Legacy Site Services LLC

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September 2, 2016

U.S. Environmental Protection Agency
805 SW Broadway, Suite 500 - Attn: Harbor Comments
Portland, OR 97205

Subject: **Comments on the EPA's June 8, 2016 Portland Harbor Proposed Plan submitted by Legacy Site Services LLC, agent for Arkema Inc.**

Dear Sir/Madam:

Legacy Site Services LLC (LSS), agent for Arkema Inc., appreciates the opportunity to provide comments on the U.S. Environmental Protection Agency's (EPA) Proposed Plan for the Portland Harbor Superfund Site (Site). LSS is extremely concerned that, as currently written, the Proposed Plan is based on both outdated information and scientifically incorrect analyses that, if not corrected, will lead to a Record of Decision (ROD) that requires an overprescribed remediation that will never achieve the unrealistic goals that EPA has proffered in its Proposed Plan. No one wants, or can afford the consequences of, a failed remediation for the river.

In addition to this fundamental and critical concern, LSS has identified issues with the Proposed Plan that are arbitrary, capricious, and in violation of the National Contingency Plan (NCP).

These issues fall into the following broad categories:

- The Proposed Plan is based on an outdated, inaccurate, and inadequate conceptual site model (CSM); therefore, the scientific and technical foundation for the criteria and calculated remediation areas is inaccurate, unreliable, and ultimately indefensible (Section 1).
- The Proposed Plan is based on flawed and unjustifiable assumptions related to exposure and miscalculated site risks that lead to inaccurate and overestimated requirements for sediment remediation than are necessary to achieve appropriate levels of risk reduction (Sections 3, 6, and 13).
- The Proposed Plan is based on outdated or misaggregated data, and miscalculated background values, which lead to a mistaken understanding of chemical distribution in

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sediment and fish tissue at the Site, post-remediation upstream impacts, and flawed remedial decision-making (Sections 2, 4, 5, and 11).

- The Proposed Plan does not consider already completed source control work at RM 7 and elsewhere in the harbor. It also inappropriately evaluates riverbank source control when this element has been planned in coordination with the lead source control agency, Oregon Department of Environmental Quality (DEQ). This results in an arbitrary assignment of remedial technologies and, in some cases, a remediation assignment based on no data from post-source control measures or a dataset that is wholly inadequate to make any evaluation or upon which to base a remedial decision (Sections 7, 8, and 9).
- The Proposed Plan has an inappropriate evaluation that leads to inaccurate delineation of principal threat waste (PTW) and nonaqueous-phase liquid (NAPL), resulting in overly conservative remedial alternative costs that are significantly greater than are necessary to achieve appropriate remedial goals and risk reduction at sediment decision unit (SDU) 7W (Section 10).
- The Proposed Plan inappropriately uses elevated detection limits (that result from chemical interferences) to calculate remedial action levels (RALs) and PTW footprints, which unnecessarily inflate the areas and volumes required for remediation and disposal to achieve risk goals (Section 12).
- The Proposed Plan is developed from a flawed technology assessment, including lack of consideration of monitored natural recovery (MNR), and waste disposal assignments that lead to unnecessary costs for the remedial alternative assigned to SDU 7W (Sections 15, 16, and 17).

To assist EPA, LSS has structured these comments to 1) identify LSS's issues of concern, and 2) provide EPA with a proposed corrective action and path forward that will correct the inaccurate assumptions and scientific and technical analyses.

To accomplish a prompt, achievable, and efficient remedy, LSS requests that EPA (a) correct the many errors and deficiencies in the Proposed Plan identified in these comments, in accordance with law; (b) evaluate the remedial alternatives once those underlying errors and deficiencies are appropriately remedied; and (c) issue a ROD adhering to the administrative process, only upon correcting the identified errors and deficiencies in the Proposed Plan and evaluating the remedial alternatives based on the corrected analysis.

If EPA chooses to proceed on the current path, then EPA must issue a ROD to include flexibility for 1) collection of pre-remedial data; 2) additional analysis based on the updated data and, as needed, a revised CSM; and 3) refinement of the remedial plan based on this updated site data, CSM, understanding of site risk, and remedial analysis. In the latter case, the ROD must not be prescriptive, which will lock EPA into selecting an inappropriate alternative that is not based on sound science and ultimately cannot be achieved. With either path to a ROD, additional data collection, CSM refinement, and transparent and realistic risk evaluation are required to design and implement a final remedy that will arrive at remedial goals that are achievable, fair, and consistent with the NCP.

Note that the issues analyzed and proposed corrective solutions presented in this letter focus on the river mile (RM) and SDU in the area of the Arkema site (RM7 W and SDU 7W); however, many of the concerns and solutions apply to the Site in general. The RM 7W area has been one of the most heavily investigated areas in the entire 11-mile Site; as such, the errors, omissions, and flawed technical analyses in the feasibility study (FS) and Proposed Plan are well illustrated in this river segment. These missteps combined with the arbitrary and capricious[1] approach are evident in the RM 7W reach and are likely magnified in other river reaches/SDUs, where there is substantially less data used by EPA to develop the Proposed Plan.

Attached are documents exchanged with EPA during the Arkema engineering evaluation and cost analysis (EE/CA); exchanged with DEQ in the course of the Arkema uplands work; generated by or for the agencies; or otherwise relate to the Arkema site, SDU 7W, or the Site. LSS is incorporating these documents as support for these comments on the Proposed Plan and for inclusion in the administrative record file pursuant to 40 CFR §300.815(b). See the accompanying DVD:

- Attachment 1—Arkema Early Action Documents

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[1] According to the Administrative Procedure Act, 5 U.S.C. § 706(2), EPA action will be set aside if it is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law," "in excess of statutory jurisdiction, authority or limitations," or "without observance of procedure required by law." APA, 5 U.S.C. § 706(2)(A), (C) & (D). Likewise, under CERCLA, EPA action must be set aside if it is "arbitrary and capricious or otherwise not in accordance with law." 42 U.S.C. § 9613(j)(2). Courts have defined the arbitrary and capricious standard. "Arbitrary means the Government simply threw darts or flipped a coin, selecting the remedy without a basis in reason or science. Capricious means it rushed through the process or made a sudden, knee-jerk decision without hearing enough evidence." *United States v. NCR Corp.,* 2012 WL 3778950, at *4 (E.D. Wisc. Aug. 30, 2012). An agency decision is arbitrary and capricious if it "has relied upon factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise." *See Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983); *Great Basin Mine Watch v. EPA,* 401 F.3d 1094, 1098 (9th Cir. 2005). And, when rendering its decision, the agency must "examine the relevant data and articulate a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'" *State Farm*, 463 U.S. at 43 (*quoting Burlington Truck Lines v. United States*, 371 U.S. 156, 168 (1962)). Under CERCLA, "the arbitrary and capricious standard . . . contemplates a searching 'inquiry into the facts' in order to determine 'whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment'." *United States v. E.I. DuPont de Nemours & Co., Inc.*, 432 F.3d 161, 179 (3d Cir. 2005)); *see also In re Bell Petroleum Serv. Inc.*, 3 F.3d 889, 905 (5th Cir. 1993) (judicial review must be based on something more than trust and faith in EPA's experience). An action is arbitrary and capricious where it fails to "determine the nature or the extent of the threat presented" and "evaluate alternatives in the manner prescribed by the NCP." *Wash. State Dept. of Transp. v. Wash. Nat. Gas. Co., Pacificorp,* 59 F.3d 793, 802 (9th Cir. 1995). Thus, where a court finds "a high degree of inconsistency with the requirements set forth in the NCP," it will have "no difficulty" finding the agency's action arbitrary and capricious. *Id.* at 805.

- Attachment 2—Arkema Source Control Measure Documents
  - Groundwater SCM Documents
  - Stormwater SCM Documents
- Attachment 3—Arkema Upland Documents
- Attachment 4—EPA Portland Harbor RI/FS and Proposed Plan Documents
- Attachment 5—LSS and LWG Portland Harbor RI/FS and Proposed Plan Documents
- Attachment 6—FOIA Documents
- Attachment 7—Other Documents.

A list of the documents included in each attachment is presented at the end of this letter.

In addition, please note that LSS supports the Sustainability Project (AECOM et al. 2016), which will also be submitted during the Proposed Plan comment period.

PROPOSED PLAN ISSUES AND LSS EVALUATION

The following sections provide a detailed assessment of the major issues with EPA's Proposed Plan followed by LSS's evaluation with proposed solutions.

1. Inadequate CSM

1.1 Issues with EPA's Evaluation

EPA has failed to utilize a scientific and factually based CSM in their development of the Proposed Plan. As a result, several of the remedial alternatives involving extensive and costly remediation, such as sediment removal and capping of large areas, are unlikely to be successful toward reducing risk. If EPA proceeds with cleanup without an accurate CSM, hundreds of millions of dollars will be spent, and the fish in the river at the Site will still not be safe to eat based upon EPA's currently imposed standards.

The purpose of a CSM, for environmental remediation, is to assist site managers in understanding the dynamic relationship between contaminant sources, environmental fate and transport processes, exposure pathways, and receptors. Preparing an accurate CSM is critical because it is used as a decision-making tool. An accurate model provides a framework for establishing testable core hypotheses related to the behavior of the system, particularly in relationship to natural processes, and in response to remedial actions.

To formulate and implement effective remedial alternatives at Superfund sites, site-specific conditions must be well characterized and incorporated into a CSM, and the CSM's similarity to observed conditions must be demonstrated to be accurate and representative of the system. National Research Council (NRC) guidance appropriately states the importance of using a CSM to conduct risk management decisions "on a site-specific basis…incorporat[ing] all available scientific information" because "[w]ithout a valid conceptual model of the site, it is not possible

to define how a management option can successfully meet the risk-reduction goals and objectives" (NRC 2001). At contaminated sediment sites in particular, "the development of an accurate conceptual site model, which identifies contaminant sources, transport mechanisms, exposure pathways, and receptors at various levels of the food chain" is "especially important...because the interrelationship of soil, surface and groundwater, sediment, and ecological and human receptors is often complex." (USEPA 2005, p. ii.) EPA's Technical *Resource Document on Monitored Natural Recovery* explains that an evaluation of the feasibility of MNR (and presumably other proposed remedial alternatives) "is best achieved through the development of a CSM that adequately captures the physical, chemical, and biological processes that control contaminant fate, transport, and bioavailability" (USEPA 2014a, Section 1.3.2, p. 6).

A CSM, by definition, is iterative; as more data and site information become available, the CSM is updated and refined. In that sense, a properly developed CSM reflects the best understanding of the conditions and dynamics associated with a site and should become more refined over time. Analytical and quantitative models of physical, chemical, and biological fate and transport mechanisms and processes should be based on the Site CSM. A more dynamic site will require a more elaborate and detailed CSM and, as a result, more elaborate and detailed analytical and quantitative models. As described in EPA's remedial investigation (RI) report (USEPA and CDM Smith 2016), the Lower Willamette River is a highly complex, dynamic system.

The Willamette River is an open system. Changes in surface sediment chemistry, surface water quality, and biota tissue concentrations over time are all a function of processes within Portland Harbor <u>and</u> upstream of the harbor. Many natural and anthropogenic activities have been ongoing throughout the RI and FS at Portland Harbor and have resulted in changes to Site conditions. For example, since completion of the RI, many source control efforts have been completed, and these efforts will specifically change conditions in and near the upland areas where they were conducted. Specifically, at the Arkema site, both stormwater and groundwater source control has substantially curtailed any remaining discharges of contaminants via these pathways to the river. These changes in condition, as well as other natural or man-made changes that can occur in an open system like the Willamette River, must be accurately reflected in the Site CSM so that remedial decisions can be made, based on current site data and sound scientific and technical evaluation.

The CSM presented in the Proposed Plan is oversimplistic and outdated. In fact, EPA fails to make use of the more detailed and accurate information they presented for the Site CSM included in the RI Report (see Section 10 of USEPA 2016b[2]). As part of the discussion of the

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[2] While the CSM presented in Section 10 of EPA's RI Report is more detailed than the Proposed Plan version, it is incomplete with respect to consideration of trends in surface water and sediment concentration data over time, the role of natural attenuation, use of more recent sampling data, and greater consideration of non-steady state conditions with respect to chemical accumulation, particularly for fish.

CSM included in EPA's RI Report, EPA explicitly described the presence of upgradient sources of contaminants entering the Site. For example, EPA presents an analysis showing DDx in upriver surface water being loaded downriver and into the Site. The load from upriver is 1–3 orders of magnitude higher than any other source present within the Site itself (see RI Figure 10.2.7-a, included here in Attachment 4). Now, as part of the Proposed Plan, EPA omits consideration of upriver sources for DDx in surface water. By failing to include the reality of upriver sources, EPA's remedial alternatives analysis is deeply flawed. Not addressing the ongoing sources of contaminants from upriver surface water means that whatever good could occur from cleanup will quickly be swamped by ongoing upriver contamination unrelated to the Site. Even though EPA presents remedial alternatives as a means to reduce risk and make fish safe to eat, the cleanup of sediments at the Site alone will not keep the Site clean and will not make fish safe to eat in the future.

1.1.1 Errors that Result from the Use of EPA's CSM

There are numerous examples of important dynamic processes that have been overlooked or ignored in the development of EPA's CSM. These omitted processes are critical to understanding source dynamics, rate and extent, exposure, and, therefore, the appropriate evaluation of remedial scenarios.

1.1.1.1 Uncertainty in Sediment Concentration and Fish Tissue Concentration Relationships

Some of the more illustrative examples of these errors of omission include the non-steady state dynamics of polychlorinated biphenyls (PCBs) and DDx concentrations in surface water. This effect on the CSM is to under appreciate important factors other than sediment concentrations, such as water quality, on DDx fish tissue concentrations. In evaluating the sediment data presented in the RI, LSS observes and calculates that the variation in Site sediment concentrations explains only about 33% of the variation of DDx in resident fish tissue (Integral 2016b). That means that 67% of the observed variation is not currently understood or explained by the CSM, and could be related to surface water quality from upriver contributions or other factors. This uncertainty in the CSM could lead to the very real possibility that sediment remediation alone will not result in acceptable levels of DDx in fish tissue based upon EPA's currently imposed standards. Eight rounds of Portland Harbor surface water data demonstrate that significantly higher concentrations of DDx are entering the Site from upstream during times of high winter river flow conditions than are present during the low river flows in summer or fall (Integral et al. 2011; Revelas and Jones 2016). As described above, loading from upriver occurs at rates 1–3 orders of magnitude higher than from the Site itself. Further, none of the upstream surface water samples for DDx or total PCBs, taken during either high or low flow conditions, were below EPA's New/Updated Clean Water Act (CWA) 304(a) Human Health Criteria.

Based upon the sediment to fish tissue mathematical relationship and surface water quality data collected during the RI, the actual mathematical relationship between tissue and sediment concentrations indicate it is almost with complete certainty that sediment remediation will not achieve the desired tissue-related outcomes. Yet, the actual mathematical relationship between surface water quality and tissue concentration has not been adequately explained by EPA's CSM.

1.1.1.2 Upstream and Portland Harbor Fish Tissue Health Advisories Not Related to Site Contaminants or Exposure at the Site

Because EPA has chosen to focus the Proposed Plan on completing sediment remediation to reduce risk from human consumption of contaminated fish tissue, it is extremely important to understand that some factors driving fish tissue concentrations are not at all related to contaminated sediments within SDU 7W or the Site. The current CSM fails to account for these external risks, which arise as a consequence of factors outside the model domain. For example, unacceptable levels of mercury in fish tissue are associated with the consumption of resident fish. Because of the widespread occurrence of mercury sources from historical upriver agricultural and mining practices (DEQ 2006; ODA 2014), as well as from ubiquitous background sources of mercury in the atmosphere and oceans, and the lack of any significant mercury sources within the Portland Harbor, sediment remediation will not have any impact on mercury concentrations in fish tissue. This error of omission in EPA's current CSM means that the proposed remediation, based on even the most invasive remedial option (i.e., alternative H), will not achieve remedial goals with respect to substantially increasing meals of fish that are safe to eat from the harbor. Ultimately, mercury will remain a limiting human health risk factor associated with the consumption of resident fish at the Site, and the most sensitive individual will still be allowed only one resident fish meal per month following even the most aggressive remedy. EPA has arbitrarily and capriciously ignored this simple, yet crucial, basic fact.

In fact, given the continuous presence of mercury in surface water from upstream sources and from the levels of PCBs, DDx, and other contaminants present in water entering the Site year-round[3], even if every grain of sediment was removed from the Site and replaced with the cleanest sand available, resident fish tissue would still be adversely impacted. Contrary to guidance, the CSM fails to address this core hypothesis related to the effect of background water quality and contaminant sources not associated with Portland Harbor on marginal risk reductions and, as a consequence, the utility of the alternatives (USEPA 2005).

1.1.1.3 Importance of Non-steady State Conditions

As examined above, sediments at the Site exist in an open, non-steady state system. Surface sediment concentrations of contaminants of concern (COCs) can increase or decrease over time depending on site-specific factors related to chemical and sediment hydrodynamics, source control, external loading, and other factors. Surface sediment data acquisition was conducted over a 10+ year time period during the RI, and the sediment data were aggregated for data

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[3] This is reflected by the fact that Willamette River water quality immediately upstream of the Site, and typically up to RM 72 or higher, is 303d limited for DDT, DDE, PCBs, 2,3,7,8-TCDD, aldrin, dieldrin, mercury, and other chemicals. Any amount of Portland Harbor cleanup, even the most stringent cleanup imagined, will not affect water quality 303d limitations or the ability to achieve these water quality criteria for these chemicals because of ongoing water quality upstream of the Site.

analysis. Due to this data aggregation, the signals of dynamic conditions (such as changes in surface sediment concentration over time) were not considered. Therefore, the CSM, as presented, is based on the flawed assumption that sediment concentrations across the Site exist at steady state.

Some of the COCs associated with Site sediments are chlorinated organic compounds. Current scientific literature documents that chlorinated compounds present in sediment can undergo biotic and abiotic changes, including aerobic and anaerobic reactions. This important natural attenuation mechanism is associated with buried sediment and contaminated groundwater/porewater. Potentially important biogeochemical degradation pathways, such as those that are observed at other sediment sites, are not operationalized by EPA in the CSM.

The dynamic sediment surface chemistry has a direct effect on sitewide and SDU 7W surface weighted average concentrations (SWACs), which are related to RAL selection to achieve preliminary remediation goals (PRGs). When sediment surface chemistry is dynamic over time, the SWAC will also be time-dependent. Therefore, if a remedy is going to be selected for implementation after the passage of time, the surface chemistry at the time of implementation should be used to establish the appropriate target RAL. Smallmouth bass fish tissue data collected in 2002, 2007, and 2012 confirmed a statistically significant decreasing trend in tissue concentrations. Multiple lines of evidence, including time series bathymetry data, the fine-grained nature of the majority of Site surface sediments, surface to subsurface sediment contaminant concentration ratios, and detailed sediment transport modeling, all indicate that the majority of the Site surface is a depositional system. An appropriate analysis of the bathymetry empirical data indicates that 63% of the Site is depositional and that an additional 25% of the Site is stable (i.e., no substantial bed elevation change). Thus, approximately 88% of the Site is stable or depositional. This is an important element that should be explicitly operationalized because natural recovery represents one of the important core processes in the Site CSM. In addition, the bathymetric surveys did not adequately cover a substantial portion of the sediment area downstream of the Arkema docks to the railroad bridge. These sediments are likely stable and should be confirmed during pre-remedial investigations. EPA has acknowledged that deposition/natural recovery is occurring and is important to the overall Site remedy. However, EPA has failed in their CSM to perform the necessary analysis to adequately understand and predict the relevance and magnitude of deposition.

1.1.1.4 Role of Spatial Complexity on Background Concentration Calculation

Data obtained during the RI demonstrate that this Site is complex and dynamic. For this reason, assumptions of steady state are very problematic when applied to issues related to potentially chaotic dynamics, such as sediment characteristics (e.g., grain size, mineralogy, and carbon content), sediment transport, bedload movement, upstream sediment loads, sedimentation processes, and surface water hydrology.

The omission of important characteristics of the spatial complexity associated with sedimentary parameters, including grain size and carbon content, are directly related to errors in calculated background concentrations using inappropriate outlier identification methods (i.e., assuming normal distributions). A normal distribution assumption might be valid in a sedimentary

environment that has isotropic grain size distributions and organic carbon content; however, Willamette River sediments are highly anisotropic with respect to grain size distributions and carbon content. Also, because organic compound concentrations in sediments co-vary with grain size and carbon content, the concentration of COCs (including PCBs and DDx) cannot be normally distributed at the sampling scales associated with the upstream reference area. EPA's application of outlier methods associated with such distributions combined with inappropriate data censoring affected the calculated background concentrations. This error could have been avoided had the CSM properly addressed spatial complexity.

1.2 LSS Evaluation and Recommended Corrective Action

1.2.1 Revising and Improving the Site CSM

The existing CSM's ability to describe the Site is severely limited and inaccurate. Further, it is inconsistent with EPA's own RI CSM, particularly with respect to consideration of upriver conditions. The CSM is limited with respect to the spatial and dynamic complexity that is present at the Site. For this reason, the CSM is not useful as a decision tool related to Site processes, risks, or the selection of an appropriate remedy; therefore, the CSM leads to errors when serving as a decision aid. Consequently, an updated, robust CSM for SDU 7W (as well as the Site) should be developed to replace the existing model prior to the issuance of the ROD. The following criteria should be followed to develop the revised CSM.

1.2.1.1 Purpose, Suitability, and Boundary

Since the purpose of the Site CSM is to evaluate the need for remediation and to assess the potential for remedial approaches to reduce Site-specific risk, the CSM must account for key variables associated with risk and remedy, including the Site's variability and dynamic complexity.

The boundary conditions need to address the Site as an open system that is influenced by variables, outside of the system, which will not be affected by the selected remedy. The CSM should also account for all variables, both within and outside of the system, that are subject to change and are, therefore, essential for understanding the dynamic processes that control sediment, water, and tissue chemistry, and ultimately Site risk. The revised CSM must also honor the data obtained during the RI, as well as all other available scientifically valid data applicable to the CSM variables. Even a revised CSM will be iterative. As new information becomes available, the parameters used in the revised CSM should be evaluated accordingly. When required, the revised CSM should be changed or modified to refine and improve its representativeness and predictive accuracy. Additional guidelines, by category, for improving the CSM follow.

1.2.1.2 Physical Structure

Ideally, the CSM should be operationalized as a quantitative model (or a dynamic model) that includes hydrodynamics, geology, sediment transport, sediment chemistry, and water and tissue chemistry. Additional work is required to properly reflect the a) surface and subsurface processes of natural recovery; b) role of surface water chemistry on risk; c) recalculation of

SWACs based on current surface chemistry and the impact on selected RALs; d) effectiveness of source controls on remedy and risk; e) reassessment of alternatives based on updated surface conditions (changing SWACs); and f) the effect of anthropogenic factors (including, but not limited to, vessel traffic) on the implementation of a remedy. The CSM should also attempt to address disequilibrium dynamics, and at least properly calculate the near-equilibrium state expected during the time horizon of active remediation and post-action monitoring.

1.2.1.3 Robustness and Sensitivity

The CSM should be sufficiently robust as to provide a complete description of the Site and its dynamics. As core hypotheses are tested, the Site description must be re-evaluated, and if refuted, revised accordingly. The CSM must also be robust even with extreme variations in input parameters. Importantly, the CSM must be capable of providing justification for policy recommendations (including RALs, remedial alternatives, etc.) that are sensitive to the anticipated variations of Site parameters within the CSM's boundary over time.

Because of the potential costs of Site remediation, an inaccurate CSM cannot be used without the risk of significant scientific and policy error. A flawed CSM should never be used to justify remedial decisions whose consequences will only become clear with implementation. EPA can do better. Data exists to revise and update the conceptual understanding of the Site in ways that honor and address its complexity and dynamics. EPA can create a valid CSM by properly incorporating this scientifically valid data. The CSM can then be validated, and if necessary revised, using data generated during supplemental remedial investigations and the forthcoming pre-remedial engineering design studies and investigations. Failure to correct the CSM and incorporate new data can only result in unacceptable and arbitrary decision-making that will result in failed public policy choices and public dissatisfaction with the remedial outcomes for this Site.

2 Inappropriate Use of an Aggregated Dataset

2.1 Issues with EPA's Evaluation

There were multiple rounds of data collected at the Site during sampling events over more than a decade. All the sediment data from the various synoptic[4] sampling events were aggregated and plotted on maps and figures of the Site without regard to when the samples were obtained. Thus, data from samples obtained in the late 1990s were combined (or aggregated) with data from 2007 into a single data set for characterizing sediment. The most recent site-wide surface sediment PCB dataset, collected in 2014, was not incorporated into EPA's evaluation.

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[4] "Synoptic data" is defined as *simultaneously* collected sediment data.

This practice is inappropriate for the Portland Harbor Site given its complexity and multiple sampling events over such a long period of time. River sediments have dynamic characteristics and parameters including chemical concentrations that likely increase or decrease over time. By aggregating synoptic data sets, which are separated by time of sampling, any signal of time-dependent variation present in the data was lost.

2.2 LSS Evaluation and Recommended Corrective Action

The existing sediment data set should have been disaggregated prior to completion of the RI/FS and must be corrected prior to issuance of a ROD to properly characterize the Site. For example, the sediment data could be broken into five distinct time intervals to assess time-dependent variations in the data:

- 1997–2001
- 2002–2004
- 2005–2007
- 2008–2012
- 2013–present.

In addition to assessing the time-dependent variation, new sediment data that are representative of current site conditions and baseline conditions for the remedial action need to be collected. These data will provide critical information for pre-remedial design and for assessing pre-remedial SWACs relative to the RALs in EPA's FS.

3 Inappropriate Evaluation of Benthic Risk in SDU 7W

3.1 Issues with EPA's Evaluation

EPA made extensive changes to the benthic approach in the FS, but those changes are still inconsistent with the comprehensive benthic risk approach (CBRA[5]), which was previously developed collaboratively between EPA and the Lower Willamette Group (LWG) based upon multiple lines of evidence derived from the EPA-approved baseline ecological risk assessment (BERA).

EPA's FS (Section 4.1.3) states: "The protection of benthic species to contaminated sediment is evaluated using the benthic risk area defined by an order of magnitude greater than the RAO5

[5] EPA uses the term "comprehensive benthic risk area" to mean something very different than the area identified by applying the LWG negotiated comprehensive benthic risk approach.

PRGs. The post-construction interim target for RAO5 was established at 50% reduction in the area posing unacceptable benthic risk" (USEPA and CDM Smith 2016). Instead of using the CBRA, EPA very simplistically and arbitrarily mapped benthic PRG (remedial action objective [RAO] 5) exceedances on a point-by-point basis, which results in 1,289 acres (USEPA and CDM Smith 2016, pp. 4–16 and Figure D-11) of the Site showing benthic risk. This is a gross overestimation of areas of benthic risk. Yet, EPA's FS alternatives miss approximately a third of the benthic areas that the LWG identified based on the CBRA approach. In contrast, the LWG's CBRA showed approximately 61 acres of benthic risk based on an evaluation by the LWG's consultant that was verified by LSS (LWG 2016). Therefore, the majority (more than 95%) of the area targeted for remediation by EPA based on RAO5 was incorrectly identified.[6]

The Proposed Plan reports that areas of unacceptable risk to benthic invertebrates are located in approximately 4–8% of the Site (p. 20); however, the total impacted area using EPA's approach is approximately 59%.

EPA's post-construction interim target for RAO5 was established at a 50% reduction in the area posting unacceptable benthic risk, and EPA used a 10 times exceedance factor to identify benthic risk areas. EPA's approach to identifying benthic risk areas differs substantially from the CBRA, which used multiple lines of evidence but still did not in all cases honor all of the benthic toxicity data. The 10x RAO5 exceedance is not supported by any long term assessment of the alternatives. No explanation or analyses is provided as to why EPA selected a 50% reduction in risk as an interim target and not some other value between 1 and 100 percent. EPA's own FS Table 4.2-7 illustrates the arbitrary nature of these decisions. EPA's FS Table 4.2-7 indicates that Alternative B addresses 48% of the 10x RAO5 benthic risk area (Alternative I addresses 64%), which is only 2% below the interim target and within the range of reasonable uncertainty. Additionally, EPA reported in FS Table 4.2-7 that Alternative B would actively remediate approximately 90 acres based on benthic risk; in contrast, the EPA-approved BERA concluded that there is 61 acres of benthic risk based on the CBRA.

Importantly, the BERA-modeled sediment quality values (SQVs; referred to as SQGs in EPA's FS) were not used as intended. As stated in the Resolution of EPA September 27, 2010 Comments on Benthic Risk Evaluation, "EPA and the LWG recognize that the sediment quality guidelines produced by any model (LRM, FPM or generic SQGs such as PECs or PELs) are intended to be used as a set – not individually" (LWG 2011).

Because the approaches are different, the areas of benthic risk identified in the EPA-approved BERA are not the same as the benthic areas identified in EPA's FS. In addition, several discrepancies are identified when the RAO5 PRGs (FS Table B-4 PRGs) are compared with BERA SQVs. Some of the identified issues are listed below:

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[6] The CBRA area was provided by LWG's consultants and confirmed by Integral.

- The selected RAO5 sediment PRGs for DDT floating percentile model (FPM) and total petroleum hydrocarbon logistic regression model (LRM) SQVs are incorrect.
- The source of the selected DDE PRG is not reported by EPA in the FS.
- The Total DDx probable effect concentration (PEC) as reported by EPA in the FS is incorrect although it is not the source of the selected PRG.
- Cadmium is included in EPA's FS Appendix D to determine the area of benthic risk but the source of the SQV is not reported in EPA's FS Table B4-1.
- The source of EPA's FS reported Sum DDT FPM SQV of 246 µg/kg dw selected as the PRG is unknown.
- The BERA reported FPM Sum DDT L3 and L2 SQVs are 8,110 µg/kg dw for all endpoints, except Hyallela biomass which has an L2 SQV of 17 µg/kg dw (USEPA 2016b, Appendix G: Table 6-10).
- The source of the Sum DDE selected PRG is also not reported by EPA in the FS. It does not agree with LRM or FPM SQVs reported in EPA's FS or the BERA.

EPA's FS did not show the footprints of the benthic areas (10X RAO5) by COC, so it is not clear what the focused COC is for these benthic areas or whether they are related to the specific area. For example, the 10X RAO5 for DDx is 5,780 µg/kg; therefore, the benthic area for SDU 7W for DDx based on EPA's criteria would be only limited to sediment adjacent to Docks 1 and 2 as shown below in Figure 1.

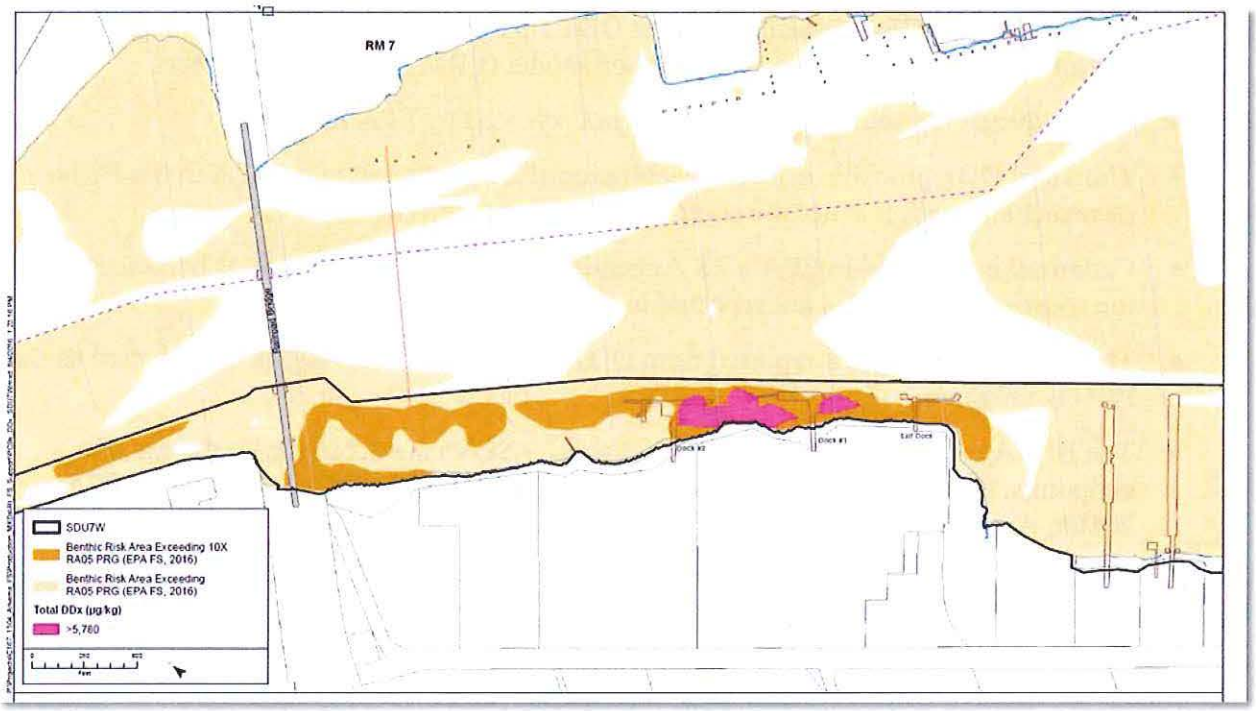

Figure 1. EPA's FS Approach to Benthic Areas for SDU 7W. (Source: Modified from USEPA and CDM Smith 2016.)

For Figure 1, LSS modified EPA's FS Figures D11-2 (showing the benthic areas exceeding RAO5 in light orange) and J2.4-3f (showing 10X RAO5 in dark orange) by overlaying the benthic area exceeding 10X DDx RAO5 (>5,780 µg/kg) PRG in dark pink for SDU 7W.

The 10X RAO5 for PCBs is 5,000 µg/kg; however, there are no surface sediment concentrations exceeding 5,000 µg/kg PCBs at SDU 7W. There are also no RAO5 PRGs for dioxins and furans. The area in Figure 1 also does not match the 10X RAO5 benthic areas in EPA's FS (Figures J2.4-3 series), nor does it match the CBRA in this area (see Figure 2 below). EPA's FS 10X RAO5 benthic area at SDU 7W is much larger, yet is evidently not related to SDU 7W COCs.

Figure 2. Approximate CBRA (green) within SDU 7W from LWG's draft FS drawn over EPA's FS Figure J2.4-3f. (Sources: USEPA and CDM Smith 2016 and Anchor QEA et al. 2012 [updated in 2015].)

EPA then arbitrarily concluded that for RAO5, if active remediation addressed 50% of this benthic risk area of concern, the alternative is "protective" on an interim basis. There is no scientific basis for EPA's abandonment of the EPA-approved BERA-based CBRA. When compared to simply using the CBRA approach, this new approach is not more accurate, not more consistent with the BERA, and not more predictive of benthic risk or effectiveness of the alternatives.

Most importantly, the benthic risk models used by EPA do not honor the measured data, despite the Proposed Plan acknowledging that the area of benthic risk identified in the BERA was primarily based on use of laboratory sediment toxicity tests. In addition, the LRM and FPM are modeling methods that yield predictions using data from the sediment toxicity tests. It is problematic that much of the available data is not appropriately honored in either model.

Any modeled risk for benthic invertebrates that ignores actual toxicity testing results (empirical data) needs to be assessed in weight-of-evidence and SDU-specific decision-making. The benthic risk areas must not extend into areas shown to have a lack of toxicity based on actual empirical laboratory toxicity tests. Figure 3 shows the locations and empirical toxicity test results for SDU 7W.

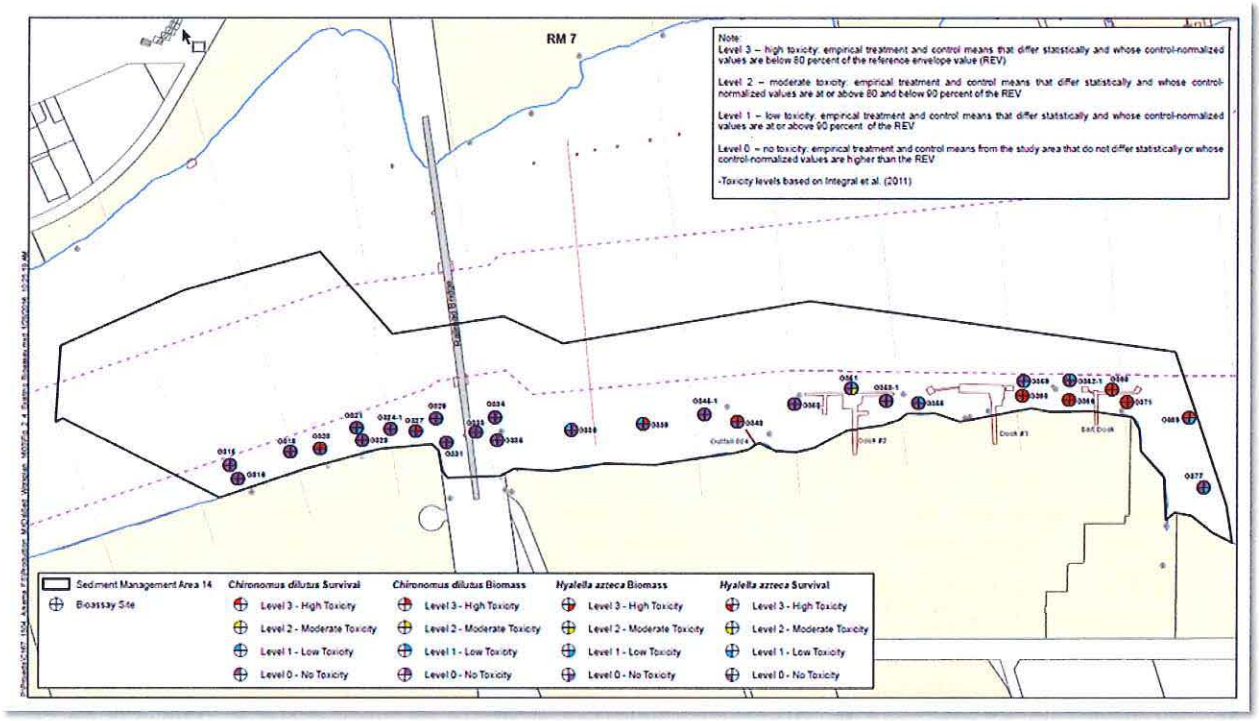

Figure 3. Existing Site-Specific Bioassay Test Results from SDU 7W. (Source: Integral 2016a [Attachment 1].)

The error of ignoring empirical benthic toxicity measurements has been carried through the alternatives analysis and therefore has biased the selection of alternatives for SDUs, specifically SDU 7W. EPA must not ignore actual toxicity testing when designing a remedy. Where no unacceptable risk actually exists, no remedial action is warranted (USEPA 1999).

Also, EPA's method of modeling reduction in benthic risk at the end of active dredging and capping fails to take into account the significant difference in time that the various alternatives are projected to take. As further discussed below, EPA's time estimates for its remedial alternatives are significantly understated and compressed; more realistic time estimates would affect the benthic risk reduction calculation significantly. If there is a large difference in time between completion of construction for two alternatives, EPA needs to take into consideration the MNR that would occur between completion of the shorter-lived alternative and the time that construction of the longer-lived alternative would take.

3.2 LSS Evaluation and Recommended Corrective Action

EPA's proposed alternative identifies areas for cleanup based upon single point exceedance of a PRG; these locations may or may not represent actual benthic risk areas when evaluated by the methods used in the BERA or more importantly if compared to existing empirical benthic toxicity tests. Relevant information, including data collected in pre-remedial design or remedial design work led by actual benthic toxicity testing, should be evaluated consistent with the EPA-

approved BERA to confirm and refine benthic risk areas for active remediation, not by using single point exceedances.

The observed toxicity from previous studies in the vicinity of the Salt Dock at SDU 7W were likely the result of elevated dissolved salt concentrations, measured as chloride and conductivity, in groundwater discharging in the area adjacent to the former Salt Dock. Reduction in chloride concentrations in groundwater collected from a monitoring well (MW-30) just north of the Salt Dock decreased by more than 90% from 2002 to 2009. This reduction occurred after the cessation of operations at the Arkema site and removal of salt from the Salt Pads, but prior to the installation of the groundwater barrier wall. Therefore, the measured benthic toxicity was likely due to dissolved salt in shallow groundwater flushing through the system including through the nearshore sediments during the benthic toxicity testing timeframe (2004–2007). Beginning in late 2012, an upland groundwater source control remedy was implemented which has further mitigated the effects of dissolved salt in upland groundwater discharging to the sediments at the bioassay study stations near the Salt Dock, although there may still be some dissolved salt attenuating through the system. However, it is unknown whether non-salt-related toxicity is present at the stations near the Salt Dock. If not salt related, the cause of toxicity near the Salt Dock and other areas is unknown; this is contrary to EPA's flawed CSM, which incorrectly attributes the toxicity to DDx. As can be readily ascertained from Figure 3, there is no observed toxicity in the area between Docks 1 and 2, which is the area of highest DDx concentrations in sediment.

Although the CBRA (Anchor QEA et al. 2012) evaluation included empirical toxicity data, it ultimately relied on modeled/predicted bioaccumulation. This evaluation resulted in the prediction of a large footprint of potential benthic risk at SDU 7W; however, the causes of benthic toxicity were not investigated. A large part of the CBRA was driven by non-COCs like salt, modeled data incorporating uncertainties, and data not representative of current conditions. Modeled data tend to incorporate large margins of safety and other uncertainties, which are acceptable for understanding baseline conditions but not for carrying forward into the FS. For remedial assessments in the FS, refinement of benthic risk areas based on actual toxicity data should trump any modeled data because they validate the actual site conditions.

The sediment remedy will focus on reducing sediment concentrations of COCs; however, the planned remediation will not address benthic risk associated with dissolved salts from groundwater discharges, assuming dissolved salt is still present in sediment porewater at toxic levels. Chlorinated organics such as DDx are less likely to be the cause of benthic toxicity given the lack of correlation between DDx concentrations and observed toxicity in the previous toxicity tests and from the published literature. Moreover, because the previously implemented upland source control addresses upland groundwater plumes, including concentrations of dissolved salt, the previous benthic toxicity results and EPA's benthic areas do not represent current sediment conditions at SDU 7W.

Natural recovery has been occurring in sediments, and these processes may have affected COC concentrations and benthic toxicity. Therefore, a reassessment of benthic toxicity is needed to refine benthic risk areas for active remediation.

In early 2016, LSS proposed (and maintains the need for) additional sampling and benthic toxicity testing for SDU 7W to collect information in pre-remedial design or remedial design work to confirm and refine benthic risk areas for active remediation. The goals are to assess whether salt is a primary toxicant in sediment near the Salt Dock, to assess degree of toxicity and potential for unacceptable risk to benthic community, to identify any locations exhibiting toxicity based on COCs (not salt), and to attempt to identify the COC or COC group causing any toxicity.

It is assumed based on site knowledge and historical upland groundwater data that previously observed benthic toxicity in sediment near the Salt Dock is not due to COCs. With additional benthic toxicity evaluation, the benthic area would likely be reduced further as shown in Figure 4 below. So instead of using EPA's approach (which is arbitrary, does not honor measured toxicity data, and unnecessarily results in large benthic areas in SDU 7W and harborwide), a more robust and empirical approach is recommended using actual toxicity data as described in Integral's pre-remedial design sediment work plan (Integral 2016a; Attachment 1).

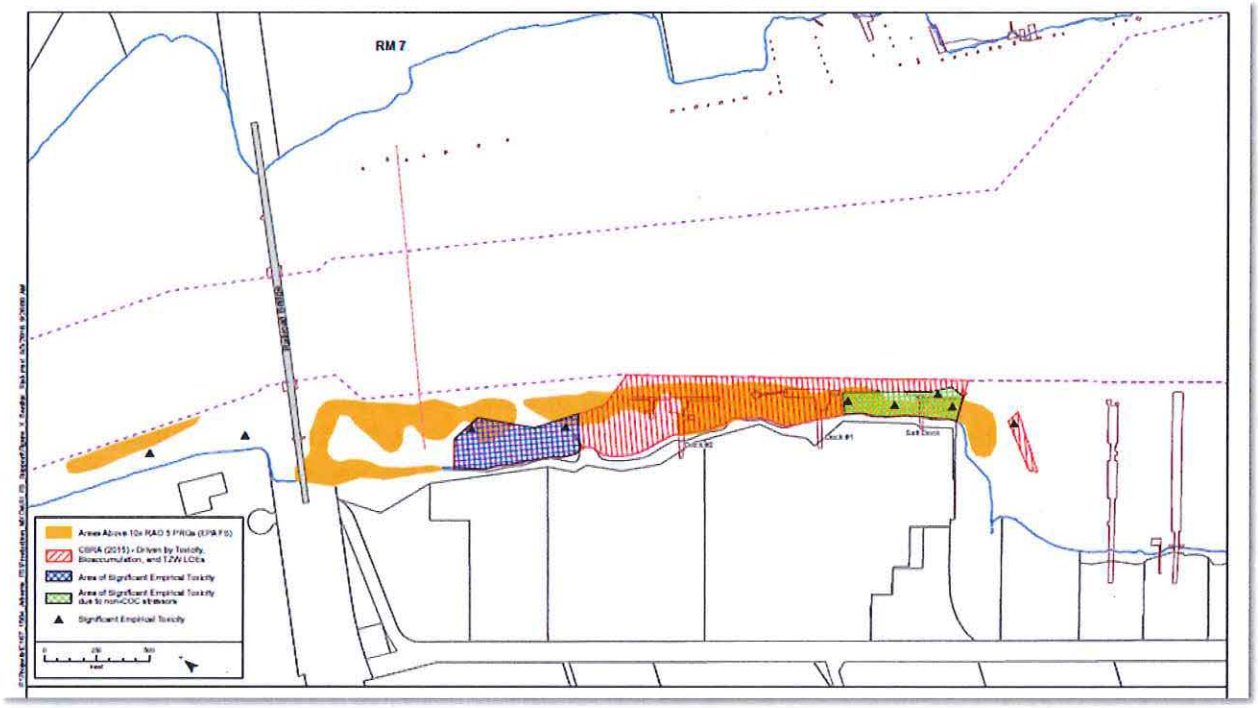

Figure 4. Benthic Areas based on Empirical Toxicity Results versus LWG's CBRA and EPA's Approach for SDU 7W. (Sources: Modified from USEPA and CDM Smith 2016 and Anchor QEA et al. 2012 [updated in 2015].)

For Figure 4, LSS modified EPA's FS Figure J2.4-3f (showing 10X RAO5 in dark orange) and LWG's CBRA (red hatched area) by overlaying the areas requiring focused pre-design investigation to verify and refine the approximate area of significant empirical toxicity (blue hatched area) and the area of significant empirical toxicity driven by non-COCs (green hatched area) for SDU 7W (Integral 2016a; Attachment 1).

4 Poor Definition of Sediment Background Concentrations

4.1 Issues with EPA's Evaluation

There are several issues with EPA's definition of sediment background for various COCs that have implications for determining whether remedial efforts are necessary or even achievable.

- The existing dataset is inadequate to calculate sediment background concentrations, most notably for dioxins/furans which results in high uncertainty in the dioxin/furan background concentrations.
- EPA continues to exclude data points considered outliers from the background dataset, which likely biases the calculated sediment background concentration low.
- Background values were not appropriately identified or utilized for surface water nor for fish tissue. Therefore, the post-construction risk assessment does not include a comparison to background conditions. In the case of water quality, background should be considered the only viable boundary condition for the cleanup.
- EPA's background values are below observed background in other urban waterways and do not consider ongoing inputs and loadings from the watershed and atmospheric deposition, as well as the impact of dredge residuals on post-remedial conditions. LWG provided an assessment of equilibrium conditions, which have not been considered in setting cleanup goals or in the evaluation of alternatives (LWG 2015).
- PRGs are set at or close to EPA arbitrarily derived background for several constituents, including PCBs and dioxins/furans, which are focused COCs for the remedial measures and SDU footprints. The use of background concentrations, that are uncertain to begin with, coupled with the lack of incorporation of ongoing sources and equilibrium conditions results in sediment remedies that are unattainable. Where risk-based PRGs are below background, risk management principles should guide the development of PRGs that incorporate these considerations (i.e., PRGs should be set above the calculated background levels at a level likely to be achievable). This is in keeping with the use of sound, scientific analysis and risk management principles, which are hallmarks of EPA policy and guidance for decision-making at Superfund sites (USEPA 1992, 1997; see also Section 6 of this letter).

4.2 LSS Evaluation and Recommended Corrective Action

4.2.1 Sediment

EPA's proposed background values are based on inappropriately derived upstream bedded sediment statistics that cannot represent achievable cleanup levels for the Site as they do not account for anthropogenic influences, which are documented in the scientific literature to exist throughout the Willamette basin. Furthermore, the background calculations inappropriately exclude outliers; LWG has commented on this in the past, including through a dispute process (LWG 2014b; Attachment 5). EPA's FS also does not present background concentrations for

surface water and does not present sediment background concentrations for all chemicals with sediment PRGs.

A sediment remedy must include evaluating what is deposited within the Study Area, both physically and chemically (i.e., potential future bedded sediment equilibrium). EPA has not conducted such an evaluation. The assumption that background sediment concentrations are the same as equilibrium is invalid. The cleanup goal for PCBs of 9 parts per billion (ppb) based on EPA's calculation of background concentrations is not achievable or sustainable by existing technology nor by nature itself. Experience gained at other sediment remediation projects conducted nationally and in Region 10 strongly argue that it is scientifically and technically inappropriate to use background as has been presently calculated to establish cleanup goals when likely ongoing contaminant inputs from upland sources within the Site and upriver of the Site exceed EPA's calculation of background. LWG provided EPA with an evaluation of equilibrium concentrations for the Site (LWG 2014a, 2015). For PCBs, the equilibrium value was estimated as 20 ppb. Equilibrium values need to be estimated for the other focused COCs (cPAHs, dioxins/furans, and DDx). LWG (2015) also urged EPA to recognize that background cannot be defined as a bright line, but rather should be recognized to encompass a range of concentrations, stating that:

> EPA's dispute resolution acknowledges that EPA's upriver background values are unattainable due to regional sources (throughout the 11,500 square miles of Willamette River watershed); therefore, those values cannot be achieved by the sediment remedy for the site. It remains to be seen if or how EPA will incorporate these factors into developing achievable cleanup levels. We continue to urge EPA to express background sediment concentrations as ranges (e.g., 6 to 19 µg/kg with outliers removed, and 14 to 60 µg/kg for the full data set for PCBs) and fully consider equilibrium (e.g., calculated to be a median of 20 µg/kg PCBs and in the range of 7 to 35 µg/kg using empirical lines of evidence).

PRGs must not be at natural background without considering and factoring in the influence of ongoing anthropogenic inputs, both upstream and in the urban watershed. PRGs set at background or detection limits are inherently unachievable. When background and the PRG are the same, just the error in measurement limits the ability to achieve such a PRG, especially given the small background dataset and its limitations. When this is coupled with ongoing sources (page 5 of the Proposed Plan as well as Section 10 of the RI discuss ongoing urban sources and offsite sources and loadings) and the impact of dredge residuals, PRGs set at these pristine background levels are recognizably unattainable.

In addition, the risks due to background were not estimated or accounted for in the assessment of risk reduction. In fact, several of the post-construction calculated sediment concentrations are below background levels and the estimate of equilibrium concentrations, which is not feasible. Equilibrium conditions should be treated as "boundary conditions" because risk reduction below site-specific equilibrium conditions cannot be achieved; thus, PRGs must be set at levels that are achievable through a risk management step that considers dynamic sediment conditions.

Table 1 presents a summary of the sediment background values from the draft RI, final RI, and EPA's FS. More specific detail is provided below for PCDD/F compounds in sediments and other COCs and media.

Table 1. Summary of Background Sediment Data

		2011 Draft RI			Final RI	FS	
		Max	95UCL (w/outliers)	95 UCL (no outliers)	95 UCL (no outliers)		Other Urban Watersheds
COC	Units	Dry Weight	OC equiv	OC equiv	OC equiv	OC equiv	Dry Weight
1,2,3,4,7,8-HxCDF	pg/g	16	2.0	0.21	NA	0.4	
1,2,3,7,8-PeCDD	pg/g	4.2	0.29	0.06	NA	0.2	
2,3,4,7,8-PeCDF	pg/g	1.8	0.17	0.23	NA	0.3	
2,3,7,8-TCDD	pg/g	4.9	0.34	NA	NA	0.2	
2,3,7,8-TCDF	pg/g	1.2	0.44	0.27	NA	0.3	
Sum of 5 congeners	pg/g	28	3.24	0.77	NA	1.4	
Total TCDD TEQ	pg/g	19	3.5	1.9	NA	NA	2–12
Total Dioxins/Furans	pg/g	NA	NA	NA	100	NA	
PCBs (Aroclors)	µg/kg	48	14	16	9	9	
DDx	µg/kg	6.7	1.9	2.9	3.1	3.1	

4.2.1.1 Background Concentrations for PCDD/F Compounds in Sediment

Background PCDD/F concentrations for individual congeners are presented in Appendix B, Table B2-4 of EPA's FS. EPA uses new methods for deriving these FS levels that appear arbitrary and significantly different from both EPA's methods for other chemicals as well as past LWG input on this subject. Sediment PRGs for RAO2 and RAO6 as well as riverbank PRGs for RAO9 for the five PCDD/Fs congeners are improperly based on a misapplied concept of background concentration.

The background values are based on limited and poor quality data (with elevated detection limits). In fact, only one congener has sufficient data (1,2,3,4,7,8-HxCDF) to calculate a background value and even that is limited (13 of 31 samples were non-detects). Thus, most of the background "values" are based on a 95% upper confidence limit (UCL) of the detection limits. The background values also appear skewed quite low compared to other urban watersheds and are of similar uncertain statistical validity. Table 2 presents dioxin/furan TEQ background concentrations using EPA-directed calculation methods (LWG 2014a).

Table 2. Dioxin/Furan TEQ Dry Weight and Organic Carbon-Equivalent Background Statistics Using EPA-directed Calculation Methods (LWG 2014a).

	95% Upper Prediction Limit, µg/kg		95% Upper Confidence Limit, µg/kg	
Analyte	Outliers Included	Outliers Excluded	Outliers Included	Outliers Excluded
D/F TEQ (mammals 2006) Dry Weight	0.0034	0.00266	0.00279	0.00127
D/F TEQ (mammals 2006) OC-Equivalent	0.00549	0.00427	0.0045	0.00205

Note:
µg/kg=micrograms per kilogram

Based upon an August 20, 2015, e-mail message from EPA Region 10, EPA has been aware of the serious data limitations associated with dioxins and furans at SDU 7W. According to this e-mail, these data limitations were well known to EPA Region 10, who conveyed their concerns to the LWG (Allen 2015, pers. comm.; Attachment 6). Based upon EPA's acknowledgement of the severe limitations, these data are scientifically inappropriate for the purpose of promulgating PRGs.

EPA's estimated background values based on this limited data set and flawed approach are low and approximately an order of magnitude lower than values from other regions and watersheds. For example, a memorandum published by EPA in 2010 provides a good summary of background levels for dioxins/furans in sediment, which range from approximately 2–5 parts per trillion (ppt) as toxicity equivalents (TEQs). It also summarizes values from Puget Sound which include a TEQ value of 4 ppt for non-urban areas but allowing up to 10 ppt as TEQs for open water disposal; this value is also used in San Francisco Bay and elsewhere (USEPA 2010). The Duwamish Waterway FS establishes an upper bound background value for dioxins/furans as 11.6 ppt TEQ.

Background values in other regions and watersheds are expressed as TEQs, which is generally the manner in which cleanup goals for dioxins/furans are expressed. For Portland Harbor, EPA has arbitrarily and without justification used 5 individual congeners. The individual congener background values provided in Appendix B of EPA's FS and in the PRG tables for RAOs 2 and 6 can be converted to TEQs using toxicity equivalency factors (TEFs), which results in a value of 0.56 ppt on a TEQ basis (since according to EPA the 5 congeners equate to the majority of the risk, this value may be slightly biased low, but probably less than 10% of the total TEQ). This background value is an order of magnitude or more lower than the range of background TEQ values, mainly for non-urban areas, from the literature. A study to better define background levels for dioxins/furans is, therefore, necessary since the calculated risk-based PRGs are well below even these low-biased background levels resulting in the background values being adopted as the final PRGs. Without additional data collection, it is unlikely that the proposed remedies for dioxins/furans will be successful, and furthermore the estimated risk reductions for dioxins/furans will not be realized. This compounded effect strikes directly at the validity of the alternatives analysis and results in a biased outcome.

It should also be noted that no background values are listed for RAOs 1 or 3. Those PRGs are expressed as TEQs, and data is lacking to identify a background level on a TEQ basis. This needs to be rectified because those PRGs may also be below background. In fact, the PRG for RAO3 is 4 orders of magnitude below the maximum contaminant level (MCL) and is likely not measurable at that level. Overall, providing PRGs that are below MCLs is inconsistent with other cleanup actions under CERCLA or other programs. Cleanup to below MCLs is likely unachievable.

4.2.2 Background Concentrations for Other COCs and Media

EPA's FS (Section 2.2.2.4) states that only sediment background concentrations were estimated and background concentrations for other media could not be calculated due to insufficient data. However, statistics were provided for upriver surface water concentrations in the Draft RI (Integral et al. 2011). Upriver surface water concentrations of focused COCs are orders of magnitude higher than the applicable or relevant and appropriate requirements (ARARs) based on ambient water quality criteria (AWQC). This is also consistent with the fact that the Willamette River is on the 303d list for these same COCs upstream of the Portland Harbor Superfund Site. These values can be compared with the upriver surface water concentrations such as upper prediction limits (UPLs), upper tolerance limits (UTLs), or UCLs. For example, the upriver UCL concentrations reported in the draft RI (dissolved concentrations with outliers removed; Table 7-4b of the draft RI [Integral et al. 2011]) for DDT, PCBs, and TCDD TEQ are all significantly higher than the respective ARAR-based PRGs for these substances:

- Upriver UCL for DDT = 0.000114 µg/L and the ARAR (RAO3) is 0.00002 µg/L
- Upriver UCL for PCBs = 0.000126 µg/L and the ARAR (RAO3) is 0.000006 µg/L
- Upriver UCL for TCDD TEQ = 0.000126 µg/L and the ARAR (RAO3) is 0.000000033 µg/L.

Not only should these upriver data be used to adjust surface-water-based PRGs, but they should also be used in the food web model (FWM).

4.2.2.1 Background in Fish Tissue

Page 19 of the Proposed Plan acknowledges that risks cannot be attributed wholly to the Site. EPA provided a summary of regional tissue concentrations. Note that the data from these studies are older and less focused than the data collected for the Portland Harbor RI, which included 12 fish samples from upriver. EPA, however, did not include these upriver fish data or an evaluation of background risk associated with consumption of fish not impacted by Portland Harbor.

Detected concentrations of PCBs for upstream whole body smallmouth bass ranged from 123 to 317 ppb with a mean of 238 ppb. If the whole-body-to-fillet conversion factor utilized in the baseline human health risk assessment (BHHRA) is applied, a mean smallmouth bass fillet concentration of 38 ppb can be estimated. The average smallmouth bass fillet concentration in the BHHRA was 166 ppb. The RAO2 PRG for fish tissue PRG of 0.5 ppb, therefore, is two orders of magnitude less than the upstream (background) fish. EPA neglects to recognize this limitation and ignored this important aspect of risk management. If an exposure point

concentration (EPC) of 38 ppb is plugged into the post-construction risk estimate calculation for Alternative A (no action; see Table J2.3-1a of EPA's FS), a risk of 8E-5 is estimated. EPA should have set the target risk for the PRG in this range. No real consideration of the limitations of upstream background conditions was used in setting target risks, although a tissue concentration of 23 ppb was identified as associated with the PRG set at EPA's arbitrarily derived background level of 9 ppb (see Table J1-2 of EPA's FS). Given upstream conditions, a sediment concentration closer to the equilibrium-based value of 20 ppb is more reasonable (LWG 2014a).

The final RI (USEPA 2016b, p. 8-14) stated:

> Regional Tissue Concentrations. PCBs and dioxins/furans have been detected in fish tissue collected in the Willamette and Columbia rivers, outside of the study area. In the Columbia River Basin Fish Contaminant Survey, the basin-wide average concentrations of total PCBs in resident fish ranged from 32 to 173 parts per billion (ppb) for whole body samples and from 33 to 190 ppb for fillet with skin samples (USEPA 2002e). In the middle Willamette River (RM 26.5 to 72), the average concentrations of total PCBs in resident fish ranged from 86 to 146 ppb for whole body samples and from 26 to 71 ppb for fillet with skin samples (EVS 2000). The regional tissue concentrations may be associated with unacceptable risks from fish consumption, especially at higher consumption rates. However, these regional concentrations are lower than the concentrations detected in the study area, where average concentrations ranged from 16 to 2,800 ppb in whole body samples and from 0.17 to 2.5 ppm in fillet with skin samples (for PCBs as total congeners). The fish species included in the studies were different than those collected within the study area, so the concentrations may not be directly comparable. Sources contributing to the PCBs and dioxins/furans detected in fish collected outside of the study area are unknown and may not be relevant to the study area.

EPA's FS correctly concludes that the majority of potential sitewide human health risk arises from exposure to PCBs through fish consumption. However, there are additional human health risks associated with non-site-related ingestion of upstream fish, as detailed above, as well as non-site-related mercury, which limits the amount of resident fish that can be safely consumed from this Site. EPA's FS estimates that a PCB RAL of 1,000 µg/kg would reduce sitewide PCB sediment concentrations to 74 µg/kg after 4 years of construction, a 64% reduction in sitewide concentrations. EPA's proposed alternative would take nearly twice as long to complete, but would reduce sitewide PCB concentrations by only an additional 17%, to 40 µg/kg, which is in the range of upstream fish concentrations. Notwithstanding the additional time and cost (about $350 million by EPA's estimate), by EPA's own calculations, the approach proposed by EPA would not support any allowable increase in fish meals at the end of construction beyond those that would be achieved through application of a PCB RAL of 1,000 µg/kg. Regardless of the cleanup criteria selected for PCBs or the ultimate effectiveness of the cleanup action, the most vulnerable subsistence fisher will be restricted to only one (1) resident fish meal per month as a consequence of the presence of high levels of non-site-related mercury in tissue throughout the Site based on the Oregon Health Agency (OHA) (which advises healthy adults to eat no more

than one 8-ounce resident fish meal per month due to PCBs in the Portland Harbor Site and mercury in the Willamette River mainstem, which includes the Portland Harbor Site).[7]

EPA is relying on unsupported assumptions, making determinations without a basis in science, and is misleading the public about what can be achieved in a manner that falls within the definition of arbitrary and capricious. EPA does not have a sound technical basis for representing that cleanup goals, particularly for PCBs, are achievable at the Site. The extremely low concentrations of PCBs in sediments and fish tissue used for remediation goals are not attainable, as demonstrated by the Willamette River upstream reference PCB sample data and reference data from other regional streams. EPA's claims that CERCLA fish advisories will be removed when cleanup goals are met and protectiveness is achieved is disingenuous and misleading to the public. The Proposed Plan acknowledges that regardless of which alternative is selected, fish advisories will be unchanged for mercury and other contaminants for which there is no relationship between fish tissue and sediment concentrations. In evaluating risk reduction at the Site, it is important to emphasize that the fish advisory based on mercury will not be removed because the source of mercury is primarily upstream agricultural runoff that is beyond the scope of the Superfund cleanup to address. EPA acknowledges this fact but asserts that it is critically important to remove the Superfund-related persistent pollutants (e.g., PCBs) from the environment. LSS agrees that removing persistent pollutants is important. However, mercury, like PCBs, is also a persistent pollutant that has sources outside of the Portland Harbor and will remain in the river after the cleanup is completed. Accordingly, LSS assumes OHA's fish advisory with respect to mercury will remain in place. To a person eating fish from the Site, the issue of critical importance is guidance from a credible health agency on how much fish is safe to eat, regardless of whether the contaminant is PCBs (site-related or non-site related upstream) or mercury (non-site related).

EPA's Proposed Plan position on eating fish from the lower Willamette River is in stark contrast with the U.S. Food and Drug Administration (FDA) and EPA position on the levels of these same contaminants allowed in fish (e.g., PCB safe level of 2 parts per million [ppm] in edible portions, FDA 2011) purchased for consumption from the supermarket. This amounts to conflicting messages that are confusing to the public.

Other public health agencies balance the potential health effects from contaminants against the benefits from eating fish (USEPA 2016d). In its FS and Proposed Plan, EPA has given no indication that it has similarly considered the benefits from eating fish in establishing its very conservative "fish meals per 10 years" amounts.

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[7] Fish consumption is limited within the Willamette River to 4 meals per month for the general population and 1 meal per month for vulnerable populations (includes children under age 6, women of childbearing age, and people with thyroid or immune system problems) due to mercury for all resident fish species; bass are of particular concern statewide.

4.2.3 LSS Evaluation and Recommended Corrective Action

Because of the deficiencies in determining the background levels, a new background study for sediment, surface water, and tissue needs to be conducted during the pre-design phase. The results of this evaluation need to be used to update PRGs, RALs, and SDUs.

Background concentrations as presently calculated should never be used to establish cleanup goals when likely ongoing contaminant inputs from upland sources within the Site and upriver of the Site exceed EPA's calculated background concentrations. A better approach was provided by LWG—using equilibrium-based values in combination with risk management decision-making—as described below in Section 6.2.1.

In summary, EPA is evaluating cleanup alternatives based upon addressing risks that are caused by background conditions, and cannot possibly be achieved by way of a sediment cleanup in Portland Harbor. EPA must utilize risk management principles to select a remediation alternative consistent with achieving a risk similar to that driven by upstream conditions.

It is important to achieve risk reduction at the Site. But the basis for the desired outcome should be explained, the outcome should be achievable, and the means to achieve that outcome should be reasonable and cost-effective. EPA's failure to show how its concept of risk reduction meets these basic requirements is another indication that its remedy selection process is arbitrary and capricious.

5 Failure to Incorporate the Role of Upstream Surface Water in Fish Tissue Concentrations

5.1 Issues with EPA's Evaluation

As mentioned previously, the CSM is inadequate due to several errors of omission. Some of the more illustrative examples of these errors of omission include the non-steady state dynamics of PCBs and DDx in surface water. The effect of this omission is to under-appreciate the likely importance of water quality on fish tissue effects for DDx. This omission leads to the unsupportable premise that sediment remediation alone can result in acceptable levels of DDx in fish tissue, a premise that ignores eight rounds of surface water data that demonstrate significantly higher concentrations of DDx are entering the Site during times of high winter flow than are present during the summer or fall (Integral et al. 2011). Further, none of the surface water samples for DDx or total PCBs taken during either high or low flow conditions entering the Site from upstream obtained during the RI were below EPA's New/Updated CWA 304(a) Human Health Criteria based on fish consumption risk. These errors could have been avoided had EPA followed standard practice that "...all sediment sites should include the development of a CSM that identifies watershed inputs and characterizes background conditions" (ITRC 2014, p. 59). Based upon the surface water quality data, it is very unlikely sediment remediation can achieve the desired tissue-related outcomes.

The CSM also failed to account for the risk, arising as a consequence of factors outside the model domain, associated with the consumption of resident fish because of the widespread

occurrence of unacceptable levels of mercury in such fish tissue. By this error of omission, EPA's FS and Proposed Plan overpredict the utility of all remedial options by considering only the effect of the remedial action on a few substances, not including mercury. Ultimately, mercury will remain the limiting human health risk factor associated with the consumption of resident fish at the Site. The most sensitive individual will still be allowed only one resident fish meal per month following even the most aggressive remedy.

5.2 LSS Evaluation and Recommended Corrective Action

The contribution of upstream surface water concentrations to fish tissue needs to be incorporated into the CSM, and it is critical to consider this contribution when assessing the potential for risk reduction of each remedial alternative. Upstream PCB and DDx concentrations in surface water samples collected during the RI are all above EPA's New/Updated CWA 304(a) Human Health Criteria, and a sediment remedy will not provide any risk reduction below the risk already posed by upstream surface water concentrations. Upstream surface water, sediment, and tissue concentrations need to be fully considered during alternative selection to adequately assess the risk reduction of each alternative and to ensure the selection of achievable PRGs.

6 Inappropriate Evaluation of Risk

6.1 Issues with EPA's Evaluation

Several fatal flaws have been identified with EPA's risk evaluation in its FS and Proposed Plan. Key points are discussed below.

- The Proposed Plan fails to utilize risk management in setting cleanup goals and developing the remedial alternatives.
  - There was no real risk management step between the RI and FS phases, i.e., no narrowing of COCs, pathways, media, or receptors, or refining of risk assumptions (e.g., ingestion rates). On the other hand, EPA developed RALs only for a set of focused COCs; therefore, "PRGs" should only be set for those chemicals and media (sediment) that can actually be remediated (e.g., not fish tissue) to avoid a confusing evaluation that lacks transparency.
  - Background risk and equilibrium conditions were not fully factored into the cleanup goal or remedy development (see Section 4).
  - Although the 10^{-4} or 10^{-5} RAO2 PRGs were presented in Appendix B of EPA's FS, no discussion of these PRGs was included, and no risk management discussion per EPA's own risk management guidance was provided.
  - There is risk inequality in the post-construction estimates, including the setting of final PRGs and target levels, for various compounds (e.g., some are based on EPA's arbitrarily derived background and some on 10^{-6} risk).

- Methods to evaluate post-construction risk were inconsistent with the BHHRA and BERA and lack transparency.
  - The set of COCs presented for the various post-construction risk estimates varies without explanation. For example, in addition to the focused COCs, the list of COCs by river mile includes arsenic, aldrin, dieldrin, chlordane, and lindane.
  - The post-construction Sitewide risk was estimated differently for rolling river mile and SDU risks and, therefore, is not comparable.
  - HxCDF appears to be a focus for risk at SDU 7W for the Proposed Plan; EPA's risk calculation in the Proposed Plan is much higher than reported in the EPA-approved BHHRA, without explanation or scientific basis. This is likely due to the inconsistent methods of estimating SWACs, averaging data, and use of modeled fish tissue concentrations.
  - Risk reduction is not accurately represented. The combination of the use of zero as replacement values in calculating post-construction SWACs (for removal and capping technologies) and the lack of incorporation of estimates of MNR/enhanced natural recovery (ENR) in any of the remedies, overestimates risks from remedies that include more capping and MNR/ENR and underestimates risks for removal technologies (i.e., ignores the impact of dredge residuals).
  - Spatial techniques are duplicative, confusing, overly complicated, and do not accurately represent potential exposures. Furthermore, these methods produce disparate risk estimates that overlap and do not contribute to an understanding of the relative risk reduction for the various alternatives.
- The risk estimates and remedy development for dioxins/furans is flawed.
  - EPA has continued to waiver on methods to assess dioxins/furans and veered from the standard approach used in the EPA-approved BHHRA, which is to assess dioxins/furans as 2,3,7,8-TCDD toxic equivalents (with exception to the rolling river mile assessment).
  - EPA initially looked at 2,3,4,7,8-PeCDF as an indicator chemical for dioxins/furans; later EPA decided to use 5 congeners that represented the majority of the dioxin/furan risks as TEQs. EPA's FS and Proposed Plan narrowed this to 3 congeners for the development of RALs, with no explanation or scientific support for this shift at the last moment.
  - The approach used in EPA's FS and Proposed Plan to estimate post-construction risks overestimates risks by two orders of magnitude; most notably, 1,2,3,4,7,8-HxCDF is curiously portrayed to be the focus of risk for dioxins/furans when it contributed less than 5% to the total dioxins/furans risk in the BHHRA.

6.2 LSS Evaluation and Corrective Action

6.2.1 Lack of Use of Risk Management Principles

One of the first steps in going from the RI to the FS should include a narrowing and focusing of the assessment on those chemicals, receptors, and pathways driving the risk and remedy. U.S. Department of Energy guidance on developing remedial goals indicates that PRGs should be developed for those chemicals that are the major contributors to unacceptable risks or hazards (DOE 1997). EPA ultimately bases the remedy in the Proposed Plan on mass reduction for a set of focused COCs and risk-driving pathways (primarily RAOs 1 and 2). Therefore, PRGs are only necessary for these two RAOs: for sediment, for which RALs and alternatives were developed; and with the post-construction risk evaluation designed to show the protectiveness of these alternatives for all RAOs. The values for other media (e.g., fish tissue, surface water) must not be "PRGs" but rather "monitoring tools" (since they are not being directly cleaned up but rather targeted for reductions in concentrations based on the sediment cleanup). Groundwater, porewater, and river banks must be addressed primarily as part of source control; therefore, PRGs are not needed in the Proposed Plan. Fish tissue, groundwater, surface water, and porewater should be evaluated for change.

Although EPA's derived background concentrations are provided for sediments, the Proposed Plan does not provide any specific comparison to actual background or equilibrium conditions or risk for context. The risk management step during PRG development, as well as the post-construction risk evaluation, should include a calculation of risks at equilibrium and considerations of upstream conditions that will limit the ability to achieve RAOs (see Section 4). All risk reduction estimates should be compared to risks at equilibrium. Figure 5 below was plotted to compare EPA's arbitrarily derived background risk and COC risk for SDU 7W for Alternative I and Alternative E. Equilibrium-based risks are also plotted.

EPA's background risks for some of the COCs (PeCDD and TCDD) are greater than post-construction SDU 7W risk for Alternative I and Alternative E. For PCBs, equilibrium-based risk is similar to SDU 7W risk under Alternative I, as shown in Figure 5.

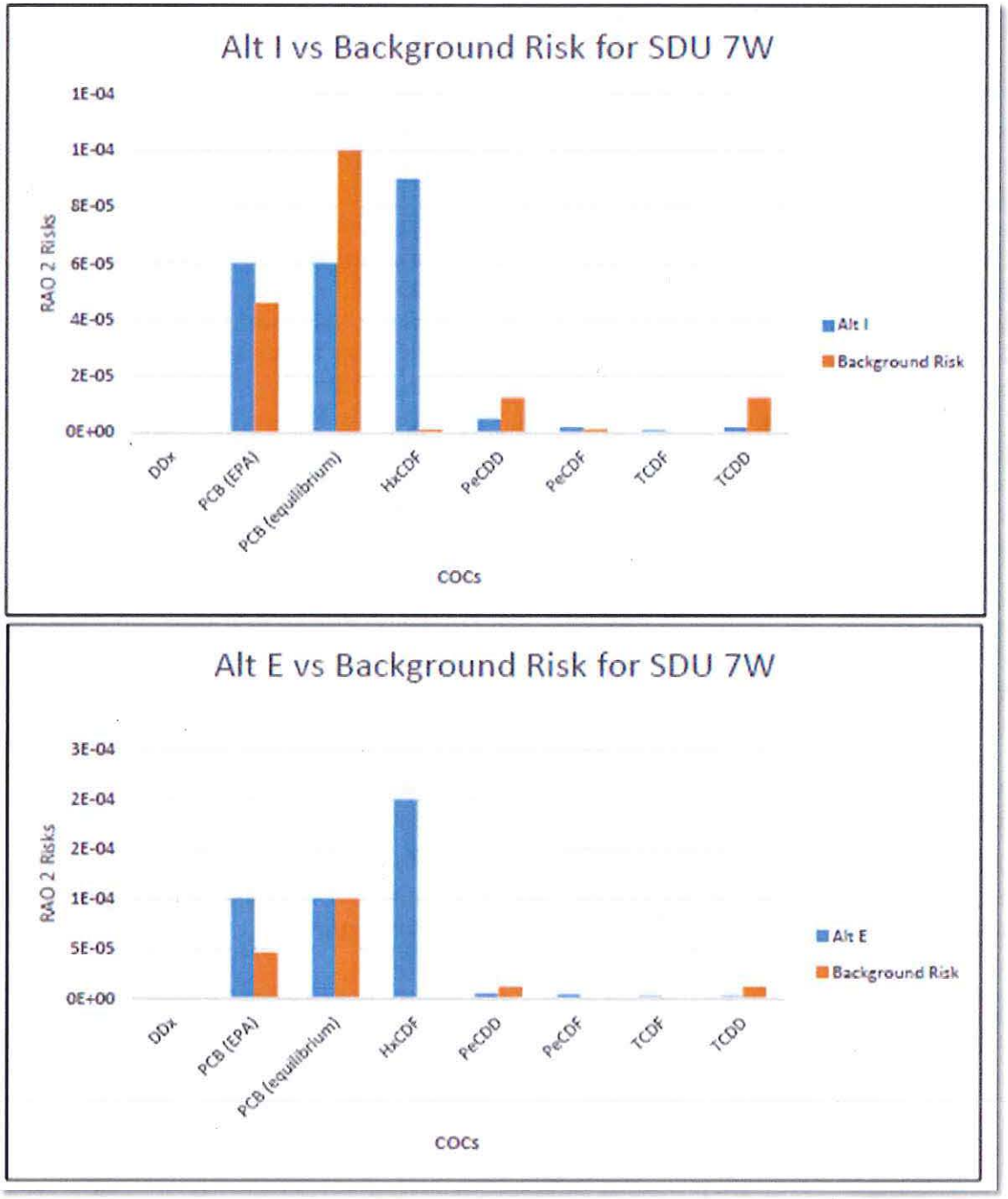

Figure 5. LSS Calculated Site and Background Risks for SDU 7W for Alternative I and Alternative E. For PCBs, risks based on EPA derived background (9ppb) and at equilibrium (20 ppb) are presented. (Source: Created using values from USEPA 2016 and CDM Smith 2016.)

For Figure 5, LSS plotted the graphs using sediment concentrations presented in EPA's FS (Appendix J). Background risk for PCBs is based on EPA's derived background concentration

of 9 ppb (Table J1-2 of EPA's FS); estimated background risks for other COCs and equilibrium-based value for PCBs assume a linear relationship with sediment concentrations.

Table J1-2 of EPA's FS shows that sitewide residual risks (i.e., the risk associated with the final PRGs) range from 3E-05 to 8E-05 primarily from the PRGs for PCBs and dioxins/furans, which EPA sets at their calculated background levels; this, therefore, represents a boundary condition. The residual hazard indices (HIs) range from 45 to 132 for the infant and from 2 to 6 for the child (RM/SDU and sitewide, respectively), and are also based on background levels of PCBs and dioxins/furans. Based on PCB concentration at equilibrium, LSS estimated a risk of approximately 1E-04, an HI for child of 11, and an HI for infant of 236, sitewide. Based on the boundary conditions and limitations expressed above, as well as EPA's own risk management guidance, EPA should have considered setting the target risk between 1E-05 and 1E-04. The following excerpts from EPA's guidance (USEPA 1991) provide context for setting risks above the point of departure of 1E-06:

- Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than E-04, and the non-carcinogenic hazard quotient is less than 1, action generally is not warranted unless there are adverse environmental impacts. However, if MCLs or non-zero MCLGs are exceeded, action generally is warranted.
- The upper boundary of the risk range is not a discrete line at 1E-04, although EPA generally uses 1E-04 in making risk management decisions. A specific risk estimate around E-04 may be considered acceptable if justified based on site-specific conditions.

Smallmouth bass upstream of Portland Harbor have a whole body concentration of 238 µg/kg on average. Applying the whole body to fillet ratio from the BHHRA of 0.16 provides a fillet concentration for upstream fish of 38 µg/kg. The tissue PRG from EPA's FS is 0.5 ppb, and the final PRG based on the EPA's derived sediment background concentration of 9 ppb results in a modeled tissue concentration of 23 ppb. The estimated equilibrium-based value of 20 ppb for PCBs should result in a fish tissue concentration of approximately 50 ppb, which is in the range of upstream fish tissue concentrations and corresponds to approximately 1E-04 risk. If current fish tissue concentrations are closer to 100 ppb (on a fillet basis), only a 2 or 3 fold decrease in sediment concentrations sitewide is warranted to reach equilibrium conditions. The current PCB PRG of 9 ppb represents a more than 20-fold decrease from EPA's sitewide no action SWAC (although this value may be overestimated, as discussed in Section 11.1.2, based on sampling conducted in 2014). A more achievable PRG for PCBs is in the range of 100 ppb. This type of analysis and risk management decision-making was not provided in EPA's FS or Proposed Plan.

EPA also should have considered modifying exposure assumptions in setting PRGs instead of continuing to utilize upper-bound fish consumptions rates of 142 g/day and 49 g/day for the subsistence and recreational fishers, respectively, even though no remedies can meet a 10^{-6} risk level due to background and upstream conditions (see the discussion about the fish advisory for mercury in Section 4.2.2.1). Instead, EPA continues to set the expectation that fish in Portland Harbor can be ingested at these high rates, which is misleading to the public since these rates of

fish ingestion will never result in acceptable risks, regardless of the degree of cleanup in Portland Harbor.

Risk targets and HIs were established by EPA in its FS "...to evaluate the potential for achievement of PRGs in a reasonable time frame" (USEPA and CDM Smith 2016, Section 4.1.3); however, these risk targets were not consistent between COCs and RAOs. As such, estimated post-construction risks were not consistent among the COCs (e.g., total PCBs has 5E-05 post-construction risk and DDx has 1E-06 post-construction risk for RAO2 [Appendix J, Table J1-2]). This inconsistency is mainly due to the very low and unattainable sediment PRG that was calculated using average fish tissue concentrations and AWQC for surface water inputs to the FWM, which resulted in very low or even "0" value PRGs. This then resulted in defaulting to background for several COCs. As discussed previously, remediation to EPA's arbitrarily derived background levels is not realistically achievable.

6.2.2 EPA's Approach to Post-Construction Risk Estimates is Flawed

EPA's FS adopts entirely new methods to estimate pre- and post-construction risks for the alternatives (Appendix J). The post-construction risk evaluation process is neither technically sound nor transparent. There is no rationale or a clear example provided for the process. EPA's FS states that methods used to evaluate post-construction risks are consistent with the baseline risk assessments, but this is not an accurate characterization of these methods. Some examples of differences in risk assessment methods and assumptions include:

- The BHHRA estimated risk based on upper bound sediment and fish tissue concentrations for fish consumption. The same approach was not used in the Proposed Plan assessment. Different data averaging methods and assumptions were utilized for the different SWAC estimates (sitewide vs. rolling river mile, and SDU-wide).
- The sitewide post-construction risk estimates are based on estimating a sitewide SWAC as the 95 UCL of the SDU-specific SWACs (which ignores spatial differences between SDUs), using the FWM to estimate concentrations in 4 fish species and average those, and then calculating risks based on an ingestion rate for a subsistence fisher of 142 g/day.
- The river-mile and SDU-specific risks utilize a SWAC calculated using different methods that is then divided by the risk-based PRG and multiplied by 10^{-6} (in the case of cancer endpoints). This approach assumes linearity in the FWM, which is not the case. More importantly for PCBs, the SDU/RM risk-based sediment PRG is reported by EPA (Table B3-5) as 0.31 ppb, which is less than EPA's derived background of 9 ppb by 30 times and less than the estimated equilibrium-based value of 20 ppb by 65 times. Therefore, the post-construction risks estimated by EPA for the SDUs/RM (Appendix J) are much higher, by an order of magnitude or more, leading EPA to select a more intrusive remedy to achieve target risk levels. A sediment PRG of 0.31 ppb is not achievable, and thus the post-construction risks calculated are meaningless. There is thus a disconnect in the rationale and basis for remediation and a clear error in judgment. The SDU/RM PRG must be based on more realistic PRGs. Even if background is selected as the SDU/RM PRG like it is for sitewide risks, then post-construction risks would be achieved using a much less aggressive remedy. Furthermore, the low risks estimated in Appendix J for the

more aggressive remedies are exaggerated given the use of zero replacement values in calculating post-construction SWACs, many of which are below background and equilibrium conditions, as discussed above.

- Fish meals/10 years was not used in the BHHRA, and no rationale was provided in EPA's FS for using this new unit.
- Some of the tables in Appendix J include arsenic, aldrin, chlordanes, dieldrin, and the dioxins/furans congeners 2,3,7,8-TCDF, 2,3,4,7,8-PeCDF, and 1,2,3,4,7,8-HxCDD, in addition to the focused COCs. Others are missing cPAHs (such as Table J2.3-1a). There is no explanation for this inconsistent approach.
- EPA uses 5 congeners to represent risks from dioxins/furans. In contrast, the EPA-approved BHHRA used dioxins/furans as 2,3,7,8-TCDD TEQs, which is consistent with guidance and approaches for dioxin/furan cleanups at sites throughout the U.S. and internationally.
- Sufficient explanation for these different approaches is not provided. This lack of consistency and transparency is another example of the process being arbitrary and capricious.

The difference in the risk assessment methods becomes apparent when the risks estimated for Alternative A (no action) are compared to baseline risks from the BHHRA; these risk estimates should be the same, yet are inappropriately not.

Table 3. Comparisons of Risk Estimates (RAO2, Subsistence Fisher) in the EPA-approved BHHRA and EPA's FS

	Sitewide		RM 7W (SDU-wide)	
COC	BHHRA	FS	BHHRA	FS
DDX	2E-5	2E-5	2E-5	3E-5
PCBs	1E-3	1E-3	1E-4	5E-4
Dioxins/furans (5 congeners; see detail below)	NA	9E-4	NA	2E-2
Dioxins/furans (TEQ)	1E-4	NA	4E-4	NA
All COCs	1E-3	2E-3	6E-4	2E-2

* All risks shown above are based on average tissue concentrations. The BHHRA evaluated risks differently than the FS, by river mile and not restricted to East or West, so comparisons are approximate.

The only spatial scale that allows for direct comparison of risks between the BHHRA and FS is the sitewide scale. Table 3 compares the risks calculated in the BHHRA based on average fish tissue concentrations and those calculated in EPA's FS for focused COCs except PAHs, which were inexplicably not included in the sitewide risk estimates in EPA's FS. DDx and PCB risks were approximately the same in the BHHRA and EPA's FS, but total risks were a factor of two higher sitewide and about 30 times higher at SDU 7W in EPA's FS. Dioxin/furan risks were an order of magnitude higher sitewide and 2 orders of magnitude higher at SDU 7W in EPA's FS.

As an example of the difference in methods between the EPA-approved BHHRA and EPA's FS, the average PCB concentration in the BHHRA based on actual tissue data was 160 µg/kg in bass and 2,500 µg/kg in carp, which includes a single outlier sample of 19,000 µg/kg (the average without the outlier is 353 µg/kg). The modeled tissue concentrations used for Alternative A are 352 µg/kg for bass and 820 µg/kg for carp, which are approximately 2 times higher than the measured tissue concentrations (excluding the single carp outlier). This difference in the fish tissue concentrations is one of the factors that leads to disparate estimates of baseline (i.e., No Action, Alternative A) risks.

The FS risks for Alternative A cannot be compared directly with the BHHRA because the FS risks for Alternative A are on a rolling river mile basis for both sides of the river and navigation channel, whereas the BHHRA risks were for an entire river mile. The risks for Alternative A are generally higher than those in the BHHRA (potentially due to spatial scale issues). In the BHHRA, risks at RM 11 were 1E-03 and all other risks were less than 1E-03. For Alternative A in the FS, there are several river segments with risks of 1E-03 or higher.

There continues to be an issue with EPA's modeled dioxin/furan tissue concentrations. In the BHHRA, the sitewide risk from the total TEQ based on the 95% UCL or maximum concentration for actual tissue data was 2E-04. For Alternative A, the sitewide risk from 1,2,3,4,7,8-HxCDF alone based on an average concentration is 6E-04 (Table J2.3-1a of EPA's FS report; see further discussion below). There is no way that the risk from an individual congener can be higher than the total TEQ. This reflects an error in the risk calculation for HxCDF for the FS.

The post-construction sediment concentrations are unrealistic. For example, some of the dioxin/furan, PCB, and DDx post-construction concentrations in Table J2.3 are below EPA's derived background concentrations. Post-construction SWACs less than EPA's arbitrary background concentrations are not feasible and are an artifact of the use of "zeroes," instead of a background or equilibrium-based value, for replacement values in SWAC calculations. Table 4 below provides an example of post-construction SWACs below EPA's background.

Table 4. Comparison of SWACs vs. EPA's Derived Background for SDU 7W

	Background		Alt						
	FS	RI	A	B	C	D	E	F	G
1,2,3,4,7,8-HxCDF	0.0004	0.002	1.2800	0.0553	0.0421	0.0136	0.00628	0.00078	0.00628
1,2,3,7,8-PeCDD	0.0002	0.0040	0.000369	0.000108	0.000082	0.000064	0.000046	0.000021	0.000046
2,3,4,7,8-PeCDF	0.0003	0.0003	0.185939	0.00888	0.00671	0.00242	0.001142	0.000166	0.001142
2,3,7,8-TCDD	0.0002	0.0003	0.000847	0.000076	0.000059	0.000045	0.00003	0.000012	0.00003
2,3,7,8-TCDF	0.0003	0.0004	0.28054	0.01387	0.01046	0.00383	0.00175	0.00028	0.00175
Sum of 5 congeners	0.0014	0.0071	1.747695	0.078234	0.059411	0.019959	0.009248	0.00126	0.009248

Notes:
Yellow cells are below background.
All concentrations are in µg/kg.

Table 4 was created using values from EPA's FS (USEPA and CDM Smith 2016) and the Final RI (USEPA 2016b).

Other tables in Appendix J show similar results. It is unclear how remedies will result in concentrations below EPA's background concentrations. In addition, the concentrations of COCs used in the remediated areas to calculate the post-remediation SWACs were 0, which does not account for dredge residuals or actual background (upstream) concentrations of COCs.

A significant deficiency of the post-construction risk evaluation is that it does not provide post-construction risks for any time frame other than the immediate post-construction condition. As reported in EPA's FS (USEPA and CDM Smith 2016, Section 4.1.3):

> As a long-term model is not available to predict the time to meet the PRGs, interim targets for risks and HIs were established to evaluate the potential for achievement of PRGs in a reasonable time frame, which was considered to be 30 years, commensurate with the site-specific contaminants and conditions. These interim targets are higher than residual risks once PRGs are achieved, and assume that further reductions will be achieved through MNR.

The calculated post-construction risks and HI values are higher than the interim target risks and HI. Because of the reliance on MNR, the lack of a post-construction risk estimation process for time intervals post-construction (up to year 30) makes the usefulness of the post-construction risk estimates limited in terms of comparing the protectiveness of the remedies.

Furthermore, there is very little difference in net risk reduction between Alternatives B and I for almost all COCs as shown in Figure 6 below. Figure 6 plots the post-construction risks using values from Appendix J of EPA's FS. For most of the COCs, the differences are less than a factor of 2 and sometimes much smaller (e.g., difference in hazard quotient HQ of 0.25).

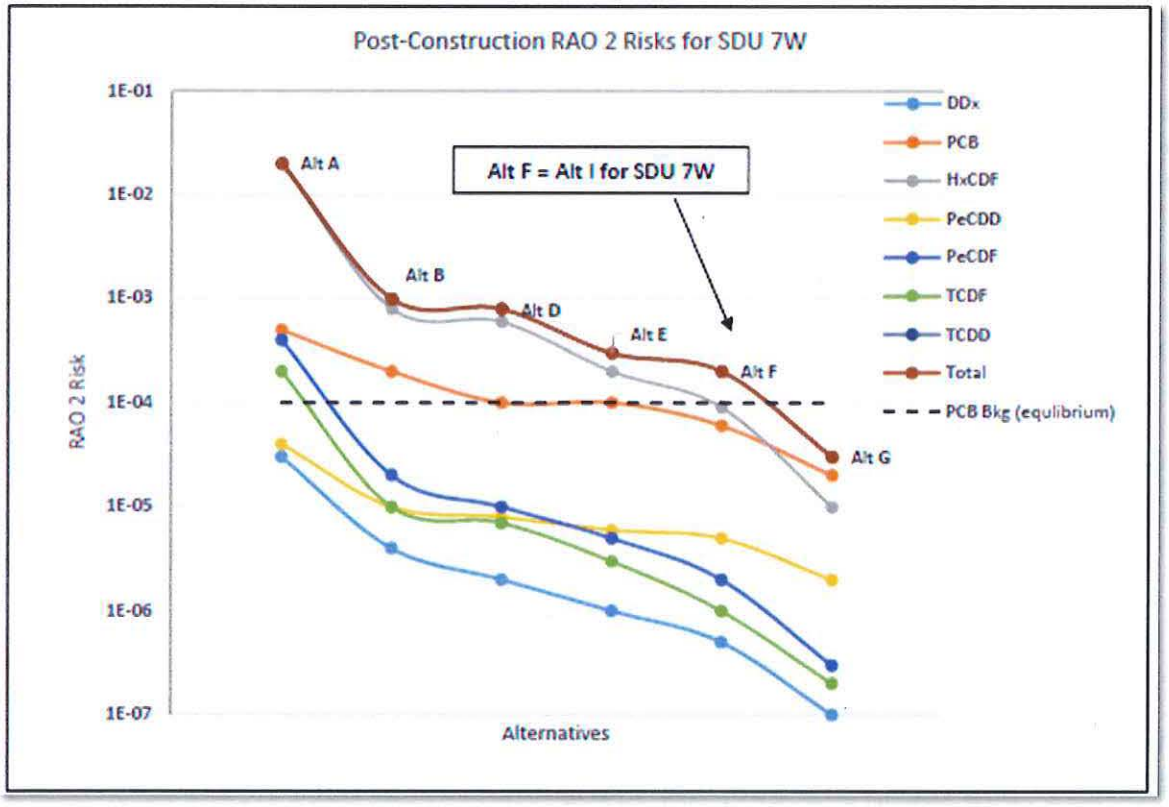

Figure 6. EPA's Post-construction RAO2 Risks for SDU 7W (Source: Created using values from USEPA and CDM Smith 2016.)

For Figure 6, LSS plotted the graph using post-construction RAO2 risk presented in EPA's FS (Appendix J) and estimated risk from PCBs at equilibrium assuming a linear relationship with sediment concentration of 20 ppb.

As shown in Figure 6, as estimated by EPA, the total risk for SDU 7W is almost entirely from HxCDF, which is not a focused COC at SDU 7W. See Section 6.2.3 for the explanation on why these estimates are flawed.

Given the very conservative assumptions that were used to calculate PRGs, differences in estimated risks by a factor of 2 or less are not significant. A more reasonable criteria for evaluating differences in estimated risk between alternatives is a factor of 10, which should be considered the minimum significant difference given the range of uncertainties in the risk assumptions. A probabilistic risk assessment, which incorporates the quantitative uncertainties, would be a more appropriate approach (USEPA 2014b).

This small difference in risk reduction between alternative remedy scenarios is likely due to the PRGs being based on background (see Figure 5). The risk associated with background levels of COCs should be presented in a side-by-side comparison to the post-construction risk estimates in order to demonstrate the benefit of the remedial measures to the public. Based on the post-construction risks presented in EPA's FS (see Figure 6), any remediation beyond Alternative B is unwarranted. Note that Alternative B does show a greater degree of risk reduction when

compared to Alternative A (No Action) than the reduction between Alternative B and the other alternatives. The very large increase in costs for minimal and insignificant risk reduction between Alternatives B and I is not recognized or acknowledged in EPA's FS. Figure 7 below illustrates this point.

Figure 7 presents the various risk estimates for SDU 7W (rolling river mile minimum, maximum and average risks, and SDU-wide risks) compared to the sitewide background risk (using the equilibrium-based value for PCBs of 20 ppb).

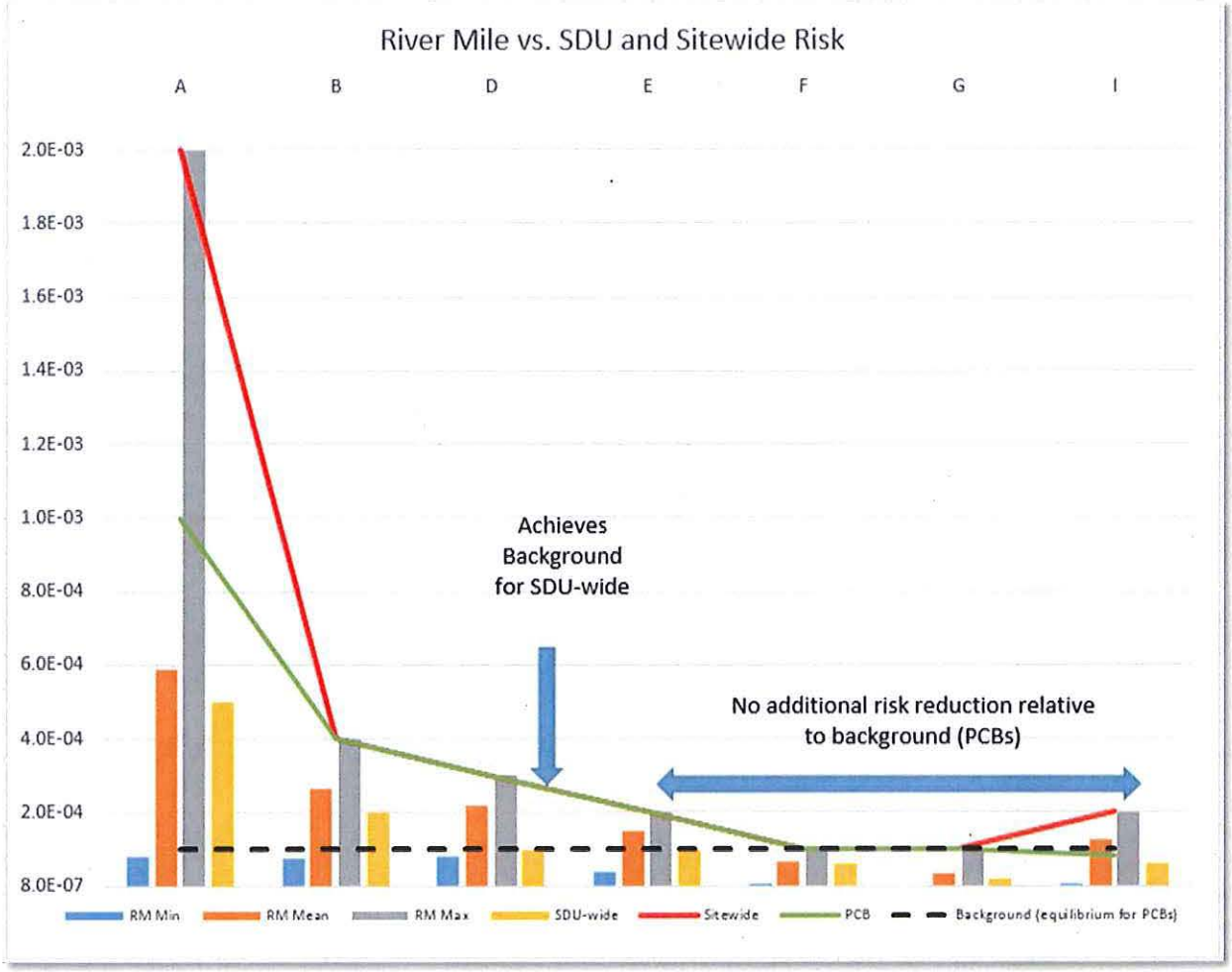

Figure 7. Comparison of Rolling River Mile and SDU-wide Risks for SDU 7W (Source: Created using values from USEPA and CDM Smith 2016.)

Figure 7 shows that Alternative B achieves risk reduction to the background level at equilibrium; any more intrusive alternatives will not result in further risk reductions since the sitewide risk will be on the order of 10^{-4} due to background conditions at equilibrium. In fact, the post-construction risk estimates for Alternative B and D for SDU 7W are not significantly different for the focused COCs in that river mile as presented in Table 5.

Table 5. Comparative Risks for SDU 7W Focused COCs for Alternatives B and D

	Alternative B	Alternative D
DDx	4E-06	2E-06
PeCDD	1E-05	8E-06
PeCDF	2E-05	2E-05
TCDD	6E-06	5E-06
Total	4E-05	4E-05

Another illustration of the lack of justification for more aggressive remedies for little change in risk reduction is provided below in Figure 8. By using the concept of "fish meals per 10 years" in their FS, EPA overemphasizes the risk reduction gained. As shown below, the differences in sitewide post-construction risk for Alternatives B through G vary by a factor of 2–4. Furthermore, fish meals are already limited by the existing mercury advisory. Also, the difference between Alternatives B and E are 0.5 meal per month, or an additional 4 ounces of fish per month. This difference is not significant and does not warrant a more aggressive remedy based on cost effectiveness.

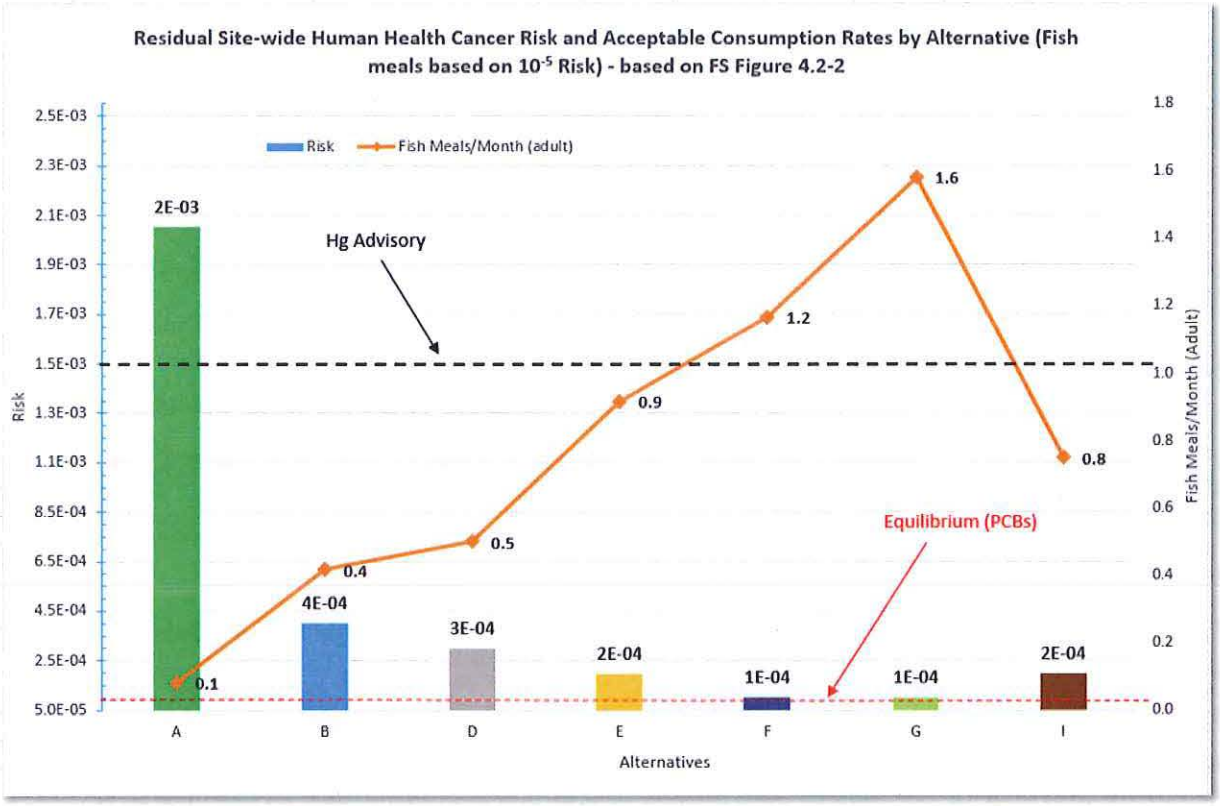

Figure 8. EPA's Residual Sitewide Human Health Cancer and Acceptable Consumption Rates by Alternative (Fish meals based on 10^{-5} Risk) (Source: Modified Figure 4.2-2 of EPA's FS [USEPA and CDM Smith 2016].)

6.2.3 The Estimate of Risks from Dioxins/Furans is Flawed

Risks for dioxins/furans were assessed on a TEQ basis in the BHHRA and based on 5 congeners in EPA's FS (although RALs were developed for only 3 congeners). CDM Smith (2014) concluded that 85–95% of the risk could be explained by the 5 congeners selected; therefore, the risk should be more or less comparable between the EPA-approved BHRRA and EPA's FS. However, risks calculated in EPA's FS are substantially higher (approximately 4 times higher sitewide and two orders of magnitude higher at SDU 7W).[8] Further discussion of dioxins/furans is provided below.

Table 6. Dioxin/furan Risks in EPA's FS for RAO2, Subsistence Fisher

Congener	Sitewide	SDU 7W
1,2,3,4,7,8-HxCDF	6E-4	2E-2
1,2,3,7,8-PeCDD	2E-5	4E-5
2,3,4,7,8-PeCDF	2E-4	4E-4
2,3,7,8-TCDD	2E-5	7E-5
2,3,7,8-TCDF	1E-4	6E-7
Total of 5 congeners	9E-4	2E-2
Total excluding HxCDF	3E-4	5E-4

Note: The BHHRA evaluated risks differently than the FS, by river mile and not restricted to East or West, so comparisons are approximate.

The CDM Smith memo (CDM Smith 2014) identified the five congeners shown in Table 6 above as accounting for 85–95% of the total risk from the fish ingestion pathway. HxCDF was found to contribute 3–20% of the total dioxin risk. (It should be noted that CDM Smith incorrectly used a TEF of 0.3 for HxCDF; the correct TEF is 0.1, and therefore, the contribution of this congener was overestimated).

Based on these data, if HxCDF was dropped from the assessment, there should have been little effect on risk management. In fact, no remedial footprint was associated with HxCDF based on the RALs provided in the CDM Smith memo. Additionally, EPA chose to develop RALs for only 3 congeners in its FS (2,3,7,8-TCDD, 1,2,3,7,8-PCDD, and 2,3,4,7,8-PeCDF) due to the lack of presumed risk from HxCDF and TCDF. Yet now in the Proposed Plan, the post-

[8] In the BHHRA, risks were estimated by full river mile (e.g., RM 7-8) since the SDU concept had not yet been established. Nevertheless, dioxin/furan risks in the BHHRA for RM 7W should be comparable to risks in the FS for SDU 7W. This is because risks in the BHHRA were actually based on the maximum concentration since there were not enough detects to calculate a 95 UCL. However, the inflated risks for SDU 7W in the FS were greater than this "maximum risk" by two orders of magnitude, which demonstrates that the risk estimate in the FS was flawed.

construction risk evaluation incorrectly shows HxCDF contributing 67% of the dioxin-related risk sitewide and essentially 100% of the risk at SDU 7W. The BHHRA by contrast showed 67% of the sitewide risk due to dioxins/furans: 17% due to PCBs and 3% due to DDx with the remainder due to other constituents.

If HxCDF were more appropriately left out of the total, the total risk from dioxins/furans would be closer to that estimated in the BHHRA as shown below in Figure 9.

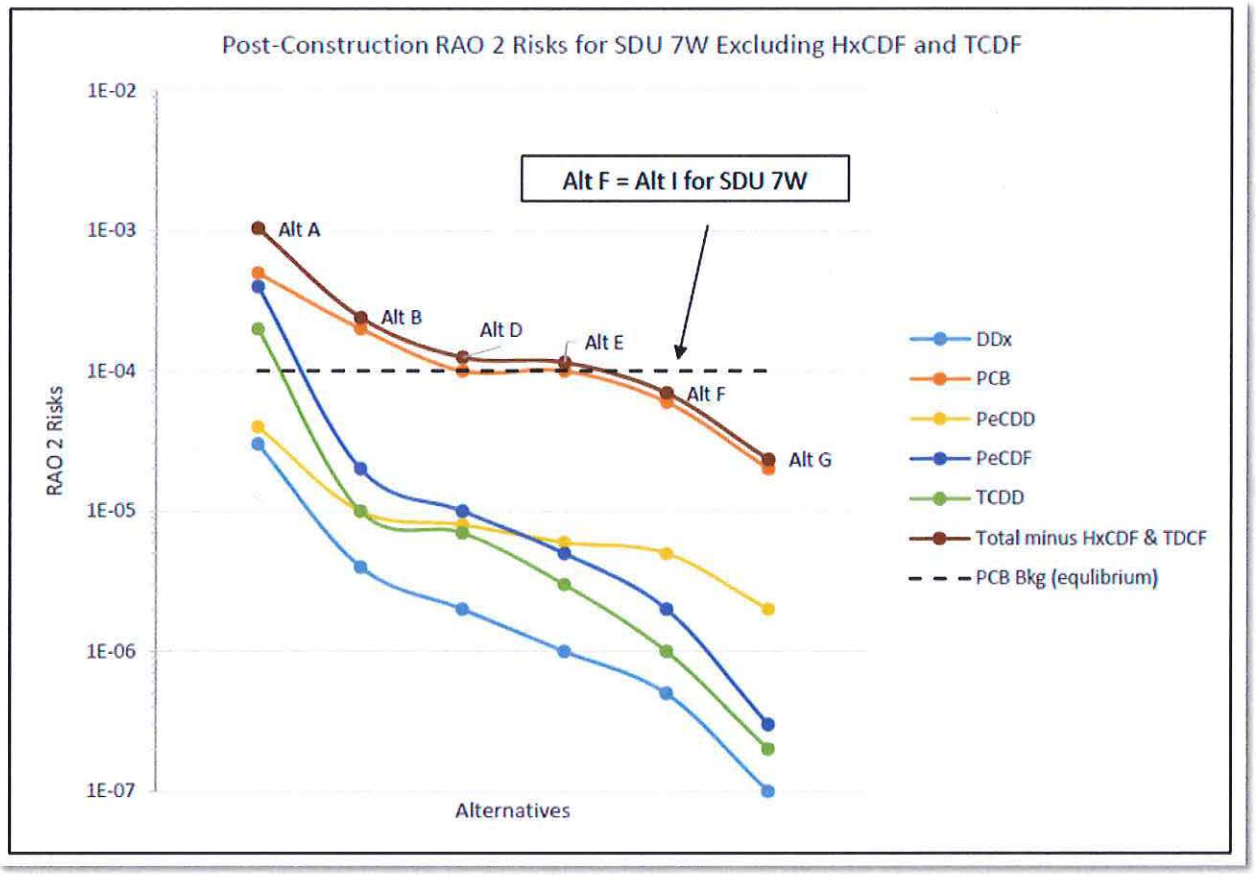

Figure 9. Post-construction RAO2 Risks for SDU 7W excluding HxCDF and TCDF. (Source: Created using values from USEPA and CDM Smith 2016.)

For Figure 9, LSS used the post-construction RAO2 risk presented in EPA's FS (Appendix J) and estimated background PCBs at equilibrium assuming a linear relationship with sediment concentration of 20 ppb. The total risks were estimated excluding HxCDF and TCDF.

With the exclusion of HxCDF and TCDF, risks from other focused COCs (DDx and dioxins/furans) at SDU 7W can be addressed by Alternative B. Alternative B is also effective for PCBs (the primary risk contributor) since PCB cleanup levels are not that different for Alternatives D, E, F, G, and I, or, for that matter, from background.

6.3 LSS Evaluation and Recommended Corrective Action

The removal volumes in Alternative I cannot be justified as a cost-effective reduction of risk in comparison to other alternatives. The use of mixed criteria such as PRGs (and RALs) from different alternatives (i.e., "E" and "F" applied either sitewide or within an SDU) cannot be justified based on differences in risk outcomes that are within the same order of magnitude and without any meaningful consideration of background conditions. Furthermore, the post-construction risk evaluation methods are flawed and misleading.

To adequately evaluate the alternatives, an accurate assessment of risk must be completed using methods such as those in the EPA-approved BHHRA and BERA, a risk management step, and realistic estimates of post-construction conditions. See Section 13 for more discussion on inconsistent use of RALs.

7 Inaccurate Riverbank Contaminant Assessment

7.1 Issues with EPA's Evaluation

Figure 10d from EPA's Proposed Plan shows technology assignments for riverbanks designated by EPA as contaminated. The exceedance of RALs does not apply to riverbanks adjacent to sediment areas. RALs are based on sediment PRGs and are only relevant to in-water pathways, not riverbanks. In addition, riverbank soils were not evaluated in the BERA, BHHRA, or RI. EPA's use of sediment PRGs for riverbanks, which were even applied to areas rarely submerged by the river and without considering fate and transport (e.g., attenuation), is technically unsupportable and inappropriate. There is a total lack of data and analysis as to what risk considerations are driving the selected alternative (and therefore how such analyses will be refined in the design phase when further data and analyses are available) and what specific remedial actions will be implemented in which areas driven by those risks. For example, PCBs are listed in EPA's FS as a riverbank contaminant at a large portion of SDU 7W, but have only been detected in a small number of samples below the applicable screening levels (with one exception, one sample slightly exceeded a conservative bioaccumulative screening level value [SLV] [ERM 2008; Attachment 2]). Yet, this arbitrary delineation is then carried forward into the Proposed Plan.

At no time during LWG's development of the RI and risk assessments did EPA suggest that riverbank data sufficient to support the development and evaluation of remedial alternatives should be conducted. EPA's last-minute incorporation of riverbanks in its FS when no upland media were evaluated in the approved RI or risk assessments is completely counter to EPA policy and guidance. "The purpose of the remedial investigation (RI) is to collect data necessary

to adequately characterize the site for the purpose of developing and evaluating remedial alternatives" (USEPA 2016b).[9]

7.2 LSS Evaluation and Recommended Corrective Action

DEQ is the lead agency with respect to source control actions in Portland Harbor. Riverbank soils at the Arkema site have already been subject to extensive evaluation, as potentially erodible soils, with respect to COC identification, risk screening, and riverbank source control area identification. In December 2008, LSS submitted to DEQ the riverbank soil source control screening evaluation, which evaluated and identified areas for source control for the Arkema riverbank. Comments on this riverbank source control screening evaluation were received from both DEQ and EPA. In 2012, riverbank source control alternatives were evaluated as part of the EE/CA report for a removal action and concomitant source control measures (SCMs) at the Arkema site (Integral 2012, Appendix F; Attachment 1). There has been no subsequent correspondence on riverbank SCMs; however, there has been a general agreement with DEQ that the appropriate SCMs for the Arkema site will be conducted under DEQ's supervision, at the same time as or before the in-water remedy for the Site is completed.

In keeping with the agencies' February 2001 memorandum of understanding (MOU) with respect to roles on the Portland Harbor Superfund Site, EPA must remove the reference to the areas requiring riverbank remediation from the Proposed Plan. Also, in keeping with the method for addressing SCMs for other media (e.g. groundwater and stormwater), EPA must reference DEQ plans for addressing upland riverbank soils under these source control requirements, such as has been done for the Arkema site. Finally, if there are any data gaps that could affect the assessment of riverbank SCMs, these must be clearly identified and addressed by DEQ as the lead agency.

8 Failure to Consider Upland SCMs

8.1 Issues with EPA's Evaluation

EPA did not consider SCMs that have been implemented at the Arkema site; thus, EPA makes arbitrary assumptions regarding the nature and extent of stormwater and groundwater contamination. EPA's selected remedy must recognize the gains made through DEQ's upland work by acknowledging and incorporating existing and committed stormwater, groundwater, and riverbank source controls. In a July 20, 2016 e-mail to LWG, EPA confirmed that "[u]pland source control systems were not considered" in EPA's selection of a preferred alternative (Koch 2016, pers. comm.; Attachment 6). This assumption nullifies years of work and millions of

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[9] 40 CFR 300.430.

dollars invested at the Arkema site (and others) where existing groundwater and stormwater source controls have been implemented under DEQ oversight and have been demonstrated to be effective.

8.2 LSS Evaluation and Recommended Corrective Action

The selected alternative in the Proposed Plan must acknowledge and consider the stormwater and groundwater SCMs implemented at the Arkema site (see key SCM documents in Attachment 2). SCMs taken at the Arkema site have largely eliminated the stormwater pathway from this site. Groundwater controls, namely the installation of a slurry wall and a groundwater extraction and treatment system designed to prevent migration of groundwater from the uplands to the river, have also largely eliminated the groundwater pathway.

In addition, EPA's status of the SCMs must be consistent with DEQ's most recent source control report, dated March 25, 2016 (DEQ 2016a). Table 4.6.6-3 of DEQ's report notes the stormwater pathway SCM status/dates as "Soil removal & cap 2000, additional cap & treatment 2012, polishing pilot 2015 – effectiveness pending." The overland flow is noted in this table as "Addressed in Stormwater measure." Groundwater is listed as "Containment 2014 – Portion uncontrolled." Since then, there has been consistent ongoing work with DEQ on both stormwater and groundwater SCMs in accordance with DEQ requirements. The bank erosion pathway is listed as "SCMs needed – Integrate w/in-water – uncontrolled." LSS has worked with DEQ on identifying a riverbank SCM to address potentially erodible riverbank soil at the Arkema site, and has a standing agreement to implement a riverbank SCM before or at the time of the in-water remedy. All of these entries in DEQ's table are consistent with the substantial progress made with DEQ on SCMs at the Arkema site.

9 Failure to Consider Natural Attenuation in the Stranded Wedge

9.1 Issues with EPA's Evaluation

EPA used more than 10-year-old sediment porewater data and nearly 15-year-old sediment groundwater data collected in SDU 7W in their evaluation of the "stranded wedge" and adjacent sediments. The evaluation did not consider the age of the data, data quality, the impact of implemented groundwater SCMs, and natural attenuation. The "stranded wedge" is defined as the saturated zone between the groundwater barrier wall and the river, which is located between the upland SCMs and the proposed in-water remedial measures. COCs in the saturated portion of the stranded wedge are expected to consist primarily of dissolved-phase chlorobenzene. Active natural attenuation mechanisms that are reducing groundwater concentrations include flushing and biodegradation, which are described further below.

9.1.1 Sediment Chlorobenzene Data Quality and Comparison to Surface Water Quality Standards

EPA's porewater analysis included groundwater and porewater data collected with similar methodologies (i.e., Geoprobe®, Trident probe). Both of these methods utilize temporary probes that can entrain turbidity in the water sample and can bias sample quality. Therefore, the data on

which EPA is basing its analysis of the stranded wedge, and in particular the concentrations of chlorobenzene, are highly suspect. Furthermore, because all of these data are more than 10 years old, they do not integrate the groundwater SCMs or active, ongoing attenuation mechanisms (discussed further below) and are, therefore, not representative of current conditions. Finally, EPA, in considering the need for remediation, has compared these *in situ* chlorobenzene groundwater concentrations to surface water AWQC, which is a surface water quality standard. This latter comparison is overly conservative and inappropriate without further assessment of attenuation mechanisms and more recent, properly collected data; this comparison is, therefore, arbitrary and capricious.

9.1.2 Contaminant Flushing

Chlorobenzene has a moderately high aqueous solubility (about 500 mg/L), and does not readily partition to soil particles or solid organic carbon phases. Therefore, chlorobenzene is mobile in aqueous solutions. As part of upland SCMs, a groundwater barrier wall was installed in 2012. Prior to 2012, dissolved-phase chlorobenzene was flushing through the stranded wedge under the hydraulic gradient from the upland site to the river. This active flushing mechanism dramatically decreased chloride concentrations in groundwater near the Salt Dock between 2002 and 2009.[10] Monitoring well MWA-30, for example, is screened in the shallow groundwater zone and is located between the Salt Pads and the top of bank just north of the Salt Dock (ERM 2007, 2010; Attachment 3). The chloride concentration in groundwater collected from this monitoring well decreased by more than 90% from April 2002 to August 2009. This reduction occurred after the cessation of industrial operations at the Arkema site, which included the removal of salt from the Salt Pads in 2002, but prior to the installation of the groundwater barrier wall. An upland groundwater source control remedy was implemented, beginning in 2012, that included the installation of a fully penetrating (to bedrock) groundwater barrier wall and a groundwater extraction and treatment system to maintain inward hydraulic gradient behind the wall (ERM 2013).

9.1.3 Anaerobic Biodegradation

Studies have shown that chlorinated benzene compounds containing up to four chlorine atoms can be degraded by micro-organisms under anaerobic conditions (USGS 2006). Anaerobic conditions are expected to be the predominant conditions within the stranded wedge. Only the top few centimeters of sediment will likely have conditions that are aerobic. In addition, sediment camera investigations (i.e., sediment profile imaging [SPI] survey) conducted in the Lower Willamette show strong evidence of anaerobic conditions in shallow sediments located

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[10] Chloride is commonly used as a tracer in groundwater because it behaves conservatively in most soils (i.e., does not adsorb to soil particles).

land-ward of the pier head line at many locations including SDU 7W. This evidence consists of images that demonstrate the presence of methane gas bubbles, which are compelling evidence of anaerobic biogeochemistry (i.e., methanogenesis) in the sediment. Anaerobic biodegradation has been occurring in the stranded wedge, the extent of which needs to be determined.

9.2 LSS Evaluation and Recommended Corrective Action

Before issuing a ROD, EPA must acknowledge the Arkema stormwater and groundwater SCMs and the processes that are attenuating COCs in the stranded wedge of groundwater and adjacent river sediments/porewater. The upland groundwater SCM has mitigated the effects of chlorobenzene in upland groundwater from discharging to the stranded wedge and into sediments; there is no gradient to induce flow and the "source" has been cut off from the river. It is anticipated that any remaining dissolved-phase chlorobenzene that was already in the stranded wedge will continue to naturally attenuate through anaerobic biodegradation processes. For these reasons, remedies that imply or include a requirement for post-remedy treatment of groundwater/porewater in the stranded wedge or that groundwater is present at concentrations above a PTW level, are based on inappropriately acquired samples of suspect data quality, and outdated or inadequate information; therefore, any such decisions are arbitrary and capricious.

10 Flawed Evaluation and Inaccurate Delineation of PTW and NAPL

10.1 Issues with EPA's Evaluation

10.1.1 Inaccurate Assessment of PTW and NAPL adjacent to Arkema

EPA inappropriately identifies chemicals in sediment adjacent to the Arkema site as PTW based on either a "source material," "not reliable contained," or "highly toxic" criterion. As expanded upon below, source material has never been identified in Arkema site sediment. EPA must not identify chemicals that can be reliably contained as PTW, as well as chemicals that require long-term exposure durations through indirect exposure pathways (i.e., consumption of fish tissue over a 30-year period) as "highly toxic." In addition, the blanket identification of large areas with low concentrations of chemicals in sediments as PTW is not required by the NCP, not necessary to protect public health or the environment, and not necessary to implement an effective and achievable remediation at the Site.

EPA errs when it misidentifies source material in its FS based on "globules or blebs of product in surface and subsurface sediments…." and when it states "NAPL observed in sediment cores offshore of Arkema contains chlorobenzene and DDT (dissolved)" (USEPA and CDM Smith 2016). LSS disputes the presence of NAPL globules and blebs related to the Arkema site or historical site operations (i.e., sheens related to oils and other uses of the river by ships and other vessels are not related to Arkema and would not contain an Arkema COC such as monochlorobenzene [MCB]). LSS responded to CDM Smith's 2013 memorandum that purports to identify NAPL at the Arkema site. To attempt to resolve the issue, LSS prepared a work plan in response to EPA requests under the EE/CA Administrative Order on Consent (AOC) to again confirm that NAPL was not present in sediment adjacent to the Arkema site. This work plan was

disapproved without any scientific justification or support by EPA and the EE/CA AOC was arbitrarily terminated. LSS stands ready to implement that work plan.

No samples offshore of the Arkema site have identified an MCB NAPL. There is no analytical data that supports EPA's statement that NAPL observed in Arkema sediment "...contains chlorobenzene...." (USEPA and CDM Smith 2016). Significantly, a document titled "Top 10 State Issues for Proposed Plan" obtained from the LWG's Freedom of Information Act (FOIA) request identified that, based on DEQ's review of the data, "The multiple phases of sediment investigation have not encountered sediment exhibiting NAPL saturated conditions that would warrant thermal treatment prior to management." The status column for the same issue states that "EPA agreed to not assume NAPL at Arkema for the purposes of the cost estimate" (Attachment 6). EPA has taken one position in its characterization of the sediment offshore of Arkema and then the opposite in its cost evaluation. In addition, as documented in meeting notes that were part of the FOIA request, DEQ reiterated the position that "DEQ doesn't feel Arkema has NAPL based on the data" during a January 28, 2016, DEQ/EPA meeting (Attachment 6). Based on these records, LSS can only conclude that EPA and DEQ agreed that there was no MCB NAPL in offshore sediments; therefore, the assertion that such sediments represent PTW source material as defined by EPA's PTW fact sheet is without foundation or support, and is completely at odds with EPA's own Cost Analysis in its FS.

EPA erred when it identified an extensive area of groundwater containing MCB DNAPL discharging to the river as "not reliable contained" (USEPA and CDM Smith 2016). First, there is no MCB DNAPL in the sediments. Secondly, EPA's basis for assuming the presence of a MCB DNAPL groundwater plume is shown in EPA's FS Figure 3.2-4, adjacent to the Arkema site. The nature and extent of MCB DNAPL in groundwater or sediment porewater as shown in this figure is not based on any valid site-specific data. Groundwater SCMs were implemented at the Arkema site beginning in 2012, including an upland groundwater barrier wall and extraction and treatment system. The groundwater pathway to the river from upland areas that have MCB in groundwater has been cut off and containment has been in existence for 4 years. Therefore, there is no ongoing source of dissolved-phase MCB from the upland portion of the Arkema site to the sediment adjacent to the site.

There is no scientific evidence that supports the existence of an ongoing source of MCB DNAPL to the sediment adjacent to the Arkema site. The error of site characterization and conceptual model, which posits the existence of an extensive area of chlorobenzene DNAPL in sediment at the Arkema site, biases the assessment, remedial options, treatment, and comparison of the effectiveness of alternatives as evidenced from the following text: "Alternative D has less capped area (71 acres), but does not reliably contain all PTW remaining in the river" (USEPA and CDM Smith 2016, p. ES-15). Without an accurate assessment of NAPL, PTW, and PTW areas, EPA's alternatives evaluation is without scientific support, is counter to EPA's Cost Evaluation in its FS and results in a highly inaccurate review of potentially appropriate remedial alternatives.

10.1.2 Biased Approach for Assignment of Remedial Technologies to Sediment Containing PTW and NAPL

In its FS (EPA's basis for selecting the Proposed Plan), central decisions for assigning remedial technologies and assembling remedial alternatives are biased by the assumed presence of PTW and NAPL. In general, areas of sediment assumed to contain PTW and NAPL are assigned active remedial technologies (i.e., dredging or capping.). Further, sediment containing PTW that EPA deems "not reliably containable" must be removed, provided such sediment is not located under critical structures, or at depths greater than 15 ft.

Therefore, the approach by which EPA determines whether PTW is "reliably contained" is a vitally important supporting element of the Proposed Plan. EPA asserts that chlorobenzene and NAPL are present offshore of the Arkema site and that such contaminants constitute PTW. This assertion by EPA has been demonstrated above to be without scientific merit specifically because it is not supported by any data or analysis. Furthermore, the record shows that it is not concurred with or supported by DEQ.

Nonetheless, as outlined in the LSS dispute of EPA's FS (LSS 2016; Attachment 5), EPA's approach for determining the effectiveness of containment to address its mistakenly presumed NAPL and/or PTW containing sediment is a simplistic, overly conservative, and fundamentally scientifically unsound screening analysis that neglects to consider the current state of practice for reactive capping. As noted above, the data by which the EPA is basing its analysis of the stranded wedge, and in particular the concentrations of chlorobenzene, are highly suspect. Further, EPA has compared these *in situ* chlorobenzene groundwater concentrations to surface water AWQC, which is a surface water quality standard. This latter comparison is without foundation and is technically inappropriate without further assessment of attenuation mechanisms and more recent, properly collected data.

Of specific interest regarding capping technologies, EPA limits its modeling to two specific cap scenarios to determine the maximum concentrations of PTW material that will not result in exceedances of AWQC in the sediment cap porewater after a period of 100 years. Neither of the cap options examined by this analysis (caps comprised of 12-inch active layers with two different assumed concentrations of granular activated carbon) are applicable to sediments containing NAPL and/or chlorobenzene. Consequently, the inevitable conclusion drawn by EPA is that a large portion of the postulated PTW adjacent to the Arkema site is "not reliably containable" and therefore requires removal.

In contrast to EPA's perfunctory approach, Appendix Hc of the LWG's draft FS (Anchor QEA et al. 2012; Attachment 5) presents a screening-level evaluation of cap effectiveness that is more consistent with the state of practice for reactive capping. An iterative approach was used to examine the effectiveness of sediment caps to provide containment of sediment with initial porewater concentrations of chlorobenzene ranging from 1,754 µg/L to 30,000 µg/L. This range represents the mean and maximum porewater concentrations detected in the 2004–2005 transition zone sampling conducted for the RI. The conclusion of this evaluation was that sediment containing chlorobenzene may be reliably contained for a minimum 100-year design life using an active cap containing an organoclay active layer ranging 3 to 5 inches in thickness.

This evaluation by LWG demonstrates that the applicability and effectiveness of sediment cap technology considering the maximum porewater concentration of chlorobenzene used as a continuous source term in the model (the same as used by EPA in its evaluation) is an overly conservative assumption that is based on old RI data and is not representative of current conditions, let alone for the next 100 years. A critical factor missed by EPA is that, since the RI data collection, a barrier wall and pump and treat system have been installed along the shoreline of the Arkema site.

10.2 LSS Evaluation and Recommended Corrective Action

10.2.1 Assessment of PTW and NAPL adjacent to Arkema

EPA errs when it misidentifies the remaining areas adjacent to the Arkema site (including areas upstream and downstream of Arkema) as containing "highly toxic" PTW based on surface sediment concentrations for DDx, 2,3,7,8-TCDD, 2,3,7,8-TCDF, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, and 1,2,3,4,6,7,8-HxCDF that exceed a 10^{-3} excess cancer risk level for fish consumption based on the fish ingestion risks from the BHHRA. This definition of highly toxic based on a long-term (30 year) exposure to a chemical substance via a fish consumption pathway is not the intent of EPA's PTW fact sheet (USEPA 1991; Attachment 7). These 10^{-3} risk levels include long-term exposure parameters and indirect exposure based on a 30-year subsistence fish consumption scenario, which does not meet the definition of highly toxic (i.e., toxic under a direct contact or acute exposure scenario). Highly toxic levels are meant to be based on direct exposure conditions only. Furthermore, the 10^{-3} excess cancer risk is only a suggested basis and is not prescriptive. It is also likely that it is not consistent with existing conditions at the Site.

The EPA's proposed highly toxic PTW levels must also be considered in a broader context. EPA's highly toxic PTW values for some constituents are well below cleanup levels and screening levels for unrestricted use established for other sites and scenarios. For example, the PCB PTW value of 200 µg/kg is below cleanup goals for many other CERCLA sites[11], which are at or above 200 µg/kg, typically in the 1,000 µg/kg range. In fact, the EPA regional screening level (RSL) for PCBs in residential soil is 230 µg/kg; in other words, soil with PTW levels specified in EPA's FS could be used as clean fill at homes and schools. In this context it does not make sound technical or risk management sense for the PTW level to be set at 200 µg/kg. An approach more consistent with the intent of EPA's PTW guidance would be to set the PTW level at a 10^{-3} risk value based on direct contact to sediment (RAO1); that would be the lower of the 10^{-3} risk level (370,000 µg/kg), the HQ of 10 (147,600 µg/kg) (as stated in the guidance). This

[11] Examples include Lower Duwamish Waterway Superfund Site, WA (PCB cleanup levels ranged from 1,300 ppb to 3,900 ppb); Yosemite Slough, CA (PCB cleanup levels ranged from 386 ppb to 1,240 ppb); Fox River, WI (PCB cleanup goal of 1,000 ppb); Hudson River, NY (PCB hotspot remediation ranged from 10,000 ppb to 30,000 ppb); and Kalamazoo River, MI (PCB cleanup levels ranged from 330 ppb to 11,000 ppb).

range of values is also consistent with decisions at other cleanup sites.[12] A similar approach should be taken for the other constituents for which highly toxic PTW has been identified, especially dioxins/furans for which the PTW level in EPA's FS is less than 3 times the EPA-recommended PRGs for dioxins/furans (once TEFs are applied). An approach that is consistent with other CERCLA sites[13] is to assess dioxin/furan risk using a dioxin TEQ. The 10^{-3} risk value based on direct contact to sediment for dioxin TEQ is 5 µg/kg.

Application of the revised and readily accepted PTW standards for "not reliably contained" and "highly toxic" material will correctly result in none of the sediment adjacent to the Arkema site being identified as PTW.

10.2.2 Assignment of Remedial Technologies

LSS intends to develop a robust pre-design investigation program to address the deficiencies in EPA's CSM, including an objective determination of the potential presence of NAPL, and obtain scientifically valid porewater concentrations of chlorobenzene in the sediments offshore of the Arkema site. Sufficient flexibility must be provided in EPA's ROD to make reasonable and defensible technology assignments offshore of the Arkema site during the remedial design phase. At a minimum, flexibility must be maintained to permit the evaluation of capping methods, as well as other technologies such as *in situ* treatment, ENR, and MNR.

11 EPA's SWACs No Longer Reflect Site Conditions

11.1 Issues with EPA's Evaluation

11.1.1 Background

The SWAC is a spatially averaged (or weighted) concentration of some variable of interest across a surface area. The RAL is the highest value of a constituent that must be remediated to achieve a desired cleanup criteria (such as a PRG) across a surface area. The value of the SWAC determines the value of the RAL for any remediation involving sediment surface characteristics. Hence, all RALs represent a unique function of the surface chemistry for which they are calculated. When sediment conditions are changing, SWACs are dynamic (either increasing or decreasing). While criteria such as PRGs may be constant over time, RALs are highly time dependent and must be established for the conditions present during the design process. A RAL

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[12] An example is the December 2015 Proposed Plan for the Indian Mountain Long-Range Radar site in Alaska, which used a PCB PTW value of 500,000 µg/kg.

[13] Examples include Lower Duwamish Waterway Superfund Site, WA; McCormick and Baxter Creosoting Company, OR; Lower Passaic River, NJ; and Port Angeles, WA.

calculated for a sediment site using data obtained 10 to 15 years prior to the engineering design process (which is the case at Portland Harbor) is likely to vary significantly from actual conditions. If a RAL is based on a "snap shot" of site conditions from some time in the past, its value will not represent current SWAC conditions, and it will lead to errors in the selection and application of remedial alternatives and technologies (see Section 2 regarding aggregate datasets).

11.1.2 Current Site Conditions

In its public presentations regarding its Proposed Plan (Attachment 4), EPA has featured prominently its "knee of the curve" figure, which it believes illustrates support for its preferred alternative. However, that illustration is dependent upon EPA's calculation of a 208 ppb initial SWAC for total PCBs that was based on data that are approximately 10 years old. LSS has estimated the current SWAC for total PCBs at approximately 40 µg/kg based on 2012 fish tissue data (Wolf 2015) and 2014 sediment data combined with RM11E Supplemental RI data (GSI 2014; Devary et al. 2015). EPA's selection of its preferred alternative based upon a SWAC value that is not representative of actual site conditions is scientifically unsupportable and is therefore arbitrary and capricious.

Figure 10 illustrates the knee of the curve when the baseline SWAC is assumed to be 208, 85, and 40 µg/kg. The 208 µg/kg is EPA's FS SWAC estimate (Appendix J, Table J2.3-1a). The 85 µ/kg is the SWAC consistent with the EPA-approved RI, BHHRA and BERA. The 40 µ/kg is the SWAC estimated from the 2012 smallmouth bass fish tissue data and 2014 sediment data combined with RM11E Supplemental RI data. As the initial SWAC decreases, the utility of the alternatives as determined by the "knee of the curve" shifts away from Alternatives F and G and toward Alternatives B and D. When a higher value is used for the initial conditions, the most intrusive and resource consuming alternatives erroneously appear to provide more benefit in reducing the SWAC. This is a significant analytical and decision-making error because such alternatives actually provide much less benefit at a significantly greater cost than when the initial condition is more appropriately represented by the lower actual values that reflect the documented conditions at the Site.

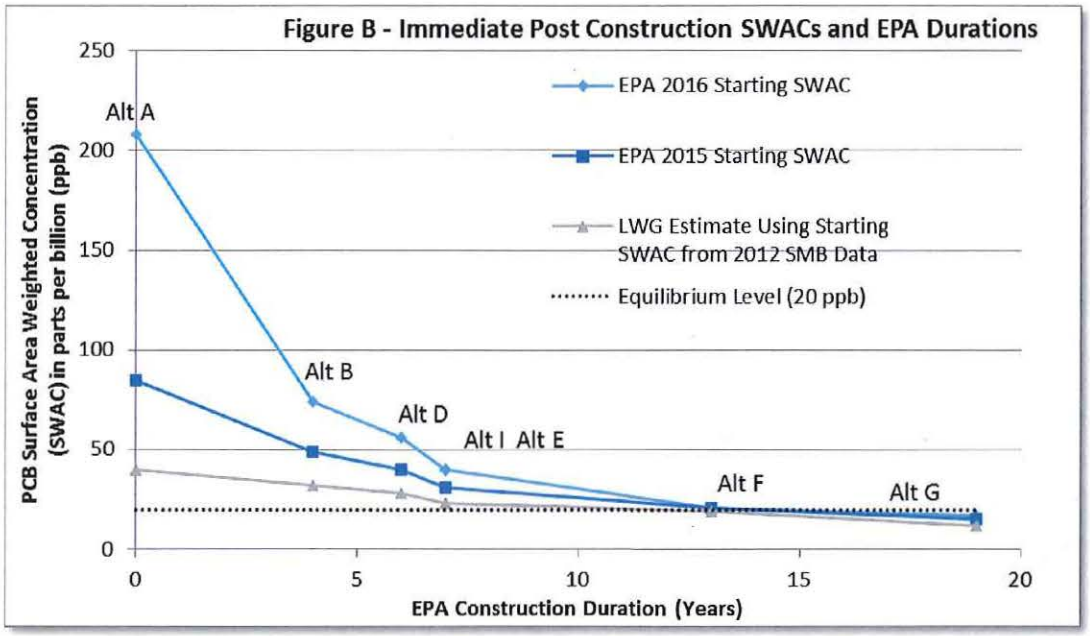

Figure 10. LWG Estimated Post-construction SWACs versus Construction Duration for Varying Initial Condition SWACs. (Source: LWG 2016.)

11.2 LSS Evaluation and Recommended Corrective Action

Before issuing a ROD, EPA must revise the PCB SWAC concentration to include the most recent dataset for the Site, which is the 2012 fish tissue data and the 2014 sediment data combined with RM11E Supplemental RI data (see the aggregated dataset issue in Section 2 above). The knee of the curve graph must be revised based on this initial condition PCB SWAC concentration, and then considered in the selection of an appropriate preferred alternative.

12 Inappropriate Use of PCB Non-detect Values in RAL and PTW Footprints

12.1 Issues with EPA's Evaluation

The RAL/Alternatives and PTW footprint maps in EPA's FS and Proposed Plan incorporate data with high PCB detection limits in SDU 7W (Figure 11). The high PCB non-detects with detection limits 5 times EPA's PTW value (e.g., >1 mg/kg) occurred in the Aroclor analysis as a result of a matrix interference with DDx (Figure 11). The RAL and PTW footprint maps should only consider detected PCBs based on PCB congener concentrations adjacent to the Arkema site, not non-detects due to matrix interference with DDx in PCB Aroclor analyses. The identification of PTW and remediation footprints for PCBs adjacent to the Arkema site based on non-detect values with elevated detection limits resulting from matrix interference with DDx is inconsistent with EPA's PTW fact sheet guidance (USEPA 1991; Attachment 7) and biases the assessment of PTW and remediation footprints for the SDU 7W alternatives. This exaggerated PCB footprint also biases the alternative selection for SDU 7W.

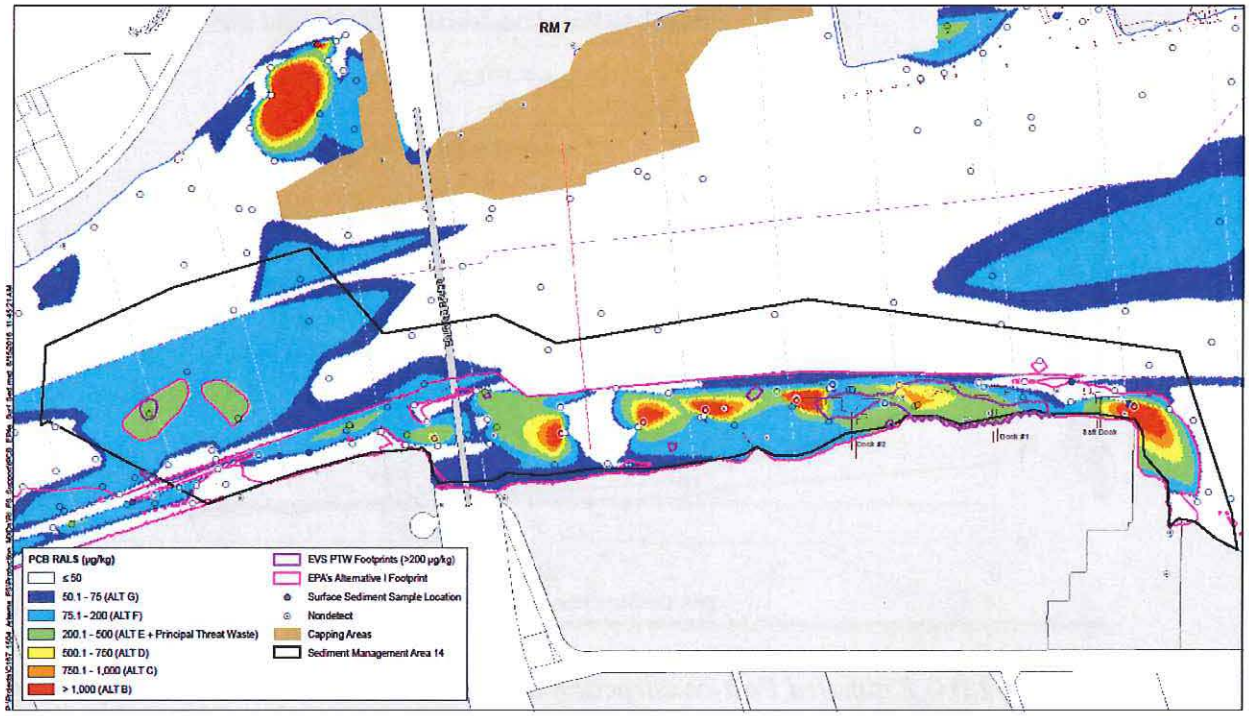

Figure 11. EPA's Total PCBs in surface sediment (0–1 ft) with all non-detects included. (Source: Based on USEPA and CDM Smith 2016.)

12.2 LSS Evaluation and Recommended Corrective Action

Before issuing a ROD, EPA must remove elevated (e.g., > 1 mg/kg) PCB non-detect values from the PCB footprint analysis as it biases and exaggerates the area of PCBs in sediment adjacent to the Arkema site (Figure 12). This is supported by an evaluation of the archived samples collected from 0–2 ft and analyzed for PCB congeners for the Arkema EE/CA (Figure 13). For these latter samples, matrix interference issues with DDx compounds were avoided and the detection limits were low because the PCB congener analytical method was used. Figure 13 shows that the concentrations of total PCB congeners are relatively low downstream of Dock 2. Although the archived EE/CA sediment samples include sediment from below the defined surface sediment layer (i.e., 0–1 ft), these data are another line-of-evidence demonstrating that using appropriate analytical methods and quantitation limits can strongly influence RAL footprints and remedial alternatives.

Additional PCB congener data could be collected from these high non-detect sample locations to confirm the absence of high concentrations of PCBs at these locations. Figure 12 shows the PCB RAL footprints with elevated non-detects (>1 mg/kg) removed, which shows that the Alternative B RAL footprints adjacent to the Arkema site were all based on non-detect values. Finally, since the data from the archived samples should be validated and updated, the Arkema pre-remedial design investigation work plan submitted to EPA in February 2016 included a robust surface sediment sampling program (Integral 2016a; Attachment 1). The pre-remedial design investigation work plan included more than 30 surface sediment samples for PCB congener

analysis to fill data gaps adjacent to the Arkema site and provide PCB results with low detection limits in the vicinity of historical Aroclor samples with elevated detection limits. Instead of supporting the collection of critically needed PCB congener data to verify current conditions, EPA disapproved the work plan without scientific justification and terminated the EE/CA AOC (USEPA 2016c; Attachment 1).

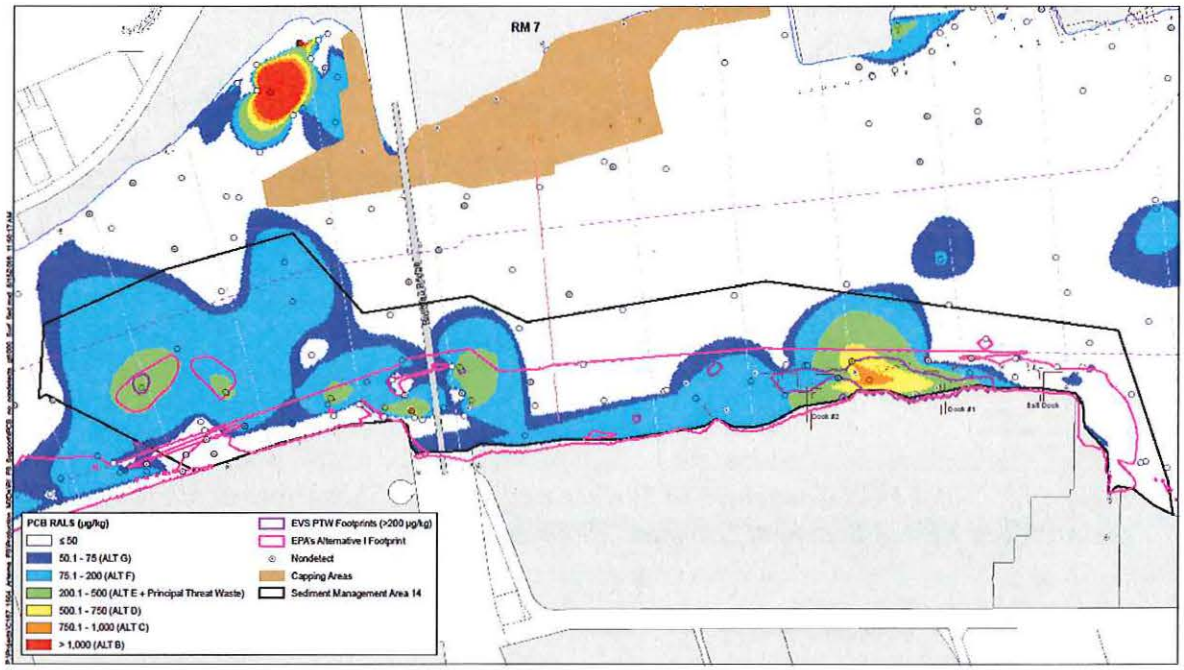

Figure 12. Total PCBs in surface sediment (0–1 ft) with non-detects greater than 1 mg/kg omitted. (Source: Integral using data from USEPA and CDM Smith 2016.)

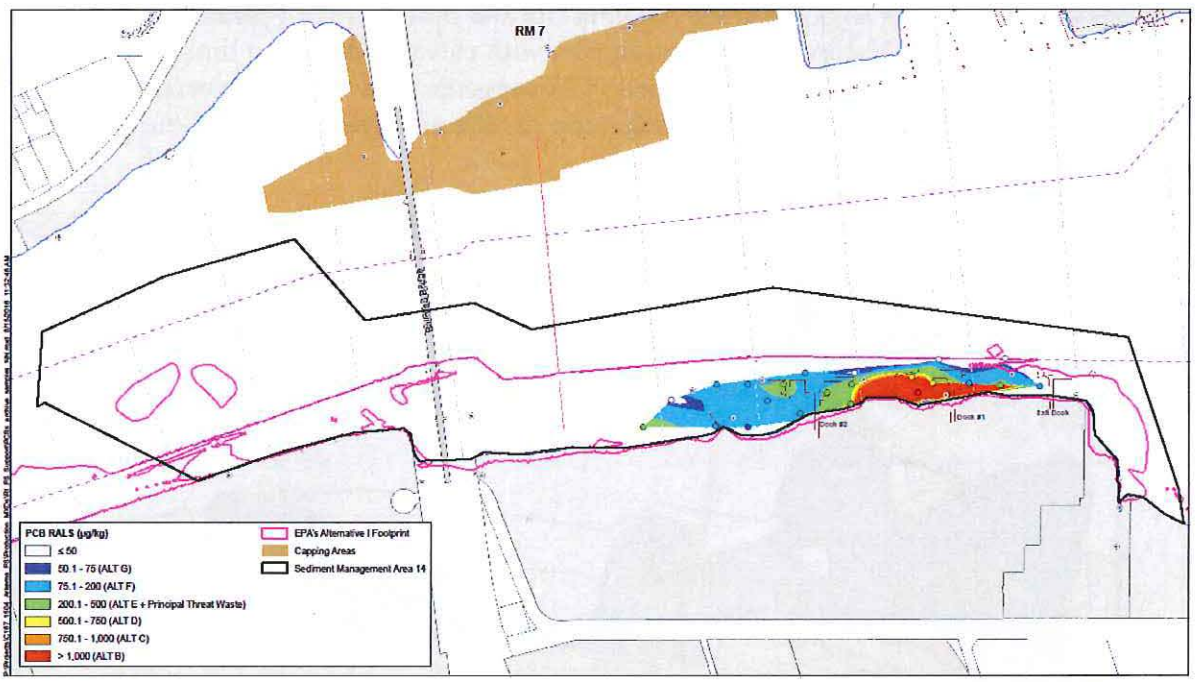

Figure 13. Total PCB Congeners in Surface and Shallow Subsurface Sediment (0–2 ft) from the Archived EE/CA Sediment Samples. (Source: Data from Integral 2016a.)

13 Inconsistent Use of RALs for Alternative I

13.1 Issues with EPA's Evaluation

EPA's Proposed Plan arbitrarily establishes different levels of cleanup for different areas of the Site. The Proposed Plan (USEPA 2016a) states:

> Initially, Alternative E achieved the best proportion of the first three balancing criteria when compared to overall costs. However, a more detailed evaluation of the effectiveness of all alternatives on a SDU-scale indicated that some areas of the Site could use a less aggressive alternative than alternative E while other areas needed a more aggressive alternative to meet the specific factors above.

Based on this, and as shown in Table 17 and Figure 9 of the Proposed Plan, EPA arbitrarily made the preferred alternative selection for SDU 7W and SDU 5.5E more aggressive going from Alternative E to Alternative F. EPA selected less aggressive alternatives for SDUs 6.5E and 6Nav going from Alternative E to Alternative B + PTW. Similarly, the preferred alternative for SDU 6W was made less aggressive going from Alternative E to Alternative D.

EPA incorrectly chose Alternative F for SDU 7W. EPA's decision is arbitrary and capricious because it is based on a scientifically inappropriate CSM, inaccurate baseline sediment concentrations and assumed risks, incorrect risk drivers (i.e., EPA's FS does not match the BHHRA), inconsistent acceptable post-construction risks among SDUs, and a faulty estimation

of risk reduction to justify large dredge volumes. In short, EPA failed to provide a rational connection between the data and facts at SDU 7W and the choice of the remedial action.

13.1.1 Inconsistent RALs for the SDUs

EPA is recommending a remedial alternative (Alternative I) that results in cleanup to different RALs in different portions of the Site (Table 13 and Figure 9 of EPA's Proposed Plan; USEPA 2016a). For example as presented in Table 7 below, PCB cleanup will be performed in SDU 6W to the Alternative D RAL of 500 µg/kg, whereas at SDU 7W, PCBs will be remediated to the Alternative F RAL of 75 µg/kg. The remaining SDUs will be remediated to the Alternative E RAL of 200 µg/kg. RALs similarly vary by SDU for DDx. For example, SDUs 6Nav and 6.5 E DDx RALs are 650 µg/kg (Alternative B+ PTW), whereas the SDUs 7W and 5.5E DDx RAL is 160 µg/kg (Alternative F).

Given that the alternatives appear to be evaluated on a SDU basis driven mainly by RAO2 risks and not the same exposure area for fish, there is no technically defensible basis for selecting 500 µg/kg for PCBs or 650 µg/kg DDx as protective in some SDUs, while RALs that are an order of magnitude lower are selected for other SDUs. If a RAL is protective in one area, it should be protective for all areas (sitewide). Otherwise, this by its very definition is an arbitrary application of cleanup standards.

Table 7. RALs for Focused COCs – Alternative I. Most Aggressive for SDUs 5.5E and 7W

SDUs	SDUs 6Nav and 6.5E	SDU 6W	SDUs 5.5E and 7W	Remaining SDUs
Preferred Alternative	Alternative B+ PTW	Alternative D	Alternative F	Alternative E
		RAL (µg/kg)		
PCBs	200	500	**75**	200
Total PAHs	170,000	69,000	**13,000**	35,000
2,3,7,8-TCDD	0.002	0.002	**0.0006**	0.0006
1,2,3,7,8-PeCDD	0.003	0.0008	**0.0008**	0.0008
2,3,4,7,8-PeCDF	0.2	1	**0.2**	0.2
DDx	650	450	**160**	300

Note: Table 7 created based on information in EPA's Proposed Plan (Preferred Alternatives and Table 17; USEPA 2016a).

For the SDUs where the preferred alternative is more aggressive, the RALs for all COCs also become more aggressive, even when some are not the focused COCs. For example, as presented in Table 16 of the Proposed Plan (and conclusions of the BHHRA), the focused COCs for SDU 7W are DDx, PeCDF, and TCDD, but assigning cleanup to the Alternative F RAL includes more aggressive RALs for other non-focused COCs. In addition, the RAL for PCBs under Alternative

F (75 µg/kg) for SDU 7W is the lowest PCB RAL across all SDUs; but as shown below in Table 8, the PCB concentrations in SDU 7W sediment are nowhere near the highest at the Site.[14]

Table 8. Post-construction Concentrations of PCBs in SDUs—PCB RAL for SDU 7W most aggressive, but PCB Concentrations higher at other SDUs

			Alternatives						
		RAL (µg/kg) [PTW = 200 µg/kg]	A	B	D	E	F	G	I
SDU	Alternative I		Post-construction Concentrations of PCBs (µg/kg)						
NoSDU	PTW	200	30.53	30.38	30.09	29.74	23.74	18.73	30.06
RM2E	E	200	217.4	64.89	46.15	32.49	19.14	14.73	32.49
RM3.5E	E	200	151.02	78.41	58.45	37.35	20.59	13.7	37.35
RM4.5E	E	200	80.42	80.17	59.12	41.87	18.99	8.57	41.87
RM5.5E	F	75	62.08	61.84	61.84	53.19	22.61	10.18	22.61
RM6.5E	B+PTW	200	76.65	27.63	24.41	23.1	12.89	9.6	26.16
Swan Island	E	200	*520.82*	193.93	124.54	47.88	11.13	6.23	47.88
RM11E	E	200	445.34	153.26	89.14	42.85	14.4	5.72	42.85
RM3.9 W	E	E	22.91	22.91	22.91	22.69	19.68	14.52	22.69
RM5W	E	E	26.78	26.52	24.86	24.04	16.73	9.83	24.04
RM6Nav	B+PTW	200	30.28	26.92	21.03	16.56	5.96	2.67	24.24
RM6W	D	500	40.48	18.33	15.78	13.25	7.94	3.46	15.78
RM 7W	**F**	**75**	**142.54**	67.68	45.86	31.02	**17.84**	5.81	**17.84**
RM9W	E	200	302.68	127.36	89.02	46.26	13.85	7.81	46.26

Note: Table created based on EPA's Proposed Plan for Preferred Alternatives and FS Post-construction Concentrations by SDUs (Appendix J [Table J2.3-7]).

Values shaded grey show concentrations at starting (Alternative A) and post-construction (Alternative I) for SDUs that are greater than at SDU 7W. Value with underline shows total PCB concentrations below equilibrium (20 µg/kg).

Note also, the sediment concentrations are calculated in multiple ways in EPA's FS (by river mile, by SDU, and sitewide); therefore, baseline (Alternative A) and post-construction concentrations between these areas are not readily comparable.

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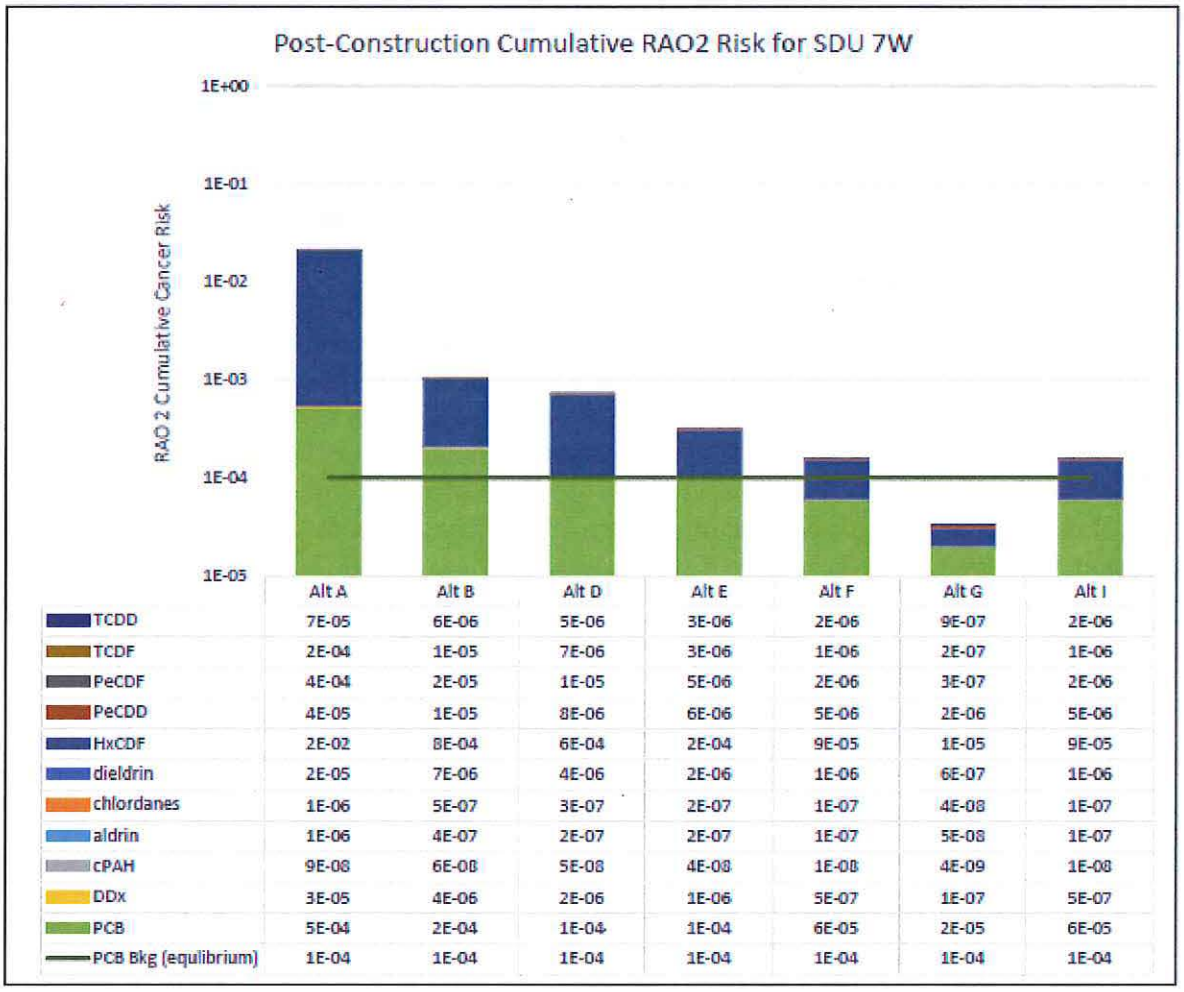
[14] And in fact the RM 7W PCB SWAC is actually much lower than calculated by EPA (shown in Table 8), if EPA had correctly omitted the high non-detects from the RM 7W PCB data set (see further discussion in Section 13.1.3).

13.1.2 HxCDF is not a Focused COC at SDU 7W

The focused COCs for SDU 7W are DDx, PeCDF, and TCDD, which are consistent with the BHHRA. However, EPA's FS estimates PCBs and HxCDF as the main contributors to the total risk at SDU 7W which is an error (see Figure 14 and Table 9 below). In fact, EPA's calculated Alternative A (no action) HxCDF risk (2E-02) is the same as the total risk (2E-02), even though HxCDF was not considered a focused COC at SDU 7W and no RAL has been developed to manage any risk from this congener. See Section 6 for details on the inaccuracies associated with risk from HxCDF at SDU 7W (and sitewide).

As shown below in Figure 14, based on EPA's assessment, the DDx risk (3E-05) for Alternative A (No Action) is actually small in relation to EPA's calculated HxCDF and PCB risks at SDU 7W. As discussed above, given that HxCDF is not a focused COC in SDU 7W in the Proposed Plan, and there is a demonstrated inaccuracy in the risk calculation for HxCDF in SDU 7W (Figure 14 and Table 9), after EPA's inaccuracies are accounted for, and consistent with the BHHRA, that leaves DDx and two remaining dioxin/furan congeners as the only relevant COCs to manage at SDU 7W.



	Alt A	Alt B	Alt D	Alt E	Alt F	Alt G	Alt I
TCDD	7E-05	6E-06	5E-06	3E-06	2E-06	9E-07	2E-06
TCDF	2E-04	1E-05	7E-06	3E-06	1E-06	2E-07	1E-06
PeCDF	4E-04	2E-05	1E-05	5E-06	2E-06	3E-07	2E-06
PeCDD	4E-05	1E-05	8E-06	6E-06	5E-06	2E-06	5E-06
HxCDF	2E-02	8E-04	6E-04	2E-04	9E-05	1E-05	9E-05
dieldrin	2E-05	7E-06	4E-06	2E-06	1E-06	6E-07	1E-06
chlordanes	1E-06	5E-07	3E-07	2E-07	1E-07	4E-08	1E-07
aldrin	1E-06	4E-07	2E-07	2E-07	1E-07	5E-08	1E-07
cPAH	9E-08	6E-08	5E-08	4E-08	1E-08	4E-09	1E-08
DDx	3E-05	4E-06	2E-06	1E-06	5E-07	1E-07	5E-07
PCB	5E-04	2E-04	1E-04	1E-04	6E-05	2E-05	6E-05
PCB Bkg (equlibrium)	1E-04	1E-04	1E-04	1E-04	1E-04	1E-04	1E-04

Figure 14. EPA's Post-construction Cumulative RAO2 Risks for SDU 7W. (Source: Created using values from USEPA and CDM Smith 2016.)[15]

[15] For Figure 14, LSS plotted the graph using post-construction RAO2 risk presented in EPA's FS (Appendix J) and estimated PCB risk at equilibrium assuming a linear relationship with sediment concentration of 20 ppb.

Table 9. EPA's Post-Construction RAO2 Total Risks for SDU 7W (from Appendix J of EPA's FS)

	Alternatives						
	A	B	D	E	F	G	I
COCs	Post Construction RAO2 Risks						
Total Risk	2E-02	1E-03	8E-04	3E-04	2E-04	3E-05	2E-04

Note: Figure 14 and Table 9 based on values from EPA's FS (Table J2.3-8b)

13.1.3 DDx Risks Are Essentially Equivalent Between Alternatives B and E and Are in the 10^{-7} Risk Range For Alternative F

In accordance with the NCP and Oregon Administrative Rules (OAR), a 1E-06 lifetime excess cancer risk for individual chemicals is acceptable. For DDx, a focused COC for SDU 7W, a 1E-06 lifetime excess cancer risk can be achieved using Alternative E (Figure 14). However, Alternatives B and D also achieve excess cancer risks in the 10^{-6} risk range for DDx, with only a factor of 4 difference between Alternative B and Alternative E (see Table in Figure 14). Given the conservative parameters used to estimate risks and also the uncertainties related to calculation of SWACs (Appendix I of EPA's FS), differences in risks by a factor of 4 or less are not significant, and, therefore, not different.[16] The difference in the scope and cost of remediation between Alternatives B and E is substantial, however, this large cost differential between Alternatives B and E cannot be justified based on the degrees of uncertainty. Yet for DDx, EPA has extended the remediation requirements even further to an excess cancer risk of 5E-07 (Alternative F), which is not only below the already acceptable individual COC threshold of 1E-06, but is also below the 1E-04 to 1E-06 risk range, to which the NCP and EPA guidance expects Superfund site risk to be managed. The use of this overly aggressive RAL for DDx is a

[16] A number of factors and assumptions went into the post-construction risk estimates that have significant uncertainties, including (1) uncertainties in the derivation of PRGs, which were used to estimate risks from the SWACs; and (2) uncertainties in development of SWACs, including different methods to estimate SWACs, based on rolling river mile, SDU-wide and sitewide. Uncertainties associated with PRG development primarily for DDx and dioxin/furans include issues associated with the FWM, which overestimates tissue concentrations within the range of concentrations of concern, with error bars that range as much as an order of magnitude (see Appendix B of EPA's FS). These uncertainties exist for all of the focused COCs, with the error bars for dioxins/furans spanning 2-3 orders of magnitude. This uncertainty may explain why the EPA FS, which used modeled tissue concentrations, is overestimating dioxin/furan risks by two orders of magnitude from those in the BHHRA which used empirical tissue data. Other assumptions that result in uncertainties include the use of a range of consumption rates and highly conservative assumptions about exposure duration, the source of fish consumed, etc. Appendix I of EPA's FS presents uncertainties associated with the estimation of SWACs and shows that SWACs can vary generally by a factor of 2, just due to statistical/spatial methods. The use of zeroes as replacement values, as mentioned previously, also adds to the uncertainty in the SWACs, perhaps as much as an order of magnitude.

more stringent risk standard for SDU 7W than the remainder of the Site, is not necessary, is ultimately not more protective when compared with other chemicals (i.e., PCBs), and is thereby arbitrary and capricious.

13.1.4 The Lowest Theoretically Achievable PCB Risk in SDU 7W is 5E-05

EPA's Alternative A (no action) risk at SDU 7W from PCBs is 5E-04 and the risk from EPA's calculated background of 9 µg/kg is 5E-05, which essentially means that the lowest theoretical risk that can be achieved at the Site for PCBs is 5E-05. The cleanup goal for PCBs of 9 ppb, based on EPA's arbitrarily derived background concentrations, however, is not achievable. Background must not be used to establish cleanup goals when likely ongoing contaminant inputs from upland sources within the Site and upriver of the Site exceed EPA's calculation of background (see Section 4). LWG provided EPA an evaluation of PCB equilibrium concentrations for the Site that is a much more reliable indicator of actual future concentrations that can be achieved.

13.1.5 Unnecessarily Large Dredge Volumes and Remedial Footprints

What the above discussion tells us is that the most invasive remedial alternative (Alternative F) for SDU 7W attempts to manage PCBs, DDx, and dioxins/furans, including HxCDF, in error. This aggressive remedial approach to SDU 7W is unnecessary, as discussed below. EPA's calculated dredge volumes associated with these alternatives for SDU 7W are shown below in Table 10.

Table 10. EPA's Dredge Volumes for SDU 7W

Alternative	A	B	D	E	F	G
Total Dredge Volume (cy)	0	100,882	124,108	170,255	260,430	436,261

Note: Dredge volume values from EPA's FS (Table P-13)

According to EPA, the focused COCs for SDU 7W are DDx, PeCDF, and TCDD; however, EPA has designed a remediation for HxCDF and PCBs. As illustrated in Figures 15 and 16, the reduction in risk between Alternatives B and E does not justify the larger dredge volumes, when cost-effectiveness is considered.

Figure 15 shows risk from all COCs identified in EPA's FS in Appendix J for SDU 7W. As previously discussed, LSS has determined that these Figure 15 risk estimates, as shown, are in error as demonstrated in part by the HxCDF risks (grey line on Figure 15) comprising the majority of SDU 7W risk. Figure 16 shows risks from the focused COCs per the EPA-approved BHHRA for SDU 7W. Based on the rigorous and transparent analysis completed for the BHHRA, LSS is confident that the risk estimates in Figure 16 are more accurate and, therefore, should supplant EPA's Figures 14 and 16, which are non-transparent and flawed.

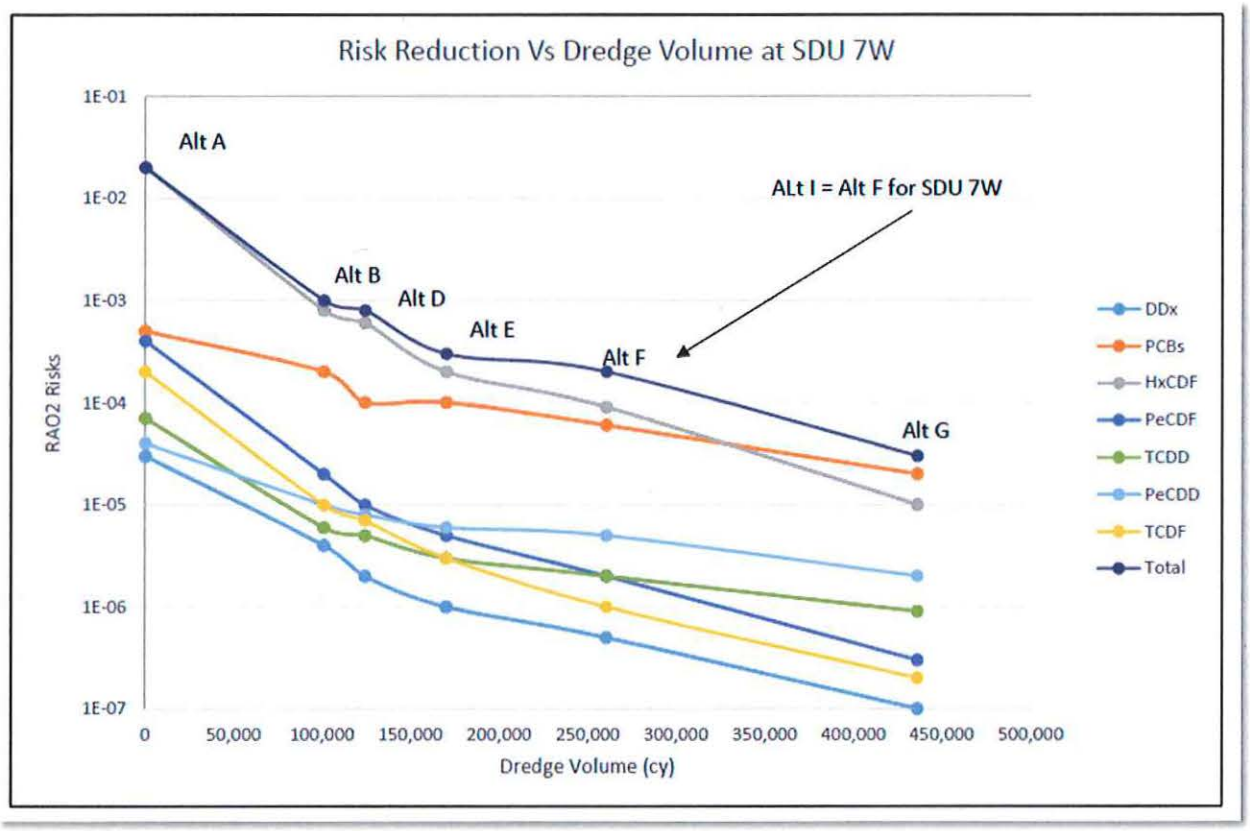


Figure 15. Risk Reduction vs. Dredge Volume for Focused COCs Identified in EPA's FS for SDU 7W. (Source: Modified from USEPA and CDM Smith 2016.)

Note: This figure was created using post-construction risks (Appendix J) and dredge volumes (Appendix P) by SDU in EPA's FS.

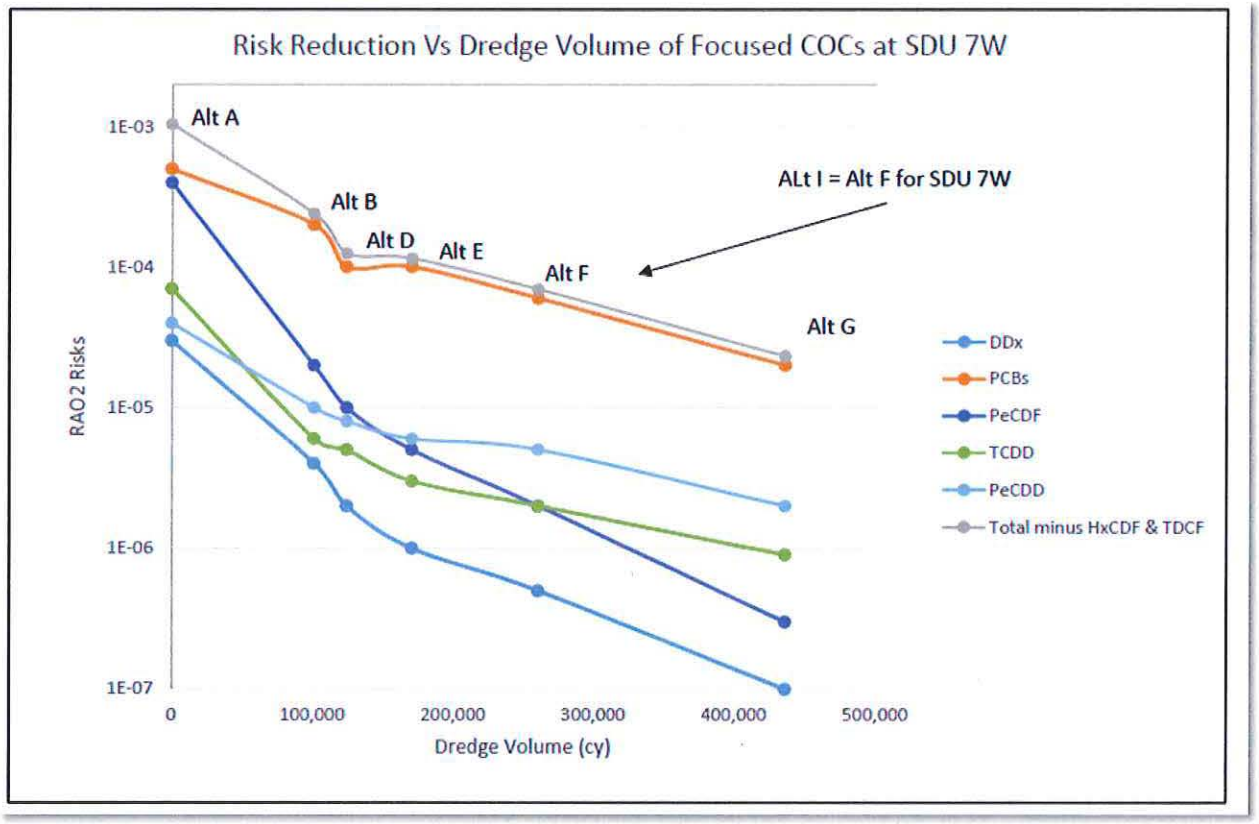


Figure 16. Risk Reduction vs. Dredge Volume for Focused COCs Identified in the Proposed Plan for SDU 7W. (Source: Modified from USEPA and CDM Smith 2016.)

Note: This figure was created using post-construction risks (Appendix J) and dredge volumes (Appendix P) by SDU in EPA's FS.

Figures 17 through 20 have been prepared by LSS for focused SDU 7W COCs (DDx, PeCDF and TCDD) to illustrate the unnecessarily large remedy proposed by EPA for SDU 7W and the insignificant risk reduction achieved between Alternatives B through E.

For DDx, based on EPA's post-construction risk estimates (Figure 14), appropriate goals can be achieved using a less invasive alternative (Alternative B through D; see Figure 14) and without dredging an additional 90,000 cy (Alternative E) to 160,000 cy (Alternative F) of sediment (Table 10). The remedial footprints and post-construction risk estimates for DDx for SDU 7W that use less aggressive alternatives than Alternative F are shown below in Figure 17. As previously discussed, Alternatives B through E all remediate DDx to a 10^{-6} risk range but with drastically different remedial footprints.

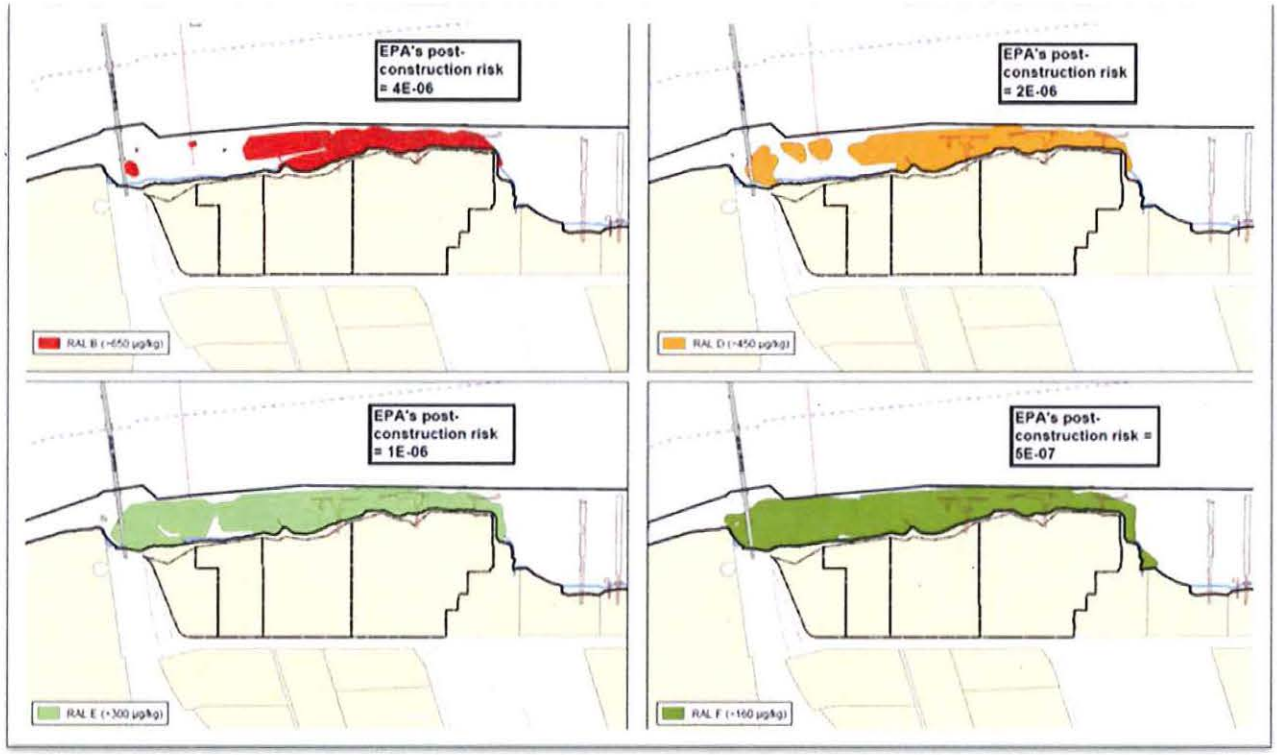


Figure 17. EPA's Remedial Footprints based on DDx RALs and Post-Construction Risks for SDU 7W for Alternatives B, D, E, and F. (Source: Modified from USEPA and CDM Smith 2016.)

For PeCDF, based on EPA's post-construction risk estimates (Figure 14), appropriate goals can be achieved using a less intrusive alternative (Alternative B through E). The post-construction risk for PeCDF for Alternative B is similar to PCB risk for the EPA derived background of 9 ppb, such that remediation below the Alternative B RAL for PeCDF will not achieve any further risk reduction in SDU 7W. The remedial footprints and post-construction risk estimates for PeCDF for SDU 7W that use less aggressive alternatives than Alternative F are shown below in Figure 18.

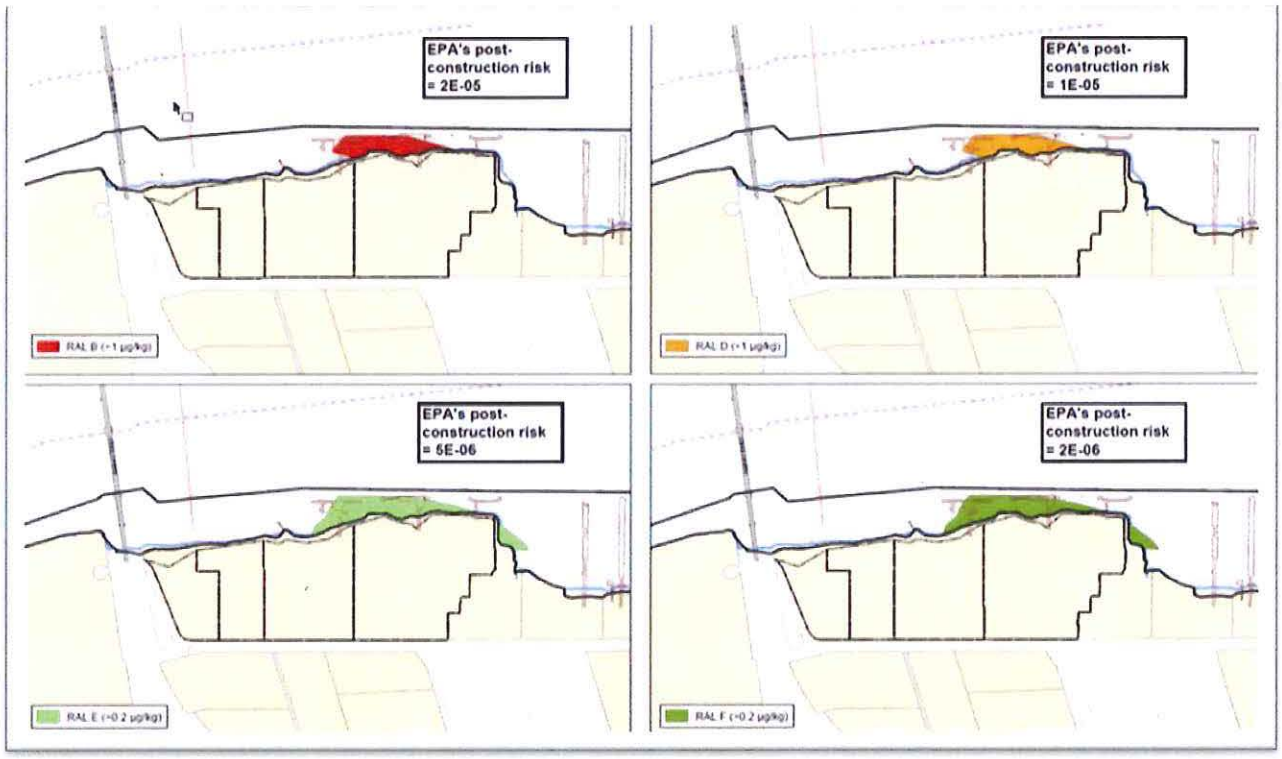


Figure 18. EPA's Remedial Footprints based on PeCDF RALs for SDU 7W and Post-Construction Risks for Alternatives B, D, E, and F. (Source: Modified from USEPA and CDM Smith 2016.)

For TCDD, based on EPA's post-construction risk estimates (Figure 14), appropriate goals can be achieved using a less intrusive alternative (Alternative B through E). The post-construction risk for TCDD for Alternative A (No Action) is similar to PCB risk for the EPA derived background of 9 ppb. The remedial footprints and post-construction risk estimates for TCDD for SDU 7W that use less aggressive alternatives than Alternative F are shown below in Figure 19.

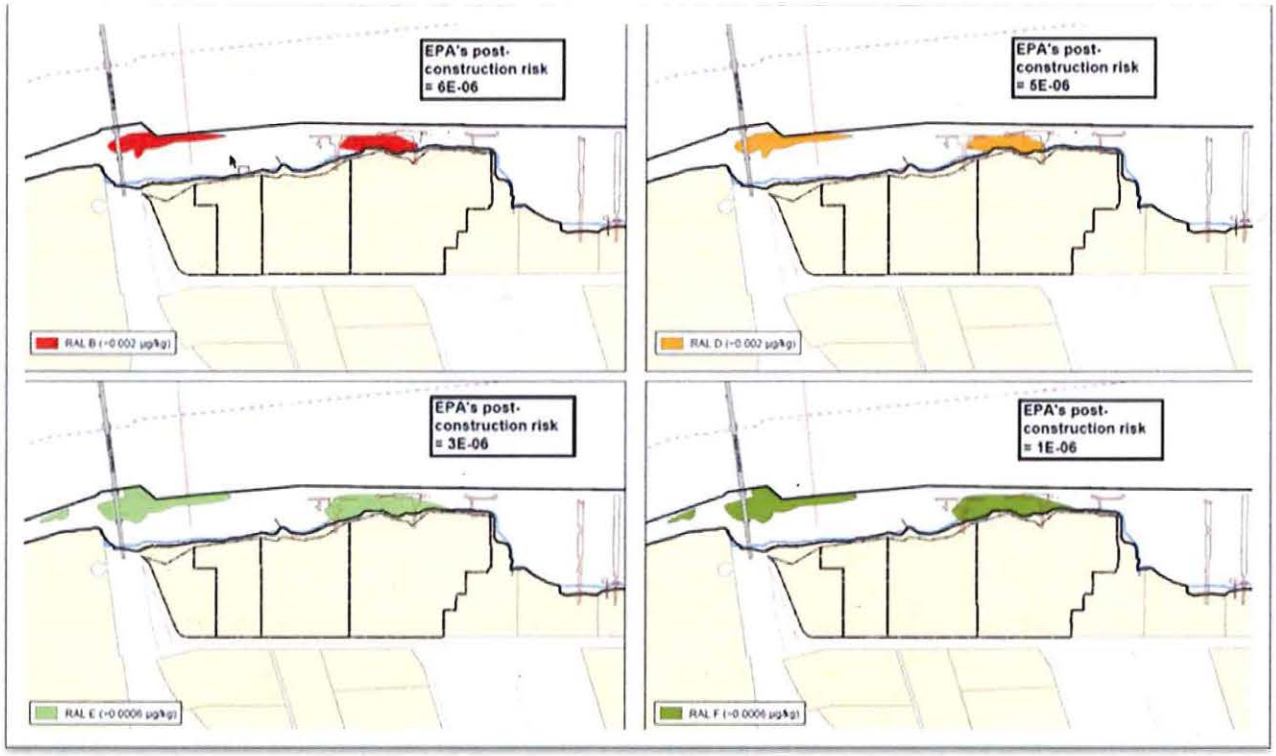


Figure 19. EPA's Remedial Footprints based on TCDD RALs for SDU 7W and Post-Construction Risks for Alternatives B, D, E, and F. (Source: Modified from USEPA and CDM Smith 2016.)

With more invasive cleanup for SDU 7W (Alternative F), the remedial footprint becomes unnecessarily large and can never address total risk to less than 1E-05 because of risk from PCBs (using either background or equilibrium). Background risks are discussed in Section 4.

According to EPA, PCBs are not the focused COC for SDU 7W; concentrations in SDU 7W sediment are less than in other areas of the Site, yet those higher PCB concentration areas outside of SDU 7W are assigned less aggressive remedial alternatives in the Proposed Plan (see Table 8 above). As summarized in Section 13.1.1, if a PCB RAL of 500 µg/kg (Alternative B) is considered protective for one area, then it should be protective of SDU 7W as well without dredging an additional 160,000 cy of sediment (Table 10). For most of the areas of the Site, including areas with higher starting PCB concentrations than SDU 7W, EPA's post-construction risk from PCBs is at least an order of magnitude higher than post-construction risk at SDU 7W (Table J2.3-8a of Appendix J of the FS), but those higher post-construction PCB concentrations are considered acceptable to meet interim targets. So, it is inappropriate and arbitrary for EPA to specify that SDU 7W meet more restrictive criteria than other SDUs at this Site. EPA's remedial footprints for PCBs for SDU 7W for Alternatives B through F are shown below in Figure 20.

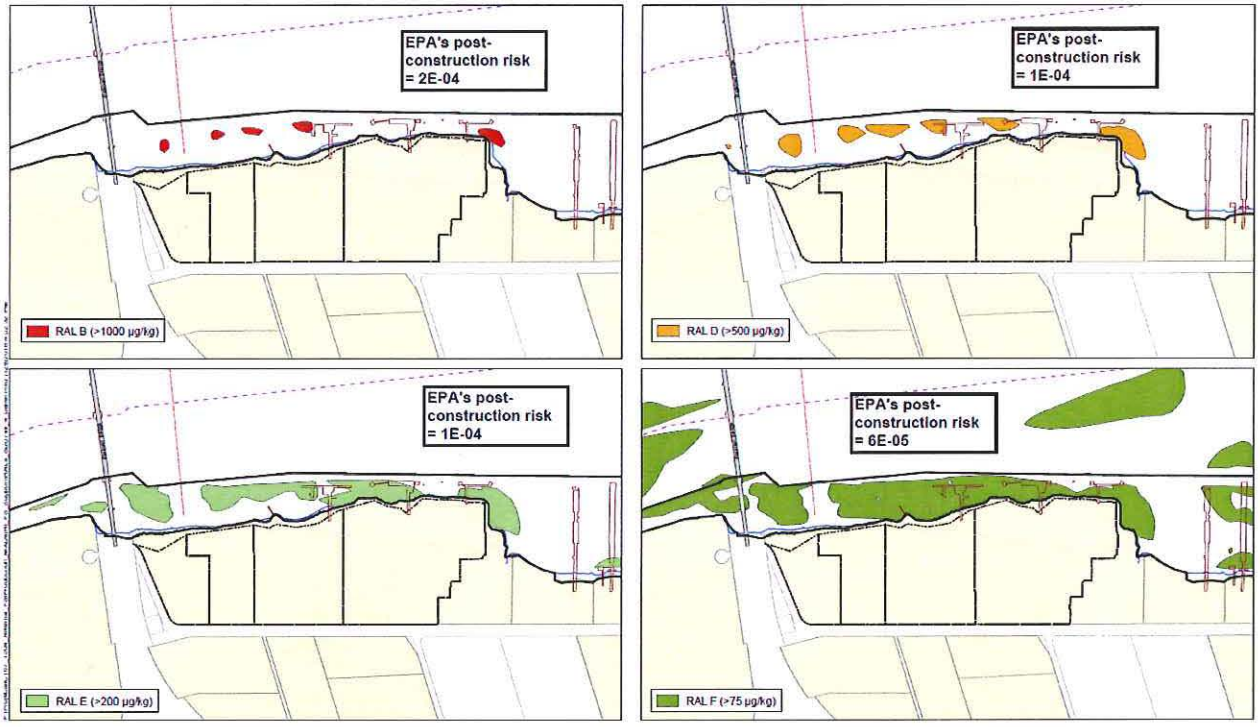


Figure 20. EPA's Remedial Footprints based on PCB RALs and Post-Construction Risks for SDU 7W for Alternatives B, D, E, and F. (Source: Modified from USEPA and CDM Smith 2016.)

However, the RAL footprints shown in Figure 20 have errors based on PCB data used in generating this figure. At SDU 7W, the frequency of detects for PCBs is low. As discussed in Section 12.1, the SWACs calculated by EPA include a large number of non-detects, artificially increasing the SWACs; therefore, the basis for the areas outlined in Figure 20 are in error. The remedial footprints for PCBs at SDU 7W omitting high non-detects (> 1 mg/kg) for Alternatives B, D, E, and F are shown below in Figure 21.

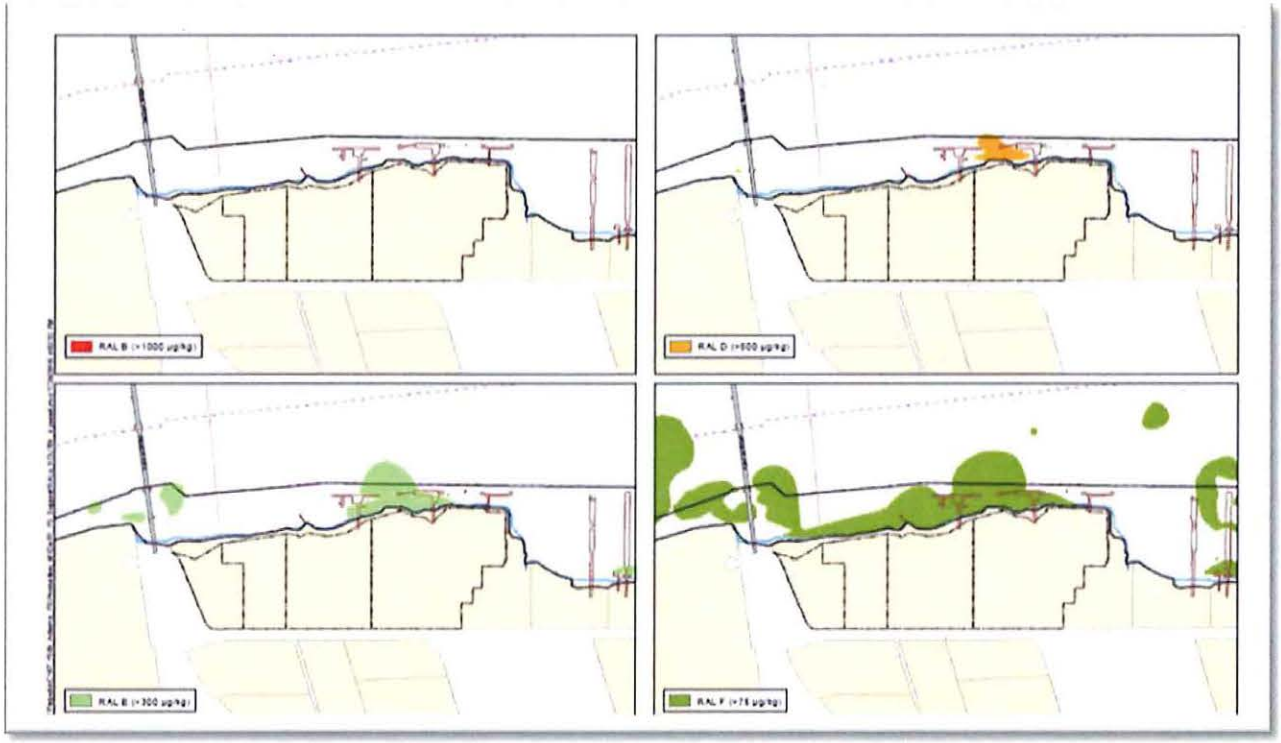


Figure 21. Remedial Footprints (omitting non-detects > 1 ppm) based on EPA's PCB RALs for SDU 7W for Alternatives B, D, E, and F. (Source: Modified from USEPA 2016.) Post-construction risks were not calculated by LSS for these alternatives.

In summary and as illustrated above in Figures 14 through 21, the reduction in risk between Alternatives B through F does not justify the larger footprints and larger dredge volumes for Alternative F, when cost-effectiveness is considered.

13.2 LSS Evaluation and Recommended Corrective Action

In summary, there is very little difference in net risk reduction between Alternatives B and I (equivalent to Alternative F at SDU 7W) for almost all COCs. For most of the COCs, the differences are less than a factor of 2 and sometimes much less. Given the very conservative assumptions that were used to calculate risks, poor quality data, and uncertainties associated with the SWACs (Appendix I of EPA's FS), differences in estimated risks by a factor of 4 or less are not significant. A more reasonable criteria for evaluating differences in estimated risk between alternatives would be a factor of 10, which should be considered the minimum significant difference given the range of uncertainties in the risk assumptions. A probabilistic risk assessment, which incorporates the quantitative uncertainties, is a more appropriate approach.

Because of these uncertainties, the removal volumes in Alternative I cannot be justified as a cost-effective reduction of risk in comparison to other alternatives. Also, the use of different RALs for different areas of the Site to achieve the same level of protection cannot be justified based on differences in risk outcomes that are an order of magnitude or less.

Based on the post-construction risks presented in EPA's FS and as discussed in this section (also see Sections 3 and 6), any remediation beyond Alternative B is unwarranted.

14 Inappropriate RCRA/State Waste Disposal Designation for Sediments Adjacent to Arkema

14.1 Issues with EPA's Evaluation

The assumed areas for disposal of sediment as RCRA waste (Figure 22; Figure 3.4-35 of EPA's FS, presented below) are based on a single toxicity characteristic leaching procedure (TCLP) sample for lead[17] and no TCLP samples for chromium. Based on sediment analytical results, the area shown on Figure 22 does not represent sediment that will require RCRA Subtitle C landfill disposal.

[17] The analytical results minimally exceeded TCLP regulatory limits for lead in this sample. LSS notes that the TCLP samples were collected from specific intervals from single boreholes and are not necessarily representative of the general area around these boreholes. A more representative sample of bulk sediments (i.e., drummed sediments that contained the referenced TCLP sample intervals) was sampled and analyzed for TCLP to evaluate the likely disposal characteristics for these sediments; none of the drummed sediment samples exceeded TCLP regulatory limits for lead or any other chemical.

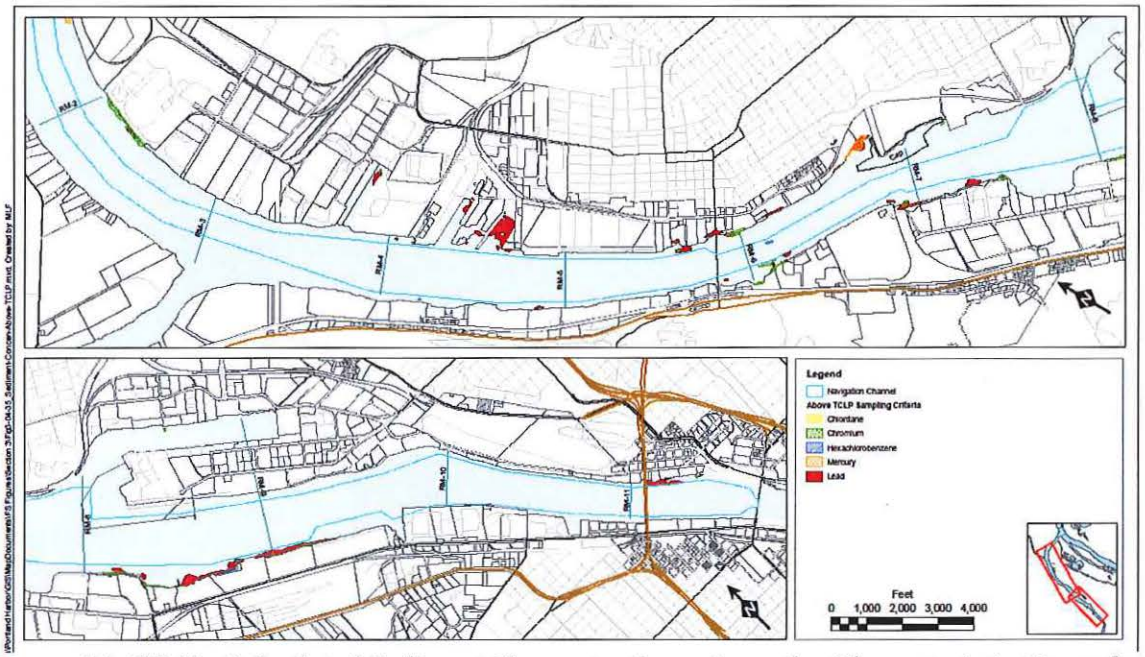


Figure 22. EPA's Calculated Sediment Concentrations above the Characteristic Hazardous Waste Criteria for Toxicity Established through TCLP. (Source: USEPA and CDM Smith 2016.)

The State-listed pesticide residue designation also does not necessarily apply to sediment offshore of the Arkema site (Figure 23; Figure 3.4-36 of EPA's FS, presented below). As recently as February 2016, DEQ was researching the issue of whether sediment offshore of the Arkema site would be designated a State-listed pesticide waste. Item 3 of the "Top 10 State Issues for Proposed Plan" document obtained from LWG's FOIA request (Attachment 6) states that "Sean needs State determination of State-only pesticide question, which Matt is researching." However, even if it is determined that some portion of the sediment is a State-listed pesticide residue waste, it would not preclude the placement of this sediment in a confined disposal facility (CDF) (see the hazardous waste identification requirements [HWIR] rule discussion below) or disposal in an out-of-State Subtitle D landfill. When a State-listed hazardous waste is transported out of state (i.e., the Roosevelt Regional landfill presented in EPA's FS), the Oregon State waste designation no longer applies, and the waste can be disposed as a non-hazardous waste so long as it meets the other landfill disposal criteria. This waste disposal process was recently demonstrated by the disposal of soil from the Arkema Stormwater and Groundwater SCMs at Roosevelt landfill in Washington under DEQ's oversight.

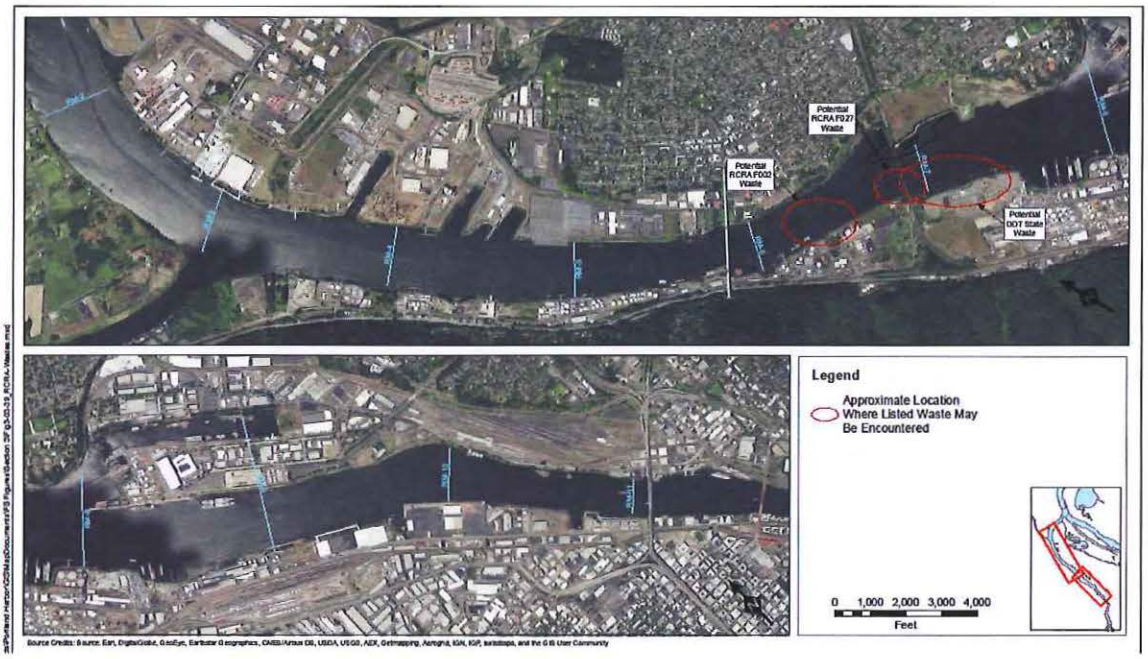


Figure 23. EPA's Areas Potentially Containing RCRA- or State-listed Wastes. (Source: USEPA and CDM Smith 2016.)

LSS disagrees with the cost assumption that "cement solidification/stabilization, low temperature thermal desorption, and no treatment will be used in equal proportions to treat pesticide/chlorobenzene PTW" for the disposal of dredged sediment that meets EPA's PTW criteria offshore of the Arkema site (USEPA and CDM Smith 2016). Notwithstanding the fact that there is no pesticide or chlorobenzene PTW sediments currently identified off the Arkema site (see discussion in Section 10 of this comment letter), EPA's FS and Proposed Plan fail to clearly outline the basis for EPA's assumptions regarding treatment as a prerequisite for offsite disposal. Section 3.2.2.3 of EPA's FS makes vague references to regulatory "standards" and "requirements;" however, it fails to identify specific regulations and the conditions under which they are assumed to apply, or not apply, to sediments that are designated by EPA as PTW and the mechanism under which they derive the need for treatment prior to offsite disposal. Furthermore, the "Top 10 State Issues for Proposed Plan" document obtained from LWG's FOIA request (Attachment 6) states that "DEQ wants to be clear that land disposal of these sediments does not require treatment under Oregon Administrative Rules." As presented, EPA has arbitrarily made more conservative assumptions for disposal of PTW defined by sediments containing DDx and NAPL than it has for PCBs, dioxin/furans, and PAHs. Based on current data, none of the sediment offshore of the Arkema site should be classified or handled as a Federal- or State-listed hazardous waste, or as PTW requiring treatment.

14.2 LSS Evaluation and Recommended Corrective Action

Based on our analysis, there are presently no data that indicate that any material dredged from the SDU 7W reach of the river would be classified as RCRA hazardous waste or a State-listed pesticide residue. Procedures can and must be included in any SDU 7W site-specific cleanup

plan to further test representative samples of the sediment volume designated for dredging. There is no PTW in the SDU 7W, and thus there is no rationale for requiring treatment of dredged sediment. LSS agrees with DEQ's assessment in the "Top 10 State Issues for Proposed Plan" document obtained from LWG's FOIA request (Attachment 6) that states "DEQ wants to be clear that land disposal of these sediments does not require treatment under Oregon Administrative Rules." Assumptions for treatment of wastes for all Portland Harbor contaminants must be consistent. The more conservative assumptions, as defined by EPA, for disposal of SDU 7W PTW (related to DDx and EPA's presumed NAPL) are arbitrary and capricious when compared to the PTW identification and PTW treatment requirement determination made by EPA for other SDUs.

15 Inappropriate Application of the HWIR Rule for Disposal of Sediment in a CDF

15.1 Issues with EPA's Evaluation

In its proposed remedy, EPA has arbitrarily precluded management of sediment dredged offshore of the Arkema facility in an onsite CDF based on the following assertion from EPA's FS (USEPA and CDM Smith 2016):

> Dredged material subject to requirements of a permit that has been issued under Section 404 of the CWA is excluded from the definition of hazardous waste (40 CFR 261.4(g)). This provision is discussed in the Hazardous Waste Identification Rule (HWIR) (63 Federal Register [FR] 65874, 65921; November 30, 1998). Oregon State adopted the HWIR rule in 2003. <u>This rule means that RCRA regulatory requirements do not apply to sediment dredged at the Site and disposed of on-site, such as at the Terminal 4 CDF, if the material otherwise meets the CDF acceptance criteria.</u> (emphasis added)

While EPA has correctly stated that RCRA regulatory requirements (including the designation of waste sediment as either a Federal- or State-only hazardous waste) do not apply to sediment placed in a CDF, it mischaracterizes the CWA requirement that the sediment must meet CDF acceptance criteria for this rule to apply. Because DEQ has adopted the Federal HWIR-media rule, and the CDF would meet CWA Section 404 requirements, RCRA Subtitle C requirements would not apply, and the dredged material placed in the CDF would not be a hazardous waste. EPA summarily disregards and undermines the scope and intent of the HWIR rule by placing broad, arbitrary restrictions on what EPA believes can be placed into the a CDF[18], if constructed.

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[18] As reported by the St Johns Neighborhood Association, Audubon Society of Portland, and the Willamette Riverkeeper, the Port of Portland released a statement on or about August 18, 2016, announcing that they would no longer be "sponsoring a CDF at Terminal 4."

This includes the blanket prohibition of any dredged sediment that may be potentially (if disposed of at an upland landfill) designated as RCRA or State hazardous waste, or meeting EPA's erroneous definition of PTW.

15.2 LSS Evaluation and Recommended Corrective Action

It is scientifically invalid to conclude that sediment may not be disposed onsite simply according to a flawed definition of PTW. This unsound action by EPA will likely have severe negative implications for the Proposed Plan and any subsequent remedial action.

In conclusion, EPA disregards the scope and intent of the HWIR Rule by placing arbitrary restrictions on what EPA believes can be placed into a CDF, if constructed. All of EPA's Acceptance Criteria for a CDF are arbitrary and must be removed. Disposal of dredged material must follow the HWIR Rule as adopted by the State or follow RCRA if disposed of at an upland landfill.

16 Inappropriate Use of Rigid Containment (i.e., Sheetpiles) for Dredging Sediment Adjacent to Arkema

16.1 Issues with EPA's Evaluation

EPA's proposed remedy for Portland Harbor incorporates the construction of sheetpile barrier walls as a dredge water quality control measure to support short-term effectiveness. Due to EPA's incorrect assertion that a large NAPL plume exists offshore of the Arkema site, a majority of the sediment footprint in SDU 7W is assumed to require a barrier wall for dredge and cap construction activities. However, EPA provides no supporting evidence that it has quantitatively estimated dredge residuals and releases associated with its proposed remedy, and the associated benefits this measure will provide relative to human health and ecological risks. EPA's sediment remediation guidance strongly recommends a comprehensive and quantitative evaluation of dredge release impacts. While several case studies have demonstrated reductions of dredging-related releases outside of the sheetpile-enclosed area (relative to releases that would have occurred without containment), release of contaminants beyond the barrier still occurs, as in practice it has not been possible to place a water-tight barrier. The variable texture and debris conditions that occur offshore of the Arkema site, along with dynamic river forces, pose particular technological challenges that could lead to separation of the barrier interlocks, which would contribute to releases through the barrier. Necessary barrier design features such as pressure equalization ports also allow transport of dredging-related releases beyond the barrier. In high-energy environments, the use of rigid containment barriers can also have unintended and undesirable environmental consequences. For example, relatively deep scour of sediments outside of sheetpile enclosures can easily occur in mid- to high-energy environments. Such scour can lead to potential water and sediment quality impacts, and the loss of lateral support at the toe of the sheetpile can result in instability and possible failure of the enclosure. Because these types of unintended consequences result from localized flow conditions that are transient in nature, they can be difficult to predict and can occur at any time during or after installation of the containment structure. Another potential undesirable consequence associated with rigid

containment structures is the accumulation and concentration of dissolved-phase contaminants in the water column within the structure (Anchor QEA and ARCADIS 2010). Removal of rigid barriers can also have undesirable consequences, as sediment adhering to the piling can be resuspended into the water column during pile pulling, resulting in potential impacts to adjacent and downstream areas.

EPA's estimated construction duration of its proposed remedy (having a related effect on short-term effectiveness) fails to incorporate the time to install sheetpile walls in each alternative's duration or lower production dredging within the confined sheetpile wall space. EPA has also grossly underestimated the cost of implementing this measure. The costs EPA uses ($2,750 per linear foot) would not be sufficient for water depths approaching 50 feet; these depths would require much more costly structures (e.g., cofferdams). EPA's assumed extensive use of sheetpile in SDU 7W suggests it would encroach upon the navigation channel, which would infeasibly obstruct vessel traffic and present significant floodway impacts. Sheet pile would impact ongoing water dependent operations and nearshore fish migration. EPA has not evaluated whether sheetpiles in the navigation channel could be permitted by the U.S. Army Corps of Engineers or allowed by the U.S. Coast Guard as possible hazards to navigation in an active vessel traffic lane. There is also no consideration of whether or not such devices are technically feasible given flow conditions, sediment depths, and water depths, or the need to place them and remove them continuously to accommodate vessel traffic if dredging in a navigation channel.

An evaluation of the effective working time for sediment remediation dredging was conducted based on production rates for the Lower Duwamish Waterway Early Action in 2013-2015 (DOF 2016; Attachment 5). The percent effective working time, the ratio of the effective working time to the dredging time, was estimated at 55 percent. This percent effective working time took into account the need to move the dredging operation for river traffic, which has right-of-way over dredging operations in the navigation channel. An animation depicting the movement of the dredging operation for river traffic can viewed through the following link: http://dofnw.com/animation.

16.2 LSS Evaluation and Recommended Corrective Action

As stated above, LSS intends to develop a robust pre-design investigation program to disprove EPA's claim that there is NAPL in sediment offshore of the Arkema site. Sufficient flexibility must be provided by EPA's ROD to make informed decisions during remedial design regarding the suite of water quality control measures that may be needed to achieve water quality performance objectives. Additionally, rather than prescribe a specific construction method, flexibility must be afforded to the construction contractors to make decisions regarding the means and methods to achieve performance objectives. Dredging pilot studies are a potential tool for performing more rigorous evaluation of dredge residuals/releases and determining the relative effectiveness of various water quality control measures.

17 No Consideration of MNR/ENR at SDU 7W

17.1 Issues with EPA's Evaluation

EPA's proposed remedy does not incorporate, in a scientifically meaningful way, MNR as a tool to address sediments in SDU 7W. This is due to the omission of key components of an MNR evaluation as required by guidance (such as EPA's 2005 sediment remediation guidance) including 1) an adequate CSM; 2) appropriate evaluation of multiple lines of empirical evidence; and 3) a quantitative evaluation of natural recovery and the associated long-term (i.e., after implementation of the remedial action) outcomes of the alternatives. As identified in the dispute filed by LSS on EPA's FS, Appendix H of the Arkema pre-remedial design investigation work plan (Integral 2016a; Attachment 1) included an evaluation of natural recovery at the Portland Harbor Site. In that analysis, the original RI data sets were evaluated against more recently collected smallmouth bass fish tissue (2012), SPI (2013), and surface sediment PCB (2014) data. Based on a total of eight lines of evidence, including tests of statistical significance and a likelihood analysis, the weight of evidence strongly supports that natural recovery is occurring and will continue to occur within Portland Harbor. Therefore, MNR is an important natural process that should be incorporated into all Portland Harbor sediment remedies, including SDU 7W. EPA's scientifically unsupportable decision to exclude recent evidence of natural recovery from its FS biased the conclusions of EPA's alternative analysis and selected remedy in the Proposed Plan.

17.2 LSS Evaluation and Recommended Corrective Action

Before EPA issues the ROD, EPA must incorporate a technically sound CSM and quantitative evaluation of natural recovery with associated long-term outcomes, drawing on all available empirical lines of evidence. At a minimum, the ROD must provide sufficient flexibility to address the deficiencies noted with EPA's evaluation of MNR during remedial design and permit an appropriate framework for making engineering adjustments and refinements to the application of MNR within remediation areas based on new information obtained during the pre-remedial engineering design studies performed in the post-ROD timeframe.

Specific examples of additional information that may be collected during the remedial design phase to address and reduce the uncertainty associated with the effectiveness of MNR include:

- Bathymetric and topographic surveys—Baseline investigations of Portland Harbor should include survey datasets of sufficient coverage to facilitate long-term evaluation of sediment transport trends. There are inherent limitations present in the existing data sets, specifically shallow/nearshore areas where vessel access has been limited.
- Geochronology—As outlined in the Arkema pre-remedial design investigation work plan (Integral 2016a), sampling of sediment cores for geochronology analysis is a valuable line of evidence that may be used to assess historical deposition rates.
- SedFlume—An assessment of the relative stability (or erodibility) of sediment using SedFlume is a potentially useful method to establish the conditions under which bedded sediments are expected to mobilize. These empirical measurements may be used to derive

incipient shear stresses for sediments that, coupled with hydraulic modeling, can be used to evaluate the potential for sediment to mobilize due to flood events, vessel movements, etc.

LSS PROPOSED REMEDIAL ALTERNATIVE

Because of the flaws and errors in EPA's remedial analysis, the inaccurate CSM, and the arbitrary and capricious nature of the remedy proposed for SDU 7W in the Proposed Plan, LSS has developed a remedial alternative for the portion of EPA's SDU 7W adjacent to the Arkema site (RM 7W) that is based on sound technical analysis and a balanced assessment of remediation requirements and post-construction risk. The RM 7W area evaluated by LSS is bounded by the shoreline to the west, navigation channel to the east, railroad bridge to the north, and the Willbridge Terminal to the south (Figure 24).

Remedial Action Levels

The Alternative B RALs provided in EPA's FS and Proposed Plan were used for PCBs, total PAHs, TCDD, PeCDD, and PeCDF in the LSS remedial alternative. LSS developed a technically sound RAL for DDx based on the DDT RAL curve presented in Appendix G-1 of the Arkema EE/CA report (Integral 2012; Attachment 1) and a 10^{-5} excess cancer risk from DDx for RAO2 (PRG of 61 µg/kg). The LSS-derived DDT RAL based on the RAO2 PRG is 5 mg/kg, which corresponds to a 10^{-5} risk level for DDx for RM 7W. The DDx risk is significantly less than this value on a sitewide basis.

Although LSS does not endorse any of EPA's scientifically inaccurate RALs, the Alternative B RALs for PCBs, total PAHs, TCDD, PeCDD, and PeCDF were selected as a starting point and refined based on an assessment of SDU 7W site risks, equitable risk reduction requirements, and cost-effectiveness associated with EPA's alternatives. All of EPA's focused COCs were used in this evaluation (PCBs, total PAHs, DDx, TCDD, PeCDF, and PeCDD). As discussed in Section 12 above, the RAL footprints must only consider detected PCBs based on PCB congener concentrations adjacent to the Arkema site, due to the well-known matrix interference with DDx in PCB Aroclor analyses. Accordingly, non-detect PCB data with detection limits at or above 1,000 µg/kg were excluded from the dataset. The RAL footprints were combined into the remedial action area presented in Figure 24 below.

As noted by EPA, because dioxin/furan spatial data density is poor (Allen 2015, pers. comm.), use of the RALs for the three focused COC congeners alone resulted in elevated post-construction risks; to eliminate this statistical artifact, the remedial footprint was expanded to encompass dioxins/furans over 0.89 µg/kg as total dioxin/furan TEQs in the central portion of SDU 7W. Note that additional data will need to be collected during the pre-remedial engineering design study phase to refine the remedial footprint for dioxins/furans, and the area affected by the 0.89 µg/kg as total dioxin/furan TEQ will need to be modified based on this additional data.

Principal Threat Waste

As discussed in Section 10 above, LSS assessed the presence of PTW in SDU 7W adjacent to the Arkema site. PTW for DDx, PCBs, and dioxins/furans was assessed within the LSS proposed remedial action footprint based on an excess cancer risk of 10^{-3} for the direct contact pathway.

This criteria is consistent with EPA's PTW fact sheet (USEPA 1991; Attachment 7). Based on this criteria, no PTW for DDx, PCBs, or dioxins/furans is present within the LSS proposed remedial action footprint. EPA used fish consumption 10^{-3} risk for 5 individual dioxin/furan congeners (USEPA and CDM Smith 2016). EPA's PTW approach is inconsistent with other sediment sites and general risk management principles.

The Proposed Plan defined PTW for chlorobenzene at a concentration >320 µg/L based on the "not reliably containable" criteria. As discussed in the PTW and NAPL section above, the cap modeling conducted by Anchor QEA as part of LWG's 2012 draft FS showed that chlorobenzene in groundwater may be reliably contained for a minimum 100-year design life using an active cap that contained an organoclay active layer ranging 3 to 5 inches in thickness. This modeling included worst case scenario concentrations up to 30,000 µg/L chlorobenzene. Therefore, LSS can conclude, in a scientifically sound manner, that there is no chlorobenzene PTW in sediments adjacent to the Arkema site.

Technology Assignments

EPA used technology flow charts to assign different technologies at SDU 7W. At this time, LSS has assigned only two categories of technologies, as shown on Figure 24. Areas of active remediation will receive a combination of dredging and/or capping, and areas of passive remediation will undergo MNR and/or ENR. The assignment of specific technologies within these broad categories will be based on data gathered as part of the pre-remedial design investigations and will be assigned during the project design phase.

Post-remedy SWAC Reduction

Pre- and post-remediation SWACs were calculated for the portion of SDU 7W adjacent to the Arkema site to assess the percent reduction in SWAC and risk reduction from the LSS proposed remedial measure. The SWACs were calculated for EPA's SDU 7W focused COCs, which consist of DDx, PeCDF, and TCDD (Table 11). The SWACs were calculated using the existing surface sediment data set adjacent to the Arkema site, which as previously discussed is now outdated. For post-remediation SWACs, remediated areas were assigned background sediment concentrations presented in Table 2.2-5 of EPA's FS (USEPA and CDM Smith 2016). The use of sediment equilibrium concentrations, such as the equilibrium calculation for PCBs calculated by the LWG, are the most appropriate because it is not possible to clean up a sediment site below equilibrium concentrations; however, because equilibrium concentrations have not been calculated for most COCs in Portland Harbor, upstream background concentrations are the next best value to use in these post-remediation SWAC calculations.

The post-remediation SWAC reductions for DDx in the RM 7W was more than 60%. The SWAC reductions for PeCDF and TCDD were nearly an order of magnitude. These results show a significant reduction in the SDU 7W focused COCs from the LSS-proposed remedial action. These results are conservative because they are assumed to be representative of conditions immediately after construction and with no natural recovery. LSS believes that this remedial action, in conjunction with the natural recovery that has been shown to be occurring in SDU 7W, is protective of human health and the environment.

Table 11. Pre- and Post-remediation SWACs for LSS's Proposed Remedial Action in RM 7W

COC	Units	SWAC - No Remediation	SWAC - Remediation to Remedial Action Area
DDx	µg/kg	1,500	434
1,2,3,4,7,8-HxCDF	µg/kg	4.18	0.231
1,2,3,7,8-PeCDD	µg/kg	0.0007	0.0002
2,3,4,7,8-PeCDF	µg/kg	0.414	0.032
2,3,7,8-TCDD	µg/kg	0.00194	0.00018
2,3,7,8-TCDF	µg/kg	0.905	0.058
2,3,7,8-TCDD TEQ	µg/kg	0.892	0.054

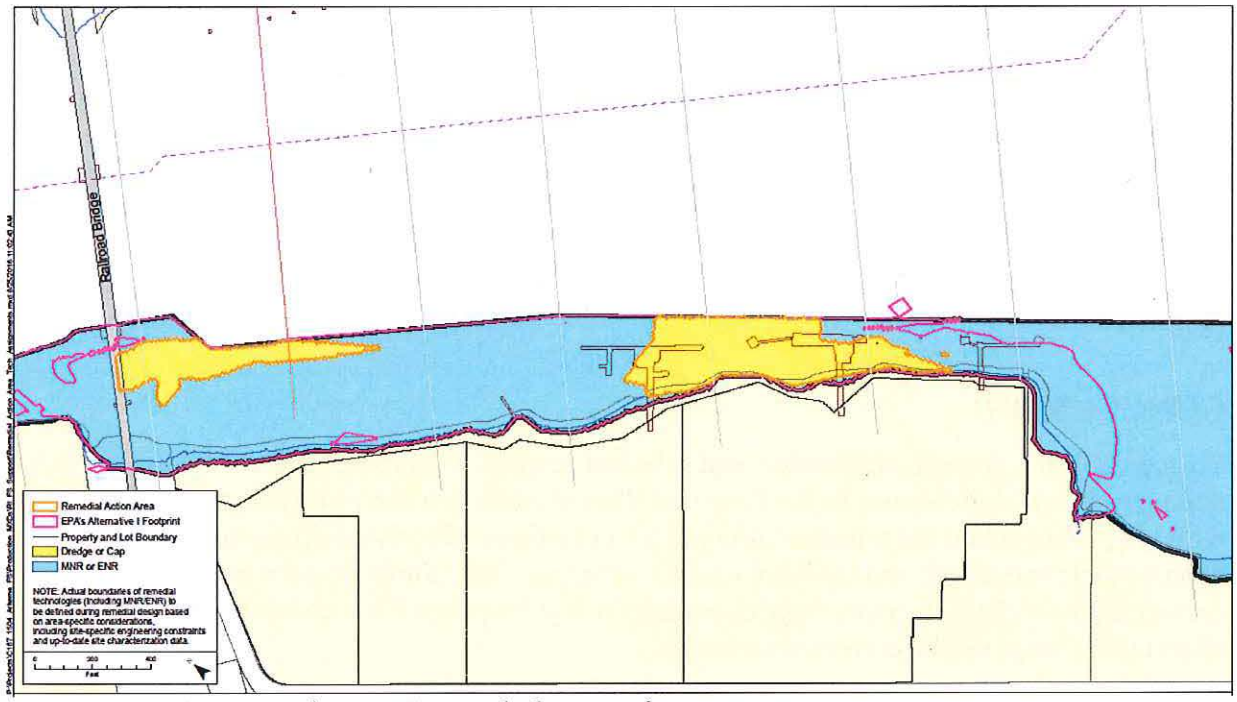

Figure 24. LSS proposed RM 7W remedial action footprints.

Table 12. Pre- and Post-remediation Risks for LSS's Proposed Remedial Action in RM 7W

	No Remediation		Remediation		Background	
Focused COC	Adult Cancer Risk[2]	Child Non-Cancer Risk[2]	Adult Cancer Risk[2]	Child Non-Cancer Risk[2]	Background Risk - Cancer[2]	Background Risk - Noncancer[2]
DDx	7E-05	2	2E-05	0.5	2E-07	0.003
1,2,3,7,8-PeCDD	7E-05	0.2	2E-05	0.07	2E-05	0.07
2,3,4,7,8-PeCDF	8E-04	41	6E-05	3	6E-07	0.03
2,3,7,8-TCDD	1E-04	0.2	1E-05	0.02	2E-05	0.03
Total	1E-03	44	1E-04	4	4E-05	0.1

Note that background values are based on EPA's arbitrary method and do not reflect equilibrium conditions.

Table 12 shows the estimated pre- and immediate post-construction risks for RM 7W based on the SWACs reported in Table 11. Note that the methodology in EPA's FS was utilized for consistency and comparability, although this method is significantly flawed and likely overestimates risks by at least an order of magnitude. Table 12 shows that the proposed remedial alternative reduces risk an order of magnitude and within 2.5 times the "background" risk and within the NCP risk management range. Dioxins/furans are responsible for any remaining risk in the post-construction condition. Based on a comparison to background levels in other urban waterways, the dioxin/furan background level is likely underestimated by at least a factor of 2 for dioxins/furans and maybe more when equilibrium conditions are considered. Given the likely overestimation of risk by the EPA's methodology combined with EPA's underestimation of background concentrations, the remedial alternative proposed by LSS will be effective and protective.

CONCLUSION

To accomplish a prompt, achievable, and efficient remedy, LSS requests that EPA (a) correct the many errors and deficiencies in the Proposed Plan identified in these comments, in accordance with law; (b) evaluate the remedial alternatives once those underlying errors and deficiencies are appropriately remedied; and (c) issue a ROD adhering to the administrative process, only upon correcting the identified errors and deficiencies in the Proposed Plan and evaluating the remedial alternatives based on the corrected analysis.

Please contact Todd Slater at (610) 594-4430 or Frederick Wolf at (253) 229-1044 if you have any questions pertaining to this letter. Thank you.

Sincerely,

Legacy Site Services LLC

for

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ATTACHMENTS

Attachment 1—Arkema Early Action Documents

- **USEPA 2005a**: Administrative order on consent for removal action (June 2005)
- **USEPA 2005b**: Appendix B: Statement of work, Arkema removal action (June 2005)
- **Parametrix 2007**: Arkema Early Action EE/CA work plan (May 2007)
- **LSS 2008a**: Dispute position statement regarding EPA's decision to eliminate the evaluation of a CDF and EPA's decision to use screening level values as cleanup standards for the Arkema Early Action (February 2008)
- **LSS 2008b**: Response to D. Opalski's request for additional information (April 2008)
- **USEPA 2008**: Final decision on disputes regarding EPA's decision to eliminate the evaluation of a CDF and EPA's decision to use screening level values as cleanup standards for the Arkema Early Action (May 2008)
- **Integral 2008a**: EE/CA work plan addendum (July 2008)
- **Integral 2009a**: EE/CA work plan addendum – revised appendices (May 2009)
- **USEPA 2011a**: Comments on the draft removal action area characterization report (February 2011)
- **LSS 2011a**: Response to EPA comments on the draft removal action area characterization report (March 2011)
- **LSS 2011b**: Dispute of EPA directed comments on the draft removal action area characterization report (June 2011)
- **Groff Murphy 2011**: Arkema Early Action settlement proposal (June 2011)
- **LSS 2011c**: Reply to EPA response to dispute of directed comments on the draft removal action area characterization report (July 2011)
- **USEPA 2011b**: Final decision on removal action area characterization report dispute (August 2011)
- **Integral 2011a**: Final removal action area characterization report (October 2011)
- **Integral 2012**: Draft Arkema EE/CA report (July 2012)
- **CDM Smith 2013**: Arkema offshore NAPL evaluation (June 2013)
- **USEPA 2013**: Comments on the draft EE/CA report (February 2013)
- **LSS 2013**: Response to EPA's comments on the draft EE/CA report (March 2013)
- **LSS 2014a**: Dispute of EPA's comments on the EE/CA report (January 2014)

- **JZP 2014**: EE/CA report dispute resolution and settlement letter (March 2014)
- **USEPA 2014a**: Comments on the draft sediment sampling work plan (June 2014)
- **LSS 2014b**: Dispute of EPA letter dated June 6, 2014 regarding sediment sampling plan disapproval (July 2014)
- **LSS 2014c**: Request for determination regarding Arkema dispute dated July 3, 2014 (September 2014)
- **LSS 2014d**: Reply to EPA's October 1, 2014 response to LSS dispute (October 2014)
- **USEPA 2014b**: Draft sediment sampling work plan dispute decision (December 2014)
- **Integral 2015a**: Evaluation of nonaqueous-phase liquids memorandum (May 2015)
- **Integral 2015b**: Evaluation of risk to benthic community memorandum (May 2015)
- **Integral 2015c**: Passive sampling technical memorandum (May 2015)
- **Integral 2016a**: Arkema final draft pre-remedial design investigation work plan (February 2016)
- **USEPA 2016a**: Arkema final draft pre-remedial design investigation work plan comment and disapproval letter (March 2016)
- **LSS 2016a**: Responses to EPA comments on the draft final pre-remedial design investigation work plan (June 2016)

Attachment 2—Arkema Source Control Measure Documents

- **Groundwater SCM Documents**
  - **ERM 2008a**: Draft focused feasibility study, groundwater source control interim measure (May 2008).
  - **ODEQ 2008**: Order on consent requiring source control measures and feasibility study, DEQ No. LQVC-NWR-08-04 (October 2008)
  - **ERM 2011**: Groundwater extraction and treatment system pre-final design (February 2011)
  - **ERM 2012a**: Groundwater barrier wall final design (July 2012)
  - **ODEQ 2012**: DEQ approval of the groundwater barrier wall final design plan (August 2012)
  - **ERM 2013a**: Groundwater extraction and treatment system final design (March 2013)
  - **ODEQ 2013**: DEQ approval of the groundwater extraction and treatment system final design (April 2013)

- **ERM 2014**: Revised final performance monitoring plan – groundwater source control measure (July 2014)
- **ERM 2016a:** Draft operations and maintenance manual – groundwater extraction and treatment system (March 2016)
- **ERM 2016b:** Groundwater extraction and treatment system corrective action plan (June 2016)
- **ODEQ Approval Letters (various years)**

- **Stormwater SCM Documents**
  - **Integral 2008b**: Draft stormwater interim remedial measures focused feasibility study report (July 2008)
  - **ODEQ 2010**: Stormwater mutual agreement and order No. WQ/I-NWR-10-175 (August 2010)
  - **Integral 2011b**: Final design report, stormwater source control measures (September 2011)
  - **ODEQ 2011**: Comments and approval of final design report, stormwater source control measures (December 2011)
  - **Integral 2013**: Performance monitoring report, stormwater source control measures (June 2013)
  - **Integral 2014**: Performance monitoring report, stormwater source control measures (June 2014)
  - **Integral 2015d**: Performance monitoring report, stormwater source control measures (June 2015)
  - **Integral 2016b**: Performance monitoring report, stormwater source control measures (July 2016)

Attachment 3—Arkema Upland Documents

- **ODEQ 1998**: Voluntary remedial investigation/feasibility study agreement for the Acid Plant Area project (August 1998)
- **ERM 2005**: Arkema upland remedial investigation Lots 3 & 4, Tract A – Revision 1 (December 2005)
- **ODEQ 2006a**: Comments and approval of the Arkema upland remedial investigation Lots 3 & 4, Tract A – Revision 1 (June 2006)
- **LSS 2006**: Response to comments on the Arkema upland remedial investigation Lots 3 & 4, Tract A – Revision 1 (December 2006)
- **ODEQ 2006b**: Comments on the Arkema upland remedial investigation Lots 3 & 4, Tract A – Revision 1 (December 2006)

- **ERM 2007a**: Response to ODEQ comments on the Arkema upland remedial investigation Lots 3 & 4, Tract A – Revision 1 (January 2007)
- **ERM 2007b**: Sitewide groundwater monitoring report – April 2007 monitoring event (October 2007)
- **ERM 2008b**: Draft river bank erodible soil source control screening evaluation (December 2008)
- **Integral 2008c**: Human health risk assessment, Arkema site: Upland areas (December 2008)
- **Integral 2009b**: Arkema upland Level II screening - ecological risk assessment (January 2009)
- **ERM 2009**: Summary of remedial alternatives, riverbank source control measure (October 2009)
- **ERM 2010a**: Sitewide groundwater monitoring report – August 2009 monitoring event (February 2010)
- **ERM 2010b**: Data gaps investigation report (June 2010)
- **ERM 2012b**: Draft RAA riverbank alternatives evaluation (July 2012)
- **ERM 2013b**: Draft upland feasibility study work plan and hot spot evaluation (July 2013)

Attachment 4—EPA Portland Harbor RI/FS and Proposed Plan Documents

- **USEPA 2014c**: Response to LWG's dispute regarding background concentrations in Section 7 of EPA's RI report (October 2014)
- **USEPA 2015**: EPA's decision regarding LWG's dispute regarding background concentrations in Section 7 of EPA's RI report (March 2015)
- **USEPA and CDM Smith 2016**: Conceptual site model figures from the final remedial investigation (June 2016)
- **USEPA 2016b**: Proposed Plan public meeting presentation (July 2016)

Attachment 5—LSS and LWG Portland Harbor RI/FS and Proposed Plan Documents

- **Anchor QEA et al. 2012**: LWG draft feasibility study Appendix Hc (March 2012)
- **LWG 2014a**: Sediment equilibrium estimates for the revised feasibility study (August 2014)
- **LWG 2014b**: Dispute of background concentrations in Section 7 of EPA's RI report (August 2014)

- **LWG 2014c**: Response to EPA's dispute position statement regarding background concentrations in Section 7 of EPA's RI report (October 2014)
- **Wolf 2015**: An assessment of the coupled sediment recovery and dynamic food web model: Predicting the concentrations of total PCBs in Lower Willamette fish tissue based on 2002 to 2012 sampling data (August 2015)
- **LWG 2015**: LWG recommended approach to Portland Harbor cleanup (October 2015)
- **LSS 2016b**: LSS dispute of EPA's Portland Harbor FS (June 2016)
- **LWG Respondents 2016**: LWG respondent dispute of EPA's Portland Harbor FS (June 2016)
- **DOF 2016**: Dredge production estimate review, Appendix G of the June 2016 Portland Harbor FS (August 2016)
- **Integral 2016c**: Review of EPA's food web model (August 2016)

Attachment 6—FOIA Documents

- **Anderson 2008**: E-mail message from J. Anderson (ODEQ) to E. Blischke and C. Humphrey (USEPA Region 10) regarding summary of outstanding RI and BRA issues (May 6, 2008)
- **DEQ 2014**: Letter from A. O'Brien (ODEQ) to S. Sheldrake (USEPA Region 10) regarding Oregon pesticide rule and waste designation (February 20, 2014)
- **Koch 2014**: E-mail message from K. Koch (USEPA Region 10) to M. McClincy (ODEQ), T. Gainer (ODEQ), and S. Sheldrake (USEPA Region 10) regarding principal threat material memo (April 11, 2014)
- **TCT Meeting Notes**: Conference call meeting notes (November 12, 2014)
- **McClincy 2015**: E-mail message from M. McClincy (ODEQ) to S. Sheldrake, E. Allen, and K. Koch (USEPA Region 10) regarding Arkema NAPL (September 10, 2015)
- **Koch and Christopher 2015**: Memorandum regarding principles for managing contaminated sediment risks at hazardous waste sites, Portland Harbor Superfund Site (October 2015)
- **Koch 2016**: E-mail message from K. Koch (USEPA Region 10) to R. Wyatt (Northwest Natural Gas Company) regarding request for clarification (July 20, 2016)
- **Allen 2016**: E-mail message from E. Allen (USEPA Region 10) to M. Poulsen (ODEQ) regarding dioxin and furan data issues (August 20, 2015)
- **DEQ/EPA Meeting Notes**: Conference call meeting notes (January 28, 2016)
- **DEQ 2016b**: Top 10 state issues for proposed plan (February 2016)

Attachment 7—Other Documents

- **USEPA 1991**: Principal threat waste fact sheet (November 1991)
- **GSI 2014**: Final supplemental remedial investigation/feasibility study field sampling and data report for River Mile 11 East (September 2014)