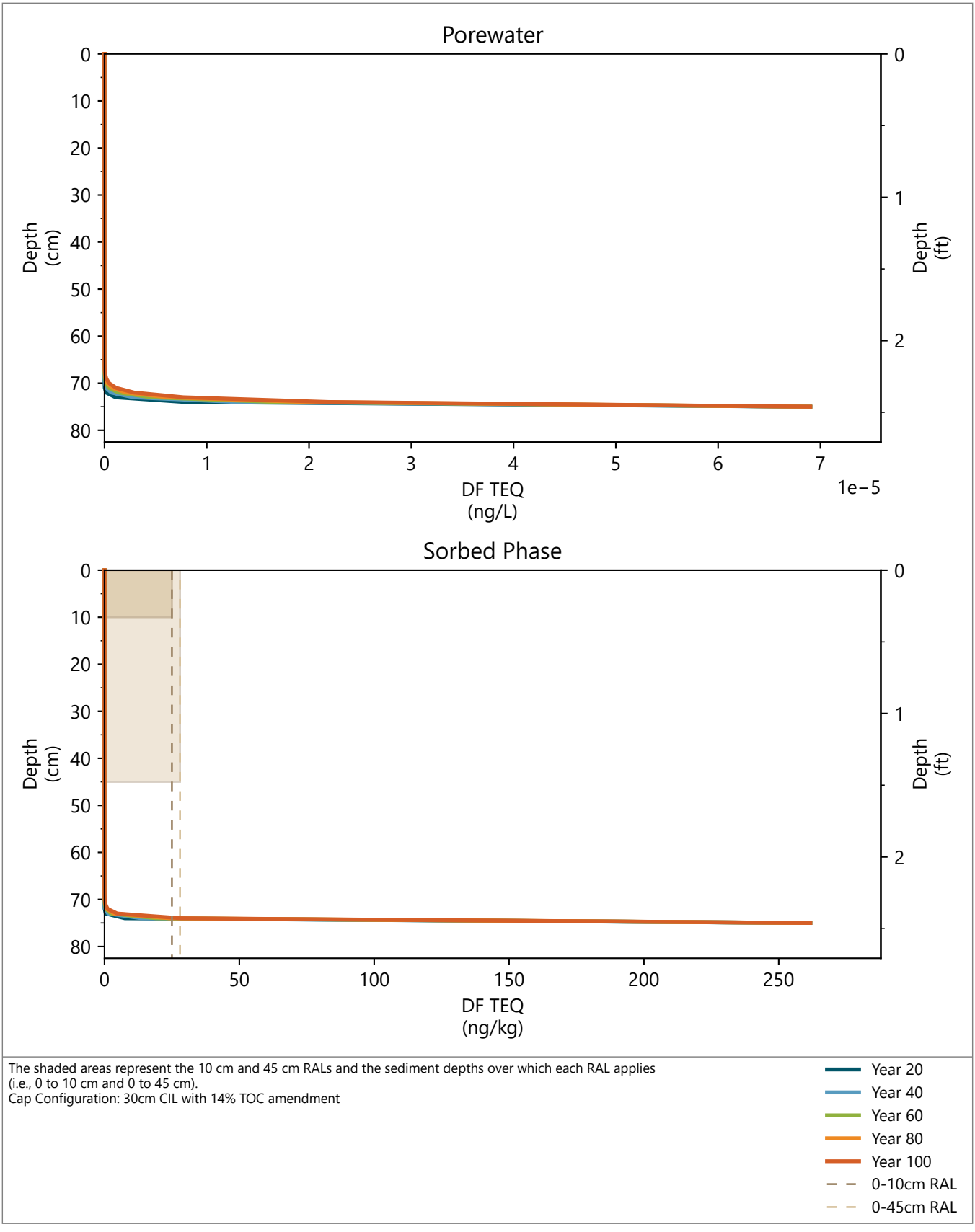


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment

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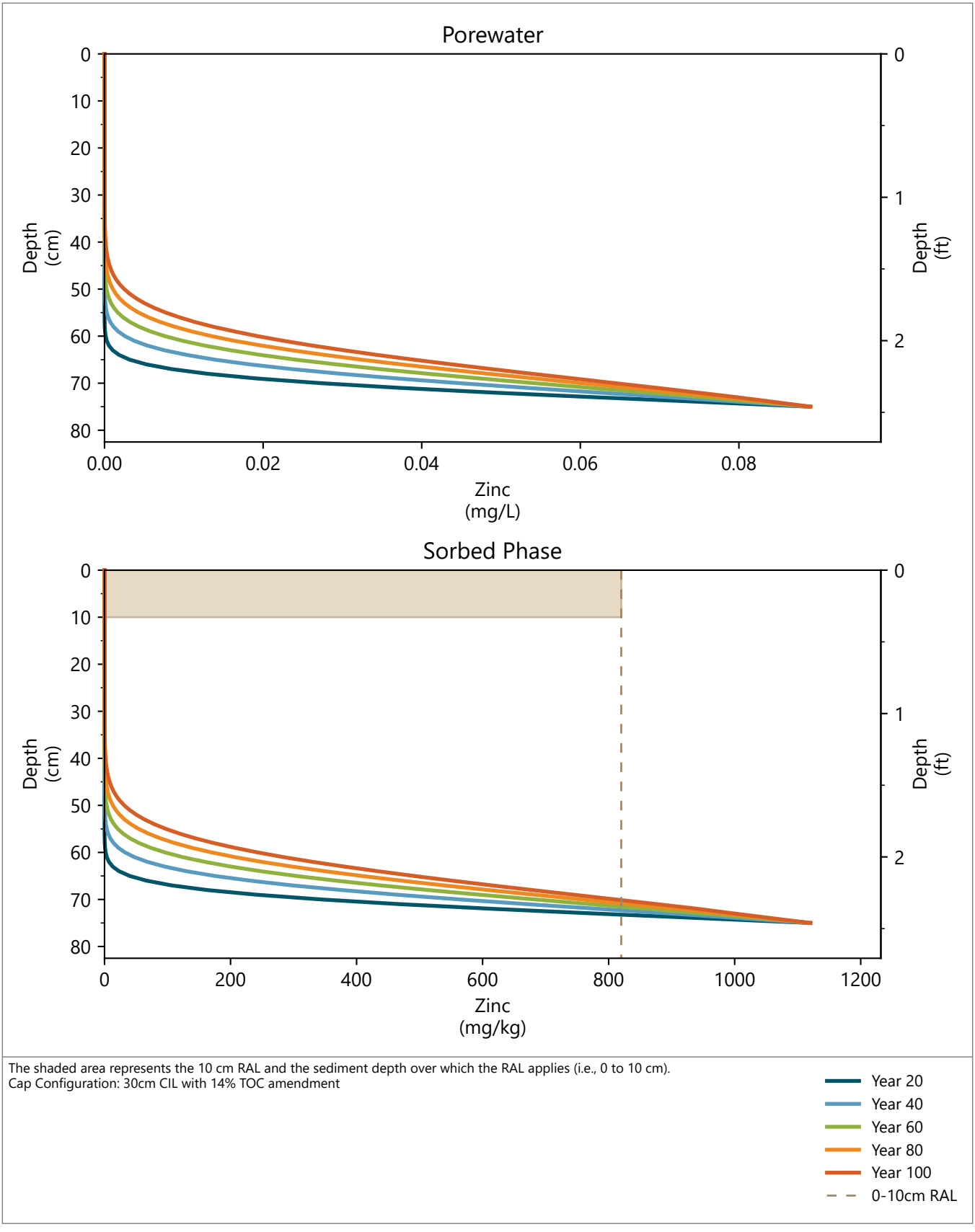
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Figure H.4.2.44a
Depth Profiles Over Time of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



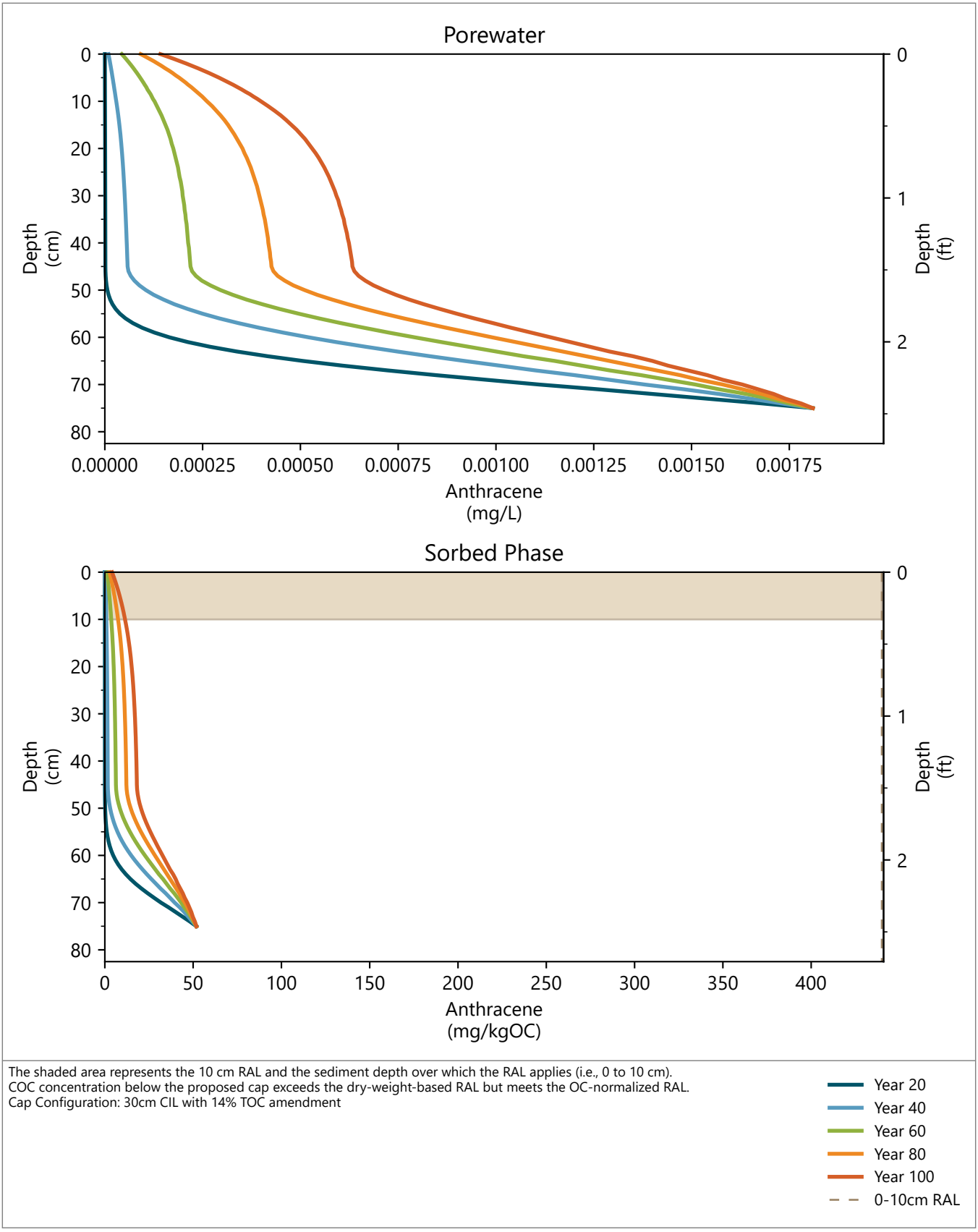
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Figure H.4.2.44b
Depth Profiles Over Time of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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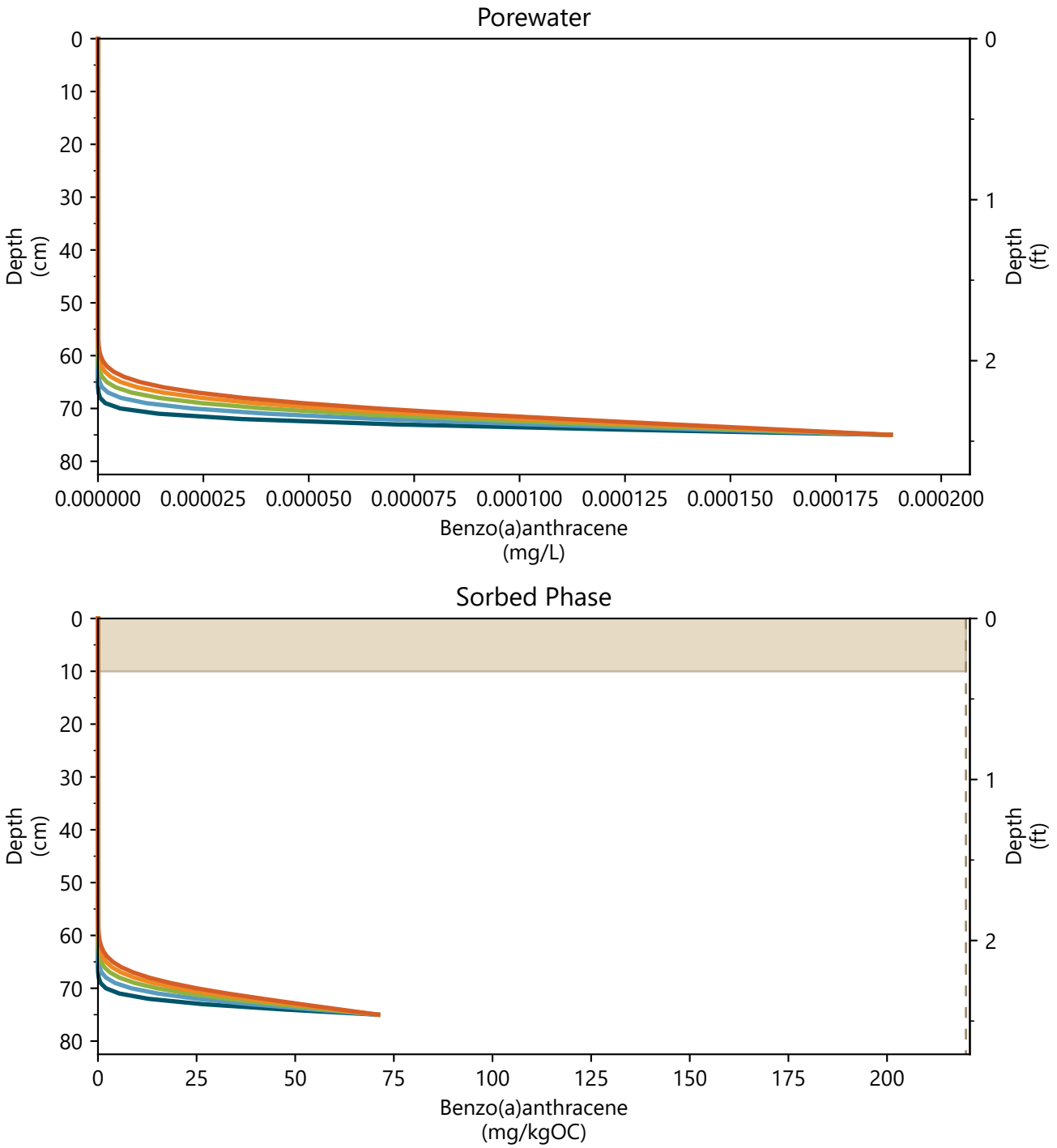
Figure H.4.2.44c
Depth Profiles Over Time of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.44d
Depth Profiles Over Time of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



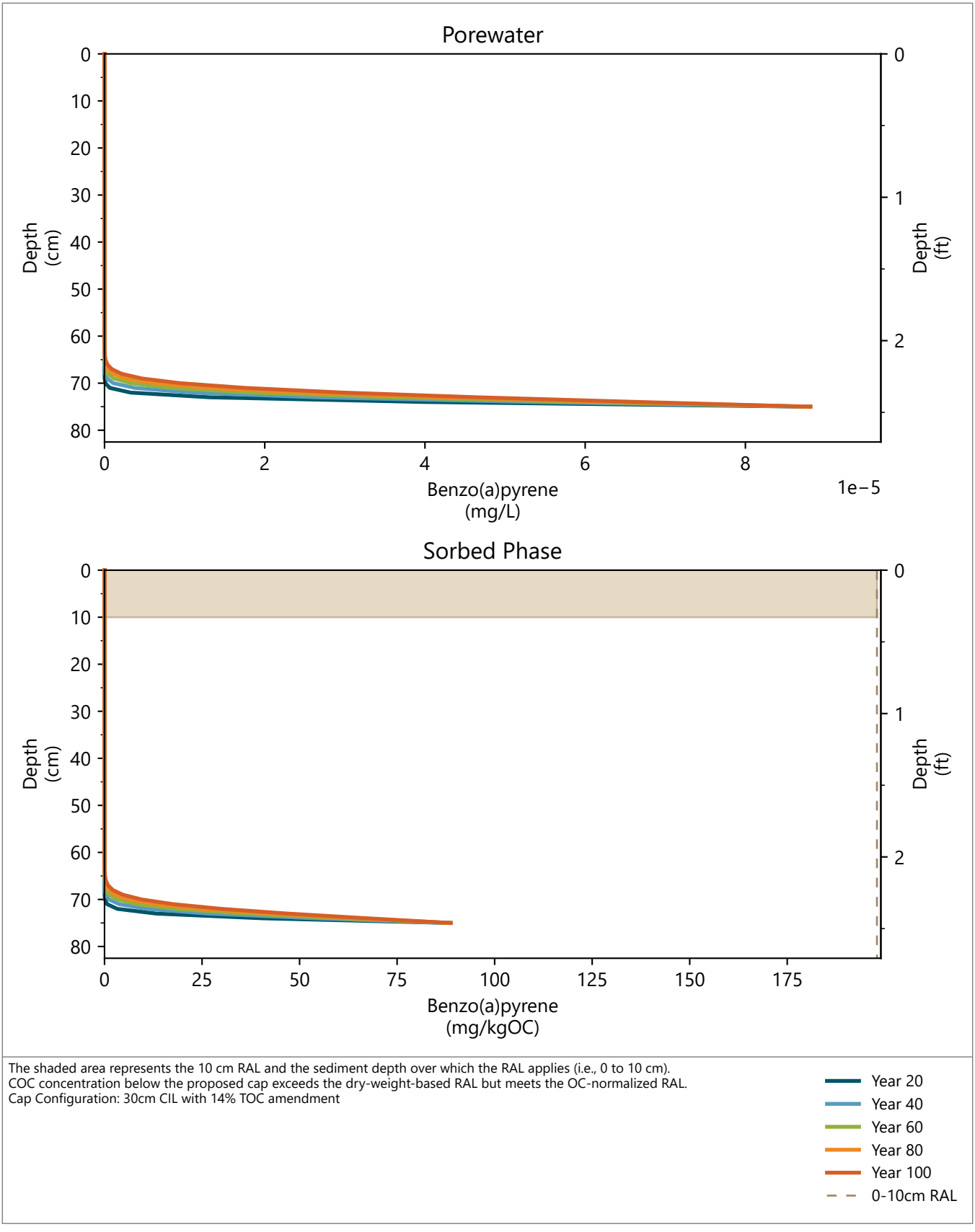
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL

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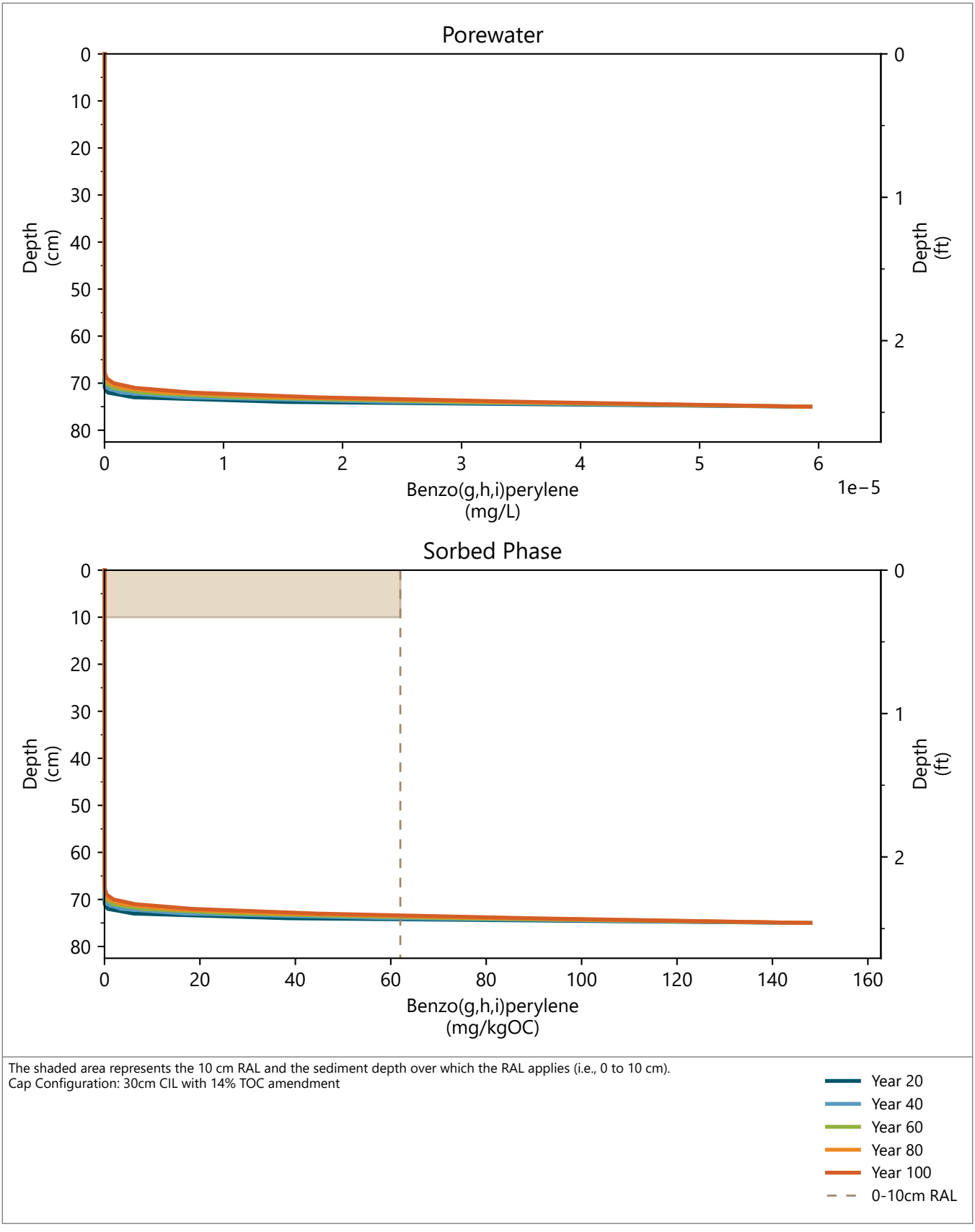
Figure H.4.2.44e
Depth Profiles Over Time of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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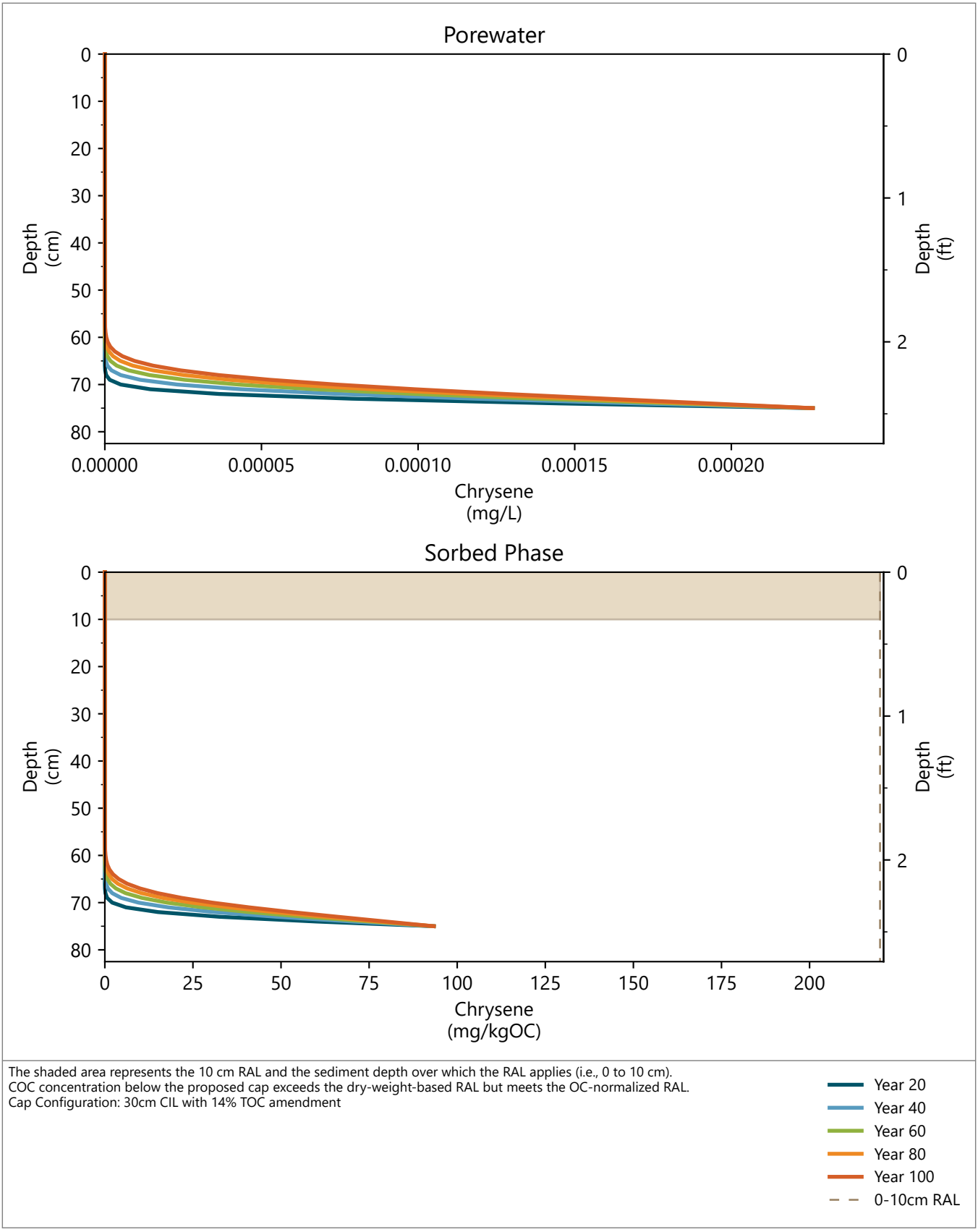
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Figure H.4.2.44f
Depth Profiles Over Time of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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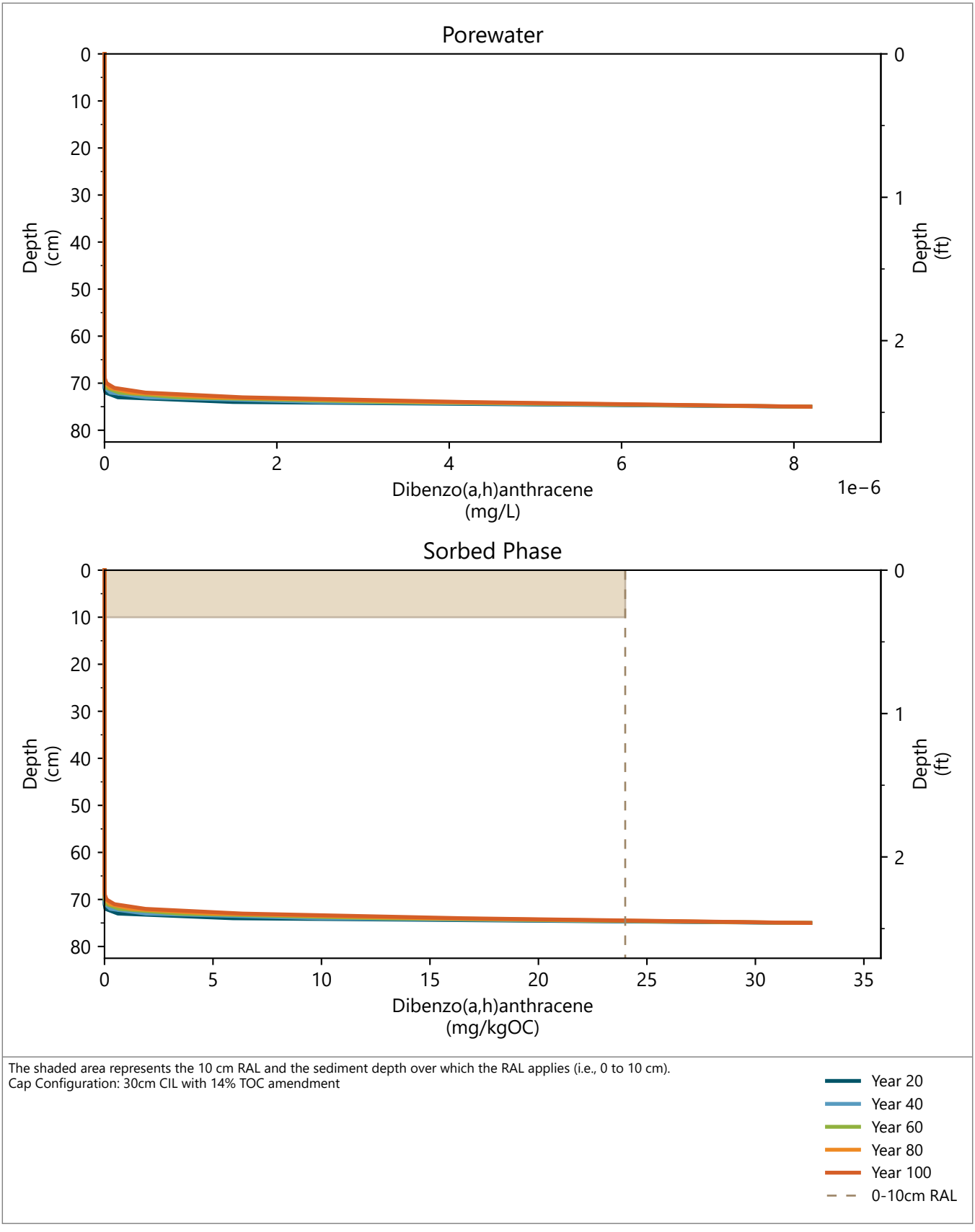
Figure H.4.2.44g
Depth Profiles Over Time of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

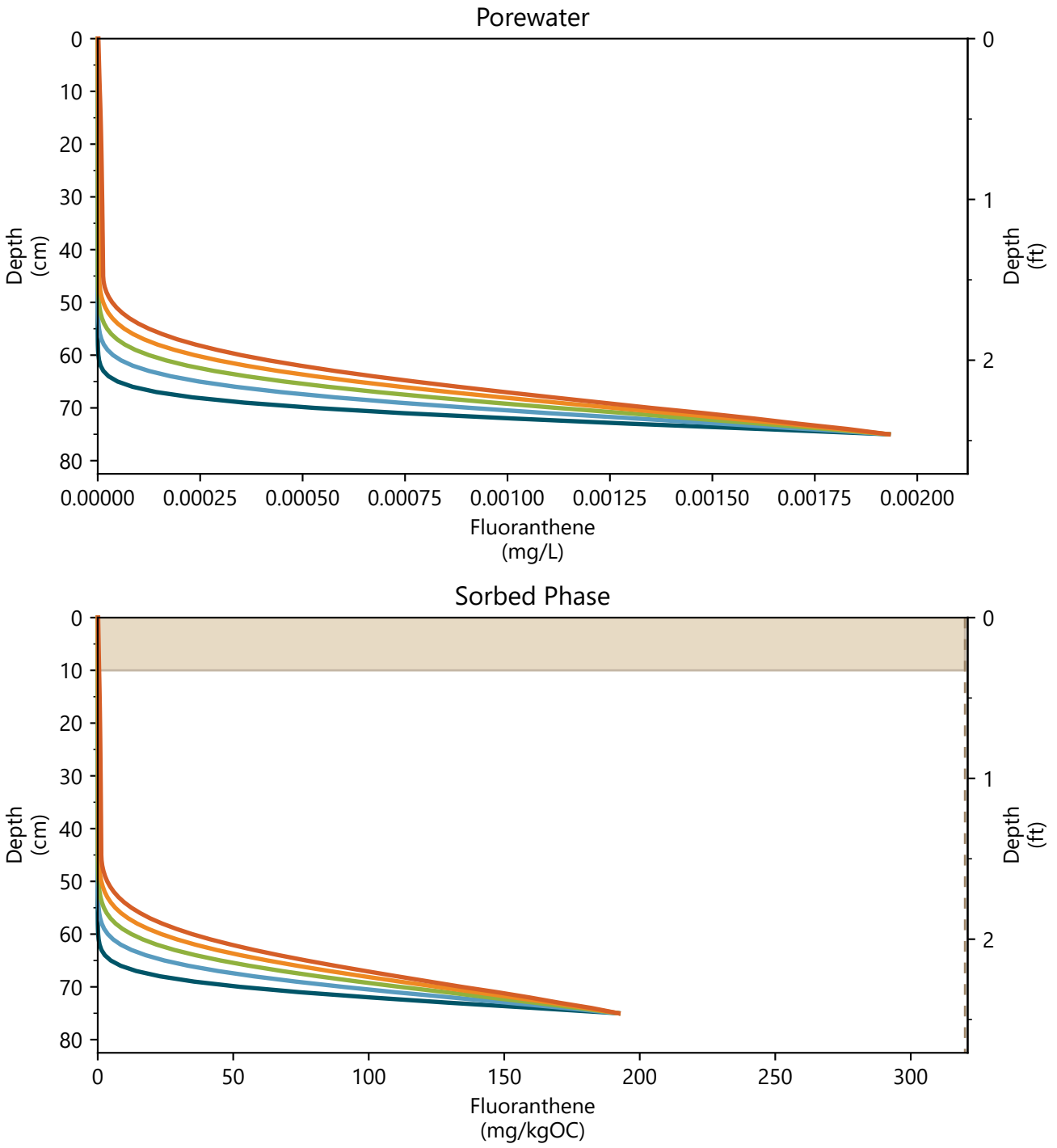
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Figure H.4.2.44h
Depth Profiles Over Time of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.44i
Depth Profiles Over Time of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

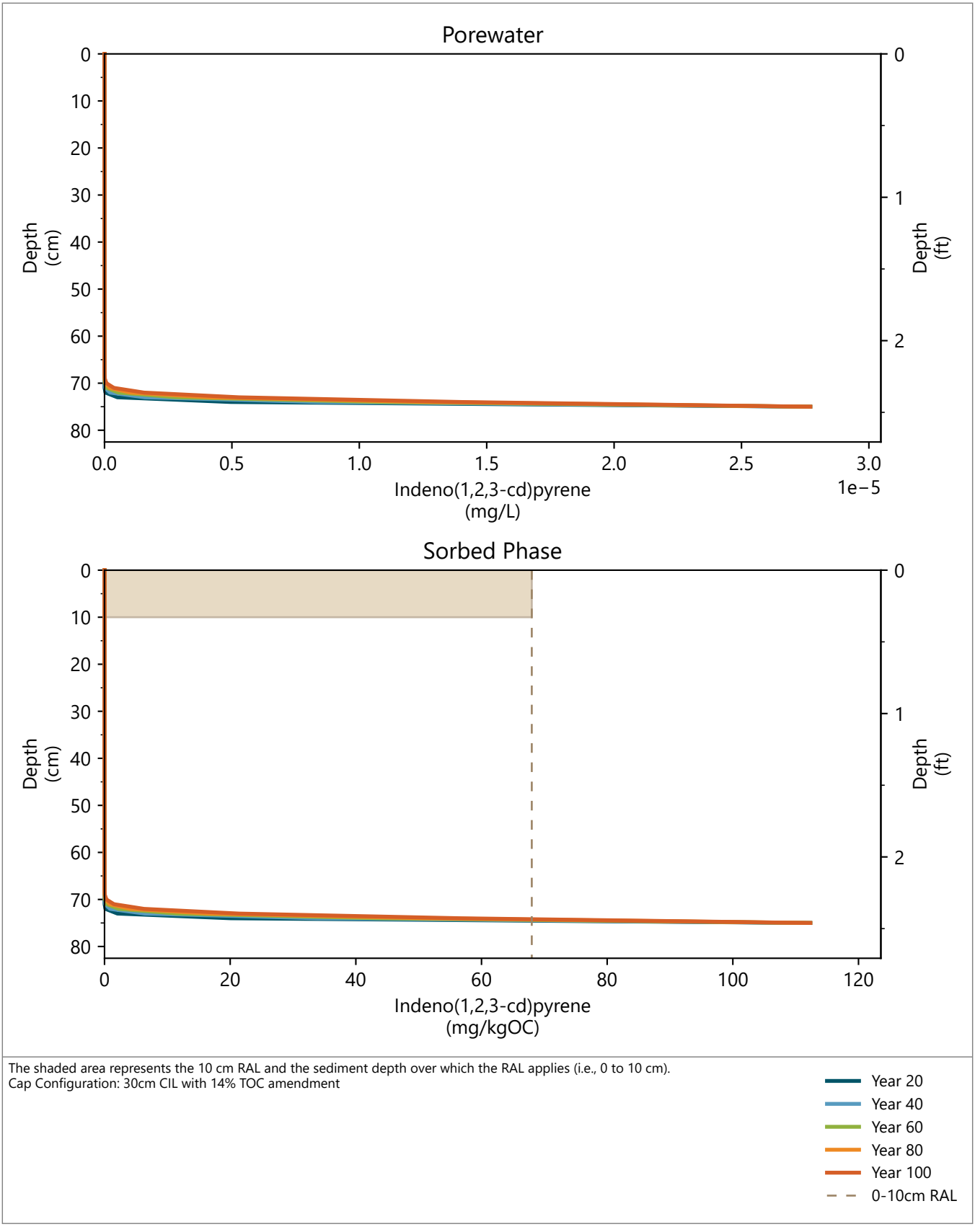


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment

Year 20
Year 40
Year 60
Year 80
Year 100
0-10cm RAL

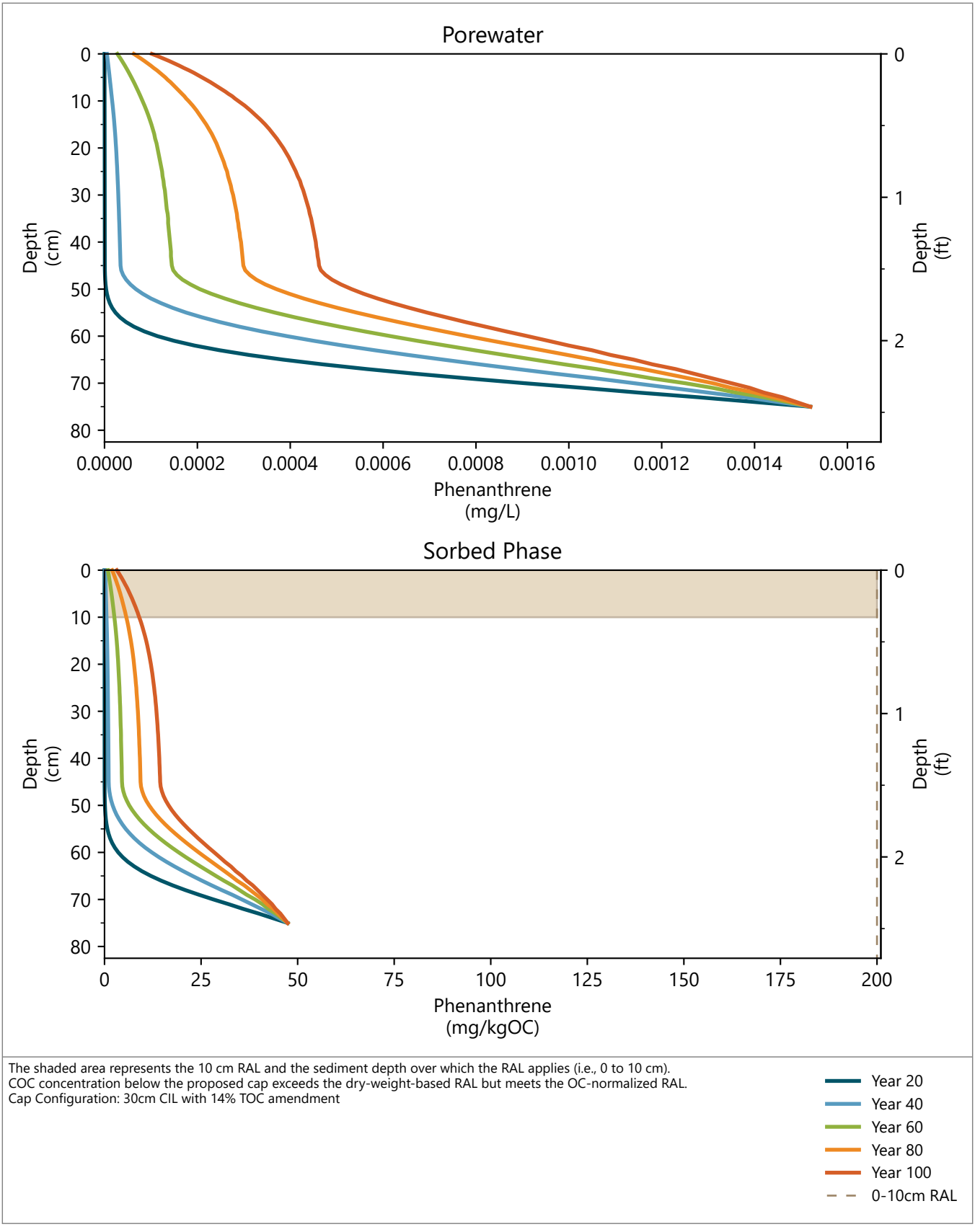
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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.44j
Depth Profiles Over Time of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.44k
Depth Profiles Over Time of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

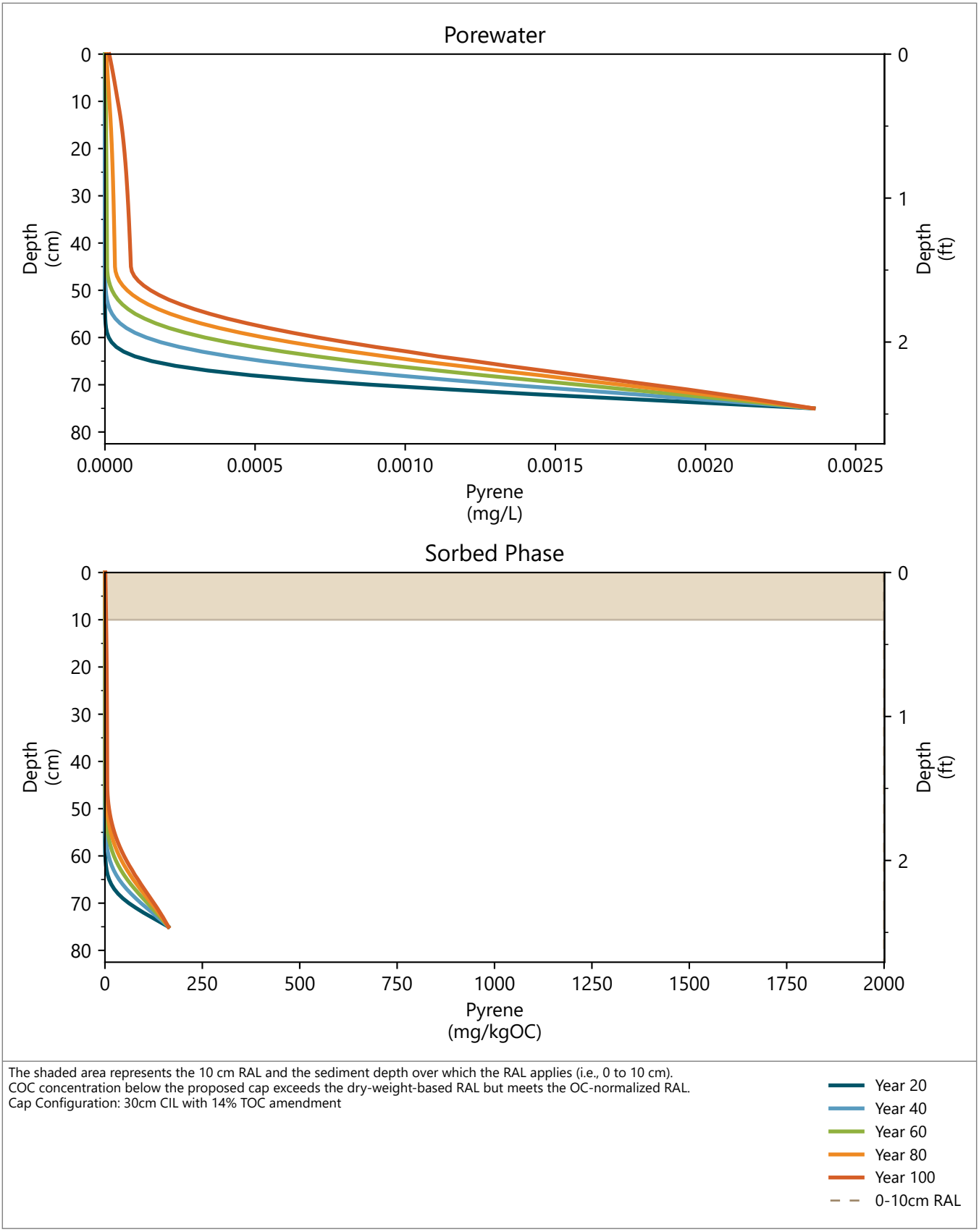


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

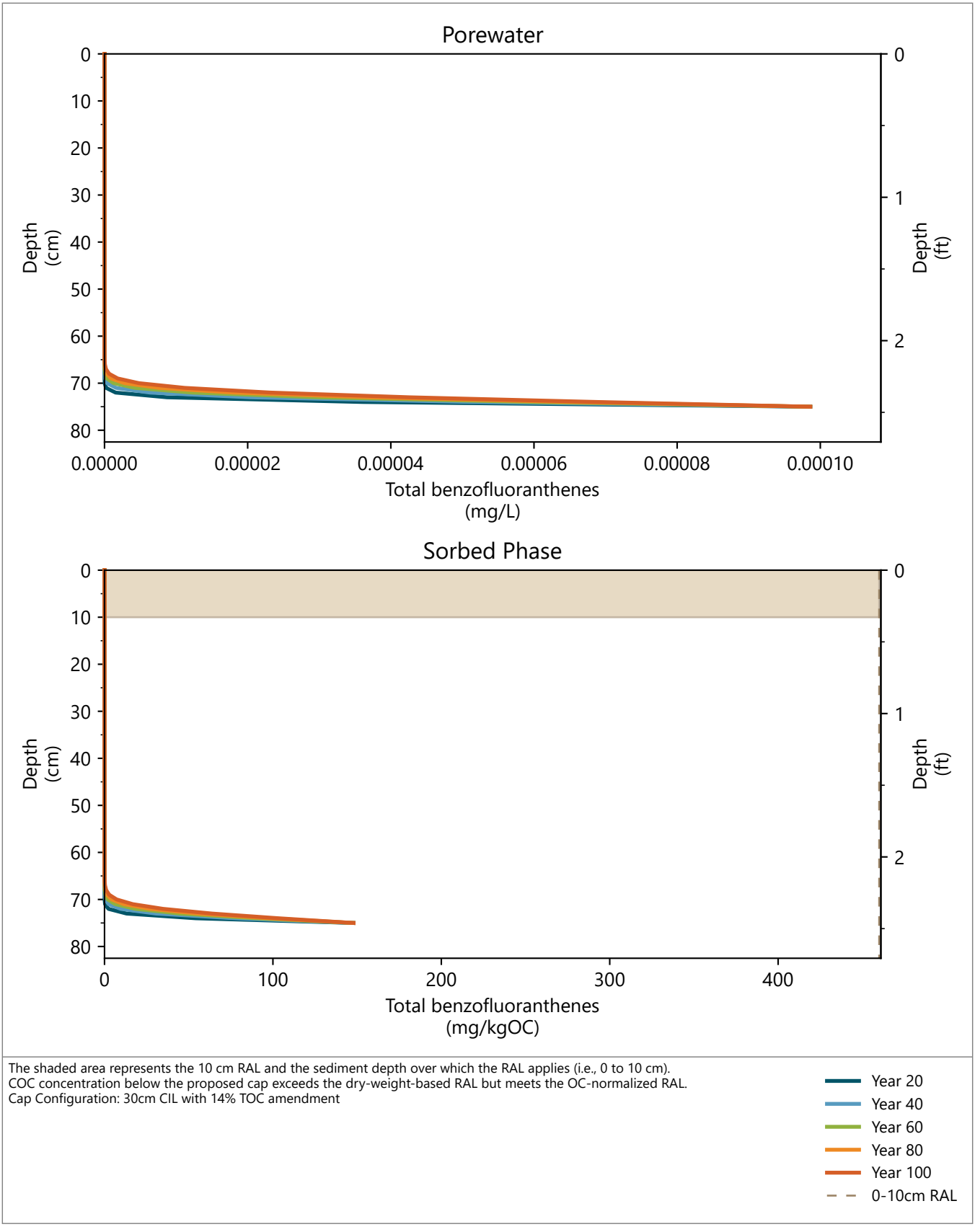
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Figure H.4.2.44l
Depth Profiles Over Time of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



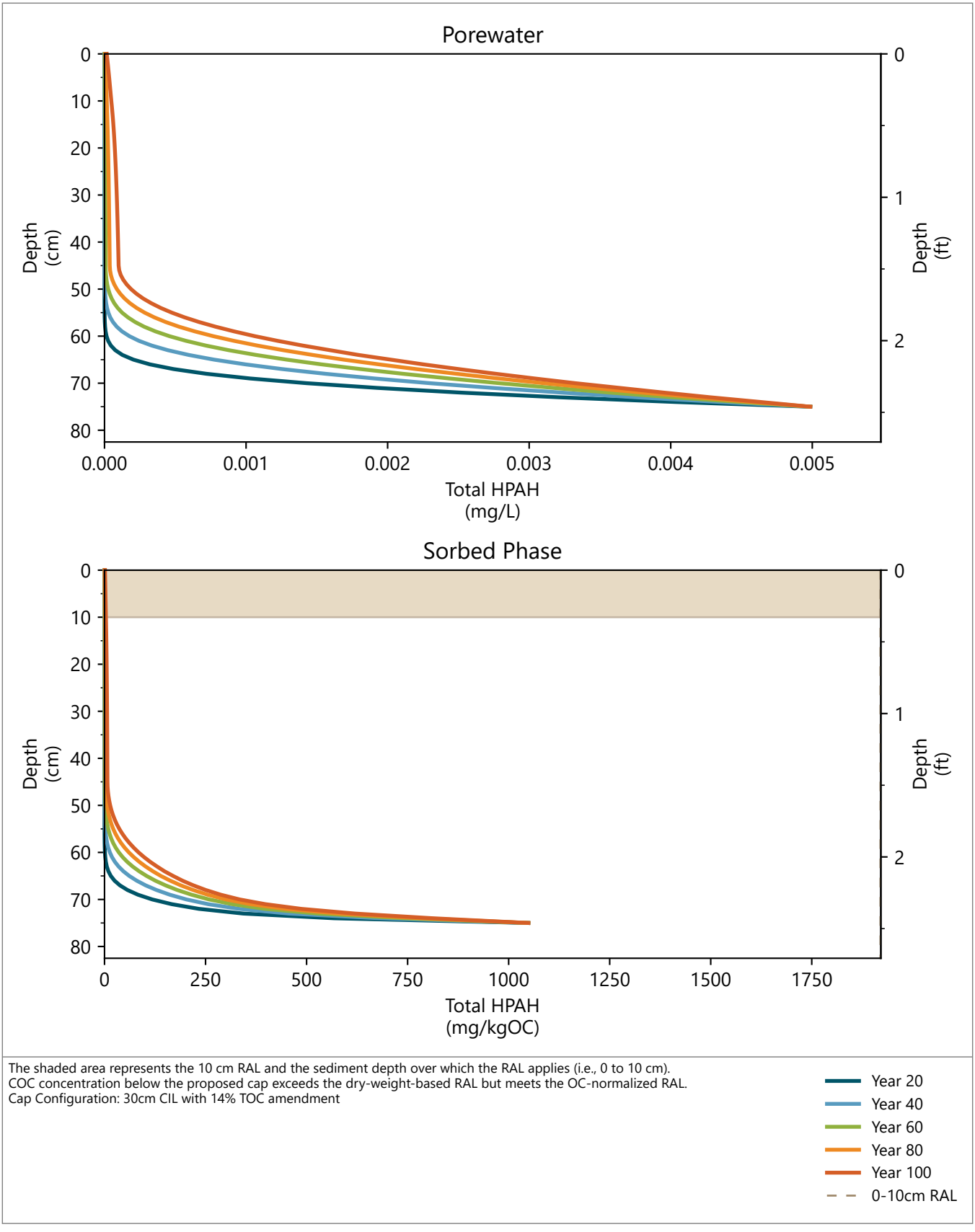
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Figure H.4.2.44m
Depth Profiles Over Time of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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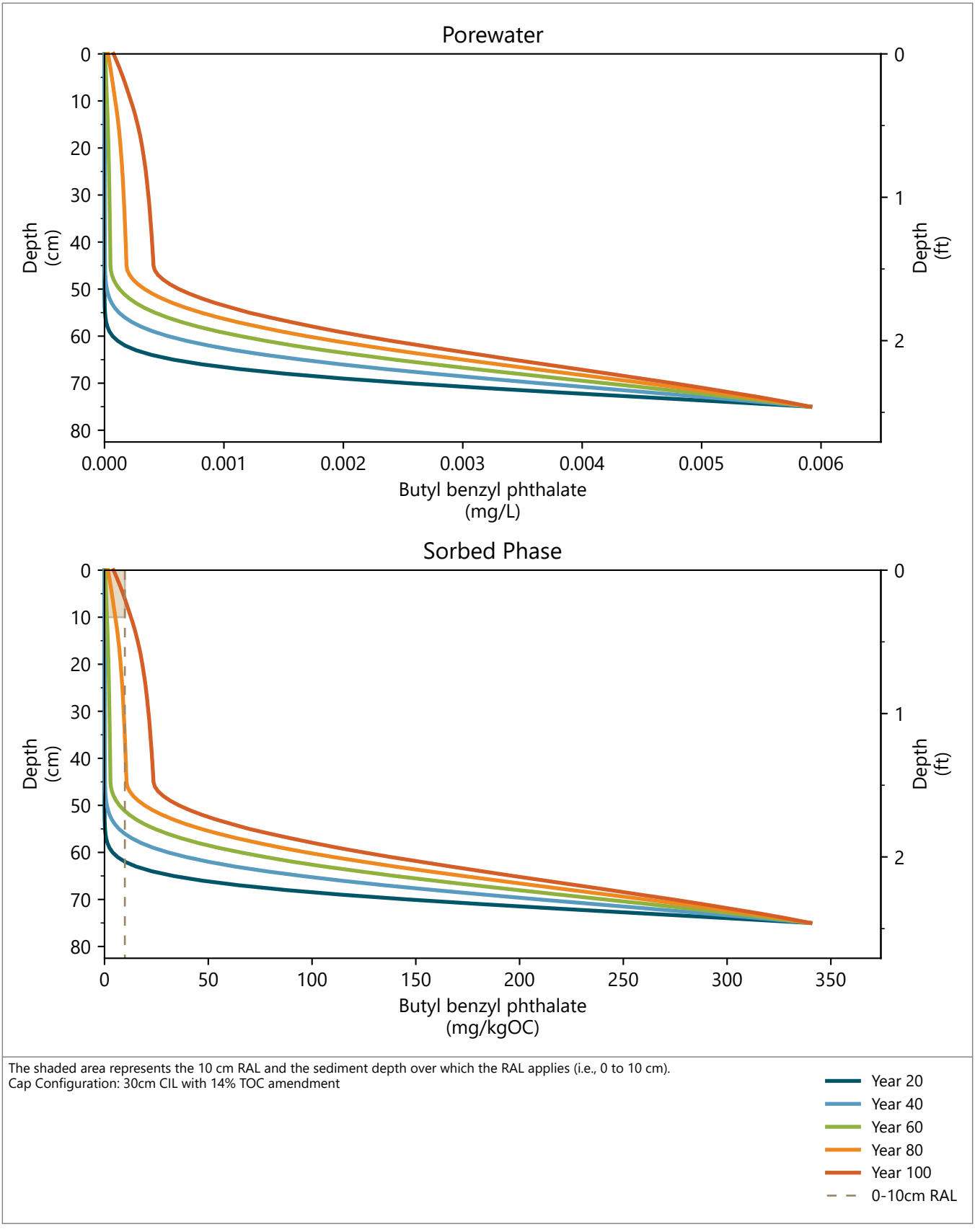
Figure H.4.2.44n
Depth Profiles Over Time of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

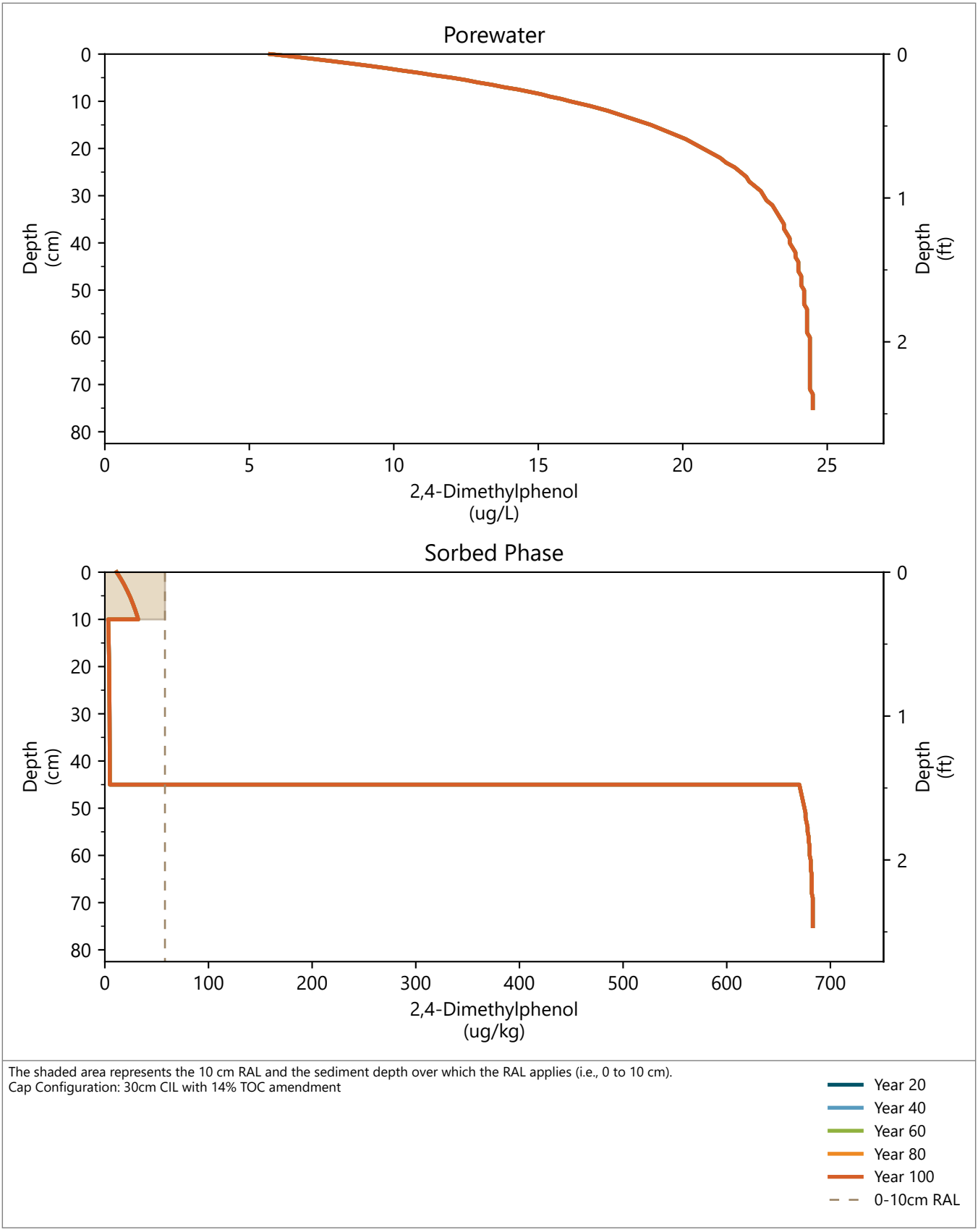
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Figure H.4.2.44o
Depth Profiles Over Time of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



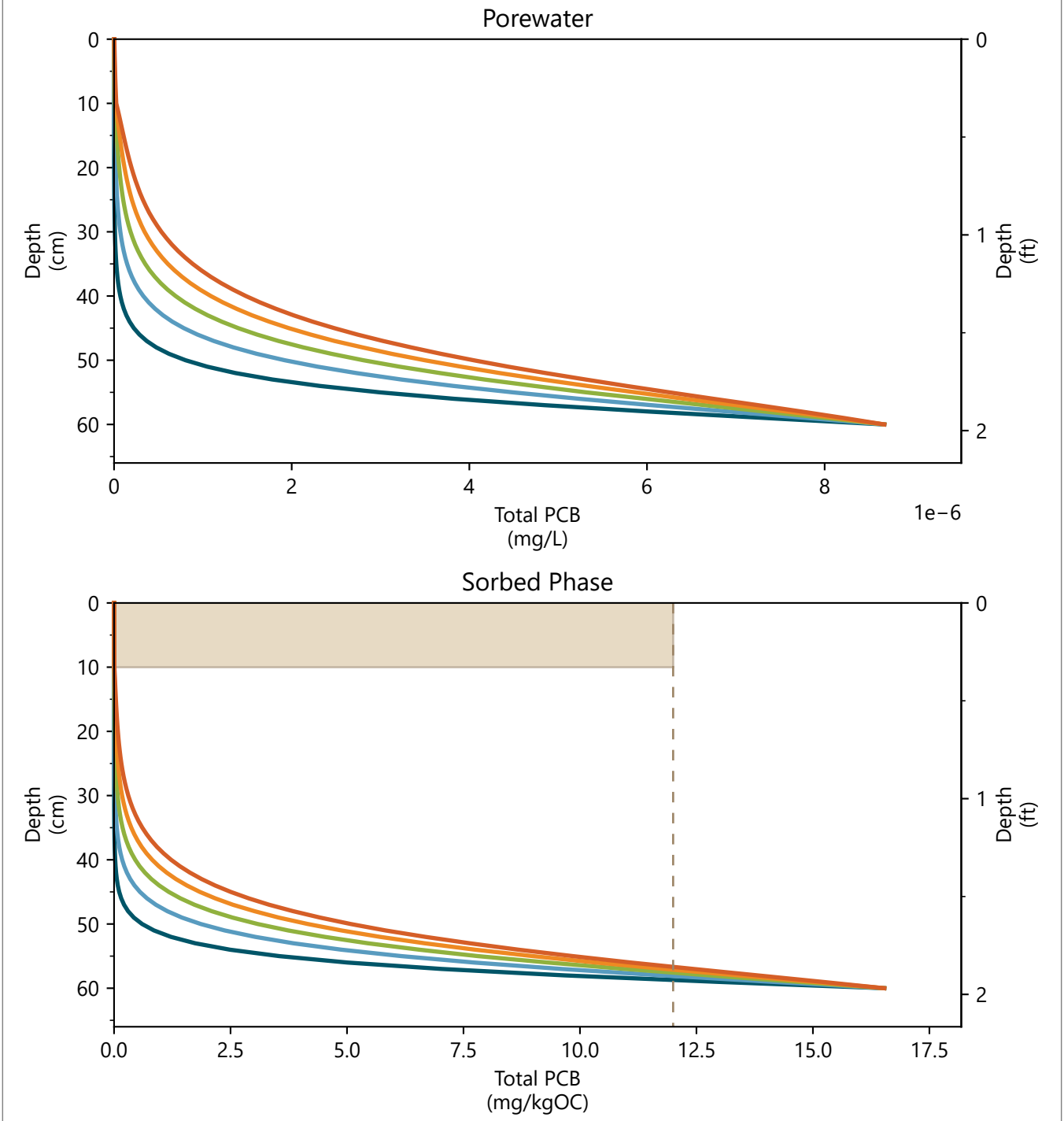
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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3.py

Figure H.4.2.44p
Depth Profiles Over Time of Model-Predicted Butyl Benzyl Phthalate Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)



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Figure H.4.2.44q
Depth Profiles Over Time of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap (800 cm/yr Seepage)

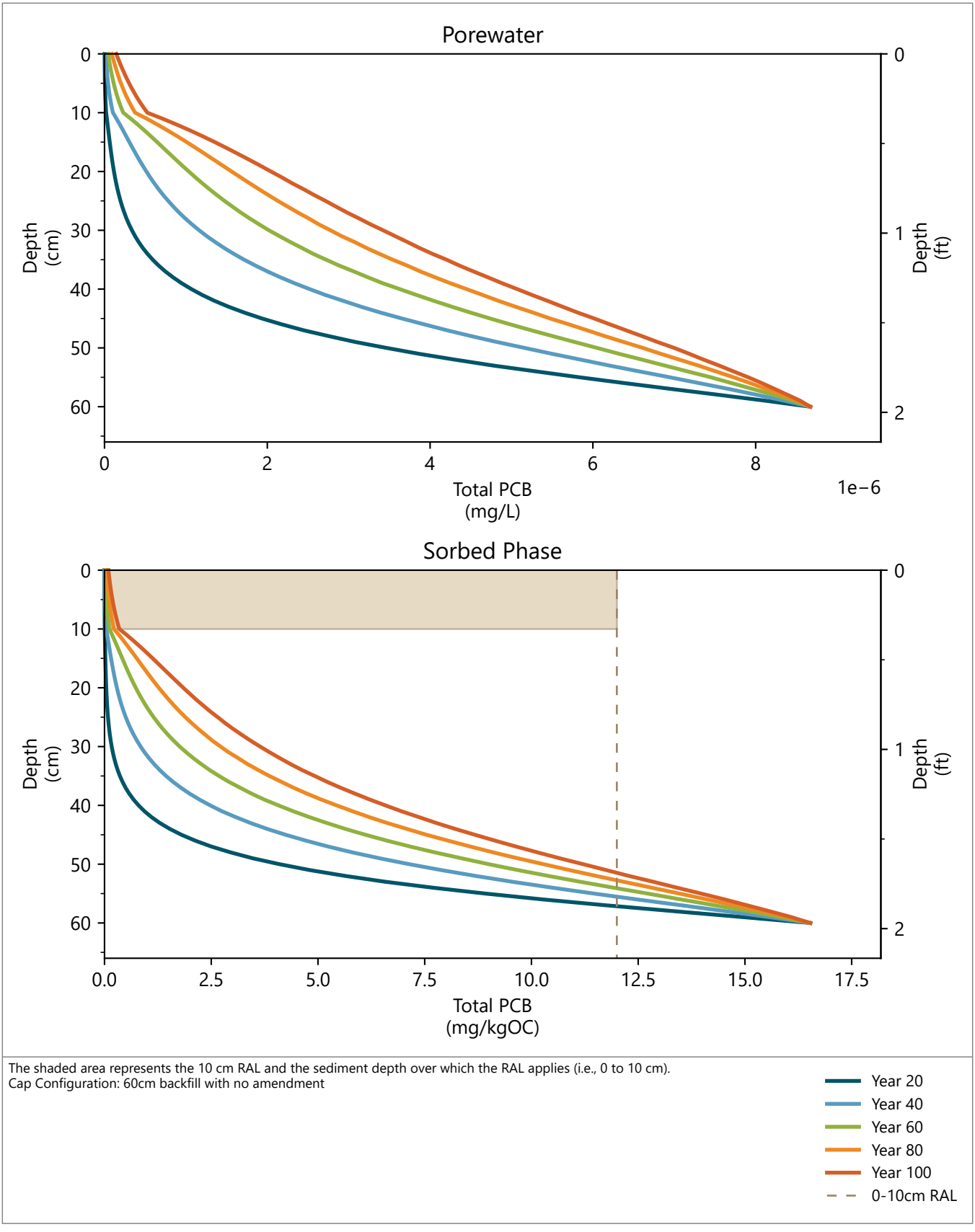


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 60cm backfill with no amendment

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Figure H.4.3.1a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9K AST Cover (100 cm/yr Seepage)



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Figure H.4.3.2a
Depth Profiles Over Time of Model-Predicted Total PCB Concentrations in RAA 9K AST Cover (400 cm/yr Seepage)

Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

Attachment H.5
Mass Transfer Sensitivity Analysis Results

Table H.5.1
Mass Transfer Sensitivity Analysis Results for Standard Cap RAAs

RAA	Cap Type	Chemical Isolation Layer		Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
		Thickness and Material	Amendment				Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
1B	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.0051	0.0051
				400	Total PCBs	mg/kg OC	0.29	0.31
9J	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.014	0.014
					Dioxin/furan TEQ	ng/kg	3.2E-07	3.2E-07
				400	Total PCBs	mg/kg OC	0.81	0.86
					Dioxin/furan TEQ	ng/kg	0.0025	0.0026
15B	Standard	15 cm gravelly sand	None	400	Total PCBs	mg/kg OC	0.71	0.76
				800	Total PCBs	mg/kg OC	2.9	3.1
22	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.031	0.031
				400	Total PCBs	mg/kg OC	1.8	1.9
23A	Standard	15 cm gravelly sand	None	400	Total PCBs	mg/kg OC	1.7	1.8
				800	Total PCBs	mg/kg OC	7.0	7.7
30A	Standard	15 cm gravelly sand	None	400	Total PCBs	mg/kg OC	1.8	1.9
					Mercury	mg/kg	0	0
				800	Total PCBs	mg/kg OC	7.4	8.1
					Mercury	mg/kg	0	0
30B	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.025	0.025
					Dioxin/furan TEQ	ng/kg	3.6E-08	3.6E-08
				400	Total PCBs	mg/kg OC	1.4	1.5
					Dioxin/furan TEQ	ng/kg	0.00035	0.00037

RAA	Cap Type	Chemical Isolation Layer		Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
		Thickness and Material	Amendment				Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
30C	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.0025	0.0028
					Dioxin/furan TEQ	ng/kg	2E-07	2.1E-07
				400	Total PCBs	mg/kg OC	0.15	0.17
					Dioxin/furan TEQ	ng/kg	0.0019	0.002
30D	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.013	0.015
					Dioxin/furan TEQ	ng/kg	2.5E-07	2.5E-07
				400	Total PCBs	mg/kg OC	0.77	0.87
					Dioxin/furan TEQ	ng/kg	0.0023	0.0024
30E	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.014	0.015
					Dioxin/furan TEQ	ng/kg	2.1E-07	2.2E-07
				400	Total PCBs	mg/kg OC	0.82	0.93
					Dioxin/furan TEQ	ng/kg	0.0019	0.0020
30F	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.015	0.016
				400	Total PCBs	mg/kg OC	0.89	1.0
30G	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.0095	0.011
				400	Total PCBs	mg/kg OC	0.57	0.65
30H	Standard	15 cm gravelly sand	None	100	Total PCBs	mg/kg OC	0.012	0.013
				400	Total PCBs	mg/kg OC	0.72	0.82

Notes:
cm: centimeter
cm/hr: centimeter per hour
COC: contaminant of concern
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
TEQ: toxic equivalents

Table H.5.2
Mass Transfer Sensitivity Analysis Results for Modified Cap RAAs

RAA	Cap Type	Chemical Isolation Layer		Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
		Thickness and Material	Amendment[1]				Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
5B	Modified	30 cm gravelly sand	1% TOC	400	Total PCBs	mg/kg OC	0.070	0.075
				800	Total PCBs	mg/kg OC	0.75	0.84
8B	Modified	76 cm gravelly sand	73% TOC	400	1,2,4-trichlorobenzene	mg/kg OC	3.6E-12	4.4E-12
					1,4-dichlorobenzene	mg/kg OC	0.031	0.04
				800	1,2,4-trichlorobenzene	mg/kg OC	5.9E-06	7.7E-06
					1,4-dichlorobenzene	mg/kg OC	1.9	2.6
9D	Modified	30 cm gravelly sand	None	400	Total PCBs	mg/kg OC	1.4	1.5
				800	Total PCBs	mg/kg OC	8.4	9.0
20C	Modified	30 cm gravelly sand	None	400	Total PCBs	mg/kg OC	0.068	0.072
					Dioxin/furan TEQ	ng/kg	0.0037	0.0039
				800	Total PCBs	mg/kg OC	0.38	0.42
					Dioxin/furan TEQ	ng/kg	0.068	0.072
24l	Modified	30 cm gravelly sand	None	400	Total PCBs	mg/kg OC	2.1	2.2
				800	Total PCBs	mg/kg OC	11	**12.5**
26	Modified	30 cm gravelly sand	14% TOC	400	cPAHs	µg/kg	3.9E-15	3.9E-15
					Dioxin/furan TEQ	ng/kg	0	0
					Zinc	ng/kg	7.8E-15	7.8E-15
					Anthracene	mg/kg OC	1.2	1.5
					Benzo(a)anthracene	mg/kg OC	3.8E-15	3.9E-15
					Benzo(a)pyrene	mg/kg OC	0	0

RAA	Cap Type	Chemical Isolation Layer		Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
		Thickness and Material	Amendment[1]				Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
26 (cont.)	Modified (cont.)	30 cm gravelly sand (cont.)	14% TOC (cont.)	400 (cont.)	Benzo(g,j,i)perylene	mg/kg OC	0	0
					Chrysene	mg/kg OC	5.1E-16	5.1E-16
					Dibenzo(a,h)anthracene	mg/kg OC	0	0
					Fluoranthene	mg/kg OC	6.0E-04	6.6E-04
					Indeno(1,2,3-cd)pyrene	mg/kg OC	0	0
					Phenanthrene	mg/kg OC	0.77	0.98
					Pyrene	mg/kg OC	0.021	0.025
					Total benzofluoranthenes	mg/kg OC	0	0
					Total HPAHs	mg/kg OC	0.024	0.025
					BBP	mg/kg OC	0.19	0.22
					2,4-Dimethylphenol	µg/kg	19	25
				800	cPAHs	µg/kg	1.4E-08	1.5E-08
					Dioxin/furan TEQ	ng/kg	0	0
					Zinc	mg/kg	2.8E-07	2.8E-07
					Anthracene	mg/kg OC	8.0	11
					Benzo(a)anthracene	mg/kg OC	1.4E-08	1.4E-08
					Benzo(a)pyrene	mg/kg OC	0	0
					Benzo(g,j,i)perylene	mg/kg OC	0	0
					Chrysene	mg/kg OC	3.3E-09	3.4E-09
					Dibenzo(a,h)anthracene	mg/kg OC	0	0
					Fluoranthene	mg/kg OC	0.32	0.38
					Indeno(1,2,3-cd)pyrene	mg/kg OC	0	0

RAA	Cap Type	Chemical Isolation Layer		Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
		Thickness and Material	Amendment[1]				Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
26 (cont.)	Modified (cont.)	30 cm gravelly sand (cont.)	14% TOC (cont.)	800 (cont.)	Phenanthrene	mg/kg OC	6.3	8.4
					Pyrene	mg/kg OC	2.0	2.5
					Total benzofluoranthenes	mg/kg OC	0	0
					Total HPAHs	mg/kg OC	2.4	2.9
					BBP	mg/kg OC	8.6	**11**
					2,4-Dimethylphenol	µg/kg	23	31

Notes:

Values in bold represent model-predicted concentrations exceed the applicable top 10 cm RALs.

1. Amendment dosage is given as percent by weight.

µg/kg: microgram per kilogram
BBP: butyl benzyl phthalate
cm: centimeter
cm/hr: centimeter per hour
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
TEQ: toxic equivalents
TOC: total organic carbon

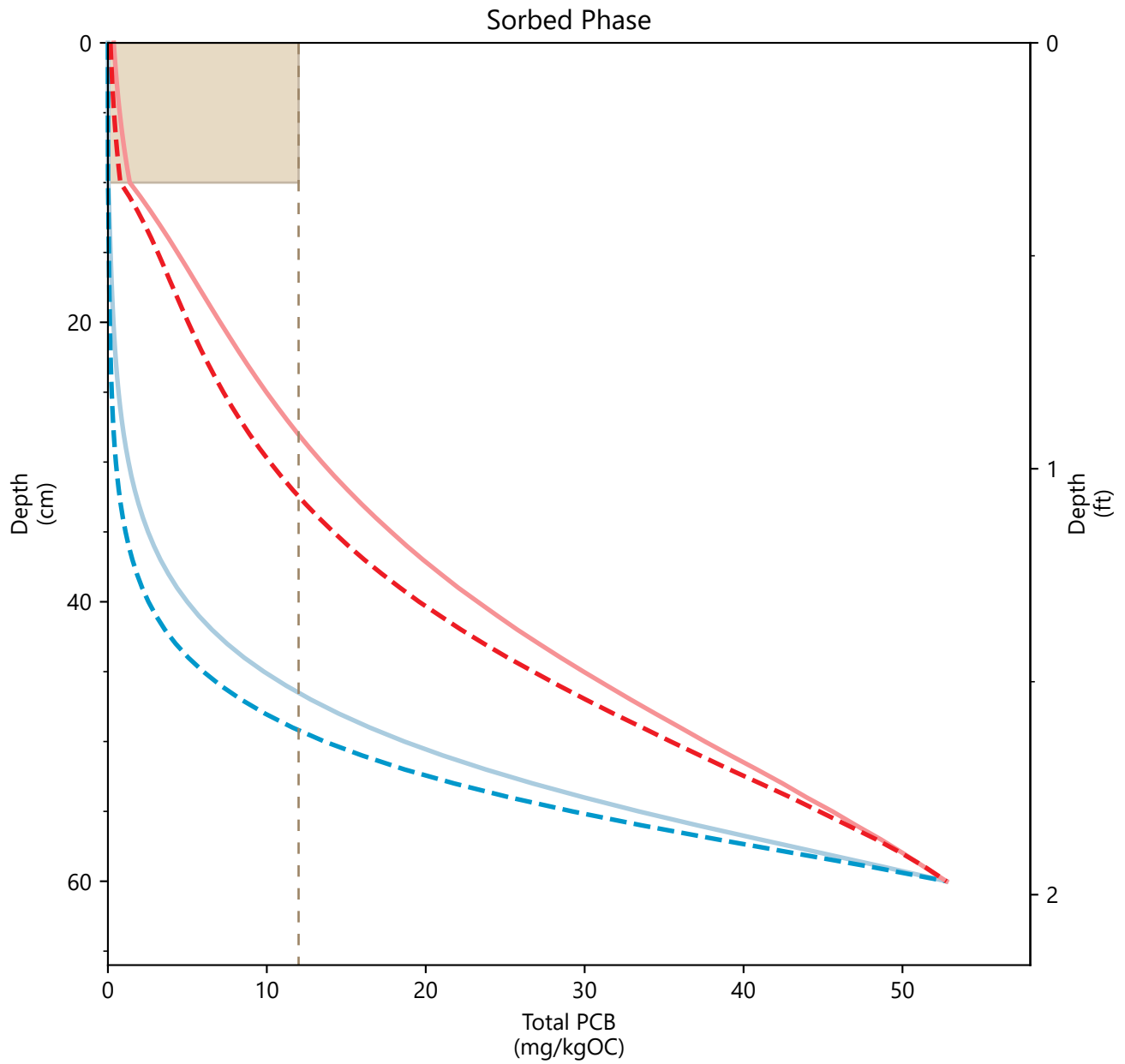
Table H.5.3
Mass Transfer Sensitivity Analysis Results for Utility Crossing AST RAA

RAA	Cap Type	Thickness and Material	Seepage Rate (cm/yr)	COC	Unit	Model-Predicted Concentration Within 0- to 10-cm Depth Interval at Year 100	
						Mass Transfer Coefficient of 0.3 cm/hr	Mass Transfer Coefficient of 0.1 cm/hr
9K	Backfill	60 cm sandy gravel	100	Total PCBs	mg/kg OC	0.0034	0.0034
			400	Total PCBs	mg/kg OC	0.20	0.22

Notes:
AST: area-specific technology
cm: centimeter
cm/hr: centimeter per hour
COC: contaminant of concern
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area

Appendix H – Engineered Cap Chemical Isolation Design Analysis and Area-Specific Technology Evaluation

Attachment H.6
Depth Profiles of Model Sensitivity Analysis Results



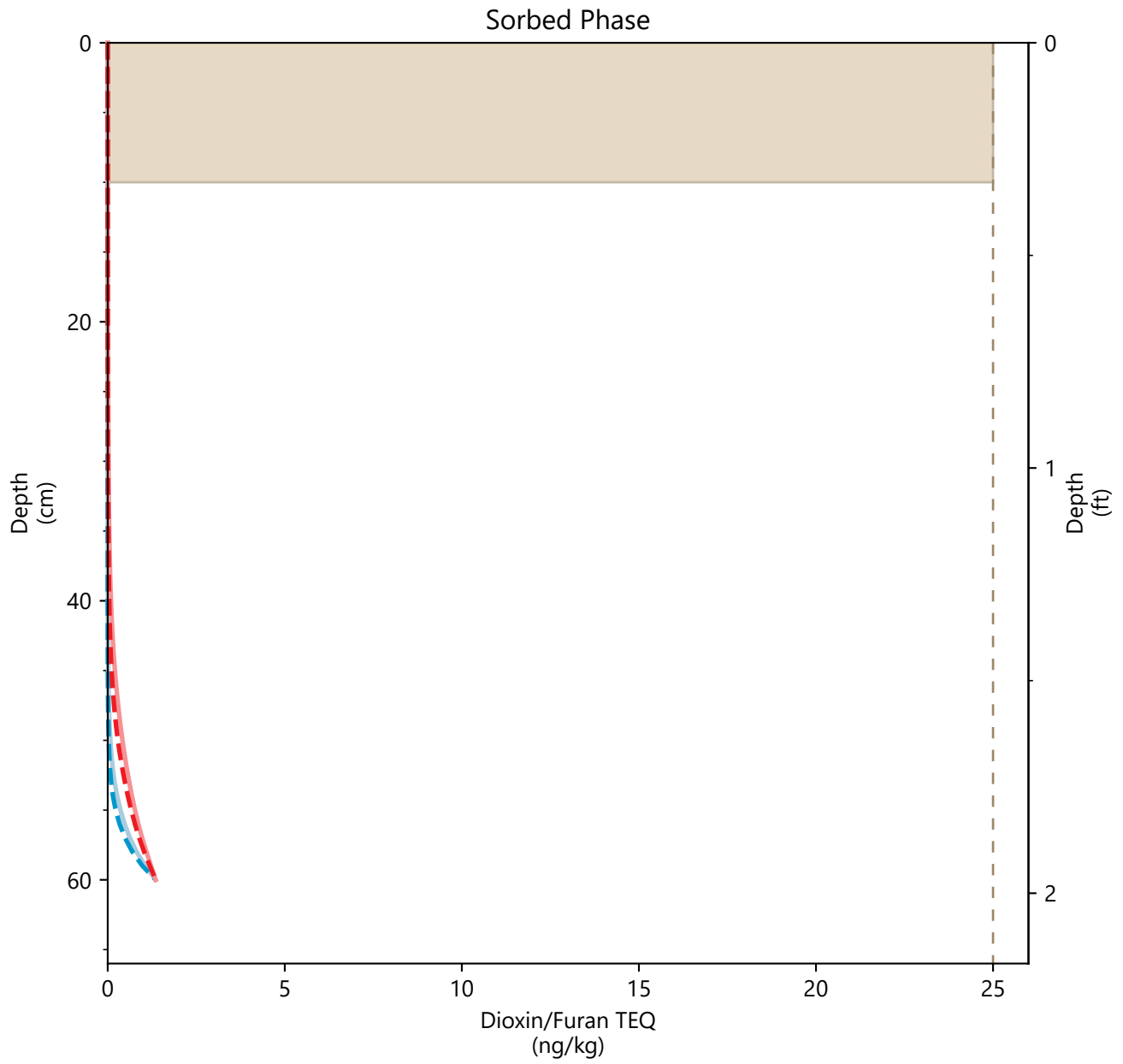
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment

- Seepage Rate: 100 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 100 cm/yr, Dispersion Length: 6 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 6 cm
- 0-10cm RAL

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Figure H.6.1.1a
Hydrodynamic Dispersivity Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 9J Standard Cap



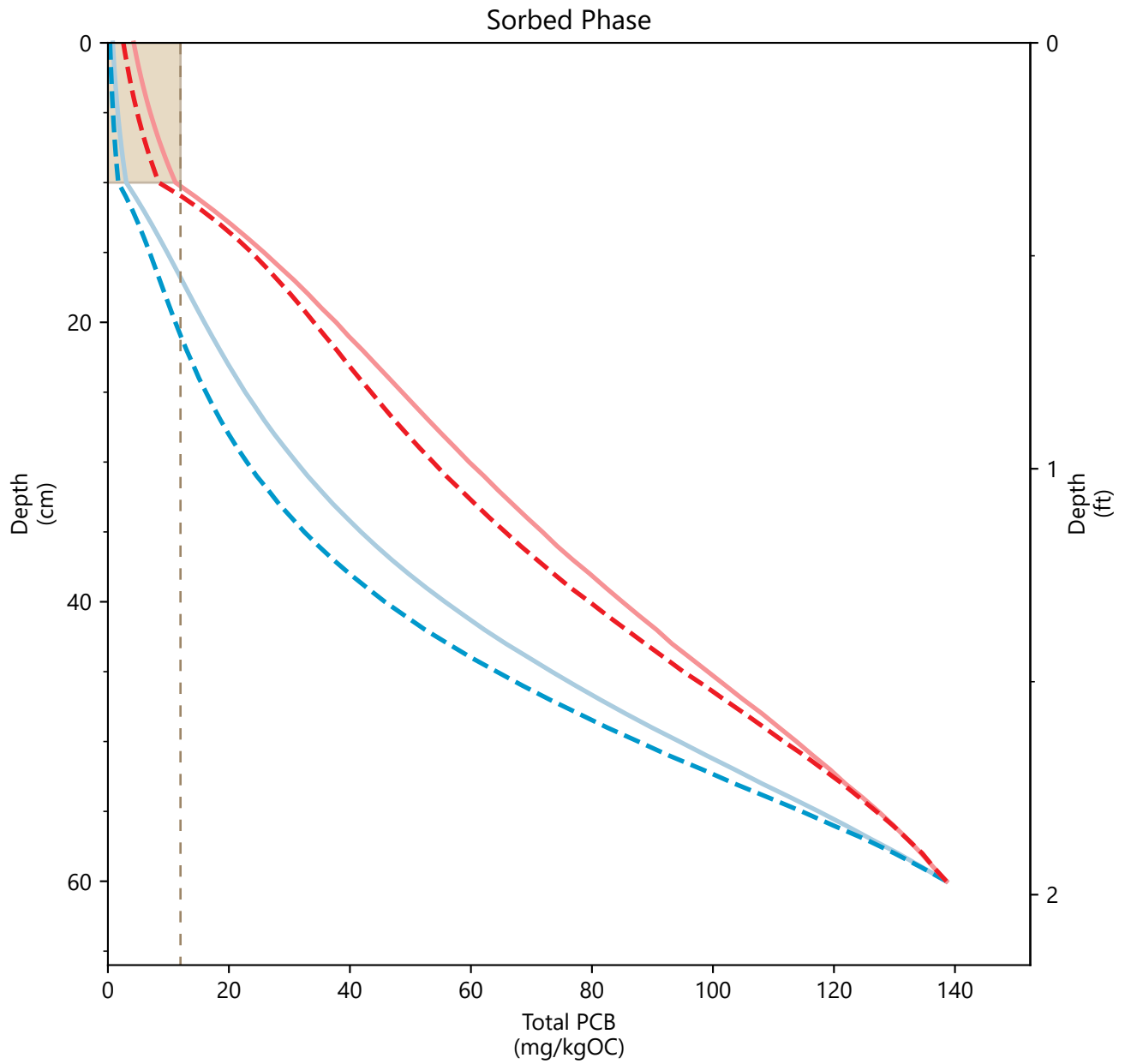
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment

- Seepage Rate: 100 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 100 cm/yr, Dispersion Length: 6 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 6 cm
- 0-10cm RAL

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Figure H.6.1.1b
Hydrodynamic Dispersivity Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 9J Standard Cap



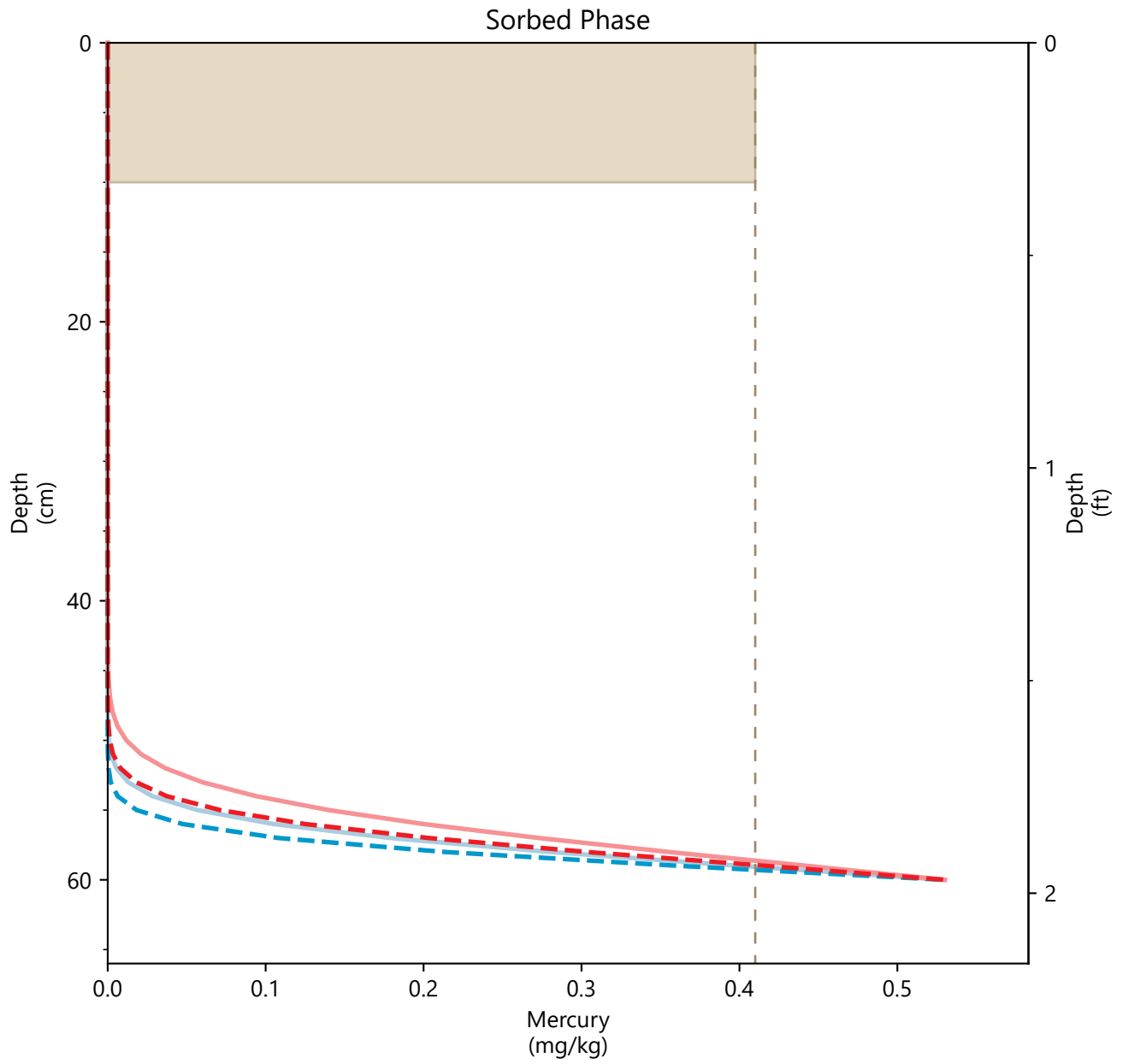
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment

- Seepage Rate: 400 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 6 cm
- Seepage Rate: 800 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 800 cm/yr, Dispersion Length: 6 cm
- 0-10cm RAL

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Figure H.6.1.2a
Hydrodynamic Dispersivity Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30A Standard Cap



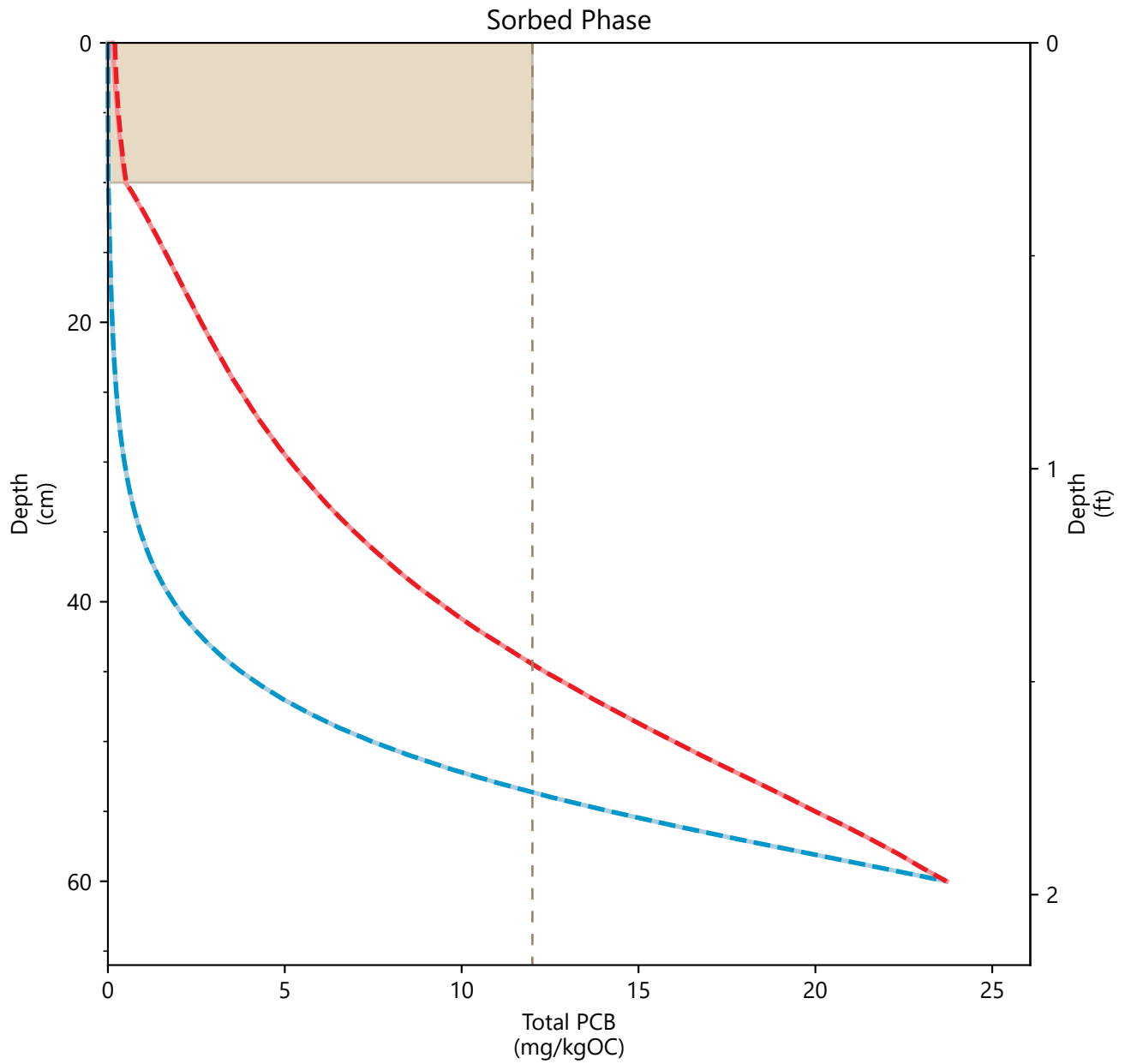
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment

- Seepage Rate: 400 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 400 cm/yr, Dispersion Length: 6 cm
- Seepage Rate: 800 cm/yr, Dispersion Length: 12 cm
- Seepage Rate: 800 cm/yr, Dispersion Length: 6 cm
- 0-10cm RAL

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Figure H.6.1.2b
Hydrodynamic Dispersivity Sensitivity Analysis: Depth Profiles of Model-Predicted Mercury Concentrations in RAA 30A Standard Cap



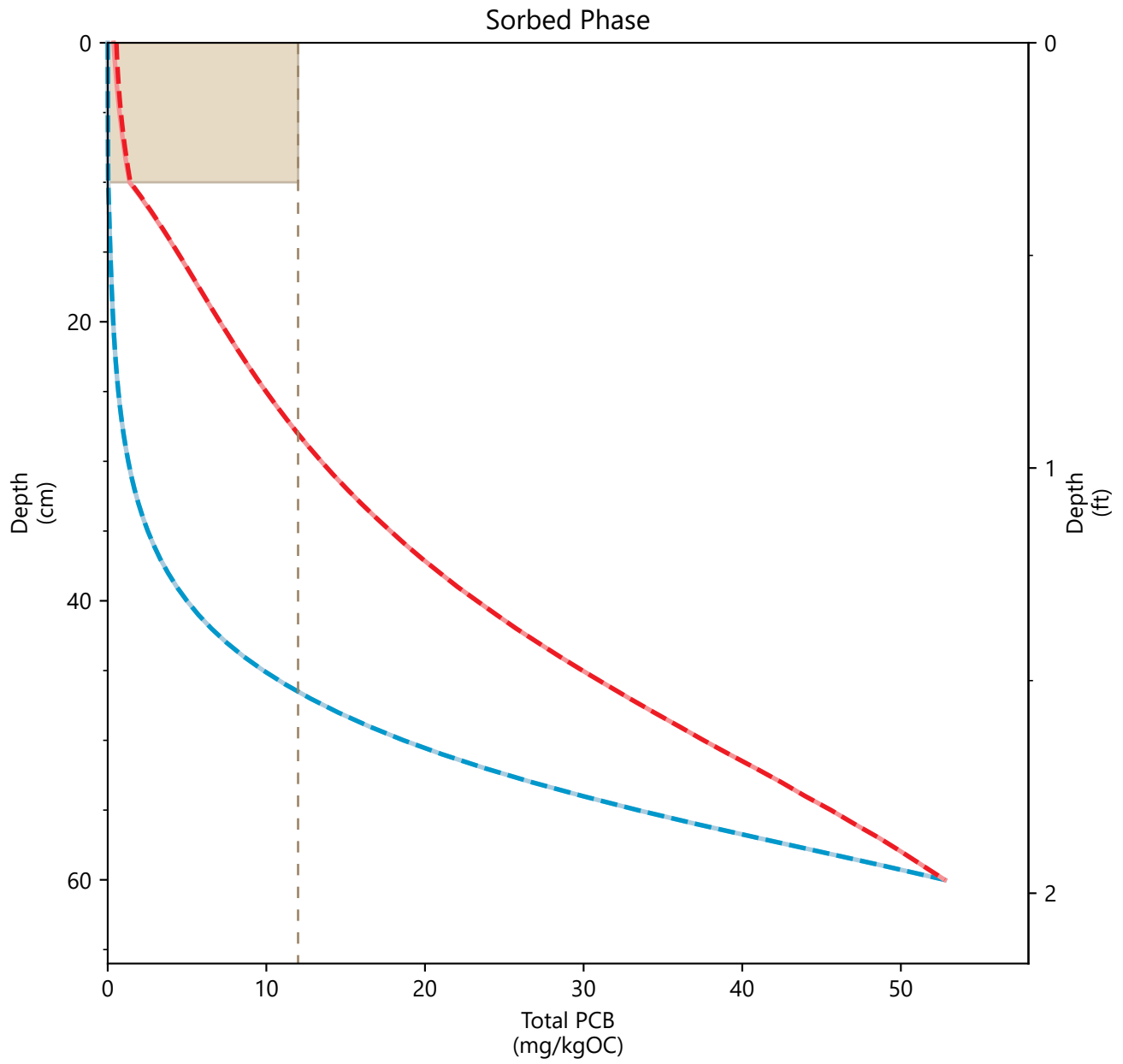
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.1a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 1B Standard Cap



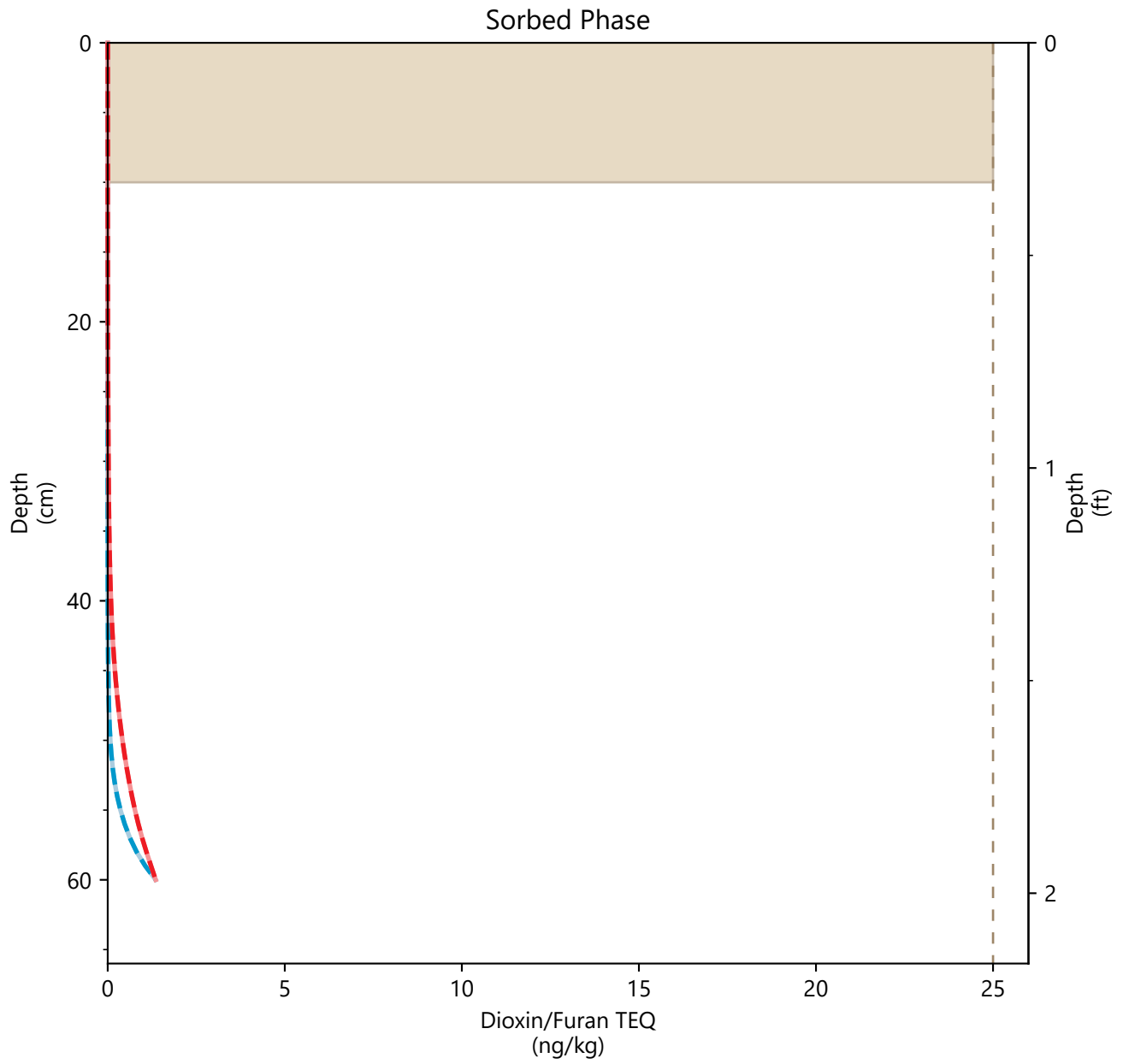
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.2a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 9J Standard Cap



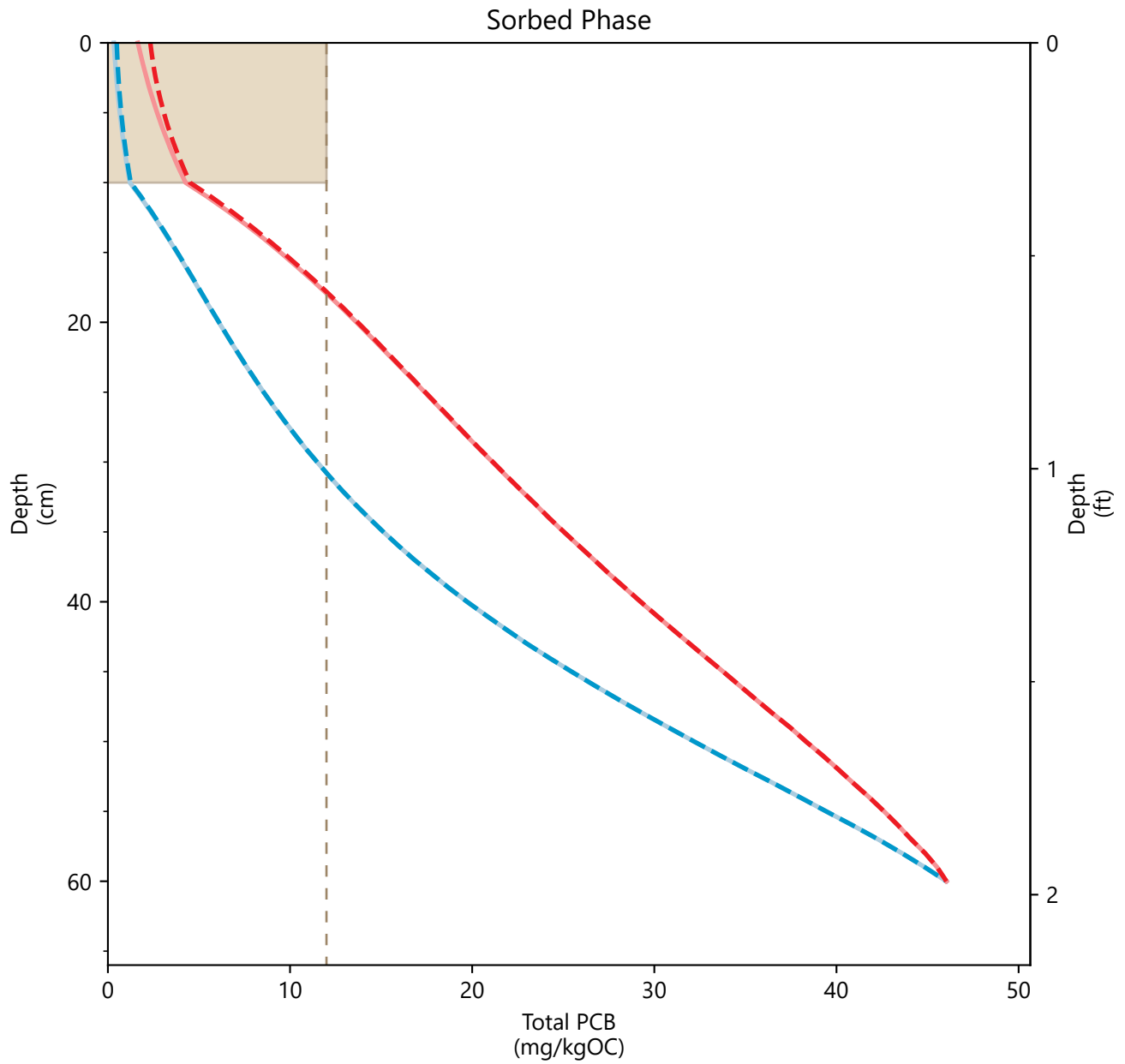
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.2b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 9J Standard Cap



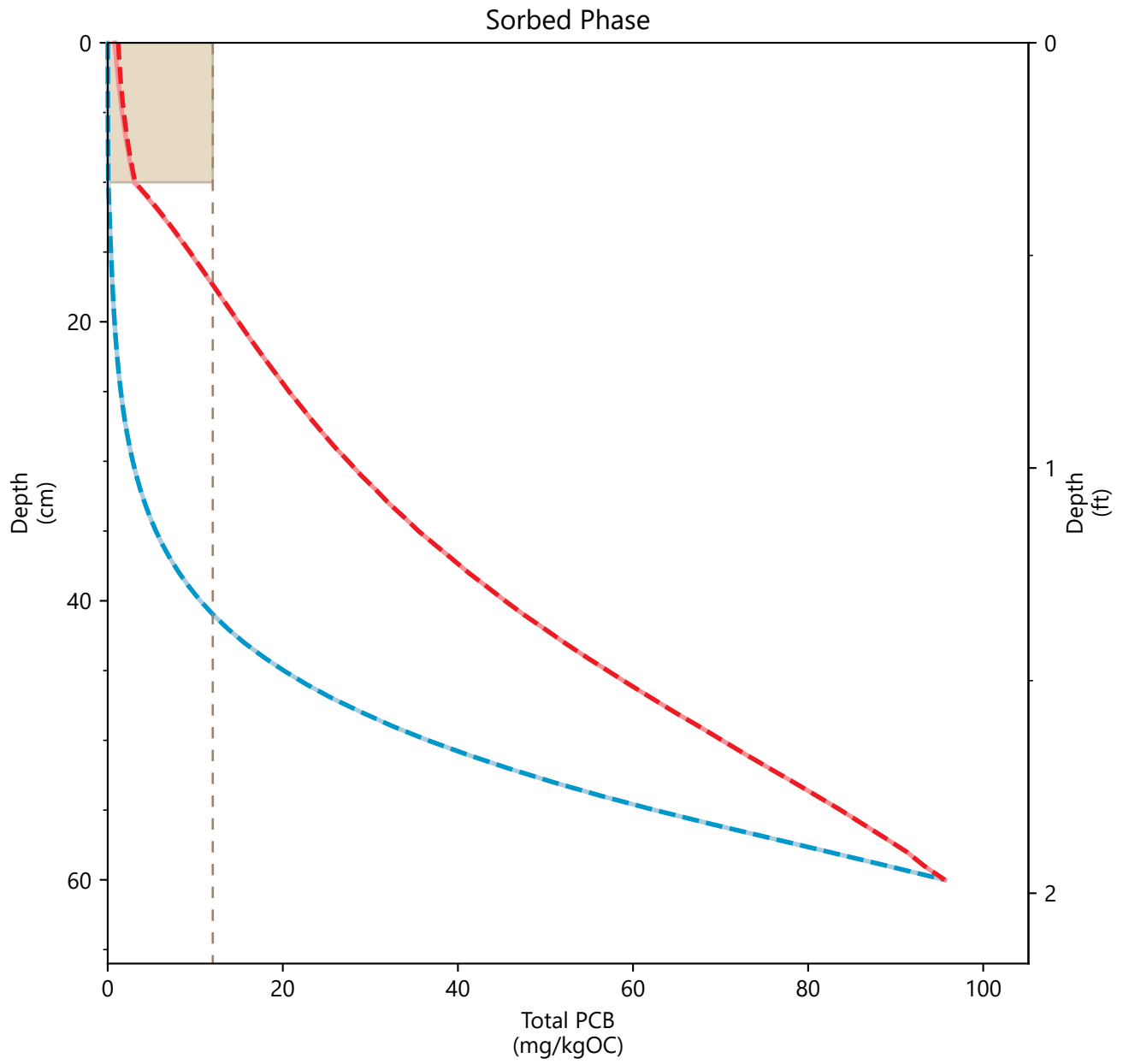
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.3a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 15B Standard Cap



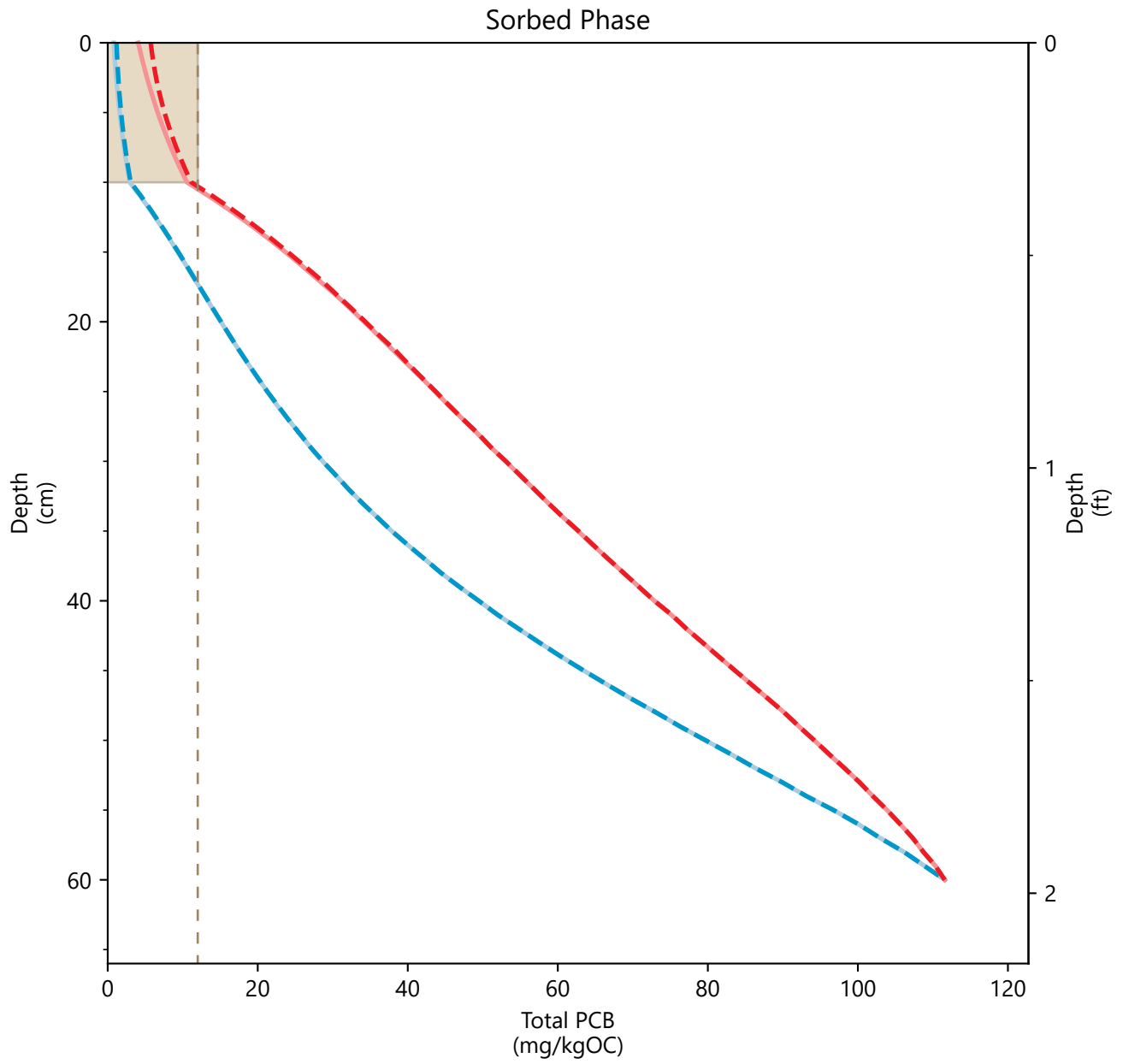
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.4a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 22 Standard Cap



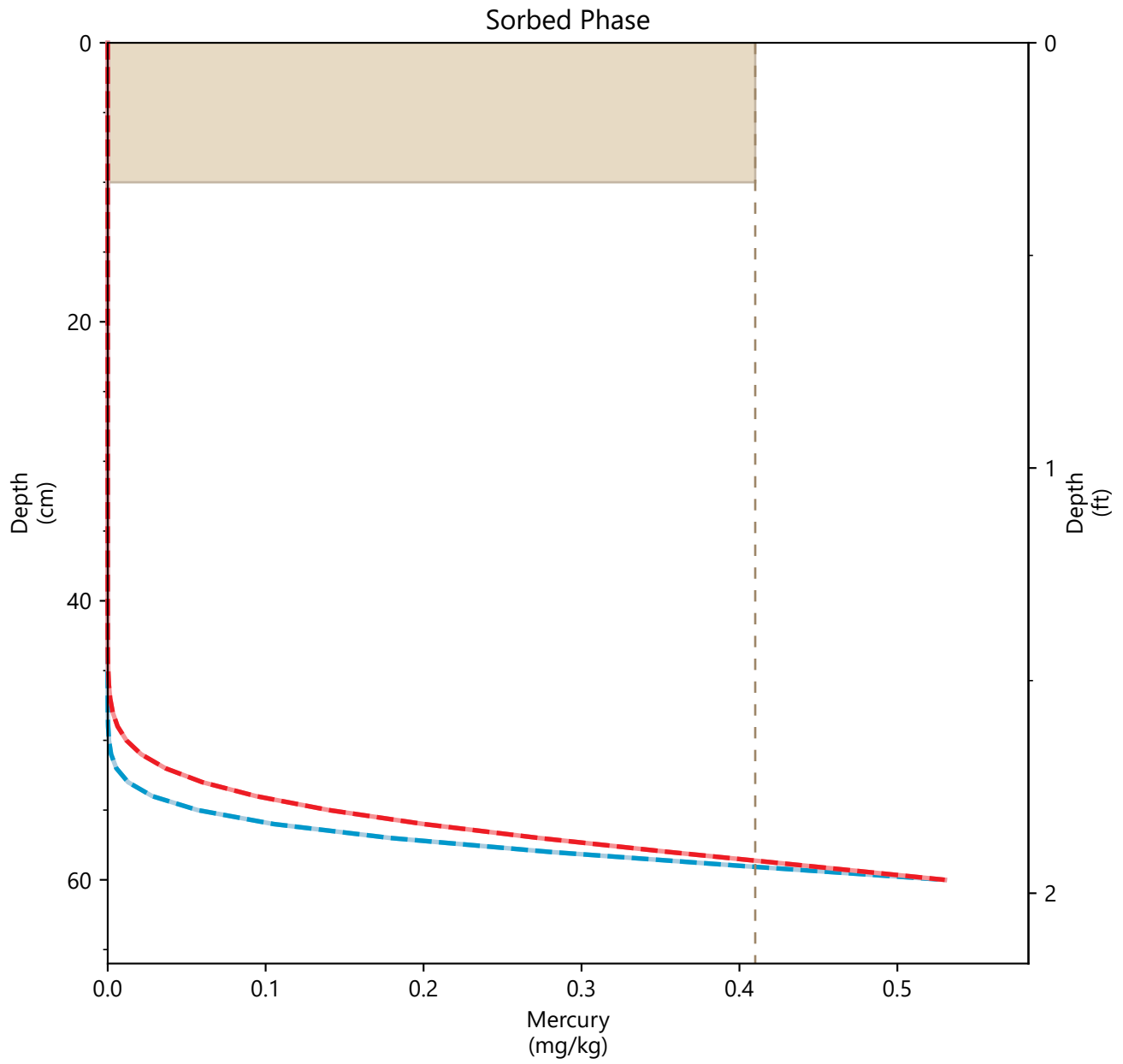
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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\\wcl-fs1\Syracuse\Projects\Lower Duwamish Waterway\MODEL\BODR\MiddleReach\CapSim4-23\Python\pythonProject\CapSim_Plots_Batch_version4pt2pt3_multi_run.py

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Figure H.6.2.5a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 23 Standard Cap



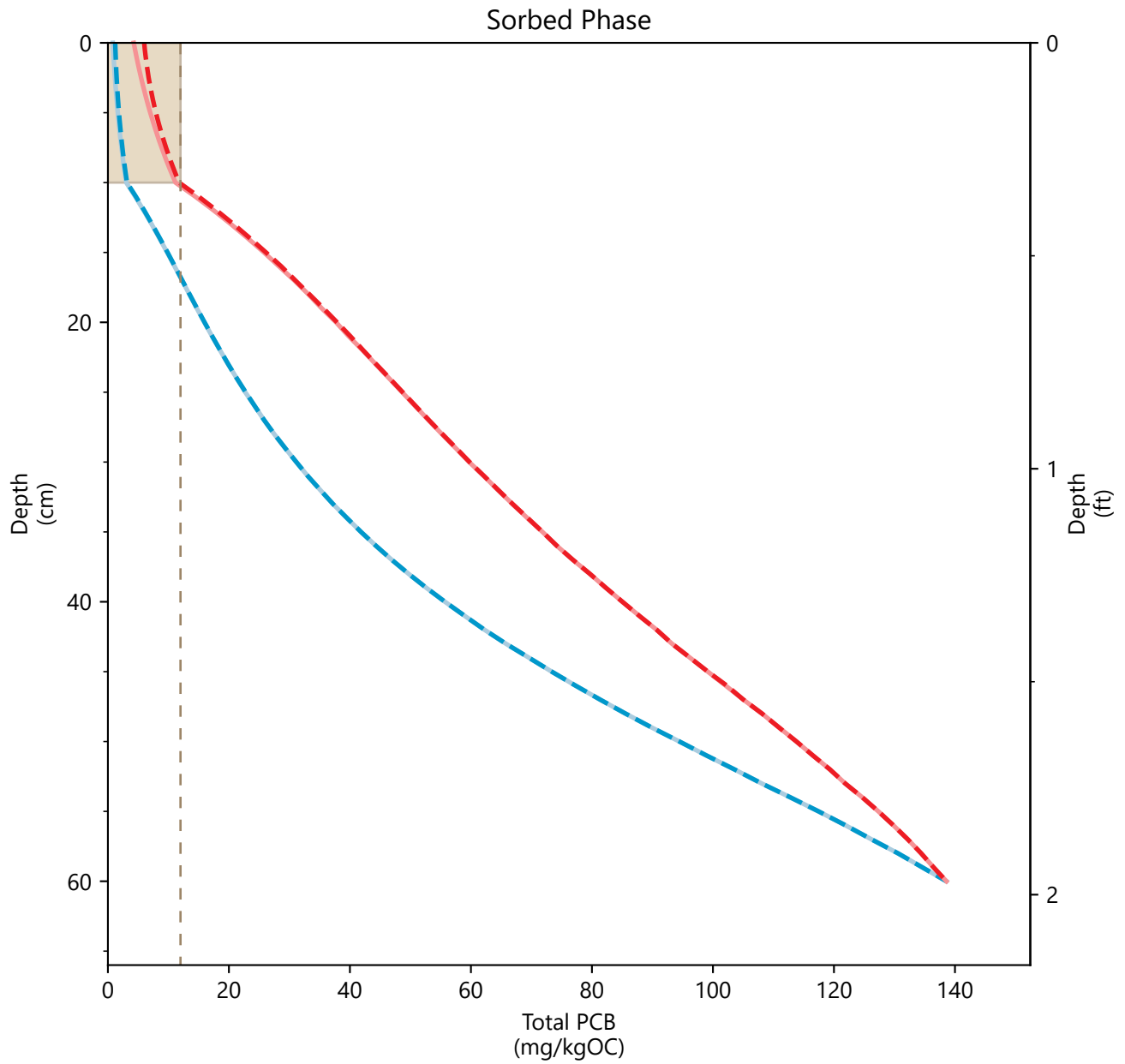
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.6b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Mercury Concentrations in RAA 30A Standard Cap



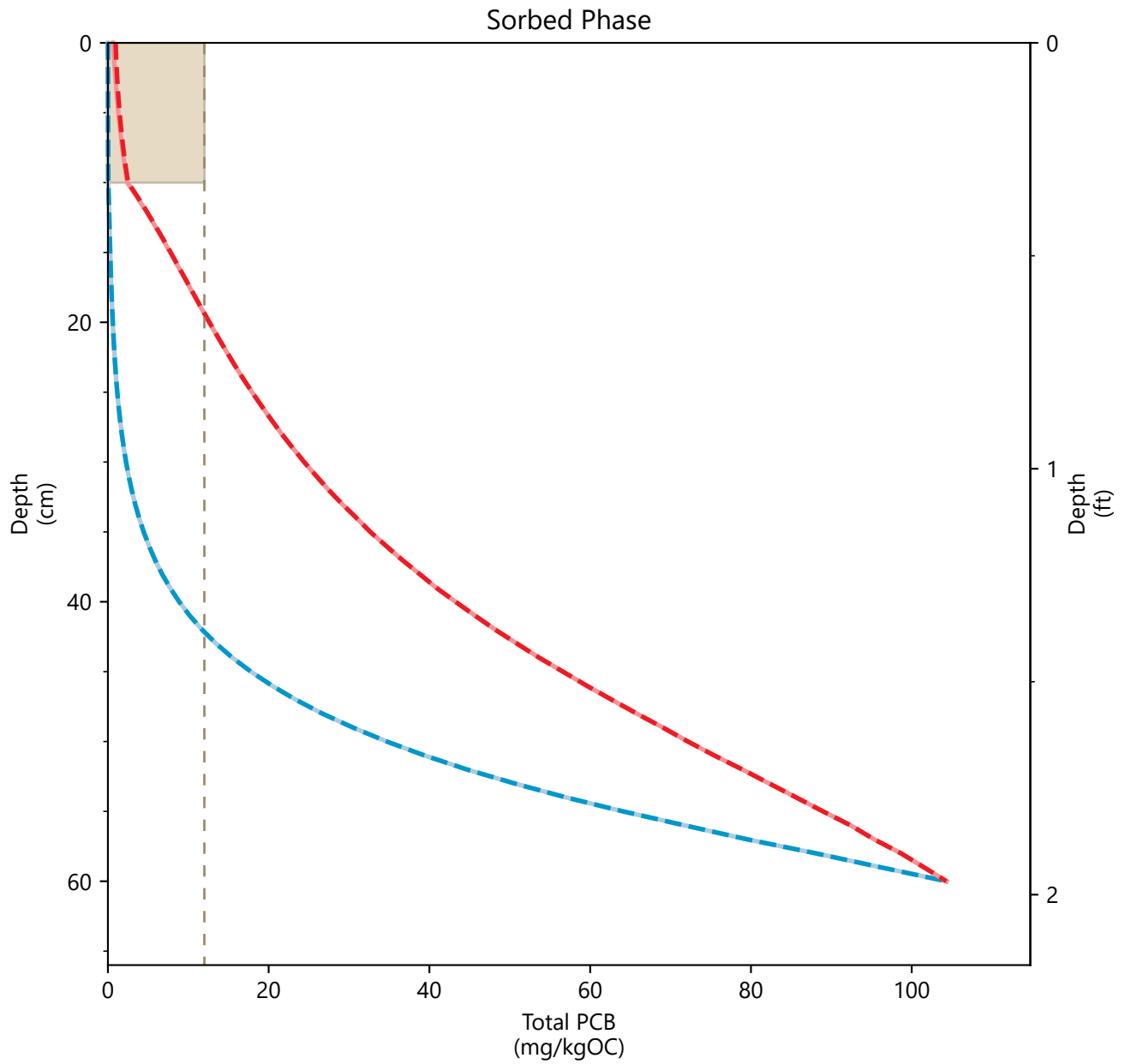
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.6a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30A Standard Cap



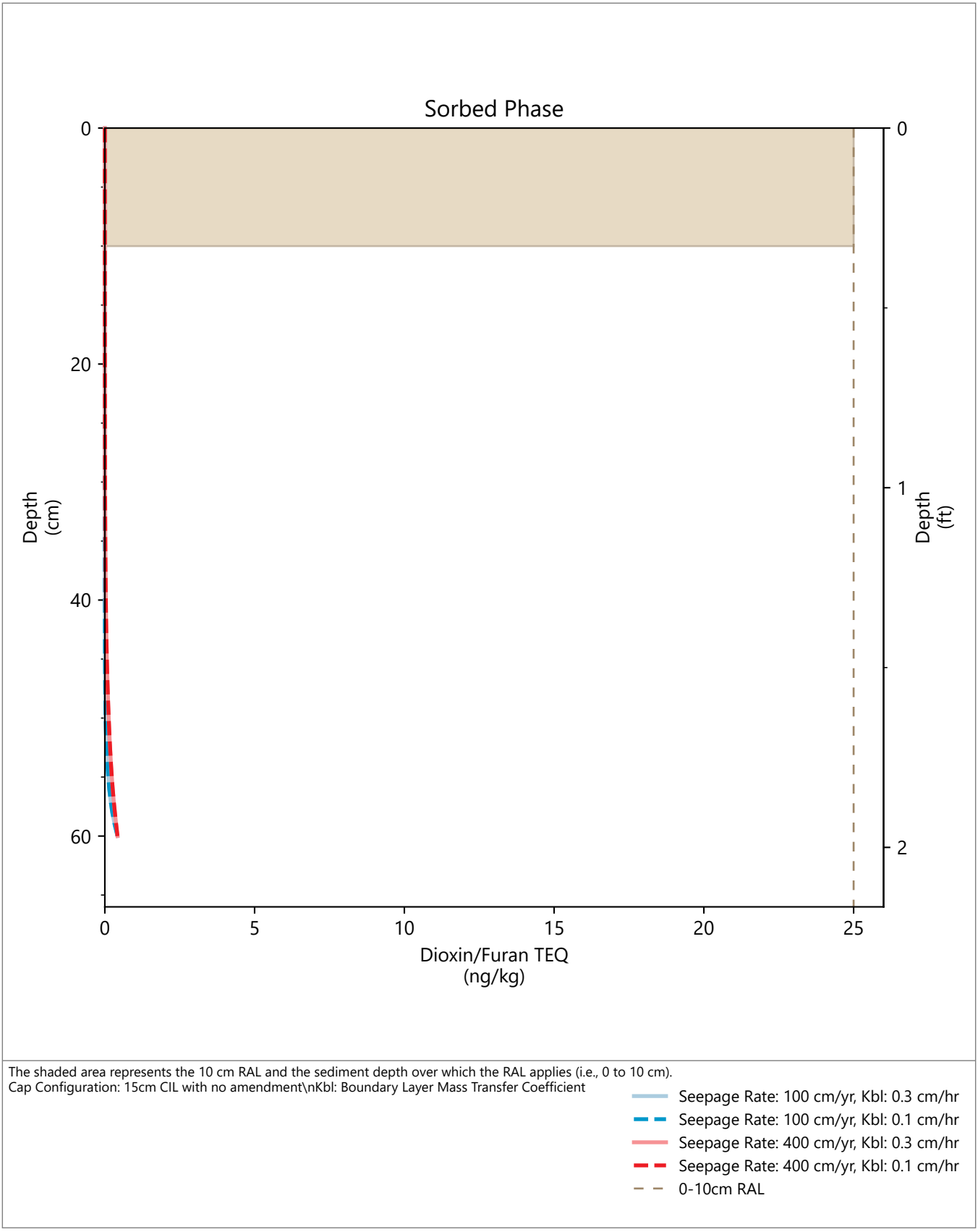
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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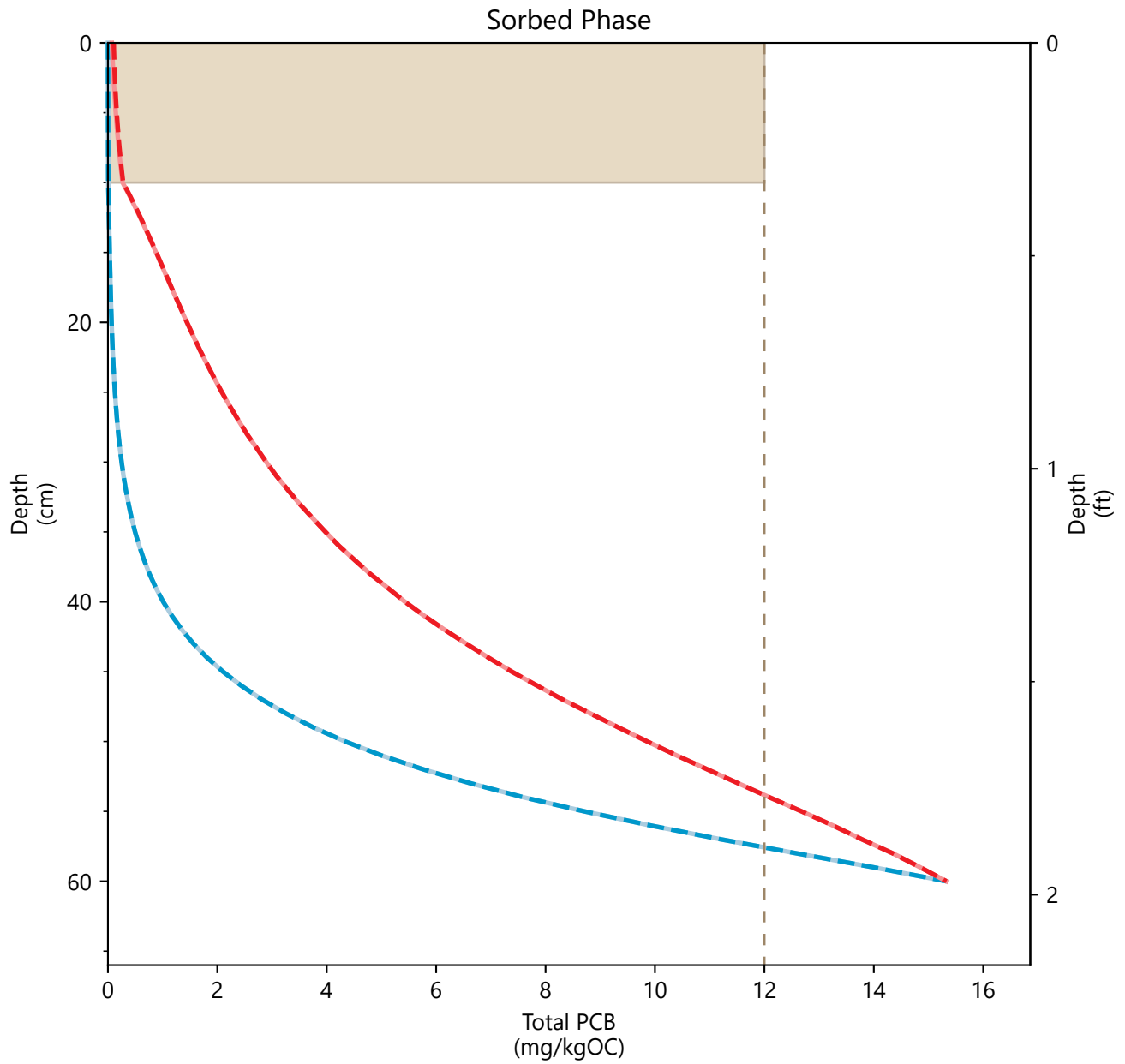
Figure H.6.2.7a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30B Standard Cap



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Figure H.6.2.7b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30B Standard Cap



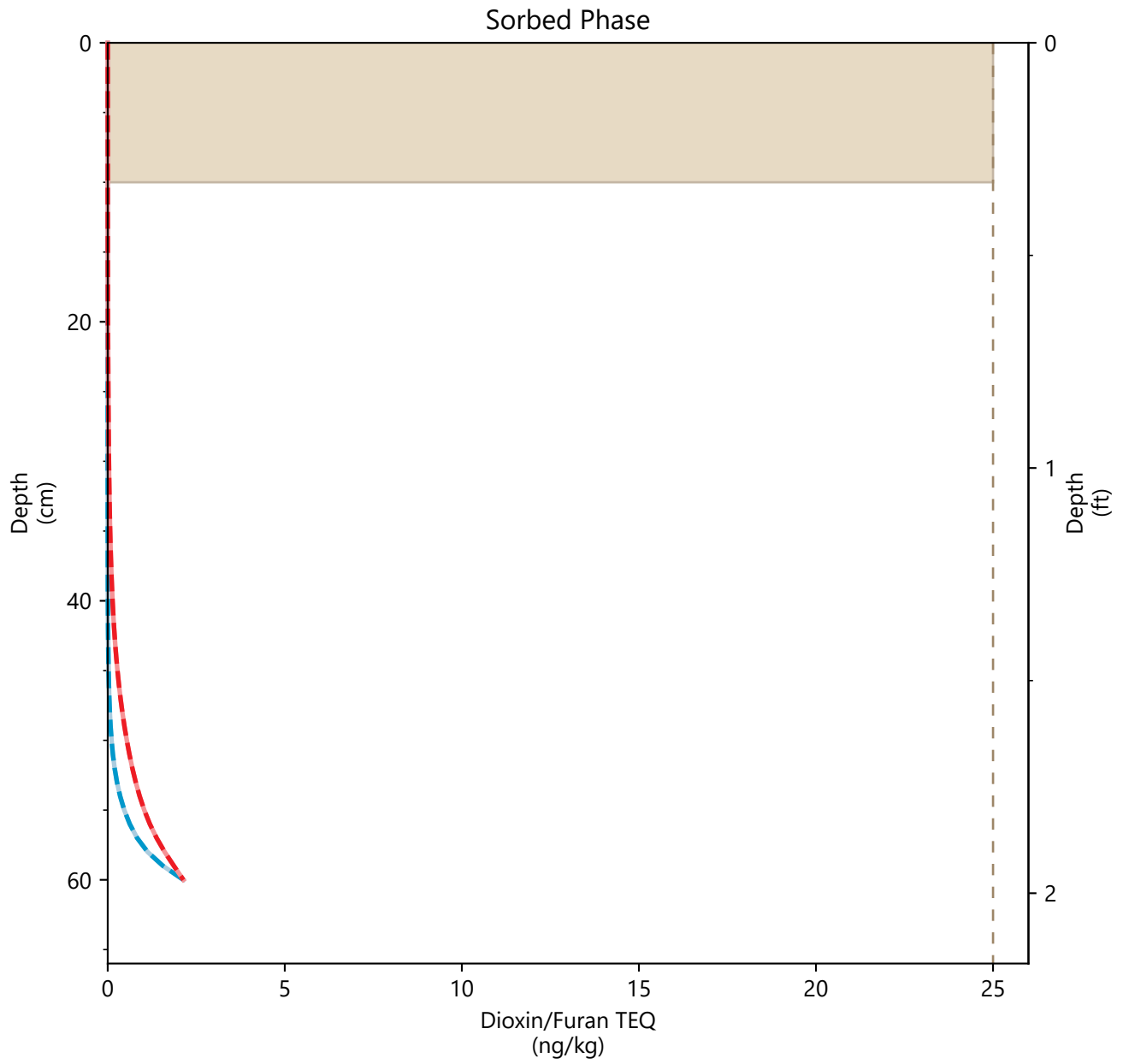
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.8a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30C Standard Cap



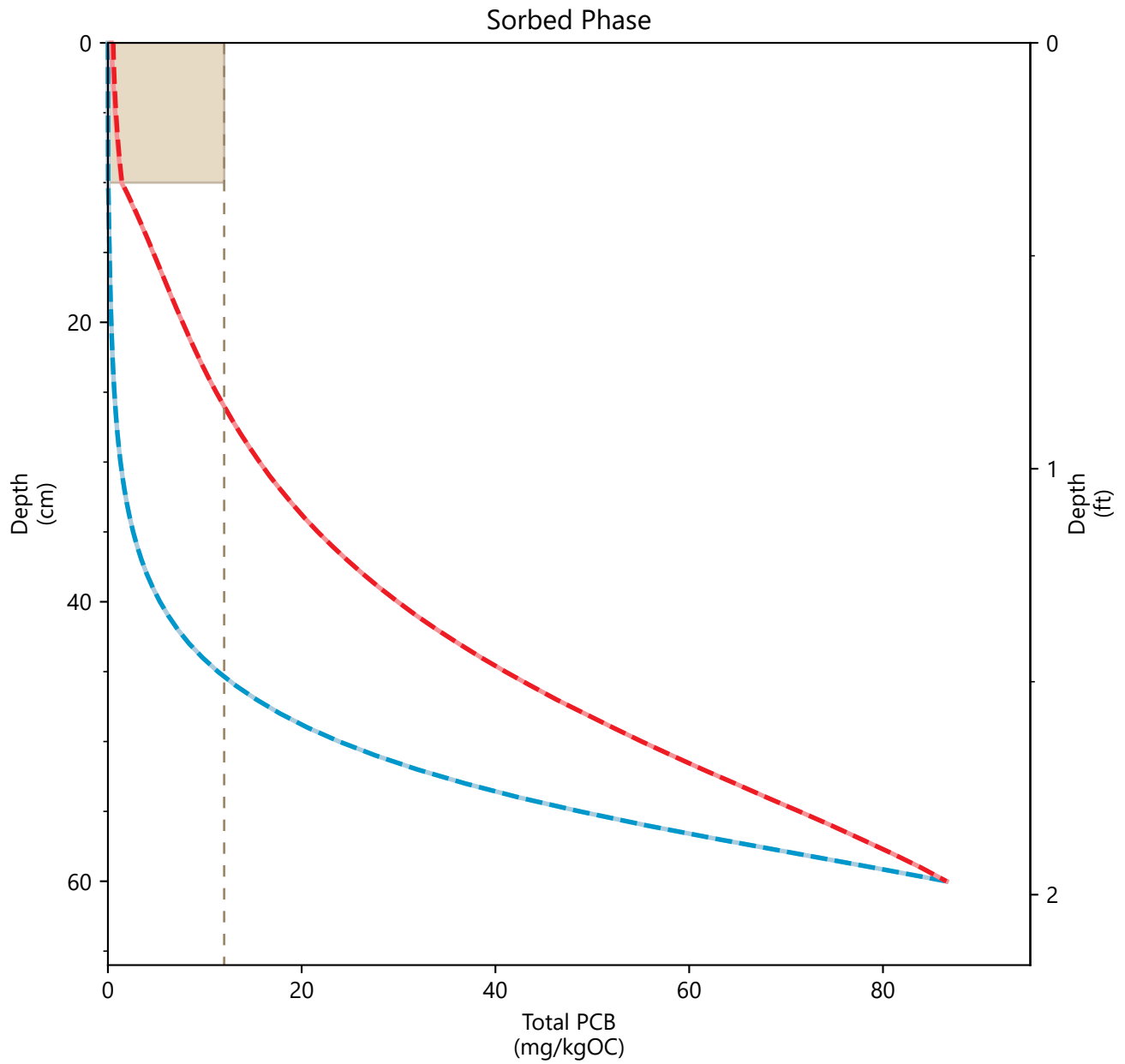
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.8b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30C Standard Cap



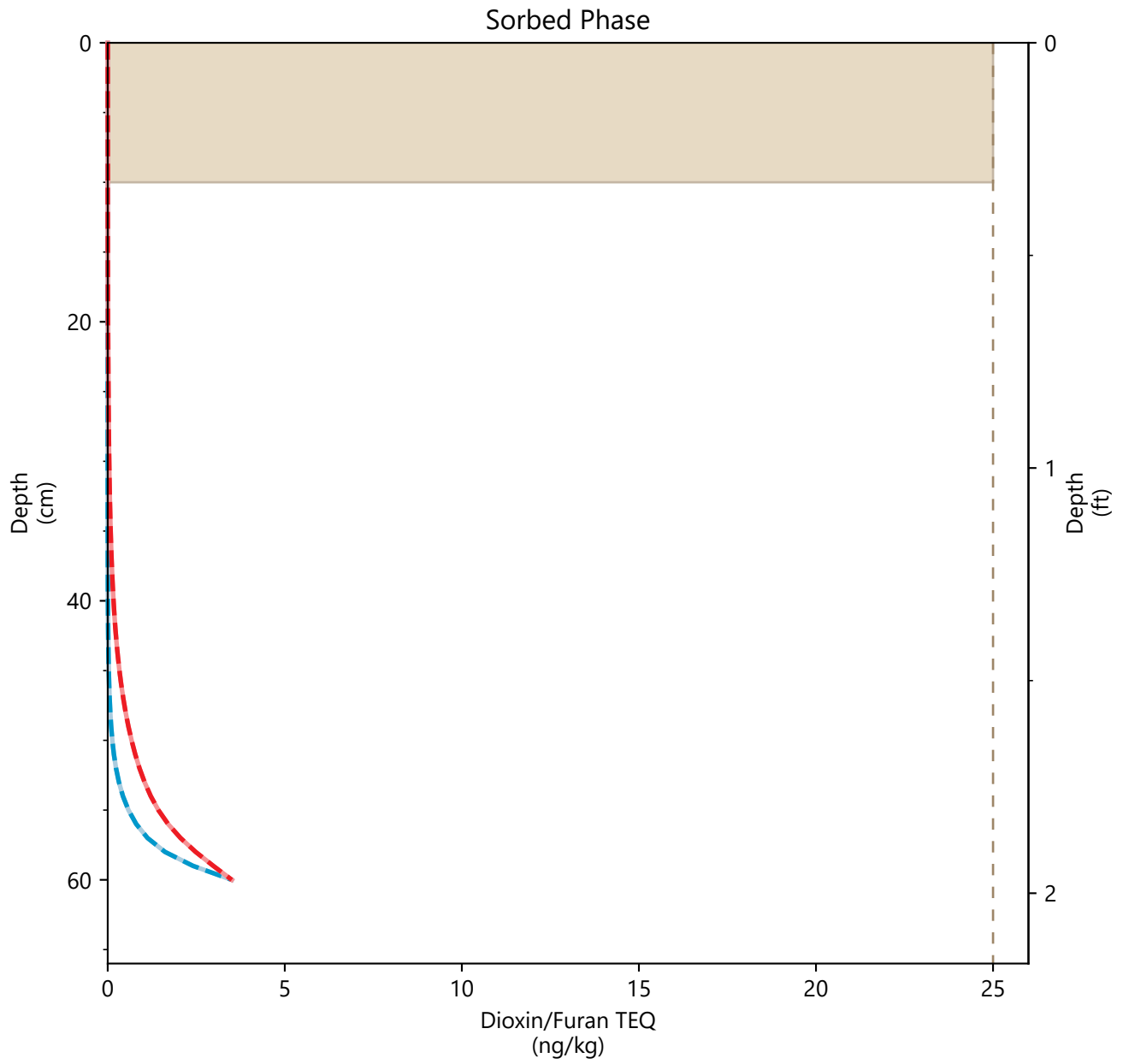
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.9a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30D Standard Cap



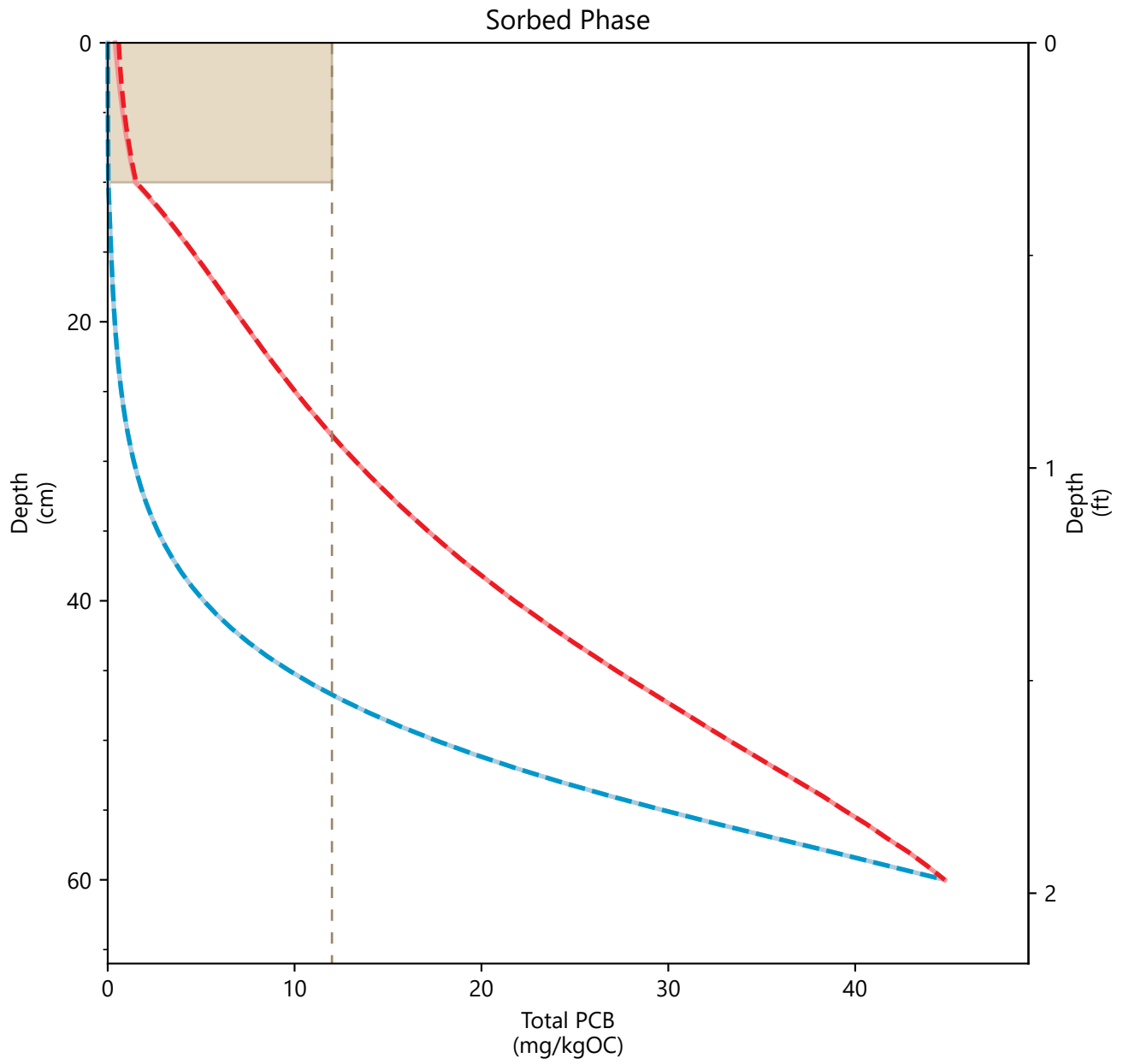
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.9b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30D Standard Cap



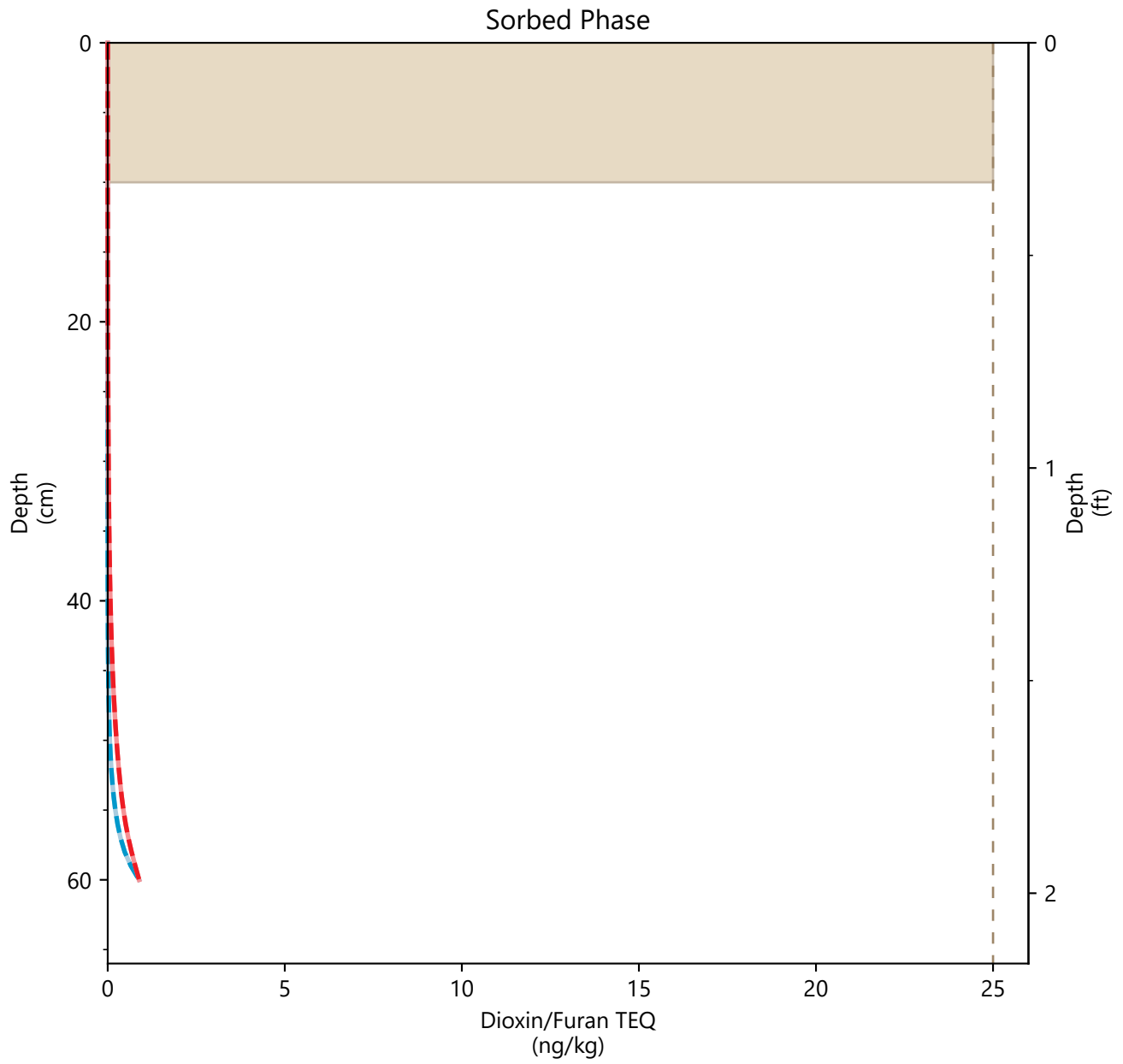
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.10a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30E Standard Cap



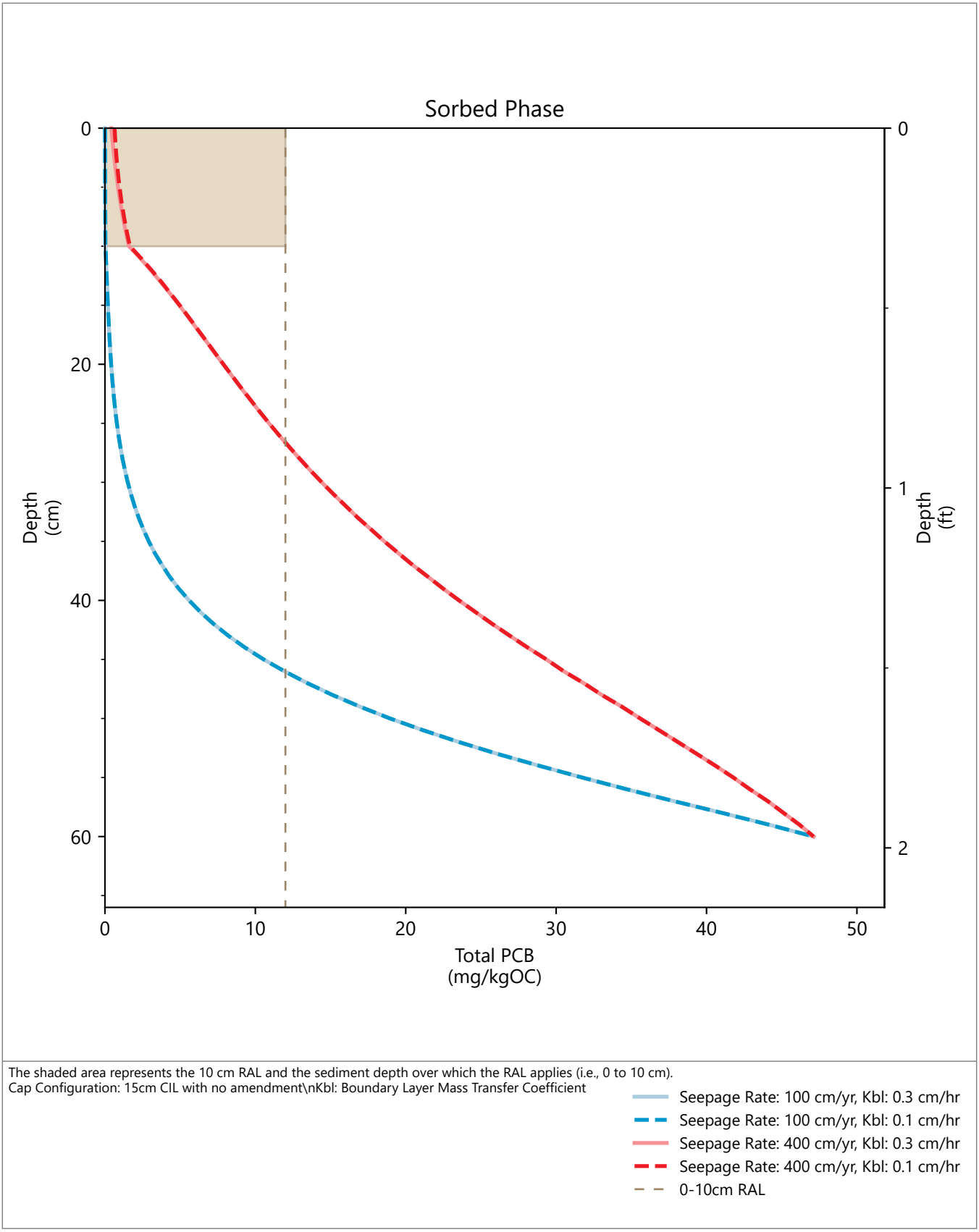
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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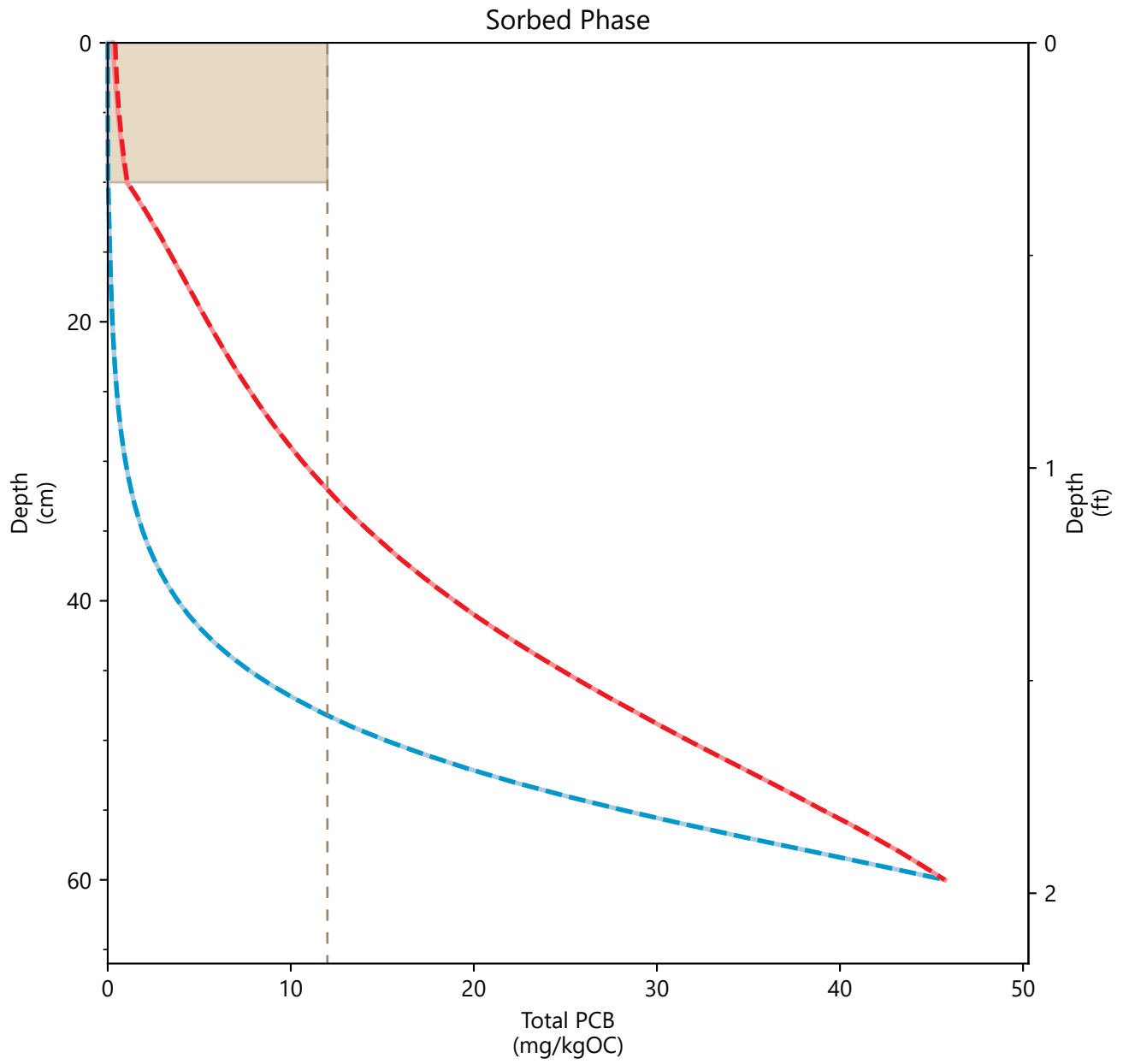
Figure H.6.2.10b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 30E Standard Cap



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Figure H.6.2.11a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30F Standard Cap



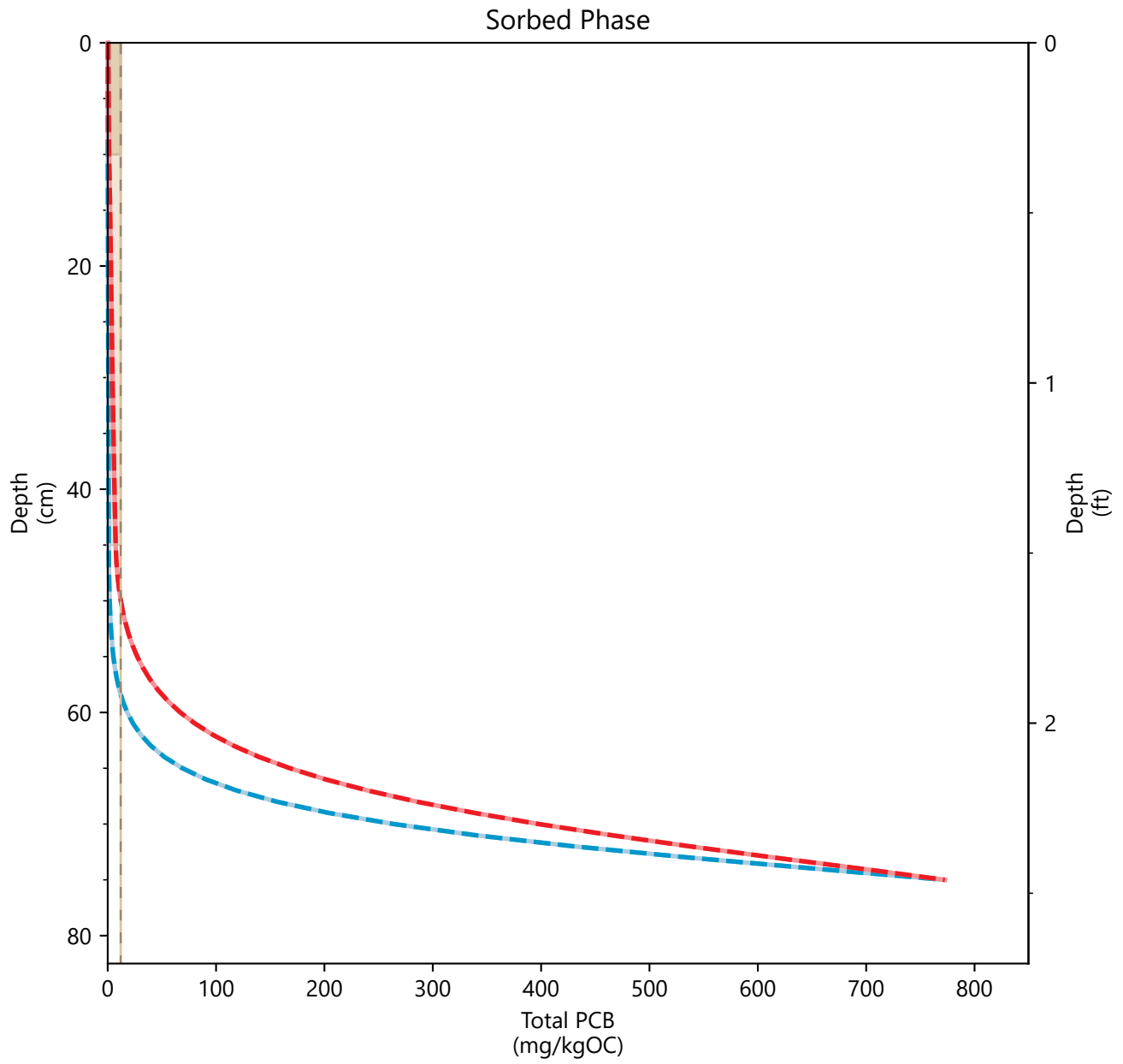
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 15cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 100 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 100 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.12a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 30G Standard Cap



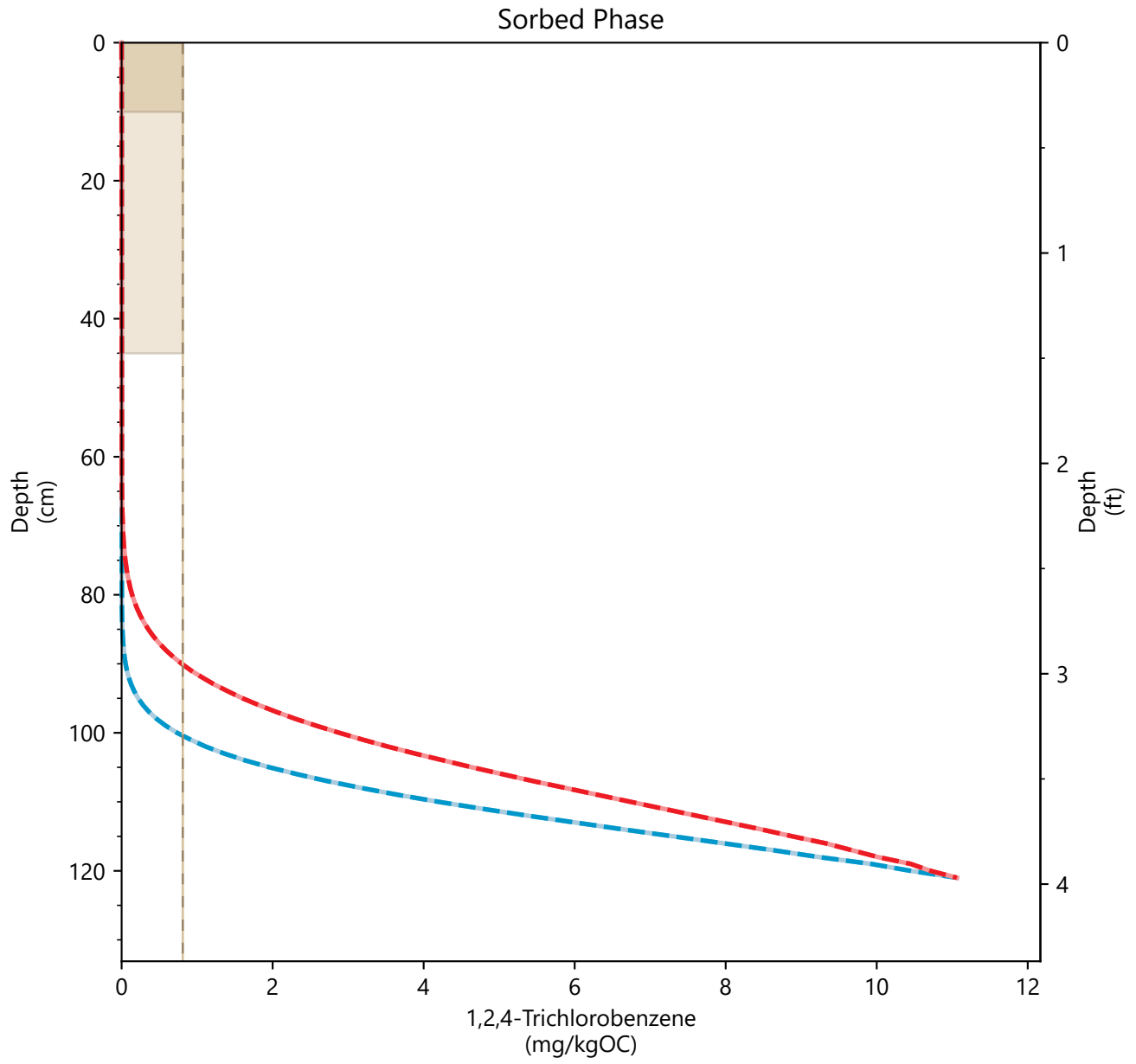
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 1% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.14a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 5B Modified Cap



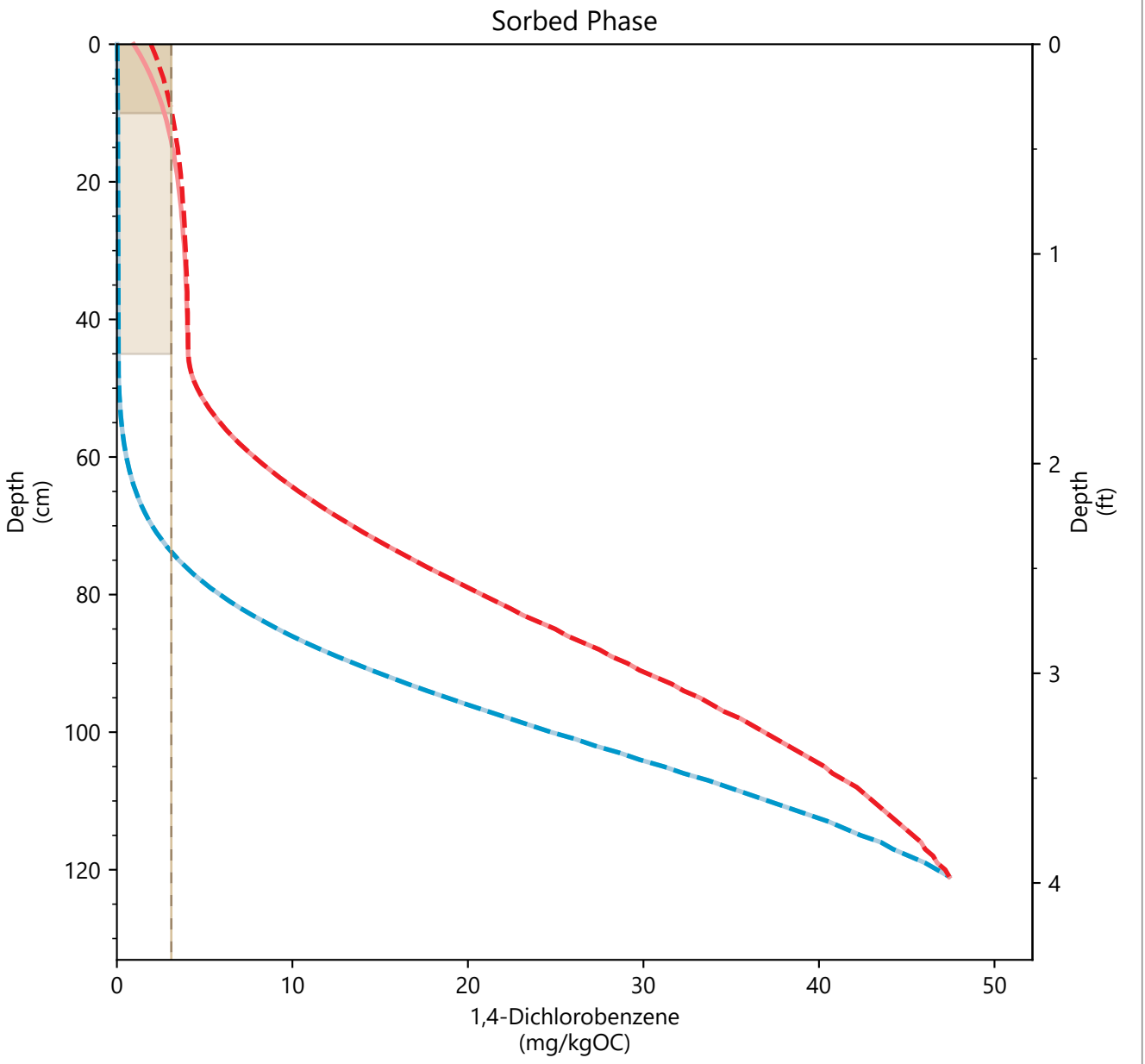
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 76cm CIL with 73% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.15a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted 1,2,4-Trichlorobenzene Concentrations in RAA 8B Modified Cap

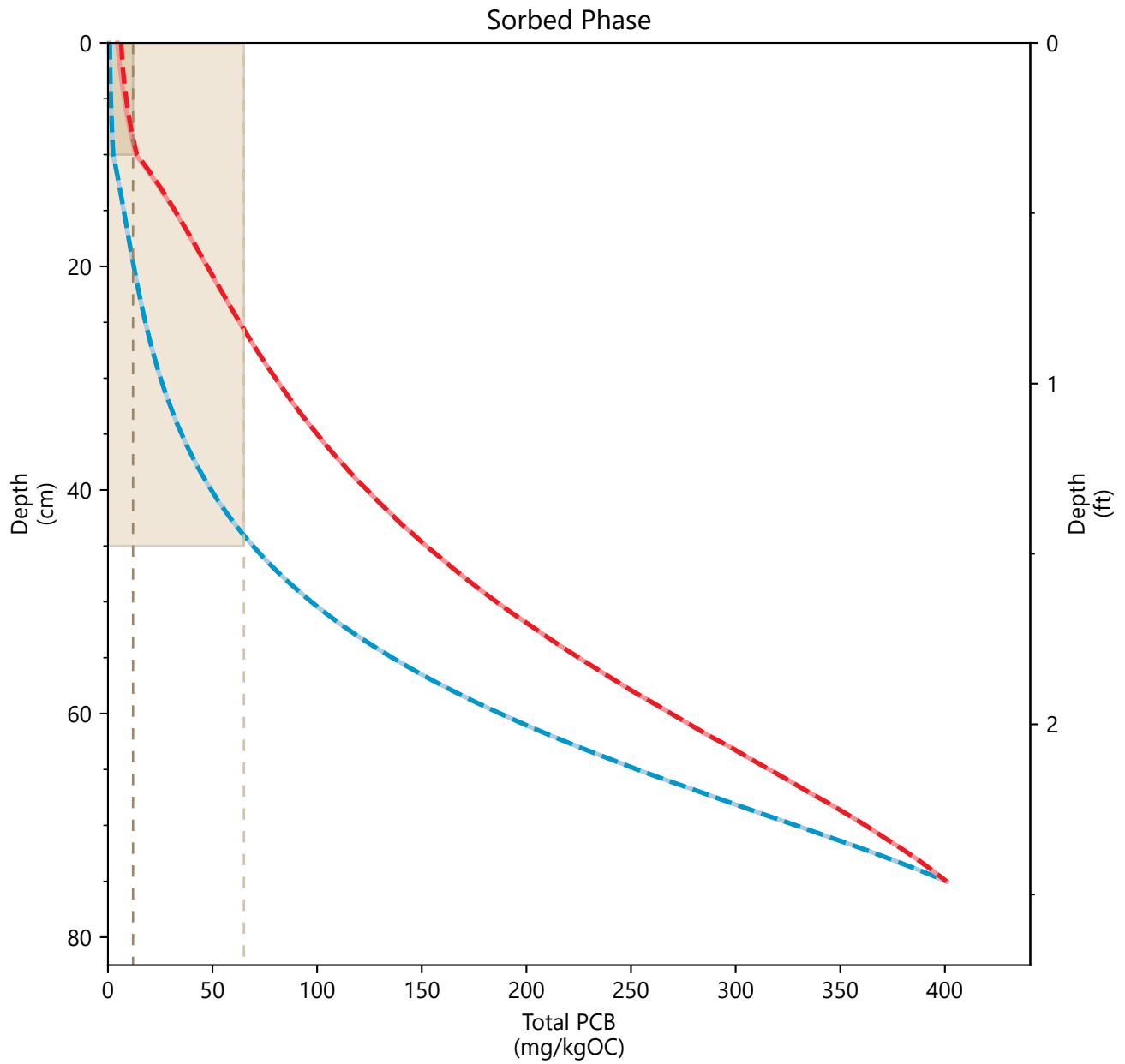


The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 76cm CIL with 73% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.15b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted 1,4-Dichlorobenzene Concentrations in RAA 8B Modified Cap



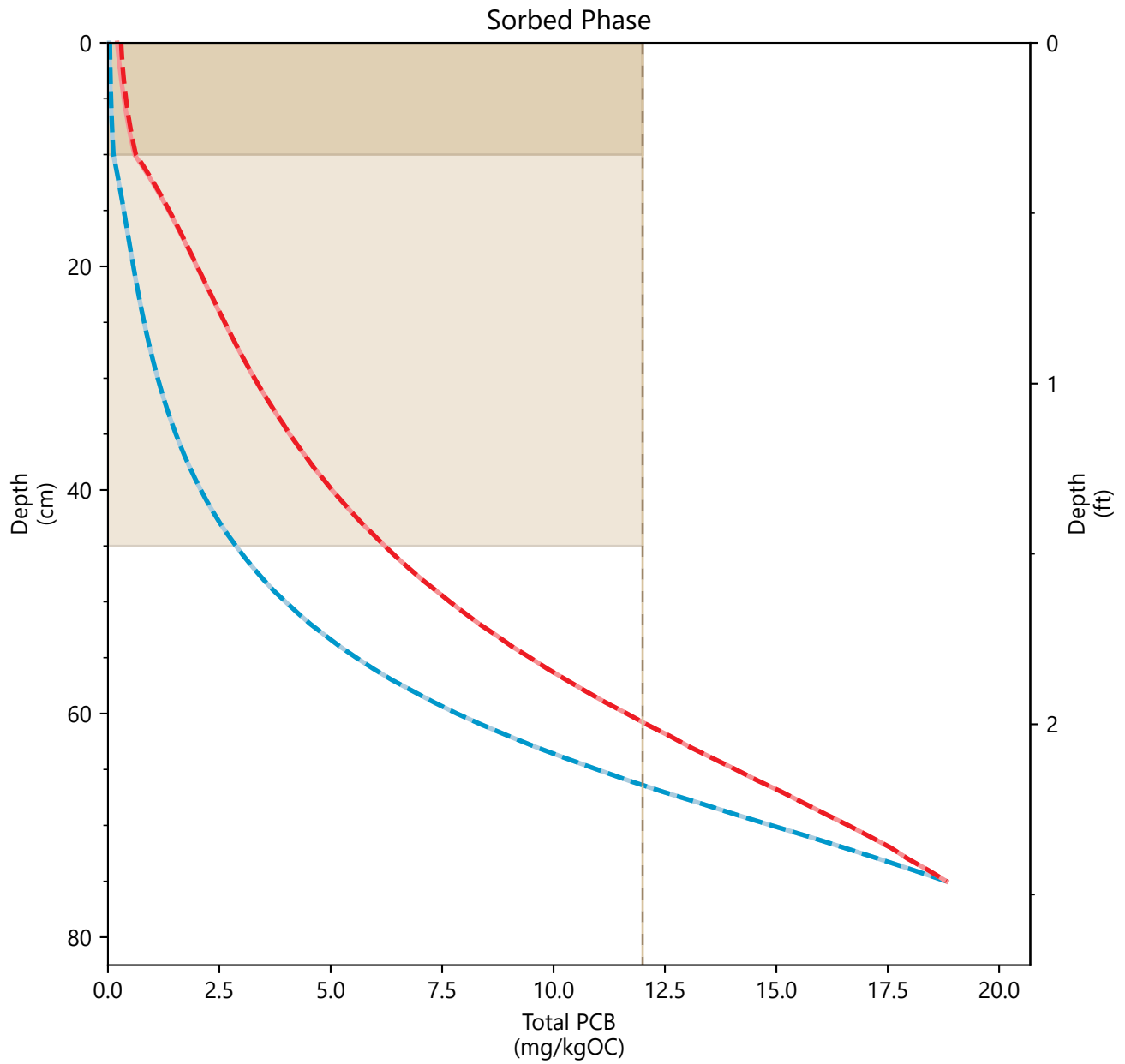
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.16a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 9D Modified Cap



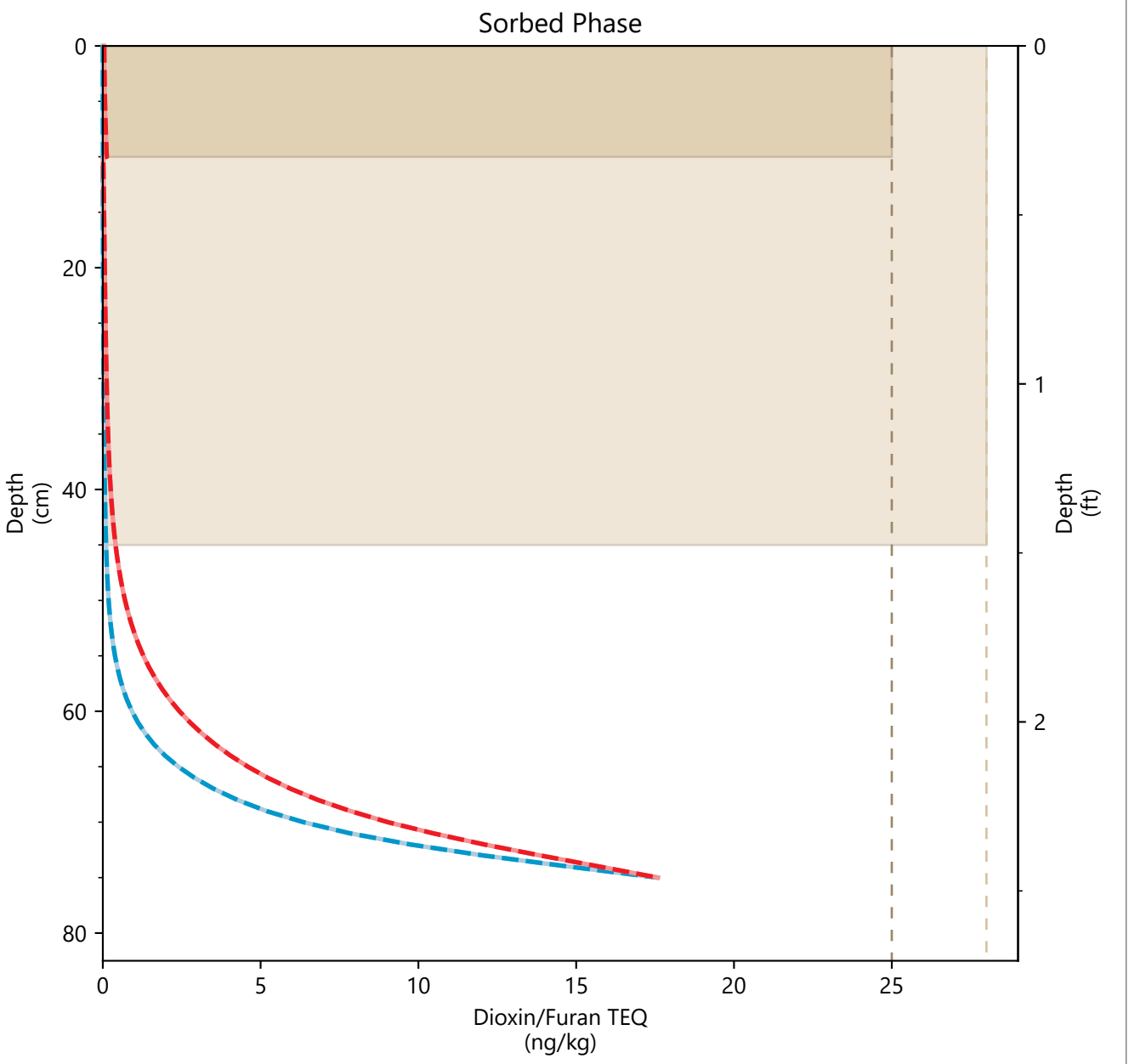
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.17a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 20B Modified Cap



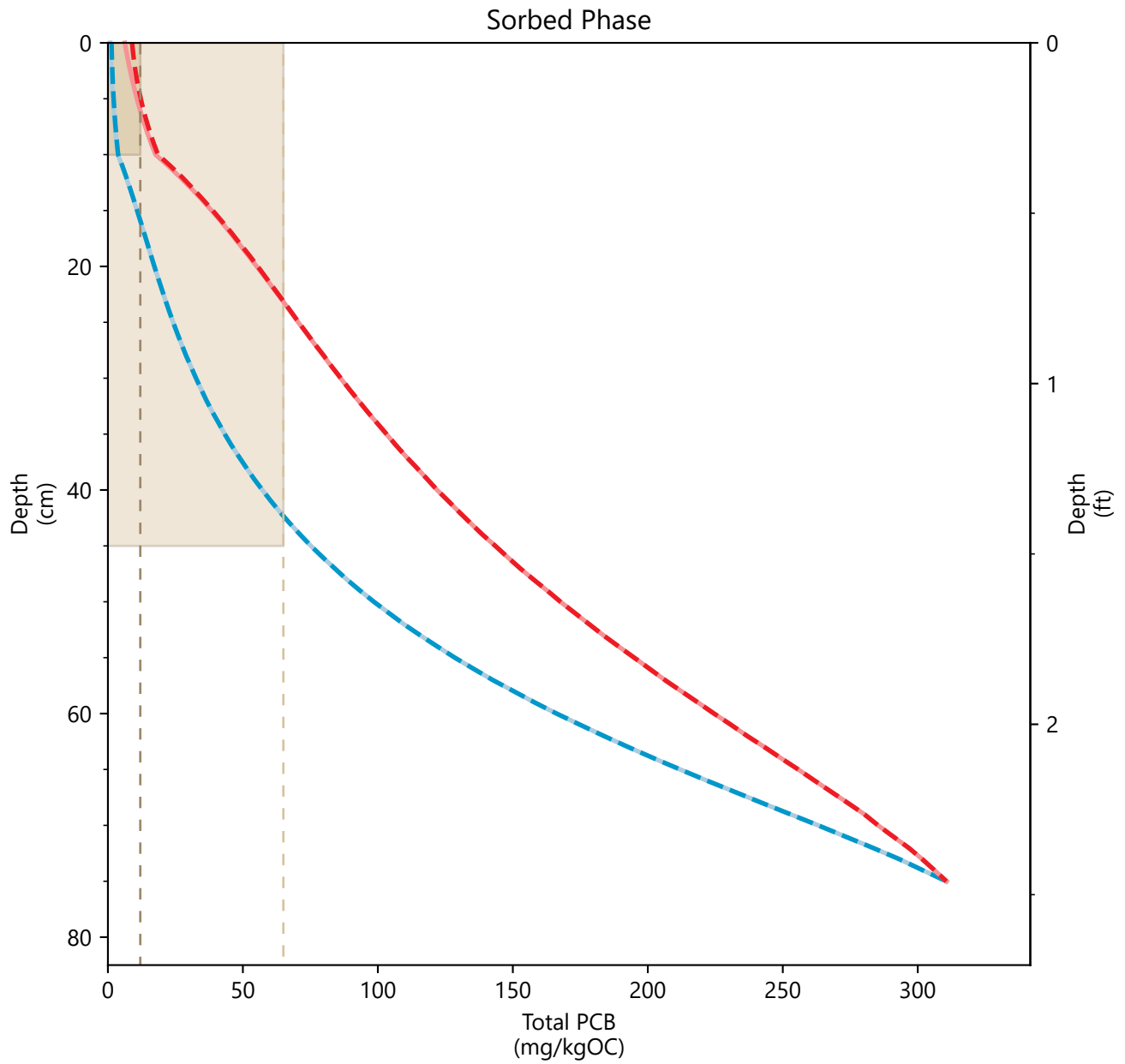
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.17b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 20B Modified Cap



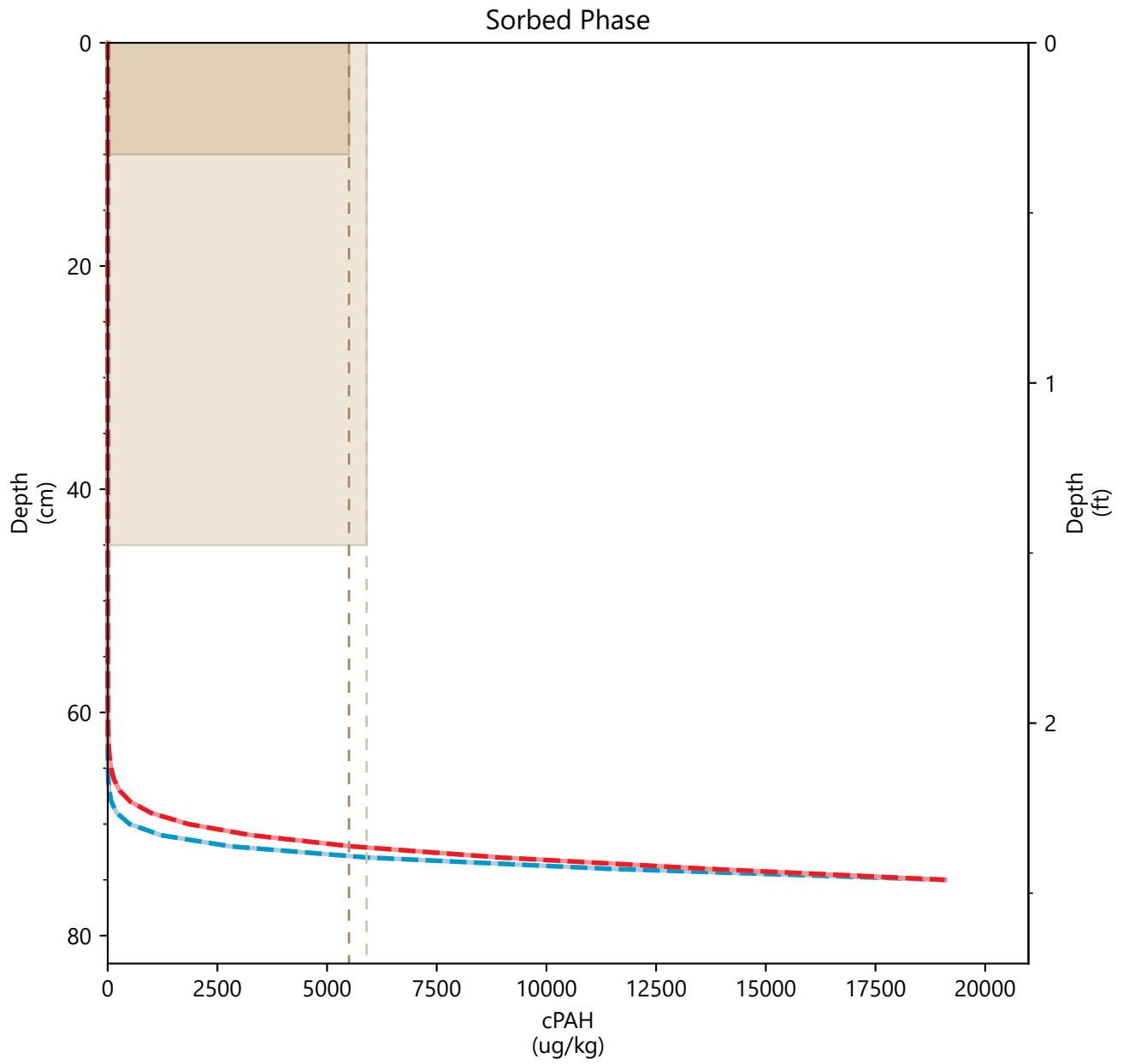
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with no amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.18a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 24I Modified Cap



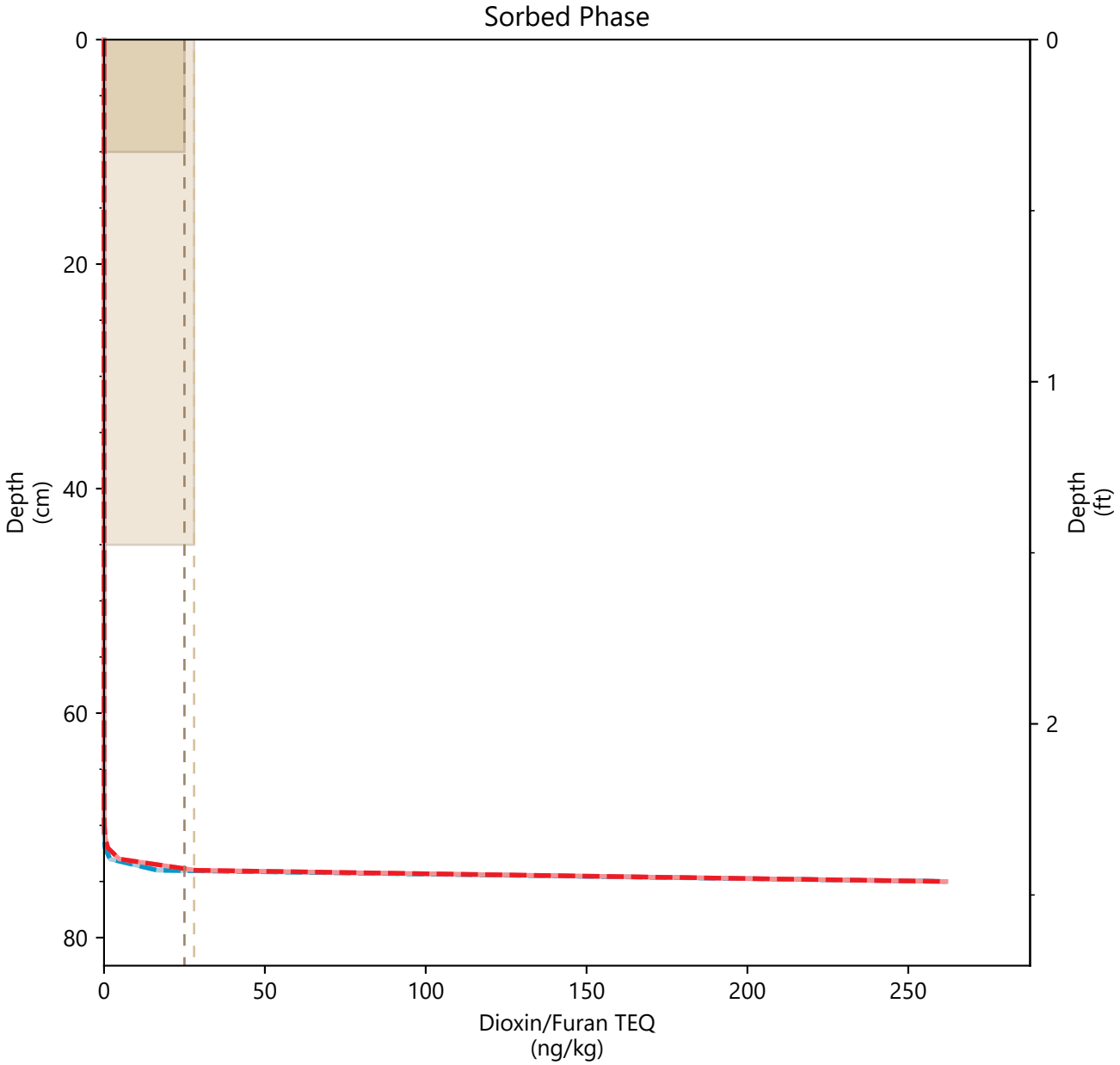
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.19a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted cPAH Concentrations in RAA 26 Modified Cap



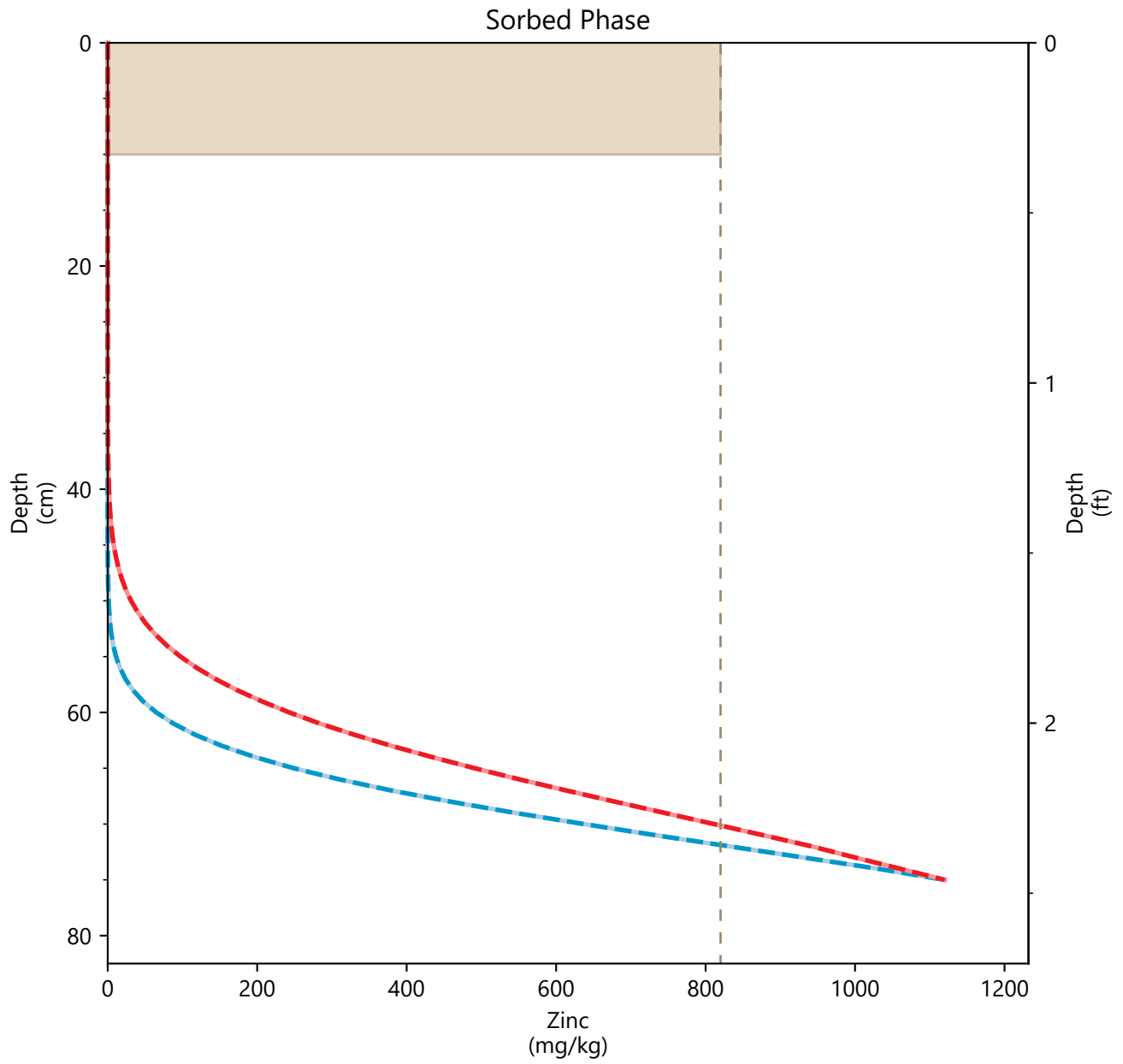
The shaded areas represent the 10 cm and 45 cm RALs and the sediment depths over which each RAL applies (i.e., 0 to 10 cm and 0 to 45 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL
- 0-45cm RAL

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Figure H.6.2.19b
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dioxin/Furan TEQ Concentrations in RAA 26 Modified Cap



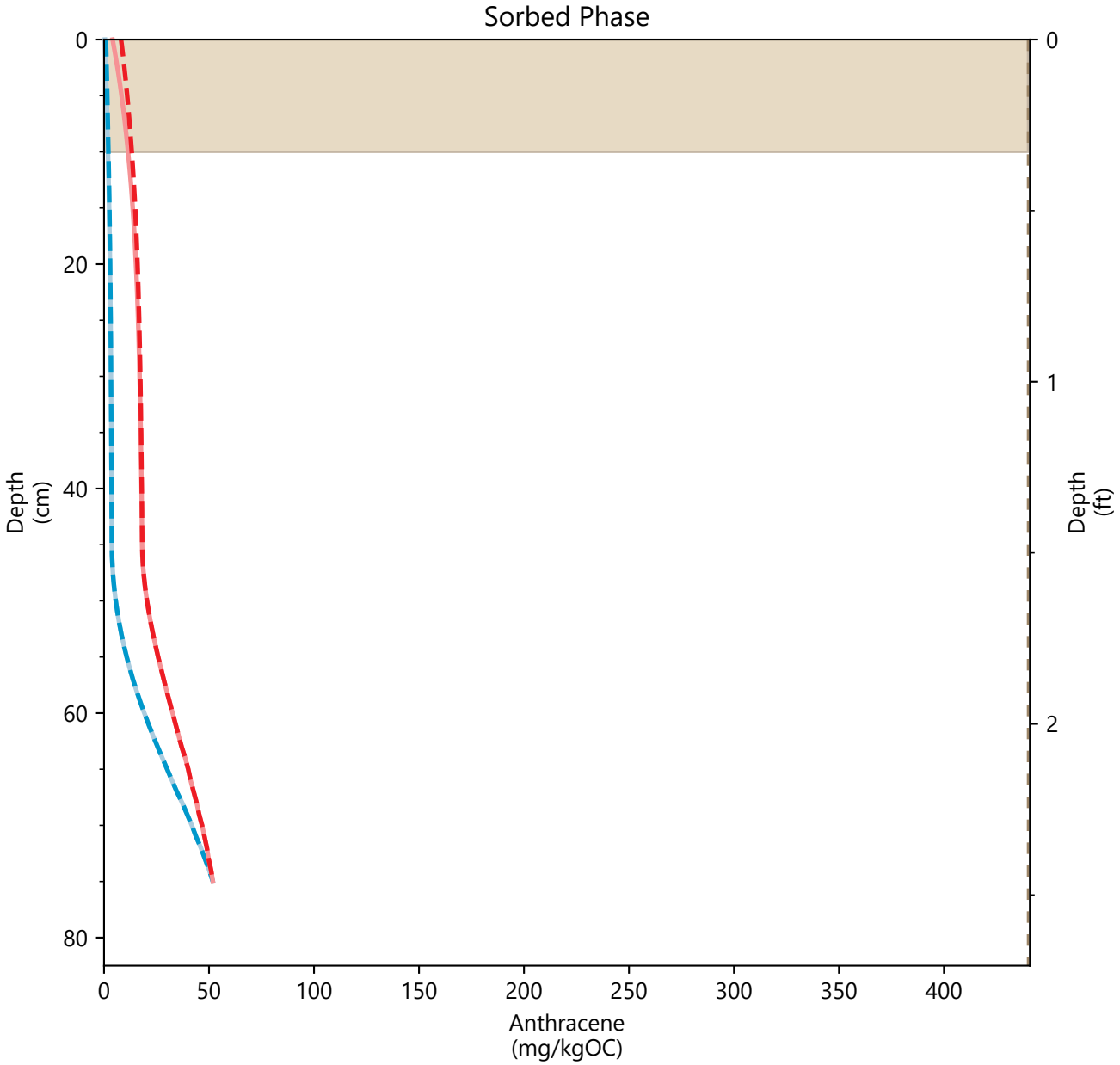
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19c
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Zinc Concentrations in RAA 26 Modified Cap



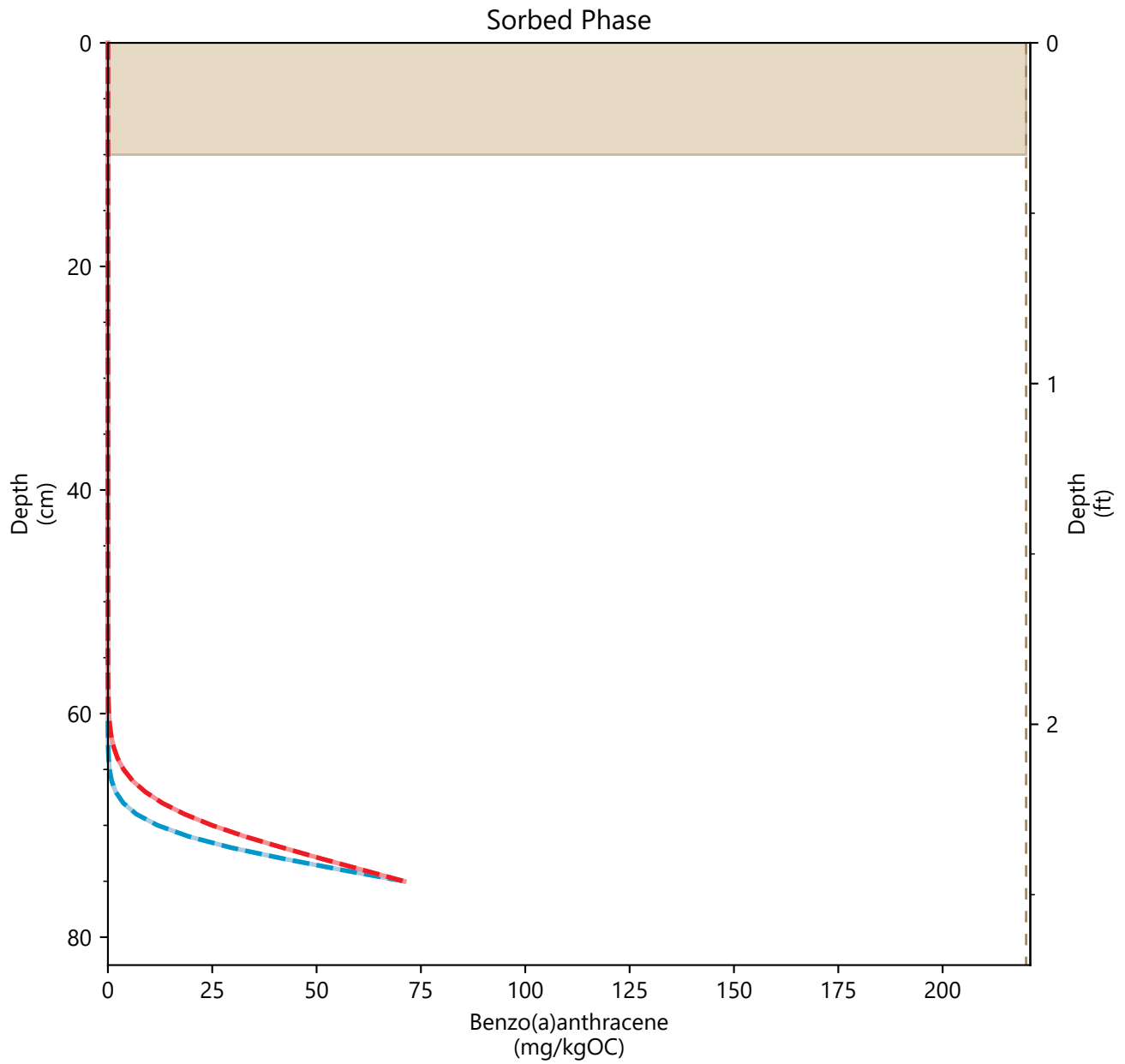
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19d
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Anthracene Concentrations in RAA 26 Modified Cap



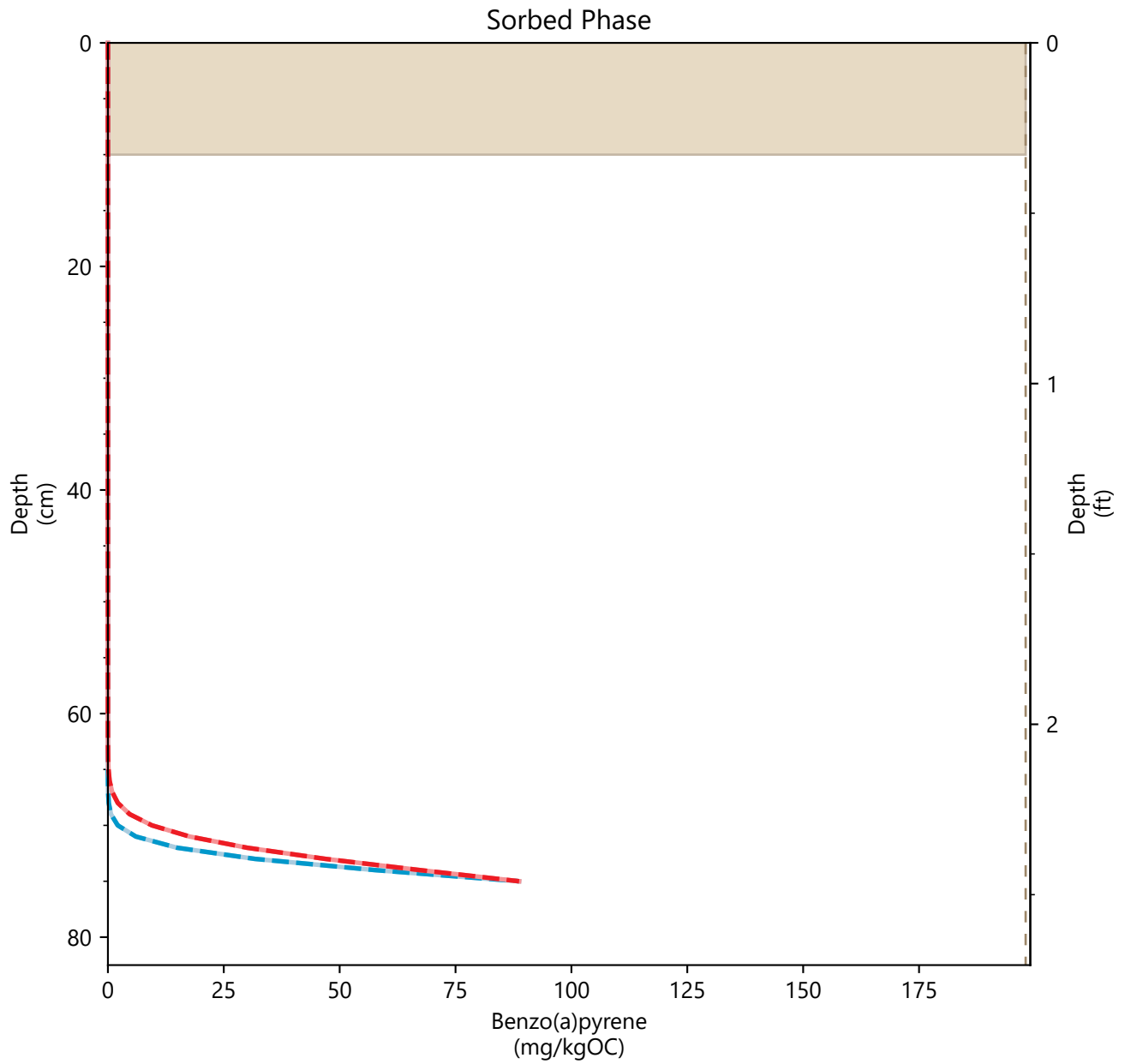
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19e
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Benzo(a)anthracene Concentrations in RAA 26 Modified Cap



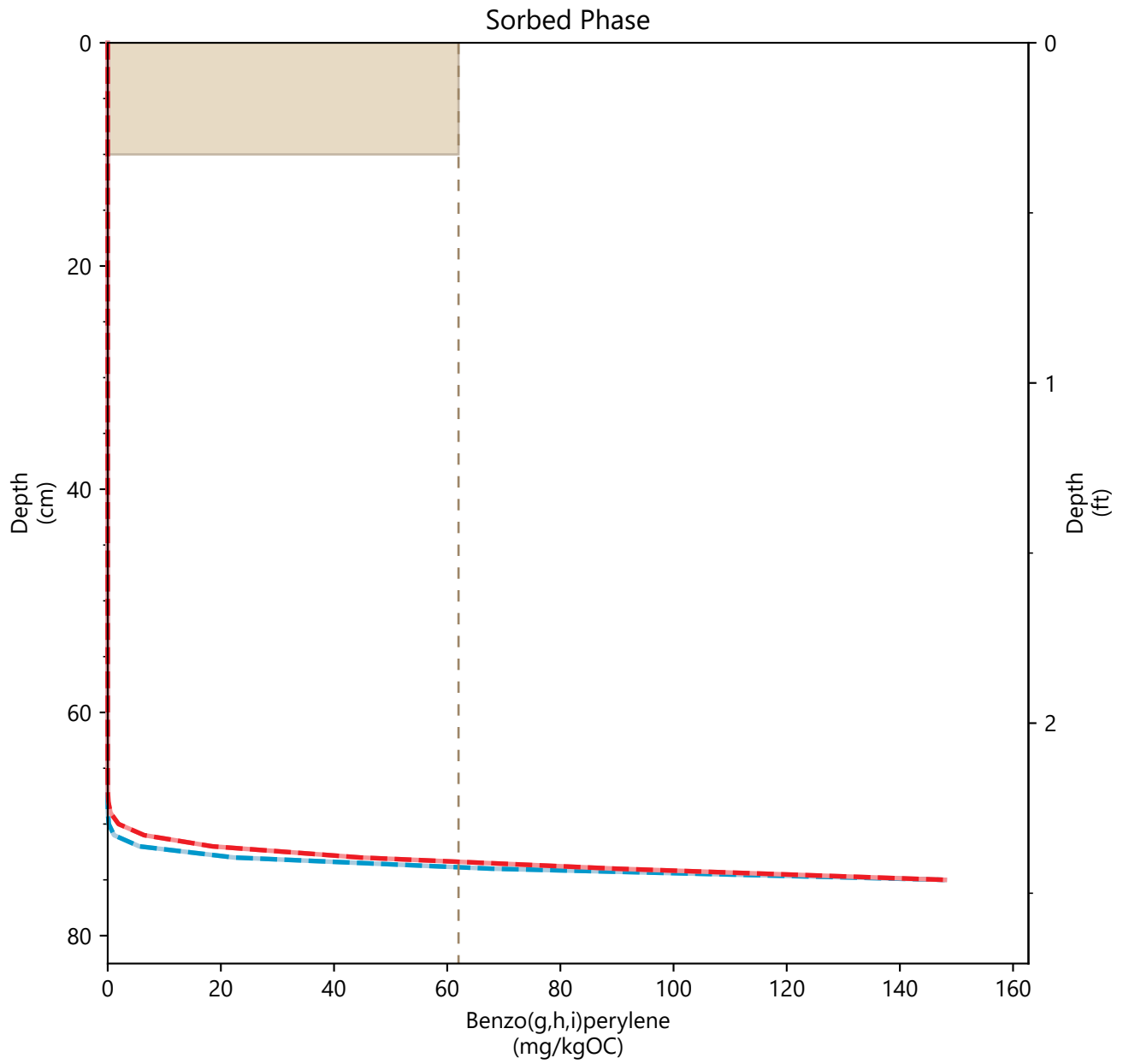
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19f
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Benzo(a)pyrene Concentrations in RAA 26 Modified Cap



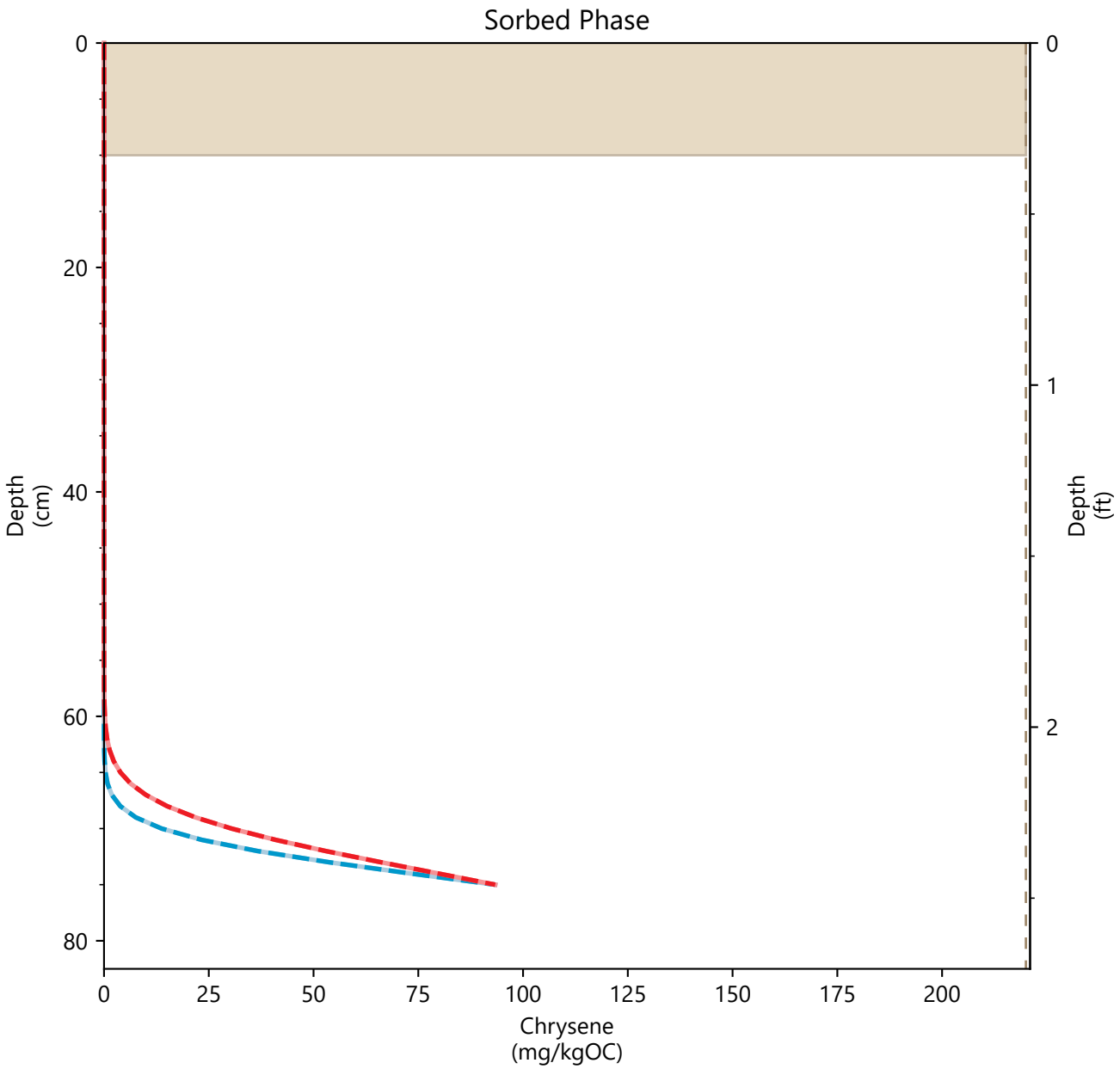
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19g
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Benzo(g,h,i)perylene Concentrations in RAA 26 Modified Cap



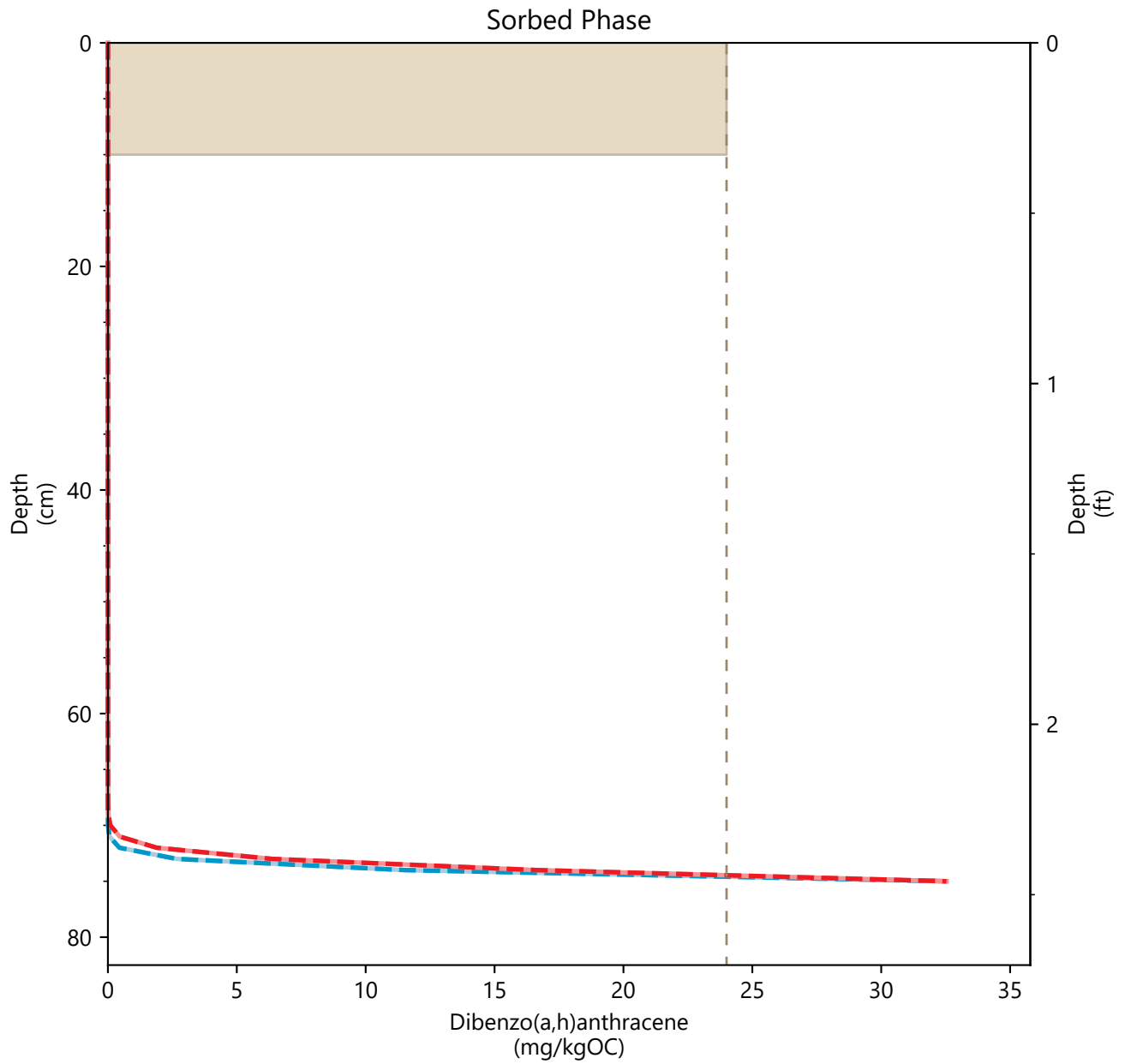
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19h
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Chrysene Concentrations in RAA 26 Modified Cap



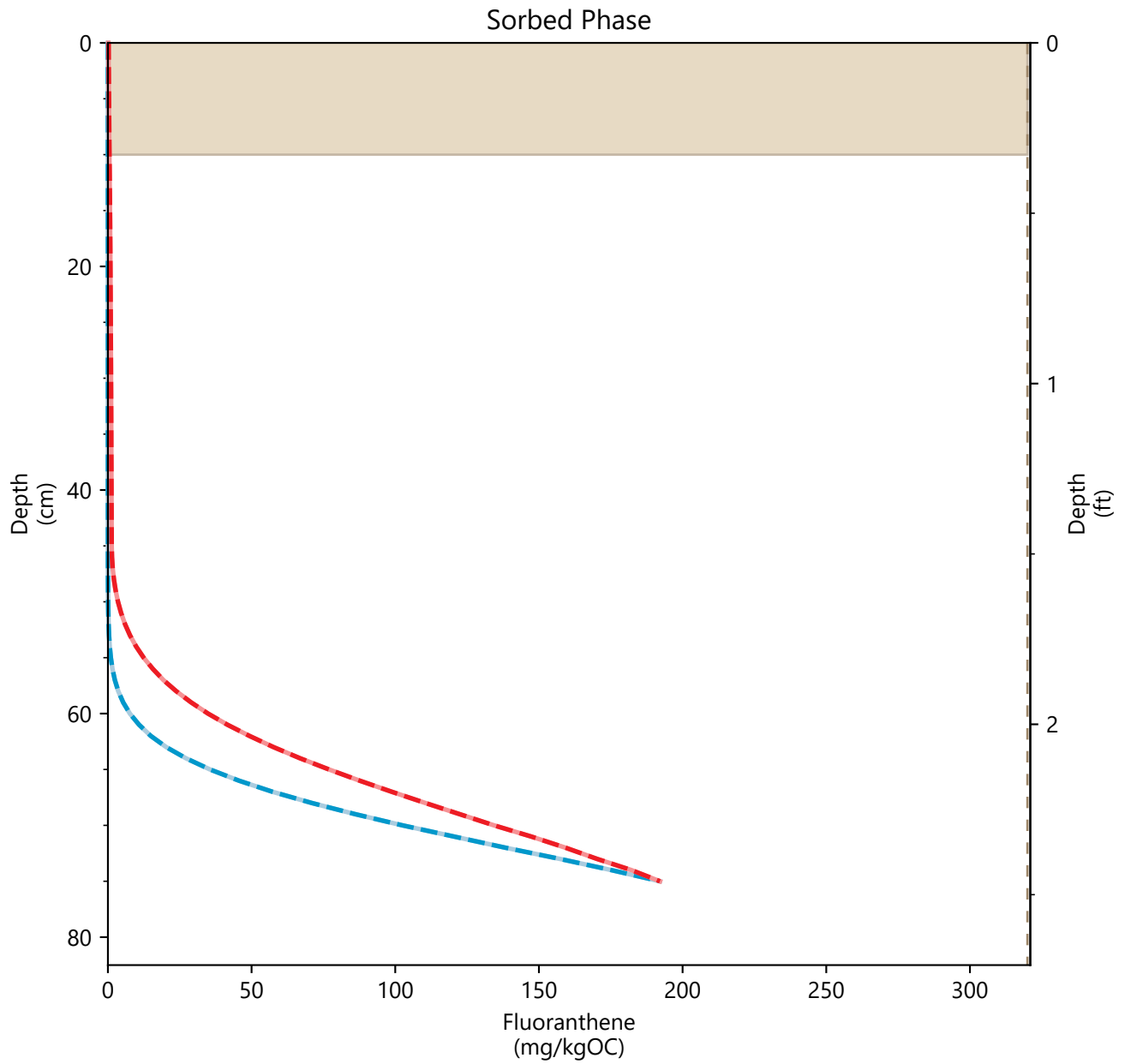
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19i
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Dibenzo(a,h)anthracene Concentrations in RAA 26 Modified Cap



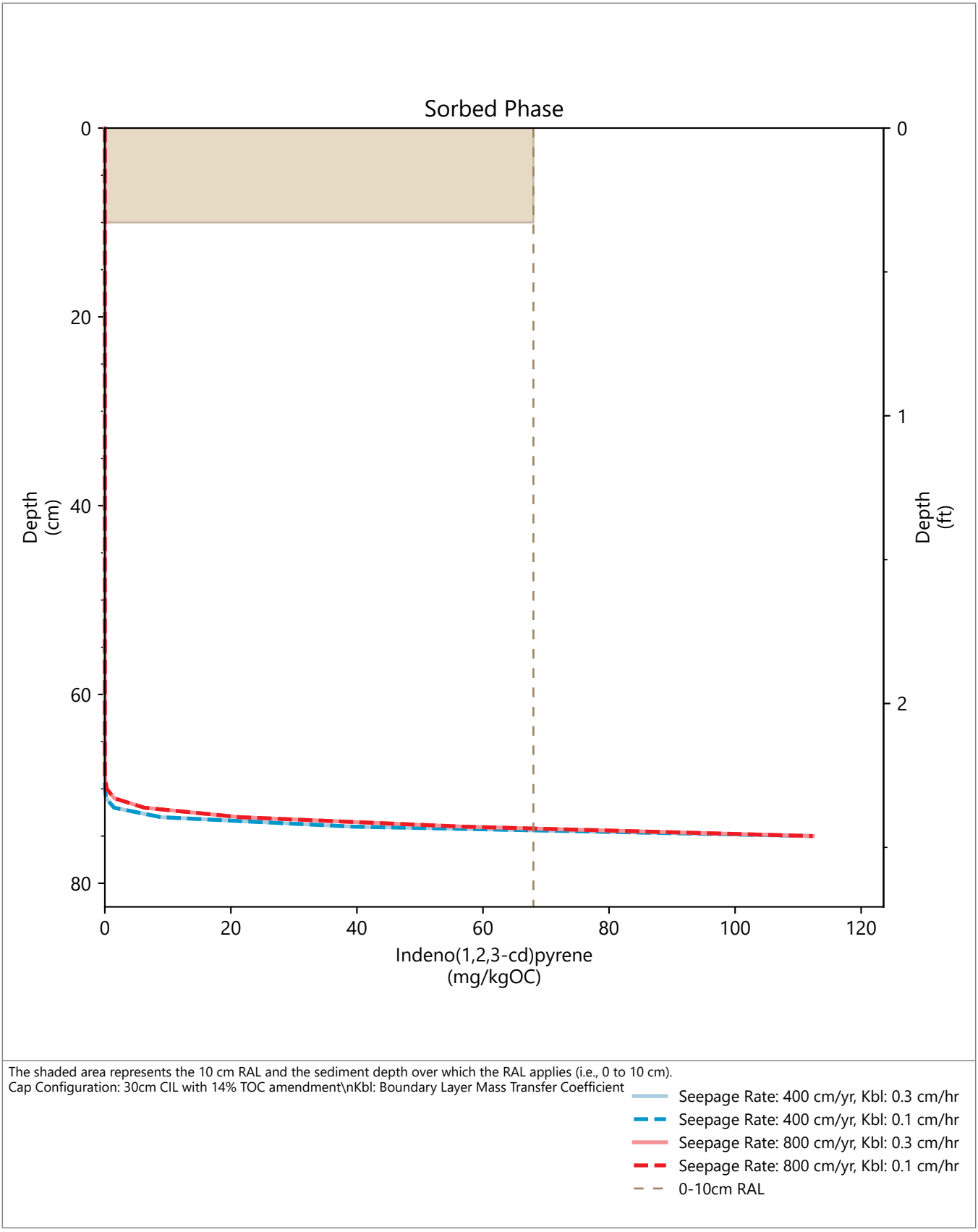
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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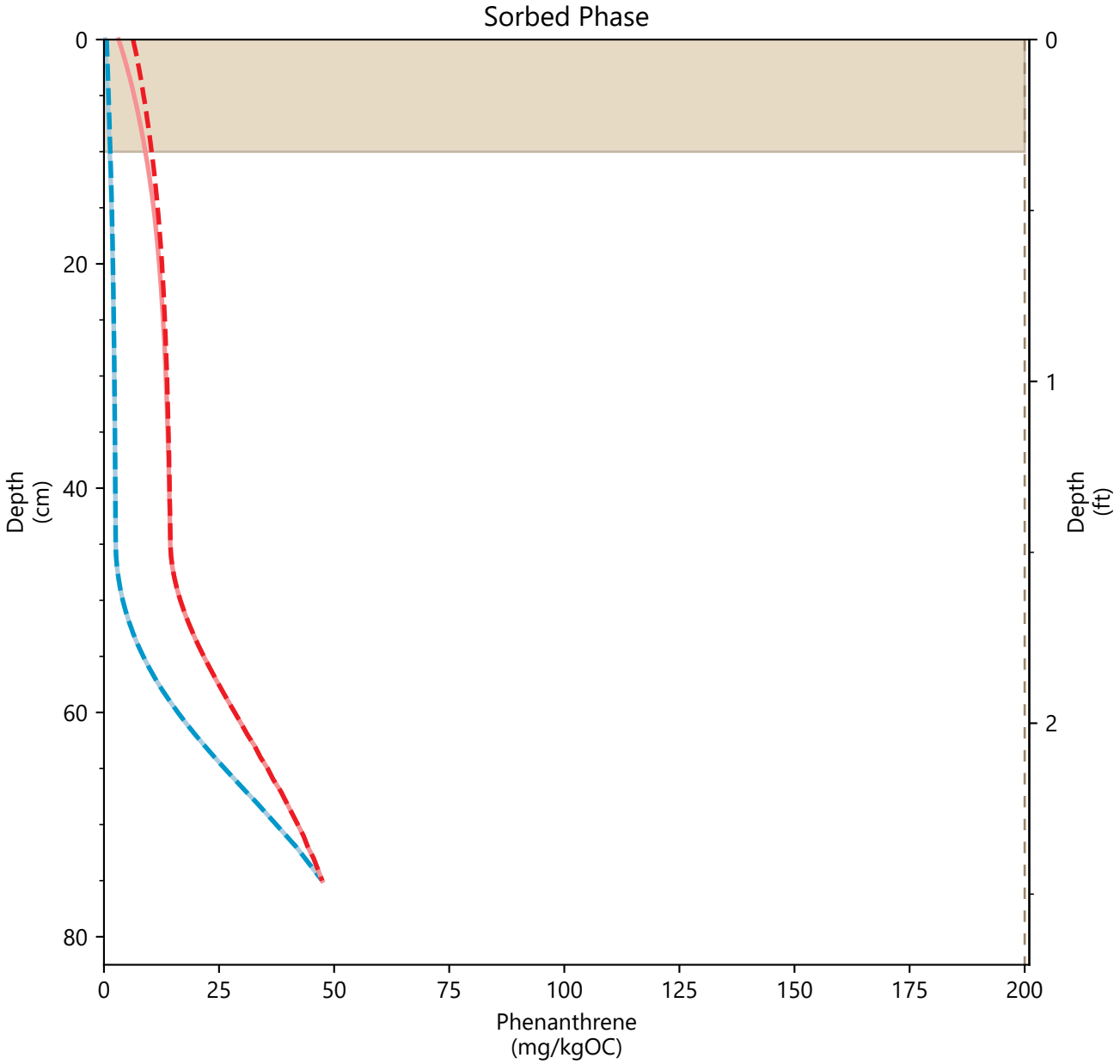
Figure H.6.2.19j
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Fluoranthene Concentrations in RAA 26 Modified Cap



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Figure H.6.2.19k
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Indeno(1,2,3-cd)pyrene Concentrations in RAA 26 Modified Cap



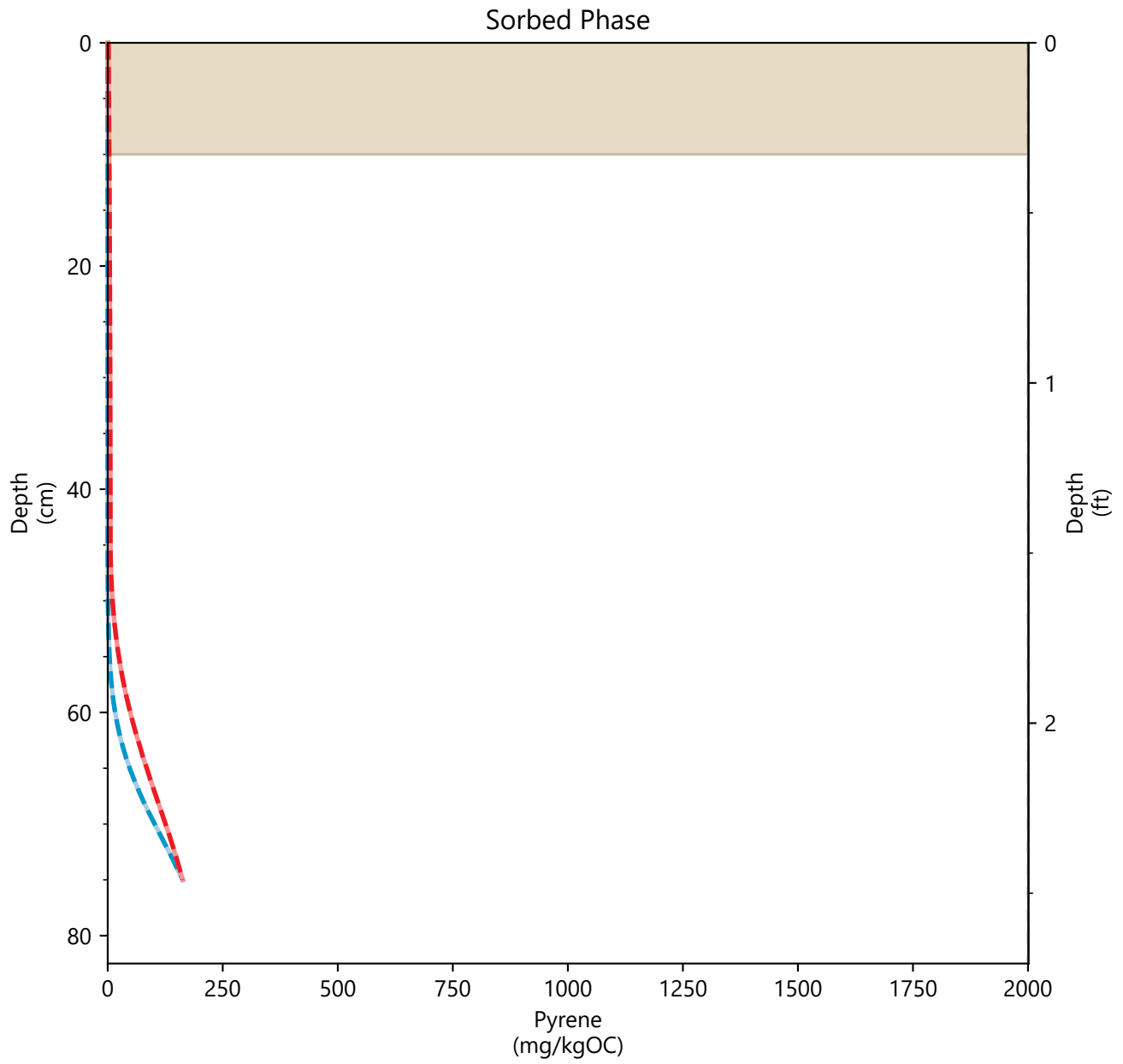
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19I
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Phenanthrene Concentrations in RAA 26 Modified Cap



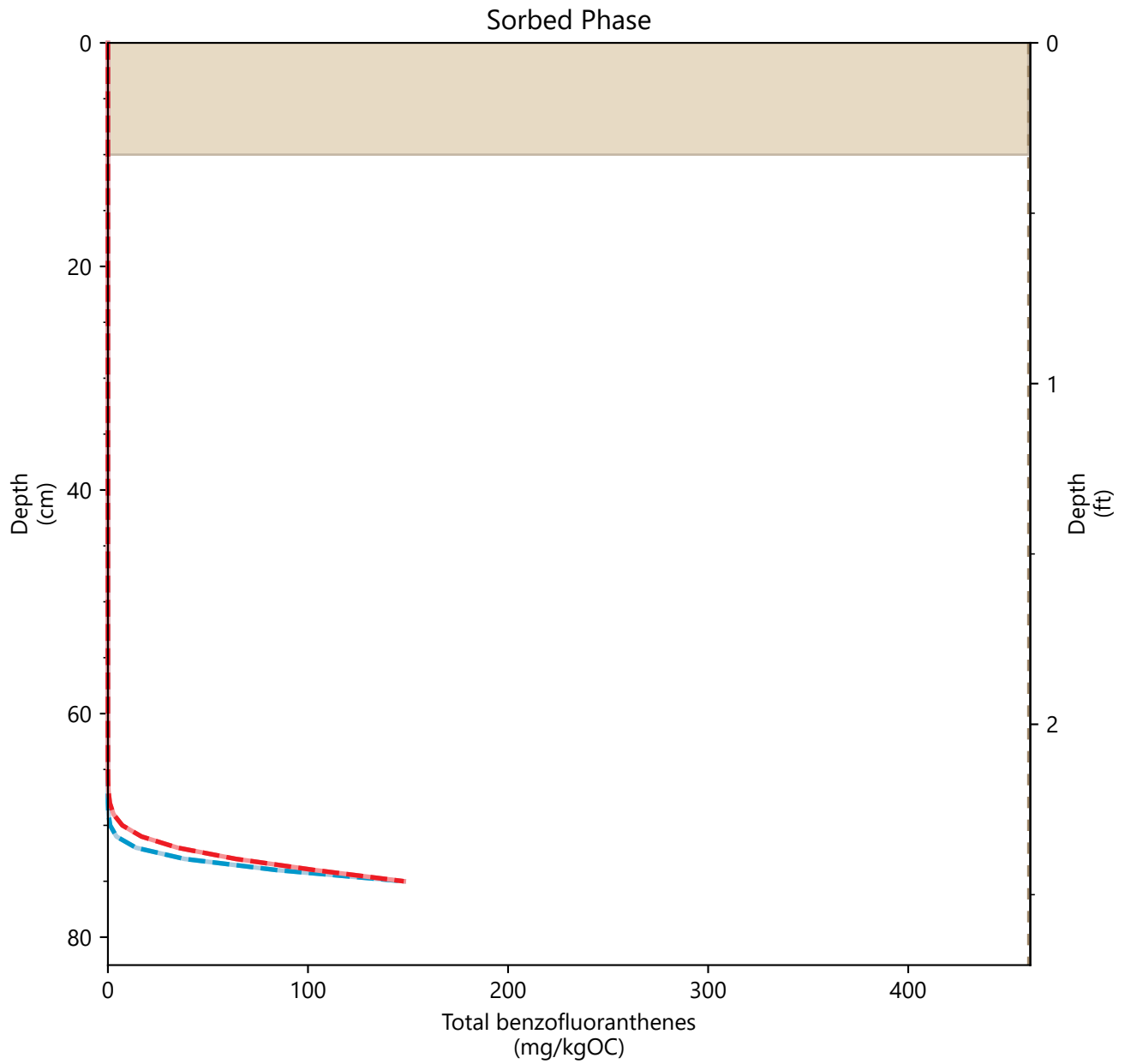
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19m
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Pyrene Concentrations in RAA 26 Modified Cap



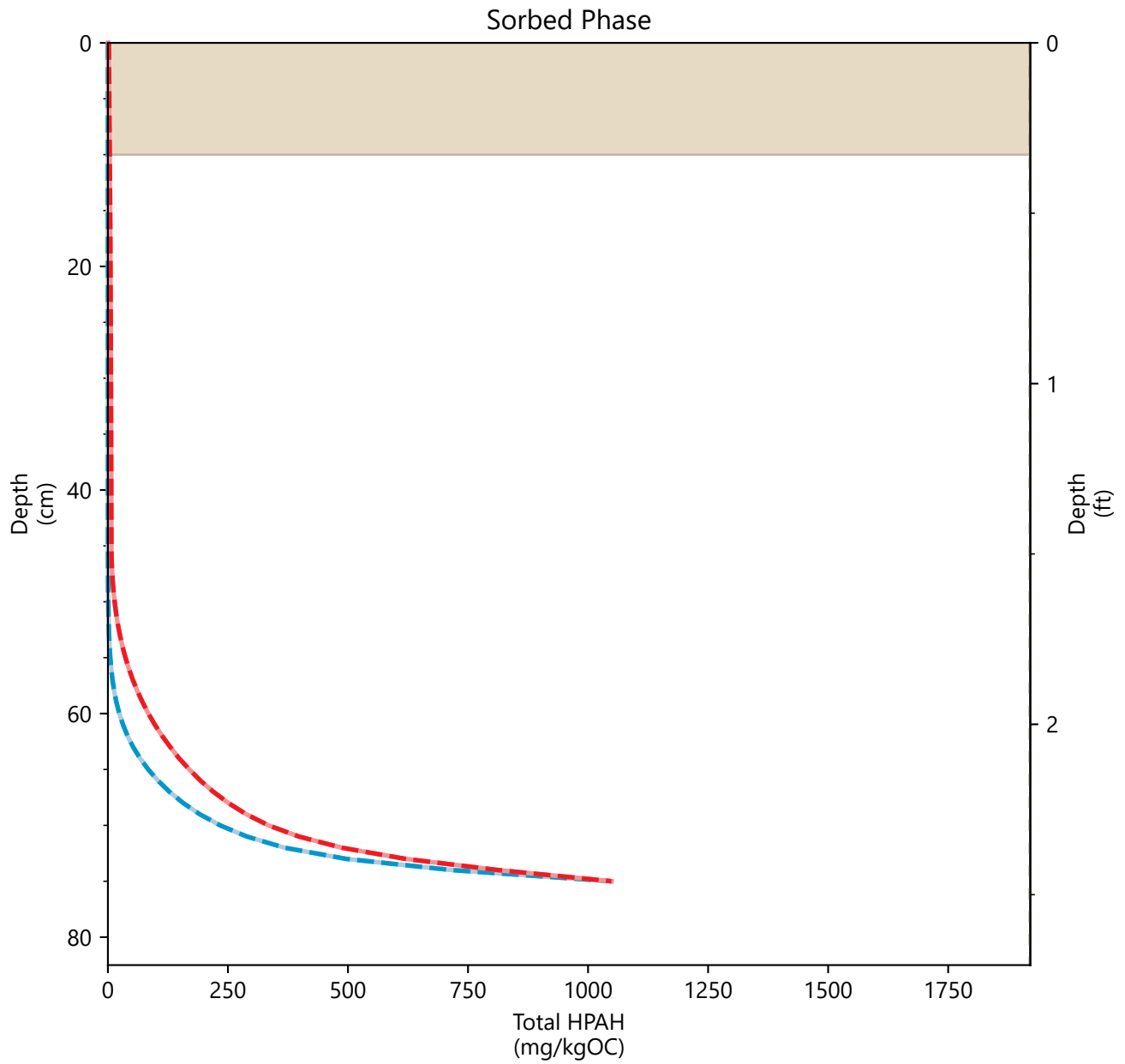
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
COC concentration below the proposed cap exceeds the dry-weight-based RAL but meets the OC-normalized RAL.
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19n
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total benzofluoranthenes Concentrations in RAA 26 Modified Cap



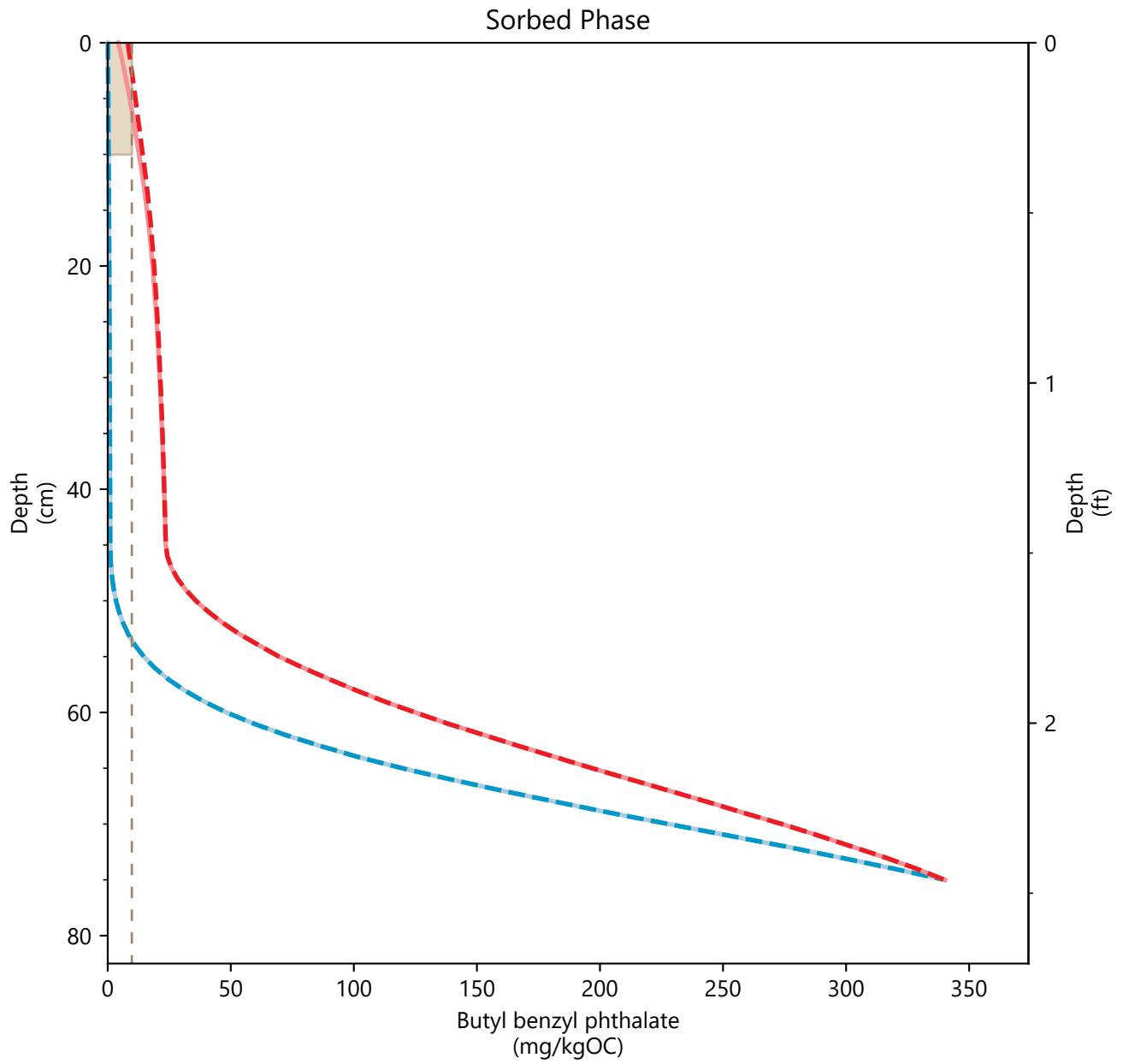
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19o
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total HPAH Concentrations in RAA 26 Modified Cap

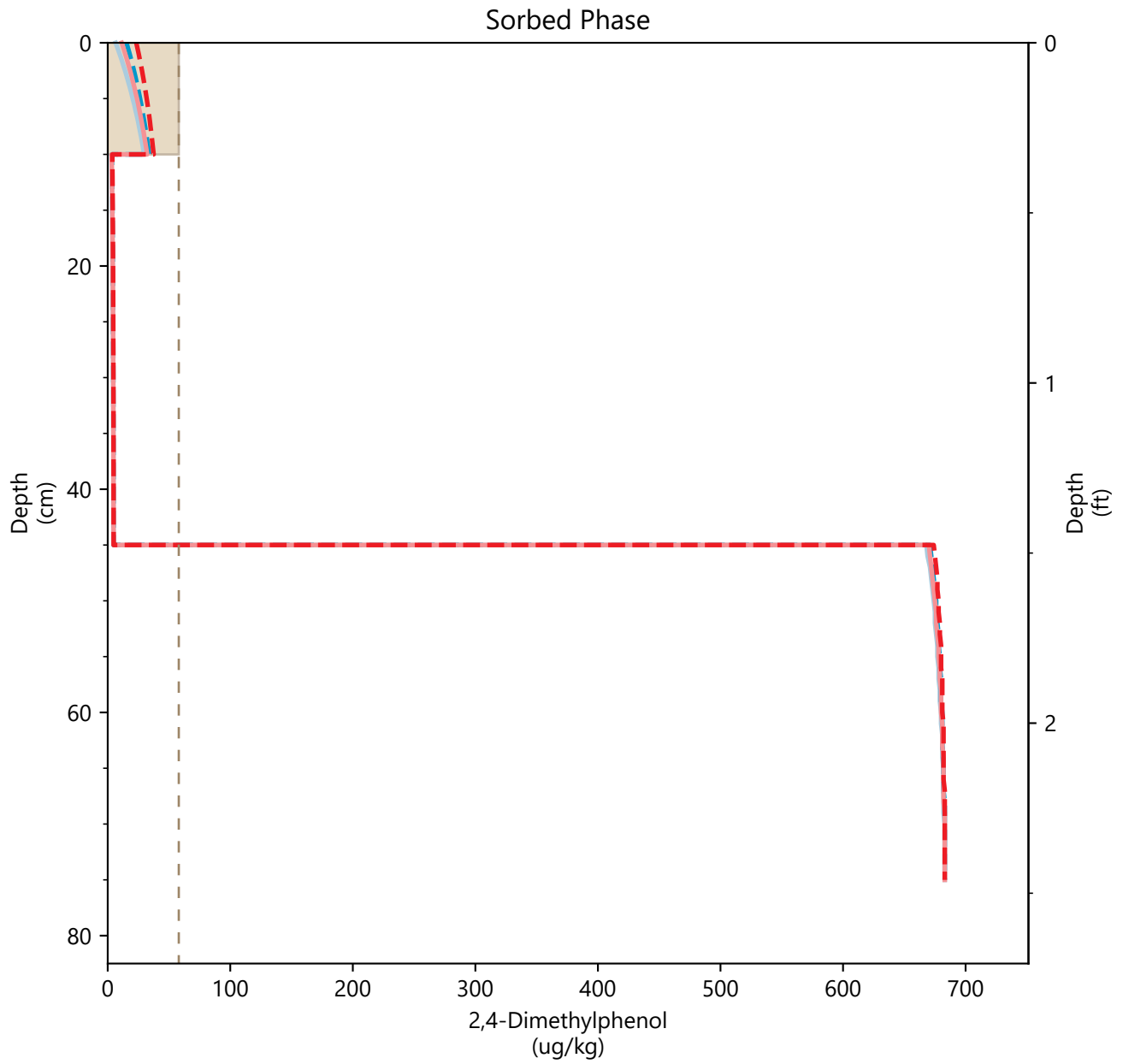


The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19p
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Butyl benzyl phthalate Concentrations in RAA 26 Modified Cap



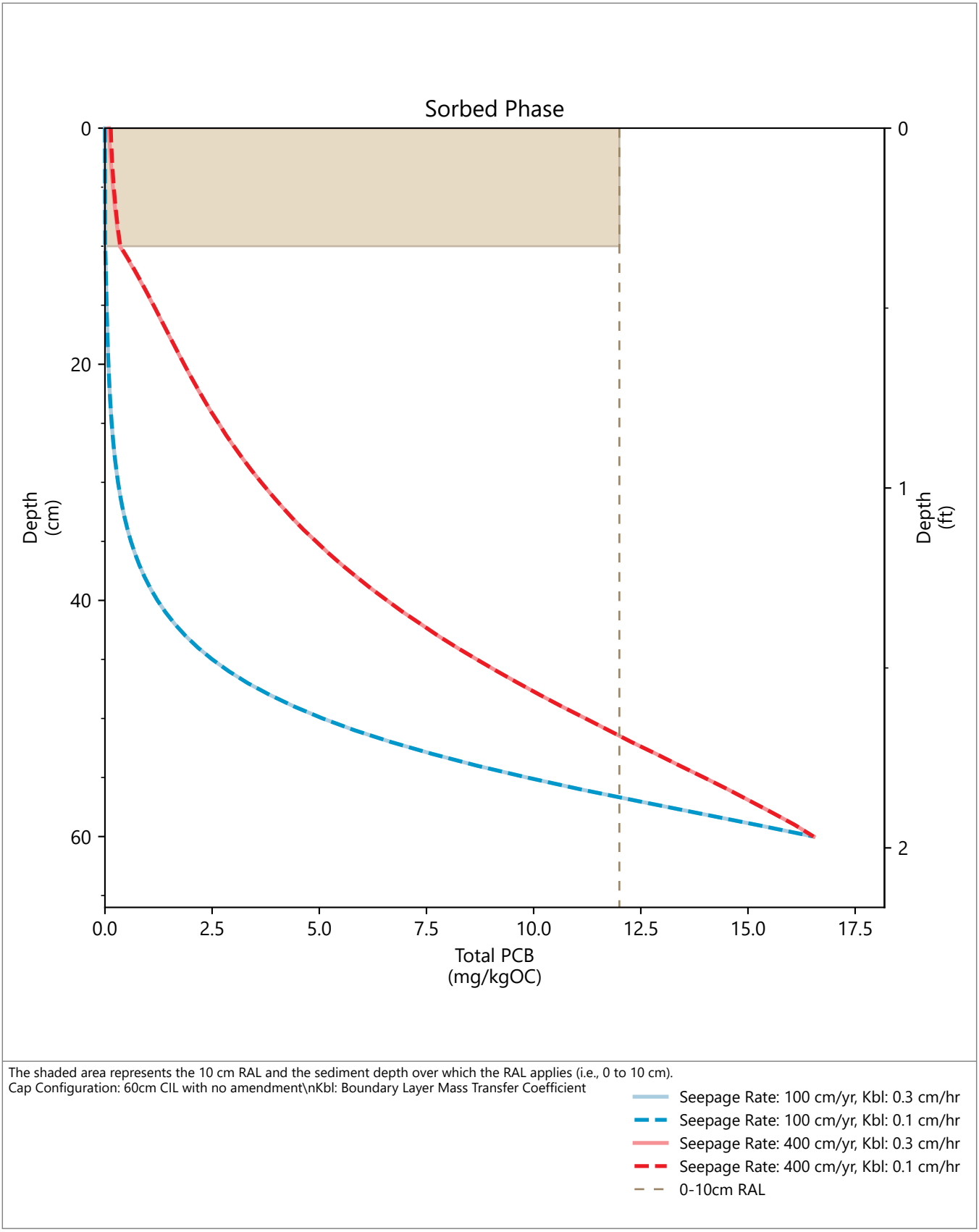
The shaded area represents the 10 cm RAL and the sediment depth over which the RAL applies (i.e., 0 to 10 cm).
Cap Configuration: 30cm CIL with 14% TOC amendment\nKbl: Boundary Layer Mass Transfer Coefficient

- Seepage Rate: 400 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 400 cm/yr, Kbl: 0.1 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.3 cm/hr
- Seepage Rate: 800 cm/yr, Kbl: 0.1 cm/hr
- 0-10cm RAL

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Figure H.6.2.19q
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted 2,4-Dimethylphenol Concentrations in RAA 26 Modified Cap



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Figure H.6.2.20a
Boundary Layer Mass Transfer Coefficient Sensitivity Analysis: Depth Profiles of Model-Predicted Total PCB Concentrations in RAA 9K AST Cover