DEPARTMENT OF ECOLOGY
State of Washington

Occidental Chemical Corporation Remedial Investigation Report

Responsiveness Summary

The Department of Ecology's response to comments received from stakeholders and the public

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Occidental Chemical Corporation
Remedial Investigation Report

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The Department of Ecology's response to comments received from stakeholders and the public

Prepared by

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Hazardous Waste and Toxics Reduction Program
Washington State Department of Ecology
Lacey, Washington

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Introduction

The Washington Department of Ecology (Ecology) held a public comment period for Occidental Chemical Corporation's (OCC) draft Remedial Investigation (RI) for their former facility at 605 Alexander Avenue in Tacoma, Washington. The RI was the compilation of data from years of investigation to identify the nature and extent of contamination from the facility. Due to the length of the investigation and the quantity of data collected, Ecology decided to provide public review of the RI before the Feasibility Study (FS) is finalized.

The Puyallup Tribe, Citizens for a Healthy Bay, and others provided advice and input to Ecology and the U.S. Environmental Protection Agency (EPA) during the investigation and before the public comment period. We heard clearly that it is important to the public to move the project forward and to have greater certainty about OCC's role in the recovery of the Hylebos Waterway.

The public comment period was originally 60 days. Due to the high level of interest from the public and requests for a public hearing we extended the end date. During the 10/23/2015-02/01/2016 public comment period we received comments by email, postal service, and in person at a formal hearing. We met with the Puyallup Tribe, City of Tacoma, Tacoma Pierce County Health Department, and Citizens for a Healthy Bay. We also held an informational public meeting at the beginning of the comment period.

These meetings allowed us to engage with members of the public about the challenges we face in solving the problems stemming from historical contamination. We appreciate the thoughtful contributions of the individuals and organizations who commented. We found the advice and the input helpful and informative.

This Responsiveness Summary consolidates comments that either ask the same question or express the same or similar concerns. The following table is a Summary of Comments and Response Cross Reference that provides a list of comments and commenters along with a cross reference to the relevant response. Ecology sought to provide a complete and comprehensive response to each concern.

Following the responses is a brief discussion of next steps in the project.

Summary of Comments and Response Cross Reference

Commenter	Representing	Issues Raised	Responses
Jori Adkins and Rick Semple	Selves	• Cleanup standards • Fishing and crabbing • Recreational uses of waterway • Impacts to wildlife • Future use of waterway	3, 4, 5
Dean Burke	Tacoma-Pierce County Sports Commission	• Recreational uses of waterway	4
Dorothy Burt	Self	• Recreational uses of waterway	4
Joy Caddock	Self	• Site definition • Recreational uses of waterway • Impacts to wildlife	1, 2, 4, 5
Su Dowie	Foss Waterway Development Authority	• Site definition • Recreational uses of waterway	1, 2, 4
Bruce Hoeft	Tahoma Audubon Society	• Site definition • Recreational uses of waterway	1, 2, 4
Steve Huntley	Huntley Environmental	• Risk Assessment	4
Charles Joy	Self	• Fishing and crabbing • Recreational uses of waterway • Impacts to wildlife	4, 5
Scott Knox	Tacoma Waterfront Association	• Site definition • Cleanup standards • Recreational uses of waterway • Impacts to wildlife	1, 2, 3, 4, 5
Shirley Lowe	Self	• Recreational uses of waterway	4
Justin Lytle	Citizens for Healthy Bay (CHB)	• Site definition • Risk assessment • Impacts to wildlife	2, 4, 5
Melissa Malott	Citizens for Healthy Bay (CHB)	• Site definition • Cleanup standards • Risk Assessment • Recreational uses of waterway	1, 2, 3, 4
Susanne Marten	Self	• Monitoring	N/A
Lorna Mauren	City of Tacoma Environmental Services Department	• Referenced written comments City of Tacoma Environmental Services Department submitted to Ecology	N/A
Kelli and Kevin O'Donnell	Selves	• Fishing and crabbing • Recreational uses of waterway • Impacts to wildlife	4, 5
Michael Slevin	City of Tacoma Environmental Services Department	• Site definition • Sediments • Data	1, 2

Commenter	Representing	Issues Raised	Responses
Sheri Tonn	Self	• Site definition • Sediments • Cleanup standards • Risk Assessment • Regulatory oversight	1, 2, 3, 4
Stena Troyer	Self	• Site definition • Cleanup standards • Recreational uses of waterway • Impacts to wildlife • Changes to waterway over time • Economic impacts	1, 2, 3, 4, 5
Ken Zirinsky	Self	• Fishing and crabbing • Recreational uses of waterway • Impacts to wildlife	4, 5

Reponses to Comments

Ecology accepted comments from October 23, 2015 through February 1, 2016. We received 18 comments through email, letter, and oral testimony.

1. Hylebos Problem area within the U.S. Environmental Protection Agency (EPA) Commencement Bay Superfund Cleanup and sediments cleanup.

The Occidental (OCC) Site is one of many environmental cleanup sites within the Commencement Bay Nearshore-Tideflats (CB/NT) Superfund Site. The OCC Site is defined in the 2005 Amended Administrative Order on Consent (AOC) between EPA, Ecology, and OCC. The draft RI focused on the OCC Site as defined in the amended AOC. The draft RI is not an assessment of the CB/NT Superfund site or the Mouth of the Hylebos Problem Area. EPA addresses areas outside the OCC Site under separate administrative orders with multiple parties throughout the CB/NT Superfund Site.

Until 2004, the OCC Site was handled as two separate sites, uplands and waterway. In 2004, it became clear to EPA, Ecology, and OCC that the remaining environmental issues at the site are interrelated and therefore should be integrated under a single cleanup action. On January 28, 2005, Ecology joined EPA's existing AOC with a single work plan and schedule for investigating the site. The result of this coordination was a more comprehensive approach to identifying the nature and extent of contamination from the OCC site that impact sediments in the Hylebos. As a party to this agreement, Ecology retained its authority to require that the investigation work meet the requirements of Washington's Model Toxics Control Act (MTCA) and dangerous waste rules.

The MTCA regulations define a site with groundwater contamination to be wherever the contamination has migrated. The point of compliance is the property boundary, the location where a site must meet cleanup standards. Based on the RI data, we know the contaminant plume extends beyond the property boundary under the Hylebos Waterway and Commencement Bay. The agencies and OCC will develop a conditional point (or points) of compliance in the draft Cleanup Action Plan phase of the project.

EPA's five-year review of the CB/NT Superfund Site cleanup discusses the Washington Sediment Management Standards (SMS) in Chapter 173-204 Washington Administrative Code (WAC). EPA is the lead agency for sediment cleanup in the Hylebos Waterway; therefore, changes to standards are reconsidered as part of this review process. Ecology is partnering with EPA on the appropriate cleanup of sediments impacted by the OCC site, recognizing that the first step is to remove or contain sources upstream.

Once OCC has contained sources of contamination and reliable information indicates that recontamination of sediments is no longer occurring, sediments can be further evaluated to determine if they meet established cleanup standards. Ecology maintains an interest in sediment quality and will work with EPA through existing agreements and through the five-year review process to advocate for more stringent cleanup standards as necessary.

2. Contaminant plume extent, especially the northern boundary.

Ecology and OCC recognize that information on the northern boundary was lacking to inform the Conceptual Site Model (CSM).

The CSM was developed using the substantial data already collected by OCC as well as supplemental information obtained by Ecology and EPA. The use of modeling to project the behavior of the plume based on the data was a key method for developing our concept of the site and our understanding of the groundwater flow. Modeling helps to fill data gaps in areas that are difficult to sample. For example, an aquitard (a natural barrier or area of resistance) that discourages the migration of the plume toward the west and the Blair Waterway, was taken into consideration and is part of assumptions made in the CSM. Existing information and data from groundwater sampled west of the site supports this part of our understanding of groundwater flow and makes the Blair Waterway a low priority for further sampling.

However, modeling indicates we would expect to see shallow discharge of contaminated groundwater into sediments at the northern end of the Taylor Way peninsula. It is important, at this point in the project, to verify and quantify this assumption. Ecology, EPA, and OCC agree with the commenters that obtaining sediment and porewater (groundwater that seeps

into the pores between sediment particles) data from this area will be helpful to the overall understanding of groundwater flow and potential impacts to Commencement Bay.

The "Sampling and Quality Assurance Project Plan" (SQAPP), prepared by Anchor QEA and GHD on behalf of OCC, is set to collect samples from both the Hylebos Waterway and Commencement Bay, specifically along the northern boundary of the mapped contaminant plume. Plans are to implement this sampling project beginning June 20, 2016.

3. Differing Cleanup Standards between the Duwamish Waterway and Commencement Bay Nearshore-Tideflats Superfund Sites.

Although different exposure assumptions were used, the action levels for the Duwamish Waterway and Commencement Bay Nearshore-Tideflats (CB/NT) are similar.

For both sites, cleanup of sediments through excavation or capping is done in areas above the action levels. Natural attenuation or enhanced natural attenuation, the process of contaminants breaking down into their chemical components, coupled with ongoing source controls, is then expected to result in reaching the final cleanup level.

	Action Level	**Cleanup Level**
Commencement Bay/Nearshore Tideflats	450 ug/kg OC[1]	300 ug/kg OC
Duwamish Waterway	12,000 ug/kg OC	240 ug/kg OC[2]

[1] Carbon normalized.

[2] Reported in the ROD as 2 ug/kg dry weight which then must be converted to OC.

The much higher action level for the Duwamish is based on the cleanup level in the Ecology Sediment Management Standards and the much higher expected sedimentation rate in the Duwamish Waterway. The final cleanup number is expected to be reached years after the completion of remediation. Both sediment cleanup numbers are protective of people who consume the highest amounts of fish and shellfish based the EPA's 10^{-6} to 10^{-4} allowable risk range.

4. Concerns about the Exposure Pathway Assessment titled "Sediment and Shallow Groundwater Discharge Assessment" referenced in the Remedial Investigation (RI) report.

A number of comments were critical of the Exposure Pathway Assessment, which was included as a referenced document in the public review draft of the RI report. The public

commented that it did not adequately describe fish and shellfish consumption rates and recreational use of the waterway such as swimming, boating, paddle sports, and beach play. This document was based on an April 2011 document titled Streamlined Risk Assessment that OCC submitted to Ecology and EPA. Both the Exposure Pathway Assessment and the Streamlined Risk Assessment were submitted to EPA and Ecology during the remedial investigation, but were not reviewed nor approved by either agency. While they are part of the administrative record, the documents are not considered final and are not part of Ecology's proposed approval of the RI report.

Ecology has requested OCC to remove any references to the Exposure Pathway Assessment and the Streamlined Risk Assessment from the RI with the understanding that a new assessment may be required. Ecology also directed its contractor, Ridolfi Environmental Inc., to re-evaluate the risk associated with fish consumption based on the 2005 data using today's fish consumption rate as proposed by Ecology's Water Quality Program.

In general, this evaluation concluded that, since it has been over a decade since the fish and shellfish tissue samples were analyzed, the data is likely not representative of current site conditions. Limited sample size and lack of precision about the sample locations are additional issues with the 2005 data. It is also notable that the specific tissue samples that had the highest levels of contaminants are not parts of the species that are likely to be consumed, for example the liver. Based on the evaluation, Ecology's current conclusion is the contaminant levels found in fish and crab in 2005 would not exceed acceptable levels under the new consumption rate.

Even so, EPA and Ecology agree that a more comprehensive study under current conditions is needed to determine whether concentrations have changed over time, and to reassess human and ecological impacts. Ecology is working with EPA to move forward with a new fish and crab tissue study. This planned study was proposed in EPA's 2014 *Fourth Five-Year Review Report for Commencement Bay Nearshore Tideflats Superfund Site, Pierce County, Washington* earlier than the planned schedule.

The first step to re-evaluate exposure pathways is to assess whether porewater is contaminated from the OCC groundwater contaminant plume. Contaminated sediments and shallow groundwater discharging into the Hylebos will be assessed by the "Sampling and Quality Assurance Project Plan" (SQAPP) prepared by Anchor QEA and GHD on behalf of OCC. This proposed plan was submitted to Ecology and EPA in late 2015. It was conditionally approved on May 12, 2016 and will be implemented from June to August of 2016. The work plan proposes the collection of new sediment and porewater data from the Hylebos Waterway and Commencement Bay. The data generated from this project will expand our understanding of exposure pathways based on the porewater results.

The next step will be to compare the porewater results to surface water quality criteria. The data will be helpful in determining whether contamination exists in sediments above cleanup standards. The results will be used to assess whether there is an exposure pathway from the OCC groundwater plume to fish and shellfish and humans through consumption, and whether exposure to humans through recreational use is a potential scenario for further evaluation. Ecology will use the information to revise the CSM if needed and to inform the Feasibility Study (FS) if the changes significantly revise our understanding of the site.

Ecology is assessing whether a comprehensive quantitative risk assessment of cleanup alternatives or a quantitative site-specific ecological risk assessment will be necessary as part of the FS. It is possible that the additional information from the porewater sampling and the fish and shellfish tissue sampling will provide what we need. Ecology will decide whether to direct OCC to proceed with a new risk assessment once we have the additional data from the summer's field work.

How contaminants affect someone is hard to determine, especially without knowing exactly how much that person was exposed to, for how long, or how often. You can search for individual contaminants or chemicals and their health effects using the United States Agency for Toxic Substance & Disease Registry. In the interim, please note that the Washington Department of Health continues to advise:

- Do not eat crab, shellfish, and bottom fish from Commencement Bay Waterways including the Hylebos Waterway.
- Limit flatfish* to two servings per month for Inner Commencement Bay.
- Limit flatfish* to one serving per week for Outer Commencement Bay (boundary between Boathouse Marina and Brown's Point).

  ** Flatfish include English Sole, Starry Flounder, and Rock Sole.*

For more information about Puget Sound fish consumption, visit Washington Department of Health's "Puget Sound Fish Consumption Advice."

5. A complete assessment of ecological receptors has not been completed.

Ecology and EPA agree that more assessment is needed. First, we need to verify that the exposure pathway from the OCC site evaluated in 2005 is still ongoing and a risk. Further, impacts to ecological receptors bear further study. Ecology's consultant, Ridolfi Environmental, concludes:

> "While all of the studies provided information relevant to contaminant concentrations in fish or shellfish species collected from in and around Commencement Bay, each of the studies was limited either by species, geographic coverage, or contaminants, and

> none of the studies provided a comprehensive view of current conditions throughout Commencement Bay and its adjacent waterways." (Beckley, 2016)

The Ridolfi memo also identifies the need for salmon species to be studied, as none of the existing studies focused on salmon; however, non-bottom-dwelling fish (such as salmon) would be exposed to a lesser degree than resident bottom fish and crabs. Further study of impacts to ecological receptors crosses over into the larger Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site project. Ecology anticipates working closely with EPA to develop and implement a successful evaluation that includes potential impacts from the OCC site.

Some commenters asserted that the OCC risk assessment reports do not include adequate assessment of risk to higher trophic level species including birds, fish, and mammals for both aquatic and terrestrial environments.

To adequately evaluate this assertion and respond to comments Ecology directed Ridolfi Environmental to provide a summary of toxicity information and screening level benchmarks for volatile organic compounds (VOCs) found in groundwater, porewater, and sediments at the OCC site. These VOCs include trichloroethylene (TCE), tetrachloroethylene (PCE), and vinyl chloride (VC).

Their memo recommended that samples of groundwater, porewater, surface water, sediment, and fish and shellfish tissue be collected and analyzed to better determine the impacts of VOCs on aquatic resources and organisms. Ecology is confident that pursuing the additional studies described in these comments will keep the project on track to selecting a remedy that is protective of ecological resources.

The memo concludes:

> "…Most of the available ecological screening level benchmarks are less stringent than the human health criteria for consumption of organisms only; therefore, applying groundwater cleanup levels based on human health water quality criteria for consumption of organisms would also be protective of ecological receptors."

Surface water quality criteria are identified as applicable for the cleanup of contaminated groundwater at the OCC site. When a remedy is selected and a draft Cleanup Action Plan has been evaluated by the Puyallup Tribe, stakeholders, and the public, the published and final Water Quality Standards at that time will be the applicable cleanup standards for the OCC site.

Next Steps

Additional work is planned to expand the current understanding of the OCC contamination and its impacts on the surrounding environment. OCC is moving forward rapidly to accomplish new work on sediment and porewater sampling. Efforts are underway to develop a new fish and crab study for Commencement Bay, the Hylebos Waterway, and near the OCC Site. We recognize there is a need to support decisions based on additional data as well as further evaluation as we examine cleanup alternatives for the site.

Ecology will approve the RI report with specific wording changes and the removal of references not previously approved by Ecology or EPA. Once approved, the document will be considered final in the administrative record. While questions remain about certain aspects of the contamination, Ecology believes that sufficient information was collected to proceed to the problem-solving phase of the FS.

The entire project team is committed to continued public involvement as we push this complex and important project forward.

Attachment A

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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October 11, 2016

Clinton Babcock
Glenn Springs Holdings, Inc.
5005 LBJ Freeway, Suite 1350
Dallas, TX 75244-6119

Subject: Occidental Chemical Corporation, Tacoma, Washington
EPA ID Number WAD009242314 and EPA Docket No. 10-97-0011 CERCLA
Conditional Approval of the Remedial Investigation Report

Dear Mr. Babcock:

The purpose of this letter is to transmit Ecology's approval of the Remedial Investigation Report for the Occidental Chemical Inc. (OCC) site with conditions.

Overview
Ecology placed conditions on the approval in order to be responsive to comments received from both stakeholders and the public. The changes to the report text are shown within the revised Remedial Investigation Report (RI Report) document in redline/strikeout or with endnotes. The endnotes are printed in red at the end of the revised report.

Background and Basis for Decision
Ecology sought comments through a public notice and public hearing process on the draft Remedial Investigation Report submitted by OCC for their Tacoma site. Public comments were received throughout the comment period. Details about this process are provided in the Fact Sheet we issued with the public notice. Enclosed with this letter is a Responsiveness Summary for your reference.

The edits to the RI Report that are part of Ecology's conditional approval fall into the following categories:

1. Clarification of the scope of Ecology's approval of the report.
2. Changes necessary to defer specific topics or issues to the Feasibility Study.

Scope of Approval
Decades of investigation produced a large body of work. There are reports in Ecology's files that did not receive specific approval by the US Environmental Protection Agency (EPA) or Ecology for various reasons. Among the RI references not approved by extension, are the Exposure Pathway and Risk Assessment reports.

Ecology is approving the RI Report with the condition that any references to documents or studies not formally approved by both Ecology and EPA are for informational purposes only, and therefore, by extension not part of this approval. The conditions for approval are intended to clarify the administrative record and the impact of the acceptance of the RI Report.

Both the agencies and OCC are in general agreement with the identification of the contaminant plume, interpretation of the model, and the representations provided in the RI Report about the nature and extent of contamination. This is the primary focus of the report approval by the agencies.

Deferral to the Feasibility Study
The changes Ecology made to the report also include deferring issues that are better addressed in the Feasibility Study or Cleanup Action Plan. These include topics such as identifying a point of compliance or conditional point of compliance, for example.

Additionally, we agreed with the public and stakeholders that the risk assessment and exposure pathway reports needed more work. The agencies, with agreement from OCC, anticipated some of these concerns. A sediment and groundwater proposed study for the Hylebos Waterway was already in development when the RI Report was released for public review. The FS and CAP will include new information about these topics and the results of the new study. The agencies will decide whether a new risk assessment is needed once we have the new study report.

Next Steps
This letter and attachments will be posted on Ecology's website and shared with members of the public and with stakeholder groups to formally close out the RI Report Review. Ecology will place these documents and the revised report in the administrative record for the OCC Tacoma site.

The contents of this letter are approved by and represents the position of EPA's Remedial Project Manager (RPM) Kevin Rochlin. Please contact us if you have any questions.

Sincerely,

Kerry A. Graber
Corrective Action Project Manager
Department of Ecology
(360) 407-0241

cc: Ava Edmonson, Ecology Section Manager
Ted Yackulic, EPA Office of Regional Counsel
Dori Jaffe, Assistant Attorney General
Shawn Blocker, EPA, SCU 3 Manager

Attachment B

January 14, 2016

Memorandum

To: Ava Edmonson
Section Manager
Hazardous Waste and Toxics Reduction Program

From: Kerry Graber
Project Manager for the Occidental Chemical Inc. cleanup site

Subject: Completion of Task 1 for contractor Ridolfi Environmental
Acceptance and Approval of Required Deliverable (attached memo)

The purpose of this memo is to acknowledge that Ridolfi Environmental (Ridolfi) completed Task 1 under the general contract by conducting the research and providing the attached memo to Department of Ecology (Ecology), and to approve the memo as document review on Ecology's behalf.

Task 1

We tasked Ridolfi to review a number of source documents, including risk assessment evaluations performed by Conestoga Rovers & Associates (CRA) on behalf of Occidental Chemical Inc. (Occidental). These risk assessment documents were referenced in the Remedial Investigation Report that is currently available for public comment through February 1, 2016. Ecology made it clear to stakeholders that the risk assessment documents were not yet approved by either Ecology or EPA, and so approval of the Remedial Investigation Report would not be an approval of the specific risk assessment documents.

To understand the potential deficiencies of the risk assessment performed for Occidental we asked Ridolfi to review the documents and provide recommendations to Ecology on what should be done to bring this work into compliance with the Model Toxics Control Act regulations, Chapter 173-340 WAC.

Memo Contents

The memo required by Task 1 was provided to me in draft. My project team reviewed the draft, and made minor suggestions for clarity. The memo was resubmitted to Ecology on October 30, 2016.

Because the memo touched on a number of issues related to the Commencement Bay Nearshore Tideflats Superfund site, and due to a number of policy issues raised by the memo, I took the last two and a half months to consult with individuals in the Toxics Cleanup Program. The feedback I received from these reviews confirmed that this is an accurate representation of the facts related to historical cleanup actions under the Commencement Bay cleanup, and the recommendations are sound.

I also provided time for a courtesy review by Kevin Rochlin, EPA's project manager for the Mouth of the Hylebos Problem Area, who read the memo and shared the contents with his management.

Memo Approval

At this point it is appropriate to acknowledge the Ridolfi memo satisfies Task 1. Ecology accepts the memo's contents as work undertaken on behalf of Ecology to review and evaluate risk assessment work, and further, it represents Ecology's position on the need for further work to satisfy the requirements of Chapter 173-340 WAC.

This memo along with the Ridolfi memo will be conveyed to Occidental as Ecology's comments on their risk assessment work. Further, any decision post-comment period on the Remedial Investigation Report will specify either the risk assessment or exposure pathway study will be set aside and will not be considered part of the report, unlike other cited references already formally approved by Ecology.

New Risk Assessment

I have already communicated with Occidental regarding concerns about the risk assessment and exposure pathway evaluation. They understand a new exposure pathway assessment is needed, and additional risk assessment work will be required. My project team will be working on providing guidance in the form of a scope to provide to Occidental so this work can proceed as soon as possible.

Please let me know if you have any questions regarding this or the attached memo. Thanks.

KAG

Attachment: October 30, 2015 Ridolfi memo

RIDOLFI Environmental

Attachment C

M E M O R A N D U M

DATE: October 30, 2015

TO: Kerry Graber, Washington Department of Ecology
Hazardous Waste and Toxics Reduction Program

FROM: Bill Beckley, Sherrie Duncan, and Bob Dexter – RIDOLFI Inc.

SUBJECT: **Review and Evaluation of Risk Assessment Documents for the Occidental Chemical Corporation Corrective Action Site**

1.0 Purpose and Scope of Review

The objective of this technical memorandum is to present a summary and evaluation of specific documents related to human health and ecological risk posed by the Occidental Chemical Corporation (OCC) Corrective Action site. To support the Department of Ecology (Ecology) Hazardous Waste and Toxics Reduction Program in overseeing ongoing investigation and remediation efforts at the Occidental Site, the Ridolfi project team reviewed risk assessments performed by the Environmental Protection Agency (EPA) for the Commencement Bay Nearshore Tideflats (CB/NT) Superfund Site, and a Streamlined Risk Assessment and Exposure Pathway Assessment Report prepared by OCC. This memorandum provides Ridolfi's professional opinions regarding the evaluation of risk that has been completed by OCC so far, and makes recommendations for further study and assessment.

2.0 Background Review

2.1 EPA Risk Assessment Summary

The primary background documents reviewed relative to previous risk assessment work performed by EPA for the Hylebos problem area included: *Commencement Bay Nearshore/Tideflats Record of Decision* (September 1989); *Explanation of Significant Difference for the Record of Decision: Commencement Bay, Near Shore/Tide Flats, Operable Unit 01 - Sediments and Operable Unit 05 - Source* (July 28, 1997); and *Third Five-Year Review Report for Commencement Bay Nearshore/Tideflats Superfund Site Tacoma, Washington* (December 23,

2009). A brief description and evaluation of the relevant portions of these documents is provided in the following sections.

2.1.1 Commencement Bay Nearshore/Tideflats Record of Decision (1989)

Human health and environmental risk assessments were conducted as part of the Remedial Investigation (RI) for the CB/NT Superfund site. The risk assessments were based on exposure of marine biota to contaminated sediment and exposure of humans to contaminated seafood. Health risks were estimated for consumers of CB/NT fish and shellfish for both carcinogens and non-carcinogens.

Sediment Quality Objectives (SQOs) for all "problem chemicals" were set based on an evaluation of the ecological and human health risks posed by those chemicals. The SQO for polychlorinated biphenyls (PCBs) was based on the human health risk assessment. The SQOs for all other chemicals were based on the ecological risk assessment, as it was determined that the ecologically-based cleanup levels were also protective of human health.

2.1.1.1 Human Health Risk Assessment

For the human health risk assessment, the average concentration of each chemical in English sole from the study area was used to calculate exposure, based on two seafood consumption rates (1 pound/day and 1 pound/month) and a 70-year exposure duration. Based on these exposure assumptions, six chemicals were predicted to result in a cancer risk greater than 10^{-6} at the maximum fish consumption rate of 1 pound/day (453 grams/day). Those chemicals included PCBs, arsenic, hexachlorobenzene, hexachlorobutadiene, bis(2-ethylhexyl)phthalate, and tetrachloroethene. Only PCBs and arsenic had predicted risk levels greater than 1×10^{-4} (although hexachlorobenzene risks were predicted to be *equal to* 1×10^{-4}). At a fish consumption rate of 1 pound/month (12.3 grams/day), only PCBs and arsenic would exceed the 10^{-6} risk level. A lifetime excess cancer risk of 2×10^{-4}, or 2 in 10,000, was estimated for a person eating one pound of Commencement Bay fish per month.

Arsenic was not subjected to further evaluation relative to human health because of its lower cancer risk level (compared to PCBs) and because arsenic concentrations in CB/NT fish were similar to concentrations in fish from the reference area.

For non-carcinogens, three metals (antimony, lead, and mercury) were present in fish muscle tissue in concentrations that would exceed the Acceptable Daily Intake (ADI) values at the consumption rate of 1 pound/day. However, the ADI values would also be exceeded for fish

from Carr Inlet (a reference area) at the 1 pound/day consumption rate. Limiting consumption of fish to 0.5 pounds/day would result in exposure below the ADI values for all three metals.

Bioaccumulation data indicated that sediment contamination by metals in Commencement Bay was not resulting in significantly increased tissue levels for metals. Therefore, risks of non-carcinogens in fish tissue were not evaluated further in estimating sediment cleanup levels. Additionally, based on the information available on the toxicity of PCBs at that time, it was concluded that the potential for non-cancer impacts was not of concern.

The baseline risk assessment concluded that the most significant human health risks were associated with elevated concentrations of PCBs in the tissues of resident seafood, and the SQO for total PCBs was set at 150 micrograms per kilogram (µg/kg).

2.1.1.2 Ecological Risk Assessment

The chemical SQOs for protection of aquatic life were set using the Apparent Effects Threshold (AET) method. The AET method does not address bioaccumulation, and thus may underestimate risks to organisms who eat invertebrates or fish contaminated with bioaccumulative compounds like PCBs. It was determined that the SQO for PCBs should be set based on the risks to human health from eating PCB-contaminated seafood, because a lower PCB cleanup level was necessary to protect human health.

The ecological risk assessment identified adverse biological effects, primarily toxic effects to the benthic infaunal community.

2.1.1.3 Discussion/Evaluation

The risk assessments performed in support of the Remedial Investigation/Feasibility Study (RI/FS) and Record of Decision (ROD) for the CB/NT site were conducted prior to the promulgation of State cleanup standards (either under the Model Toxics Control Act [MTCA] or the Sediment Management Standards [SMS]), and were generally similar to other Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk assessments of that era. However, the assessments would not necessarily be consistent with regulations and guidance that were promulgated, revised, or finalized shortly after the ROD was signed. The "acceptable range of risk" used to develop cleanup standards (10^{-7} to 10^{-4}) is less protective than the risk range that would be allowable under the MTCA regulations. The MTCA regulations [Washington Administrative Code (WAC 173-340)] require that cleanup levels do not

result in cancer risks exceeding 1 x 10^{-6} for individual carcinogens and 1 x 10^{-5} for multiple carcinogens, and that effects from non-carcinogens do not exceed a hazard quotient (HQ) of 1.

Additionally, Risk Assessment Guidance for Superfund (RAGS), finalized shortly after the ROD, recommends the use of an upper confidence limit on the mean concentration for characterizing exposures, rather than a simple arithmetic mean, which is the value that was used in the human health risk assessment to represent contaminant concentrations in English sole tissue. The ROD acknowledges that "for English sole, there was considerable variability in PCB concentrations among the waterways and within the waterways." Maximum PCB concentrations in English sole from the Hylebos Waterway were six times higher than the average concentration used for the risk assessment. Use of an upper confidence limit on the mean would have likely resulted in higher risk estimates and may have resulted in a greater number of chemicals exceeding risk thresholds.

Finally, while the ROD acknowledged that the AET method may underestimate risks to higher trophic level species from bioaccumulative compounds, it is not clear that SQOs for other bioaccumulative compounds, including hexachlorobenzene, were set at levels protective of higher trophic level species (PCBs and hexachlorobenzene were selected as chemical indicators at the mouth of Hylebos waterway).

2.1.2 Explanation of Significant Difference for the Record of Decision (1997)

In 1997, EPA published an Explanation of Significant Difference (ESD) for the 1989 ROD. The purpose of the ESD was to modify the cleanup level for remediation of marine sediments contaminated with PCBs at the CB/NT Superfund site.

2.1.2.1 Human Health Assessment

EPA updated the human health risk evaluation as a basis to evaluate the risks associated with a variety of potential PCB cleanup levels. Although EPA's risk assessment methodology had not been modified substantially since the original risk assessment was performed in 1988, some of the exposure and toxicity assumptions had been changed based on new information and new Superfund guidance.

Because the Puyallup Tribe of Indians has treaty rights to fish in Commencement Bay, "high-end Tribal fishing" was used as the reasonable maximum exposure scenario for EPA's decision-making purposes. An average and high-end recreational fishing scenario and an average Tribal fishing scenario were also calculated for purposes of comparison. Fish consumption rates for the

recreational fishing scenario were the same as those used in the 1989 ROD. Because no studies had documented Tribal fish consumption rates in Commencement Bay, rates were estimated from recently completed surveys (1996) of fish consumption by members of two other Puget Sound tribes, the Tulalip Tribes and the Squaxin Island Tribe.

The high-end Tribal scenario was intended to represent risks to "a tribal fisherperson who consumes a relatively large amount (upper 90th percentile) of fish compared to other tribal members."

The estimated post-cleanup cancer risks at a PCB SQO of 300 µg/kg were determined to be within EPA's acceptable risk range of 10^{-4} to 10^{-6}. Cleanup to a PCB sediment remedial action level (SRAL) of 450 µg/kg was determined to result in interim risks that were also within EPA's acceptable risk range. Although the estimated risk was 1.4×10^{-4} for the CB/NT Site and 1.6×10^{-4} for the Hylebos Waterway, EPA indicated that its policy states that the upper boundary of the risk range is "not a discrete line at 1×10^{-4}". Cleanups to levels "slightly greater than" 1×10^{-4} may be considered acceptable if justified based on site-specific conditions. EPA assumed that people were more likely to fish in more than one location in Commencement Bay than in Hylebos Waterway alone, so the CB/NT Site-wide risk estimate was determined to be the best estimate of risks to area fisherpersons.

The National Oil and Hazardous Substances Contingency Plan (NCP) does not set a numeric target range for non-cancer risks, but states that acceptable exposure levels shall represent "concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety." Cleanup to 300 µg/kg PCBs was determined to result in a CB/NT Site-wide Hazard Quotient (HQ) of 7. EPA reasoned that "the HQ of 7 is not appreciably different than the HQ of 6 estimated for cleanup to 150 µg/kg PCBs under the 1989 ROD."

2.1.2.2 Discussion/Evaluation

During pre-design sampling, new data were collected from the Hylebos Waterway that indicated approximately twice the amount of sediment originally estimated in the ROD would require cleanup, and that cleanup costs would also be about twice the estimate in the ROD. This appears to be a primary driver for increasing the PCB SQO. However, in 1996 the cancer slope factor for PCBs was decreased from 7. 7 to 2.0 milligrams/kilograms-day^{-1}, and the risk evaluation updated for the ESD includes the new cancer slope factor, as well as a new exposure duration, and a new range of fish consumption rates.

Although not prominently explained in the text of the ESD, the tribal "high-end" and average consumption rates (listed as 123 grams/day and 41.7 grams/day, respectively) were modified to reflect that only a portion of that rate (69 percent) would be associated with the site, effectively making the rates 85 grams/day and 29 grams/day. Further, rather than assuming a 70-year (lifetime) exposure duration, as was assumed in the ROD, the ESD assumes a shorter, 30-year exposure duration. Consumption rates of 85 grams/day and 29 grams/day over a 30-year exposure duration are equivalent to 36 grams/day and 12.4 grams/day over a 70-year exposure duration. While intended to represent Tribal fisher exposure scenarios, these rates may underestimate a Tribal exposure scenario.

Since the ESD only updated the human health risk assessment for PCBs, it did not account for risks from other carcinogens that may result from leaving higher levels of contamination in place. The allowable risk range cited by EPA (10^{-4} to 10^{-6}) is intended to address *cumulative site risk* from multiple carcinogens.

In addition to these updates, the ESD also acknowledges that "[s]ince publication of the ROD, the State of Washington has promulgated Sediment Management Standards (SMS), which require that contaminant levels in sediments within the State be protective of human health and aquatic life." There is not a further acknowledgement that the cleanup standards in the MTCA regulations, including maximum allowable risk levels, had also been revised and updated since publication of the ROD.

In a letter of qualified concurrence with the ESD, the Department of Ecology states that "[a]s the proposal currently stands, the termination of cleanup after dredging to 450 parts per billion (ppb) will not achieve a level of protection for humans or wildlife that will meet Ecology's requirements. Ecology's goals for acceptable human health risk for carcinogens are 1×10^{-6} to 1×10^{-5} and for noncarcinogens, hazard indices for human or ecological health are not to exceed a value of one." Since the requirements of MTCA are considered applicable requirements for CERCLA cleanup actions, the proposed changes in the ESD do not appear to comply with Applicable or Relevant and Appropriate Requirements (ARARs) that existed in 1997, which is one of the "threshold criteria" for CERCLA cleanups.

Despite the fact that the proposed change would not meet Ecology's requirements, Ecology did concur with the proposed increase in the PCB SQO, noting that the agency would "endorse the implementation of a 10 year natural recovery period as an element of the cleanup to achieve further reduction of PCBs." Ecology's concurrence was subject to the following conditions:

- Active Remediation to 450 ppb PCBs throughout Commencement Bay
- Recovery within ten (10) years to a maximum level of 300 ppb
- Monitoring to confirm recovery will be achieved
- Additional remedial action triggered if recovery will not meet cleanup levels
- Cleanup action to commence no later than year 2001

The Puyallup Tribe of Indians did not concur with the selected PCB cleanup level.

2.1.3 Third Five-Year Review Report (2009)

The purpose of a Five-Year Review (FYR) is to determine whether the remedy at a site is protective of human health and the environment.

2.1.3.1 Human Health Risk Assessment

Since the 1989 ROD, new information had become available on Tribal seafood consumption rates and exposure durations for Tribal populations. In the Third FYR EPA considered this new information for the Sediments Operable Unit (OU).

In August 2007, EPA Region 10 issued a "*Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia*". The Framework was designed to assist EPA Region 10 with managing hazardous waste cleanup sites with Tribal seafood consumption exposures and concerns.

In areas of the Sediments OU where PCBs remain in sediments (including the Hylebos Waterway), PCBs are a human health contaminant of concern. Therefore, for its Third FYR, EPA identified the consumption rates and exposure duration in the Framework (97.6 grams/day over 70 years) as new information that could impact the estimated risk associated with residual PCBs that could call into question the long-term protectiveness of the remedy.

The "high end" Tribal fishing scenario used in the 1997 ESD, which modified the PCB goals for the CB/NT Sediments OU, used a rate of 123 grams/day over 30 years and estimated the post-cleanup residual excess cancer risk associated with that level at 1.2×10^{-4}. In the ESD, EPA stated that "The analysis focused on cancer risks as the most conservative estimate of risks to human health. The risk assessment estimated cancer risks only, because a PCB cleanup level based on cancer risks was shown to be protective of non-cancer risks as well." EPA indicated in the FYR that the Agency was "still evaluating whether the revised exposure assumptions could make a significant difference to non-cancer risk. "

Application of the Framework exposure assumptions discussed above resulted in a revised post-cleanup estimated residual excess individual lifetime cancer risk of 2.2 x 10^{-4}.

Based on this evaluation, EPA did not believe that this difference was significant enough to call into question the protectiveness of the remedy nor to require any additional action at this time. EPA believed that the PCB SQO (300 µg/kg) remained protective.

The Third FYR notes that since the ROD, the Dredged Material Management Program (DMMP) had listed both Chlordane and dioxins/furans as bioaccumulative chemicals in the Hylebos Waterway. Neither chemical was evaluated for human health risks in the RI/FS.

2.1.3.2 Discussion/Evaluation

Since there was no indication in the Third FYR that additional fish tissue sampling had been conducted, it is assumed that the updated risk assessment was based on the same tissue concentrations as the previous risk assessments.

It appears that the revised risk estimate (2.2 x 10^{-4}) was calculated by simply determining the difference between the previous exposure assumptions (123 grams/day over 30 years) and the revised Framework assumptions (97.6 grams/day over 70 years). A consumption rate of 123 grams/day over 30 years is equivalent to an exposure of 52.7 grams/day over 70 years. The relationship between these two rates (97.6 and 52.7 grams/day) is identical to the relationship between the calculated risk levels (1.2 x 10^{-4} and 2.2 x 10^{-4}).

However, as noted previously, the 1997 ESD used a modified Tribal consumption rate based on the assumption that only 69 percent of the consumption was attributable to the Site, so the effective rate, over a 70-year exposure, would be 36.3 grams/day (52.7 x 69 percent). Based on the actual difference in exposure assumptions, the revised post-cleanup risk level would be 3.2 x 10^{-4}, and as noted previously, this is only for a single carcinogen, and does not account for cumulative risk. It is not clear whether this difference is "significant enough to call into question the protectiveness of the remedy." The potential risks from other carcinogens were not evaluated based on the revised exposure assumptions.

Based on updated exposure assumptions regarding fish consumption, and the level of protection required by State regulations, it is possible that other contaminants, that may not be co-located with higher concentrations of PCBs, may still be present at unacceptably high

concentrations. As noted in the Third FYR, certain bioaccumulative chemicals, including dioxins, were not evaluated for human health risks in the RI/FS, and may be present at levels that present unacceptable risks to human health.

2.1.4 Other Relevant Background

In addition to the documents discussed in the preceding sections, other relevant background documents were reviewed and are briefly summarized below.

Explanation of Significant Difference for the Record of Decision (2000)
EPA published another ESD for the CB/NT Site in 2000. Among other changes, this ESD required the inclusion of the Endangered Species Act (ESA) as an ARAR for remedial actions conducted under the ROD.

Measurement of VOCs in Finfish and Shellfish Harvested from Commencement Bay, Washington (2009)
EPA worked with Ecology to measure volatile chemicals in resident fish and shellfish to assist in evaluating human health exposures related to the Occidental site. The Washington Department of Fish and Wildlife provided EPA with 23 specimens of resident finfish and crab harvested from "an area affected by releases of chlorinated VOCs from Occidental."

VOCs analyzed for the Occidental site were perchloroethylene (PCE), trichloroethylene (TCE), vinyl chloride, and hexachlorobutadiene. At least one VOC was detected in all samples. Vinyl chloride was not detected in any samples, but EPA noted that it "probably was not present as a contaminant in the immediate area where the tissue samples were obtained". The highest VOC concentrations were detected in crab hepatopancreas samples, the highest being 79.8 µg/kg PCE. PCE, TCE, and hexachlorobutadiene were detected in 90 percent, 83 percent, and 40 percent of all samples, respectively.

EPA indicated that the study, while limited, "demonstrates that the common assumption that VOCs will not be present in fish or shellfish tissue where VOCs have been released to surface waters is not necessarily true." Further, EPA noted that because anadromous species, particularly salmon, were not included in this study, this remains a data gap.

2.1.4.1 Discussion

The majority of risk assessment work related to the Occidental Site has been conducted as part of the larger CB/NT Site, and has focused primarily on PCBs in sediment. While the human health risk assessment done in support of the 1989 ROD ultimately focused on health risks from PCBs, it did identify PCE as one of three carcinogens present in fish tissue above background concentrations (in addition to PCBs and BEHP). At a fish consumption rate of one pound/day, the cancer risk from PCE was estimated to be 1×10^{-5}. EPA noted that "as the predicted risk values for tetrachloroethene and BEHP are so much lower than those for PCBs, they would not significantly add to the CB/NT Site risk due to PCBs", and no additional risk evaluation of PCE or other VOCs was conducted.

The primary VOCs present at the Occidental Site (PCE, TCE, and vinyl chloride) have a low tendency to bioaccumulate in the food chain, but can bioconcentrate in fish and shellfish tissue by exposure through the water column. VOCs have been measured in shallow groundwater potentially discharging to the Hylebos Waterway at concentrations several orders of magnitude higher than applicable water quality criteria for the protection of human health based on the consumption of fish and shellfish. They have also been detected in fish and shellfish tissue in the "area affected by releases of chlorinated VOCs from Occidental." While the most common route of exposure to VOCs is inhalation, ingestion of VOCs in contaminated foods may lead to both cancer and non-cancer health effects.

Based on a number of factors, including current MTCA and SMS requirements, known concentrations of VOCs in shallow groundwater, and the limited number and age of tissue samples, additional fish and shellfish tissue sampling would support a more robust evaluation of potential human health exposures.

3.0 Summary of Review Comments

Based on a review of both the *Streamlined Risk Assessment* (April 2011) and Appendix V (Exposure Pathway Assessment Report) of the *Draft Site Characterization Report Groundwater and Sediment Remediation* (August 2014), we recognized that the documents are sufficiently similar that we have focused our comments on the more recent Exposure Pathway Assessment Report. The Exposure Pathway Assessment Report includes a Site Characterization, which provides a discussion of the Conceptual Site Model (CSM); a Human Health Exposure Pathway Assessment (HHEPA); and an Ecological Health Exposure Pathway Assessment (EHEPA). General

comments regarding the Exposure Pathway Assessment Report are provided in the following section, followed by specific comments in the next section.

3.1 General Comments

1. The Exposure Pathway Assessment Report does not provide adequate characterization of natural resources, including habitats and species and their life histories, present at the Site and in the surrounding area. The Exposure Pathway Assessment Report also does not adequately describe the human activities that occur in the area. This incomplete information results in major gaps in the risk assessments and the CSMs, which in turn results in an inadequate selection and assessment of exposure pathways, receptors, and endpoints.

2. Because contamination remains in the sediments and embankment area of Hylebos Waterway, including contamination resulting from bioaccumulative chemicals, and has or will potentially reach Commencement Bay, the assessment should be revised to adequately evaluate the potential risks to human health and the environment.

3. While the Site and the surrounding areas are not pristine, they are certainly not devoid of life. Commencement Bay and the Hylebos Waterway provide important rearing, foraging, migratory, and adult habitat for numerous aquatic and terrestrial species. These estuarine waters are an important transitional area for juvenile salmonid species, bottom fish, forage fish, crab, bivalves and many other resident marine species. All of these species are found in these waters during every month of the year. The riparian buffers, salt marshes, and mudflats in the area provide important habitats for these aquatic species including plants, birds, and mammals. Commencement Bay and the Hylebos Waterway also provide recreational access and opportunities to the communities residing in and outside of the area.

4. The 2000 ESD added the ESA as an ARAR to the CB/NT ROD, which includes the Hylebos Waterway and Commencement Bay. The Hylebos Waterway and Commencement Bay provide habitat for federally-listed species, and critical habitat for several of these species has been designated in both waterbodies. Additionally, the area is home to several non-listed species, including forage fish, flatfish, crab, bivalves, and other inshore resident marine fish and benthic species which provide important prey resources to the federally listed fish, bird, and mammal species. Federally listed species for the area include Chinook salmon, steelhead trout, bull trout, three rockfish species, two whale species (including Southern resident killer whale), marbled murrelet, and streaked horned lark.

Several other bird and mammal species including but not limited to purple martin, great blue heron, kingfisher, osprey, bald eagle, peregrine falcon, raccoon, river otter, seal, and sea lion are also found in the area.

5. The Exposure Pathway Assessment Report does not provide adequate information regarding the existing and proposed mitigation and habitat restoration that has, is, and will continue to occur in the Hylebos Waterway in the vicinity of the Site and in Commencement Bay. Aside from the habitat restoration related to the Commencement Bay Natural Resource Damage Assessment settlement and mitigation related to Port of Tacoma development, millions of dollars have been and continue to be spent on salmon recovery efforts in the Puyallup River Watershed, which includes habitat restoration in the nearshore areas of Commencement Bay and its tributaries. As shown in Figure 3-1 of the Fourth FYR for CB/NT, several of the mitigation and restoration sites are in Commencement Bay and the Hylebos Waterway in the vicinity of the Site. These areas are backed by undeveloped wooded bluffs and green belts that provide terrestrial habitat for several bird species. These sites provide terrestrial, riparian, and aquatic habitat to the species discussed above, several of which have been observed in the Hylebos Waterway, and at the habitat restoration and mitigation areas and wooded bluffs and green belts across from the Site.

6. The Exposure Pathway Assessment Report does not provide adequate information about the human uses of Commencement Bay and the Hylebos Waterway. Human uses in the area include recreational and tribal fishing, crabbing, marina use, boating, sailing, diving, kayaking, paddle boarding, beach play, and bird and wildlife viewing. Commencement Bay supports both hatchery and listed- and non-listed salmon species including Chinook, coho, chum, and pink salmon for which run sizes have increased in recent years. These salmon species support a robust recreational fishery and provide food and sustenance to sport and tribal fishers in the area. The area is also within a tribal Usual and Accustomed fishing area.

7. The Exposure Pathway Assessment Report does not consider that it is unknown what development and future use will occur on the Puyallup Tribe's properties across the Hylebos Waterway from the Site. It should be assumed that humans will continue to access the beaches and riparian areas along the Hylebos Waterway.

8. As stated in the Exposure Pathway Assessment Report, the area is in an active shipping and industrial area. Because of this, more information should be provided regarding the potential for contaminated sediments below the biologically active zone [BAZ (0 to10

centimeters)] to be brought to the surface as a result of dredging activities and scouring related to shipping.

9. In addition to providing more robust information on ESA-listed species, designated critical habitats and human uses, the Exposure Pathway Assessment Report should include additional descriptive information for the area and reference the following:
    - Washington State designated uses and criteria for the Hylebos Waterway and Commencement Bay (WAC-173-201A-210; WAC-173-201A-612), which among other parameters includes criteria for pH and temperature.
    - Washington Department of Fish and Wildlife Priority Habitats and Species.
    - Mitigation and restoration sites in the Hylebos Waterway and Commencement Bay.

10. The guidance listed for performing the Exposure Pathway Assessment should also include the revised SMS, and the guidance for implementing the SMS included in the Sediment Cleanup User's Manual II (SCUM II).

    Because the revised SMS are an ARAR for the Site, the Exposure Pathway Assessment Report should be updated to include the current marine sediment chemical criteria to ensure that risks to human health and the environment are adequately assessed at the Site.

    The Exposure Pathway Assessment Report should be revised to include the appropriate methods and procedures from the SCUM II for assessing risks to human health and the environment, which are presented in Chapters 8 and 9 and Appendices E and K of the Manual. It should also be noted that the Manual suggests reviewing the Lower Duwamish Waterway and Portland Harbor risk assessments for additional guidance. The Lower Duwamish Waterway CSMs are included as examples in the SCUM II manual.

11. Per the SMS, sediment cleanup objectives and cleanup screening levels for contaminants based on protection of human health "shall be calculated using reasonable maximum exposure scenarios that reflect the highest exposure that is reasonably expected to occur under current and potential future site use conditions" (WAC 173-204-561). The default reasonable maximum exposure scenario "shall be tribal consumption of fish and shellfish." The sediment exposure pathway description should be updated to include this exposure scenario.

    Additionally, the SCUM II notes that "exposure scenarios for human health typically assume activities such as beach play and clam digging that may involve exposure to

sediment at least as deep as targeted shellfish species are found. Depending on the activities, depth of exposure may exceed the BAZ." Since site-related contaminants are known to exist at elevated levels in embankment and intertidal sediments, these activities should be considered as part of a recreational user exposure scenario, and the HHEPA should be modified to include this scenario.

12. Chapter 9 of the SCUM II provides detailed guidance on approaches for addressing risk-based sediment concentrations for bioaccumulative chemicals, and should be followed. This chapter notes that the preferred approach for setting cleanup standards where only sediment data are available (and not both sediment and tissue data) is to base cleanup levels on background concentrations or Practical Quantitation Limits (PQLs), whichever is higher. It further notes that this approach is appropriate "for sites where it is expected that risk-based sediment concentrations would be below background, which is the case for most bioaccumulative carcinogenic chemicals (e.g., dioxin/furan congeners, PCB congeners, and cPAHs)." Bioaccumulative contaminants are known to be present at elevated concentrations in the embankment, intertidal, and subtidal sediments, including PCBs, DDT, dioxins/furans, hexachlorobenzene, and hexachlorobutadiene.

13. The SMS also require that sediment cleanups are protective of "higher trophic level species", and that sediment cleanup objectives and cleanup screening levels based on protection of higher trophic level species shall be established at concentrations that have no adverse effects. The Exposure Pathway Assessment Report should consider "the potential for the contaminant to bioaccumulate or biomagnify through the food chain. According to the SMS, a contaminant will be presumed to have this potential if any of the following conditions are met:
    - The contaminant is listed as a persistent, bioaccumulative, or toxic (PBT) contaminant on the department's PBT list in WAC 173-333-310; or
    - The log of the contaminant's octonal-water partitioning coefficient is greater than 3.5 (log Kow > 3.5).

    Note that Site-related contaminants of concern (COCs) including PCBs, DDT, dioxins/furans, hexachlorobenzene, and hexachlorobutadiene are listed on the PBT list. In general, the high fish/shellfish consumption rates and the exposure factors for individual humans based on the tribal fisher scenario will also be protective of most of the higher trophic level species at the population level.

14. Because groundwater at the Site has been determined to be non-potable, and because contaminated groundwater discharges to surface water, groundwater cleanup levels are based on the protection of surface water. While this requirement is noted in the

Exposure Pathway Assessment Report, recently updated national water quality criteria have not been included. MTCA requires that surface water cleanup levels be at least as stringent as "water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under Section 304 of the Clean Water Act." The Section 304 human health criteria for a number of site-related contaminants have been updated, and the report should be updated to reflect this. Note that the criteria for most Site-related contaminants have become more stringent than those listed in the Exposure Pathway Assessment Report.

Additionally, the potential for Washington State water quality criteria to be updated prior to the final Cleanup Action Plan should be evaluated. On September 14, 2015, EPA published draft revised federal water quality criteria applicable to Washington in the Federal Register.

Because surface waters at the site are marine waters, and not suitable for drinking water, the applicable human health water criteria are those based on the consumption of organisms only.

15. Certain site-related chemicals, including PCE, TCE, and vinyl chloride, do not have applicable numeric water quality criteria for the protection of aquatic life. The EHEPA proposes addressing ecological effects from these chemicals in porewater through a narcosis-based screening approach. To address the potential site-specific toxicity of these chemicals, both individually and cumulatively, and to address other factors potentially affecting toxicity (e.g. elevated pH or temperature), toxicity testing of sediment porewater should be considered.

16. For various media, including soil, groundwater, and sediment, the Exposure Pathway Assessment Report should include a discussion of the likely point of compliance based on MTCA requirements. This will be important when considering and evaluating remedies in the FS.

    Soil Point of Compliance

    - For soil cleanup levels based on the protection of ground water, the point of compliance shall be established in the soils throughout the Site.
    - For soil cleanup levels based on protection from vapors, the point of compliance shall be established in the soils throughout the Site from the ground surface to the uppermost ground water saturated zone (e.g., from the ground surface to the uppermost water table).
    - For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the

pathway, the point of compliance shall be established in the soils throughout the Site from the ground surface to fifteen (15) feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of Site development activities.

The Exposure Pathway Assessment Report discusses only the upper 10 feet of soil, and it is not clear how deeper soils will be assessed. Table 3.10 indicates that the depth to groundwater at the Site is 12 feet below ground surface (bgs).

MTCA recognizes the remedies that rely on containment may not meet cleanup levels at these points of compliance. If the selected remedy involves containment of hazardous substances and the cleanup levels will not be met at the standard points of compliance, the cleanup must meet all the requirements included at WAC 173-340-740(6)(f).

Groundwater Point of Compliance

The Exposure Pathway Assessment Report, while not specifically discussing a groundwater point of compliance, leads the reader to understand that compliance with groundwater cleanup levels based on the protection of surface water will be determined based on porewater concentrations. The standard point of compliance for groundwater is "throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site." Under specific conditions, Ecology can allow an off-property conditional point of compliance in surface water "as close as technically possible to the point or points where ground water flows into the surface water" (WAC 173-340-720(8)(d)). However, there are several conditions that must be met before Ecology can allow such a point of compliance, including the following:

- It has been demonstrated that the contaminated groundwater is entering the surface water and will continue to enter the surface water even after implementation of the selected cleanup action;
- It has been demonstrated that it is not practicable to meet the cleanup level at a point within the groundwater before entering the surface water, within a reasonable restoration time frame;
- Use of a mixing zone under WAC 173-201A-100 to demonstrate compliance with surface water cleanup levels shall not be allowed;

- Groundwater discharges shall be provided with all known available and reasonable methods of treatment before being released into surface waters;
- Groundwater discharges shall not result in violations of sediment quality values published in chapter 173-204 WAC;
- Groundwater and surface water monitoring shall be conducted to assess the long-term performance of the selected cleanup action including potential bioaccumulation problems resulting from surface water concentrations below method detection limits; and
- Before approving the conditional point of compliance, a notice of the proposal shall be mailed to the natural resource trustees, the Washington state department of natural resources, and the United States Army Corps of Engineers. The notice shall be in addition to any notice provided under WAC 173-340-600 and invite comments on the proposal.

Sediment Point of Compliance

The point of compliance for sediments "shall be established at a location that is protective of both aquatic life and human health." To protect aquatic life, the point of compliance shall be established within the BAZ (the upper 10 cm). However, in cases where humans could be exposed to deeper sediments, the point of compliance may be established at a different location that is also protective of human health. In areas including the embankment and intertidal areas of the Site, which includes intertidal areas on the east side of the Hylebos Waterway, the potential for recreational users or fishers to be exposed to deeper sediments should be considered.

3.2 Specific Comments

Section 2.2.1, 2.2.3 and Figures 2.1 and 2.3: The Exposure Pathway Assessment Report does not seem to include Commencement Bay in the CSM and does not evaluate risks to human health and the environment of Commencement Bay. It should be revised to do so. The SCUM II manual should be referenced for guidance on how to develop an adequate CSM.

Section 2.2.2, 2.2.3, and Figures 2.2 and 2.3: The human health CSM should be revised to include direct contact to sediments for recreational users, recreational fishers, and tribal fishers. The SCUM II manual should be referenced for guidance on how to develop an adequate CSM.

Section 2.2.2, 2.2.3, and Figures 2.2 and 2.3: As required by the SMS (WAC-173-204-564), the Exposure Pathway Assessment Report needs to consider risks to higher trophic levels including birds, fish, and mammals. The assessment should evaluate higher trophic level species that currently utilize, may potentially inhabit, or have historically inhabited the Site. Higher trophic level species should be included in the CSM and evaluated in the risk assessments. Species to consider for inclusion include the following:

- Insectivorous birds
- Crab, flatfish, sculpin
- Great blue heron, belted kingfisher, hooded merganser, bald eagle, osprey
- River otter, harbor seal

Additional information can be found in Chapters 3, 4, 9, and in Appendices E and K of the SCUM II manual. The Lower Duwamish Waterway CSM and risk assessments should also be referred to for more guidance.

Section 2.2.2: The evaluation of terrestrial ecological risks should follow the procedures outlined in MTCA for the Terrestrial Ecological Evaluation (WAC 173-340-7490 through 7492), including completion of Table 749-1.

Section 2.2.2: The ecological risks are only considered for the limited areas of identified groundwater discharge and adjacent nearshore sediments. It would be useful to include a figure to identify the specific areas of the Site the authors are addressing.

Section 2.2.2: The Exposure Pathway Assessment Report should consider whether deeper soils and sediments (greater-than3 feet) may be exposed with future development, particularly since the Port of Tacoma is projected to receive larger, deeper draft ships in coming years.

Section 3.2.2: While this section acknowledges that site-related COCs may migrate through "leaching or partitioning from one medium to another", this route is not discussed in Section 3.2.2.2 (Fate and Transport in Receiving Media). The potential for soil contamination to migrate from soil to groundwater should be thoroughly evaluated.

Section 3.2.2.2: Where hazardous substances are released to the surface water as a result of groundwater flows, no mixing zone shall be allowed to demonstrate compliance with surface water cleanup levels. The recreational user surface water exposure pathway should be maintained.

Section 3.2.2.4: Human exposure to contaminants in sediment through consumption of biota should be evaluated.

Section 3.2.3: The recreational user exposure scenario, including potential exposure to sediment, should be maintained in the evaluation.

Section 3.3: This list should include the SMS, SCUM II manual, National Toxics Rule, and the most up-to-date Clean Water Act Section 304(a) water quality criteria.

Section 3.3.4: In addition to sediment ingestion and dermal contact, the sediment to biota to human consumer should be evaluated. Per the SMS, the default human health exposure scenario for sediment is tribal consumption of fish and shellfish. This scenario should be included. (While the fish consumption pathway is included in the Fisher exposure scenario, it is only considered with respect to the surface water to biota pathway, and does not consider bioaccumulation from the sediment or food chain pathways.)

Section 3.3.5: MTCA cleanup levels for surface water include "Water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health criteria published under Section 304 of the Clean Water Act." The national 304 water quality criteria for human health have recently been updated, and should be included as ARARs for surface water and groundwater discharging to surface water.

Section 4.2.2: The phrase "at least temporarily" should be removed. There is no reason to believe that federally listed salmonids will not continue to use the Hylebos Waterway, and given the focus for salmon recovery in the watershed their numbers are expected to increase.

Section 4.2.2: Columbia River coho salmon should be removed, and the ESA-listed species and designated critical habitat for Commencement Bay and the Hylebos Waterway should be added.

Section 4.2.6: The discussion of assessment endpoints should be refined. "Productivity" is a complex concept that is difficult to assess. It would be better to consider using the more typical metrics of survival, growth, and reproduction. In addition, the report should clearly identify the specific measurement endpoints, according to the guidance that will be used to evaluate whether the assessment endpoints are protected.

Section 4.2.6: As noted above, the report improperly limits the species to be addressed in the assessment. In addition, the benthos are stated to include "benthic" fish, although it is not clear what species or feeding guild the authors are referring to. Exposure to contaminated sediments is an important exposure route that should be identified, rather than simply assuming that exposure through shallow contaminated groundwater discharge is the most important.

Section 4.2.6: PCBs and DDT may have greater groundwater transport in association with higher concentrations of volatile organic compounds (VOCs), and this potential for greater transport should be considered. The risks posed by "moderate" concentrations and "very limited areas" should be evaluated quantitatively, and not simply discounted. At the screening level, there should be no assumptions used to *a priori* limited exposure areas. It is also not clear whether the whole of the non-dredged area was considered as previously stated in the earlier sections of the Exposure Pathway Assessment Report.

Section 4.2.6: Direct toxicity to benthos (which would apply only to benthic infauna) has little to do with the protection of the food web via bioaccumulation. In fact, the more healthy the benthos, the greater the transfer from sediments to higher organisms may be. Toxicity data for aquatic species are limited, and the "true" exposure conditions are poorly estimated with available data. There is a difference between identifying the "conservative" (i.e., reasonable worst-case) situation and deciding whether that situation warrants corrective action. As the text notes early on, the screening risk assessment is intended to identify those worst-case scenarios.

Section 4.3, Table 4.1 and 4.2: The Exposure Pathway Assessment Report uses several Site SQOs as ecotoxicity screening values (ESVs) to calculate screening quotients (SQs). These SQOs are cleanup levels, and they are not risk based. The Report should be revised to include the applicable water quality criteria and SMS marine sediment chemical criteria for ESVs to more adequately assess potential risks to human health and the environment related to the Site.

Additionally, it is unclear how the estimated exposure concentrations (EEC) were calculated for each constituent. The report should clarify what was used to develop each EEC (i.e. maximum, 95 percent upper confidence level, and mean concentration).

The report makes judgements on level of risk related to the SQs. For a screening level risk assessment all SQs greater than 1 should be further evaluated.

Section 4.3.1.1: The Washington State aquatic life criteria for PCBs and DDTs should be used, as they are legally applicable requirements. There are both avian and mammal species to be protected. At the screening stage, "home range" considerations should not be included.

Section 4.3.1.1: The Exposure Pathway Assessment Report states that new information was used to revise the Site's previous clean up goals for VOCs, but does not apply the same reasoning to the criteria for other substances.

Section 4.3.1.1: The list of "qualifiers" on this page are uncertainties, and should be moved to a separate discrete section. In addition, the items listed include unsupported assumptions, and unnecessary qualifiers on the meaning of SQs greater than one.

Section 4.3.1.2: As noted in the text, the 300 µg/kg cleanup goal for PCBs is not protective of natural resources. A much lower concentration is appropriate. At the Portland Harbor site, for comparison, the accepted lowest preliminary remedial goal (PRG) for PCBs in sediments is 36 µg/kg for the protection of predators of the benthos, and the cleanup objective for PCBs is even lower for the Lower Duwamish Waterway site where it is 2 µg/kg, based on a "natural background" concentration.

Section 4.3.2.5: High concentrations of VOCs can have a solvent effect on PCBs and DDTs in groundwater, potentially increasing their mobility. The post-construction monitoring at Area 5106 found concentrations of VOCs that could indicate free product. The distribution of the PCBs and DDTs should be carefully compared to the locations of the discharge of contaminated groundwater to determine if evidence exists for enhanced transport.

Section 4.4: The Exposure Pathway Assessment Report summary section continues to use professional judgment to dismiss risks to natural resources from all exposures. This section is based on faulty evaluations in the previous sections.

4.0 Summary and Recommendations

Based on our review of the Draft Exposure Pathway Assessment Report, a summary of significant issues and recommendations follows.

1. The characterization of ecological and human use is inadequate.

The Exposure Pathway Assessment Report does not provide adequate characterization of natural resources, including habitats and species and their life histories that are present at the site and in the surrounding area.

Commencement Bay and the Hylebos Waterway provide important rearing, foraging, migratory, and adult habitat for numerous aquatic and terrestrial species. These estuarine waters at and in the vicinity of the Site are an important transitional area for juvenile salmonid species, bottom fish, forage fish, crab, bivalves and many other resident marine species. All of these species are found in these waters during every month of the year. The riparian buffers, salt marshes, and mudflats in the area provide important habitats for these aquatic species including plants, birds, and mammals. Commencement Bay supports both hatchery and listed- and non-listed salmon species including Chinook, coho, chum and pink salmon for which have run sizes have increased in recent years.

The Exposure Pathway Assessment Report does not provide adequate information regarding the human uses of Commencement Bay and the Hylebos Waterway in the vicinity of the Site. Human uses in the area include recreational and tribal fishing, crabbing, marina use, boating, sailing, diving, kayaking, paddle boarding, beach play, and bird and wildlife viewing. Anadromous and resident fish species support a robust recreational fishery and provide food and sustenance to sport and tribal fishers in the area. The area is within a tribal Usual and Accustomed fishing area.

This incomplete information results in major gaps in the exposure pathway assessments and their associated CSMs which leads to inadequate selection and assessment of exposure pathways, receptors, and endpoints.

Recommendation: The Exposure Pathway Assessment Report should be revised to fully characterize ecological and human uses, including potential futures uses of the Site and surrounding area, and the CSMs should be revised to more fully address all potentially complete

exposure pathways. Further evaluation of current and potential future human uses and associated exposure pathways should be considered.

2. References to and use of applicable regulations and guidance are incomplete.

The Exposure Pathway Assessment Report omits reference to and inclusion of a variety of applicable regulations and relevant guidance documents that affect Site cleanup requirements, including most notably the Washington Sediment Management Standards (SMS) and supporting guidance included in the Sediment Cleanup Users Manual II (SCUM II). Requirements related to the protection of human health and higher trophic level species are not addressed in both the development of CSMs and the evaluation of exposures. Federal regulations and guidance not referenced include the recently revised Clean Water Act Section 304 water quality criteria and the federal Endangered Species Act.

Recommendation: The Exposure Pathway Assessment Report should be revised to include all relevant regulations and guidance. Most significantly, the Exposure Pathway Assessment Report should ensure that the exposure assessment fully complies with SMS requirements and is consistent with the guidance provided in the SCUM II manual. Further, all screening levels should be reviewed and updated as appropriate, including updating the Clean Water Act Section 304 human health water quality criteria.

3. The discussions of human health and ecological exposure pathways are incomplete.

For both the reasons discussed above, the Exposure Pathway Assessment Report provides an incomplete discussion and evaluation of human health and ecological exposure pathways. The incomplete evaluation of sediment and food-chain exposures to fishers and to higher trophic level species is a significant gap in the exposure assessment. The SMS requires that sediment cleanup objectives for the protection of human health are based on tribal consumption of fish and shellfish, unless that scenario is not appropriate.

Recommendation: Since tribal fish and shellfish consumption is a recognized use and treaty-reserved right, the exposure pathway assessment for the fisher scenario should be revised to include consumption of biota impacted by contaminated sediments. The recreational user exposure scenario should also be revised and fully evaluated and should include exposures to contaminated sediments through ingestion and dermal contact, exposure to shallow groundwater discharging to surface water through ingestion and dermal contact, and ingestion of contaminated biota. Ecological exposures should consider exposure to bioaccumulative

chemicals of higher trophic level species, as required by the SMS. Finally, the evaluation of terrestrial ecological exposure should be consistent with the terrestrial ecological evaluation requirements of MTCA.

4. The discussion of points of compliance is inadequate.

The Exposure Pathway Assessment Report does not include a discussion of the relevant points of compliance for the media evaluated. An understanding of the standard and conditional points of compliance for soil, groundwater, and sediment are critical for understanding what data and exposure pathways need to be considered. This is also a critical element in evaluating the protectiveness of remedies that will be evaluated in the feasibility study.

Recommendation: For each of the media and exposure pathways evaluated, a relevant discussion of the regulatory points of compliance should be included to assist in determining the adequacy of both the existing data and the appropriate exposure pathways.

5. The discussion of total site risk is incomplete.

The human health risk assessment procedures included in MTCA state that "[a]t sites where the same individuals or groups of individuals are or could be consistently exposed through more than one pathway, the reasonable maximum exposure shall represent the total exposure through all of those pathways" (WAC 173-340-708). The Exposure Pathway Assessment Report does not include a discussion of the potential or likelihood of exposures to the same individuals through multiple exposure pathways.

Recommendation: In addition to ensuring that all potentially complete human health exposure pathways are adequately evaluated, the Report should include a discussion of the potential and probability of individuals being exposed through multiple pathways (e.g. as both a site worker and a fisher), and the combined risk of multiple exposures. Cleanup levels based on one pathway of exposure must be adjusted downward to take into account exposures from more than one exposure pathway if the total risk exceeds the maximum allowable cancer risk or poses a non-cancer health hazard. This may be particularly important to consider since different regulatory authorities (Ecology and EPA) are addressing different exposure areas within the same site.

5.0 References

Bailey, Marcia L., Michael Hiatt, Dave Terpening, and Jean Zodrow. 2009. *"Measurement of Volatile Organic Chemicals (VOCs) in Finfish and Shellfish Harvested from Commencement Bay, Washington*." In: 2009 National Forum on Contaminants in Fish. Appendix B Poster Abstracts. November.

Conestoga-Rovers & Associates. 2014. *Draft Report: Site Characterization Report, Groundwater and Sediment Remediation, Occidental Chemical Corporation, Tacoma, Washington.* August.

Conestoga-Rovers & Associates. 2014. *Exposure Pathway Assessment*, *Occidental Chemical Corporation, Tacoma, Washington*. April.

Final Updated Ambient Water Quality Criteria for the Protection of Human Health. Notice of Availability. 80 Federal Register 124 (June 29, 2015) pp. 36986 – 36989.

Revision of Certain Federal Water Quality Criteria Applicable to Washington; Proposed Rule. 80 Federal Register 177 (September 14, 2015) pp. 55063 – 55077.

State of Washington Department of Ecology (Ecology). 2015. *Sediment Cleanup Users Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC.* Publication No. 12-09-057. March.

U.S. Environmental Protection Agency (USEPA). 2009. *Five-Year Review Report: Third Five-Year Review Report for Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington.* Region 10. December 23.

U.S. Environmental Protection Agency (USEPA). 2000. *EPA Superfund Explanation of Significant Differences: Commencement Bay, Near Shore/Tide Flats, EPA ID: WAD980726367, OU 01, Pierce County, WA.* Region 10. August.

U.S. Environmental Protection Agency (USEPA). 1997. *EPA Superfund Explanation of Significant Difference for the Record of Decision: Commencement Bay, Near Shore/Tide Flats, Operable Unit 01 – Sediments & Operable Unit 05 – Source, Pierce County, WA.* Region 10. July 28.

U.S. Environmental Protection Agency (USEPA). 1989. *EPA Superfund Record of Decision: Commencement Bay Nearshore/Tideflats, EPA ID: WAD980726368, OU 01, 05, Pierce County, WA*. Region 10. September 30.

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Attachment D

M E M O R A N D U M

DATE: October 1, 2016

TO: Kerry Graber, Washington Department of Ecology
Hazardous Waste and Toxics Reduction Program

FROM: Bill Beckley and Sherrie Duncan – RIDOLFI

SUBJECT: **Toxicity Information for Trichloroethylene (TCE), Tetrachloroethylene (PCE), and Vinyl Chloride**

1.0 Purpose and Scope

The objective of this technical memorandum is to provide a summary of toxicity information and screening level benchmarks for volatile organic compounds (VOCs) found in groundwater, porewater, and sediments at the Occidental Chemical Corporation Corrective Action Site (Occidental Site). The major contaminants of concern in groundwater, porewater, and sediments include the VOCs trichloroethylene (or trichloroethene or TCE), tetrachloroethylene (PERC or PCE), and vinyl chloride. There are currently no federal or Washington state numeric water quality criteria for protection of aquatic life for any of these contaminants. The information provided in this technical memorandum related to these particular VOCs and the toxicity effects and screening level benchmarks associated with each is intended to support the Department of Ecology (Ecology) Hazardous Waste and Toxics Reduction Program in overseeing ongoing investigation and remediation efforts at the Occidental Site.

2.0 Background on VOCs

TCE, PCE, and vinyl chloride are VOCs frequently found in hazardous waste sites and their surrounding areas. TCE and PCE are colorless liquids primarily used as solvents for degreasing metal parts and dry cleaning. Vinyl chloride is used to produce polyvinyl chloride to manufacture plastics. Vinyl chloride is also a biodegradation product of TCE and PCE and it is more toxic than TCE and PCE (Lawrence, 2006). These VOCs enter the environment through industrial discharges, atmospheric transport and deposition, landfill leaching, spills, and improper storage, handling, and disposal.

These compounds break down very slowly in soil and water and are removed primarily by evaporation or volatilization to air; as such, they generally remain as contaminants in groundwater at higher concentrations for a long period of time (ATSDR, 2016 a, b, c; CCME, 1999). In groundwater, the half-life degradation rate of PCE is expected to occur in 1 to 2 years; however, it can take substantially longer given certain conditions (CEPA, 2015). TCE does not readily degrade in groundwater and when it does it may degrade in to more toxic substances such as vinyl chloride and dichloroethylene [(DCE); CEPA, 2015]. In some aquifers,

biodegradation might not continue to completion, which can result in compounds such as vinyl chloride accumulating in groundwater (Lawrence, 2006).

TCE is expected to volatize in freshwater environments in under 12 days but is thought to be more persistent in marine environments with an estimated half-life of 13 to 28 days (CCME, 1999). Even with these rapid dissipation rates in surface water, aquatic organisms may be impacted. The toxic effects to aquatic resources are further discussed throughout this memorandum.

TCE and PCE are characterized as likely carcinogenic to humans, and vinyl chloride is a known human carcinogenic (ASTDR, 2016 a, b, c). These compounds can result in toxic effects to the central nervous system, including acting as a depressant, causing dizziness, sleepiness, headaches, lethargy, confusion, nausea, etc. The compounds also cause liver and kidney ailments including cancer, as well as congenital heart defects and impaired reproduction and reproductive systems.

For TCE, the U.S. Environmental Protection Agency (EPA) human health water quality criteria for the consumption of water and aquatic organisms and organisms only are 0.6 micrograms/liter (µg/L) and 7 µg/L, respectively (EPA, 2016a). The more stringent maximum concentration level (MCL) for TCE is 5 µg/L. For PCE, the EPA human health water quality criteria for the consumption of water and aquatic organisms and organisms only are 10 µg/L and 29 µg/L, respectively (EPA, 2016a). The more stringent MCL for PCE is 5 µg/L. For vinyl chloride, the EPA human health water quality criteria for the consumption of water and aquatic organisms and organisms only is 0.022 µg/L and 1.6 µg/L, respectively (EPA, 2016a). The MCL for vinyl chloride is 2 µg/L.

VOCs have been measured in shallow groundwater that is potentially discharging into the Hylebos Waterway at concentrations several orders of magnitude higher than applicable water quality criteria for the protection of human health based on the consumption of fish and shellfish. Groundwater discharging to sediments in the area is highly contaminated with PCE, TCE, and vinyl chloride. PCE and TCE were detected in porewater samples collected from the Occidental Site at concentrations of 15,000 µg/L and 180,000 µg/L, respectively (EPA, 2009). Vinyl chloride was detected in shallow groundwater collected from the Occidental Site at a concentration of 20,000 µg/L (Conestoga-Rovers & Associates, 2014). PCE and TCE have also been detected in fish and shellfish tissue in the area affected by releases of VOCs from the Occidental Site.

3.0 Bioconcentration of VOCs

These VOCs are not known to build up significantly (bioaccumulate) in plants and animals (ATSDR, 2014 a, b); however, while PCE, TCE, and vinyl chloride have low tendency to bioaccumulate in the food chain, these compounds can bioconcentrate in fish and shellfish tissue through exposure to the water column.

In the mid-2000s, EPA, along with Ecology and the Washington State Department of Fish and Wildlife, conducted a collaborative study on resident finfish and crab harvested near the Occidental Site. The study was conducted to determine whether or not VOCs, including PCE, TCE, hexachlorobutadiene, and vinyl chloride, were accumulating in fish tissue at and in the area of the Occidental Site. The study found that at least one of the four VOCs analyzed was detected in all 23 samples collected at or near the site. This, according to EPA, demonstrates that the common assumption that VOCs will not be detected in fish or shellfish tissue where the contaminants have been released to surface waters is not necessarily true (EPA, 2009). The highest concentrations were detected in crab hepatopancreas. These maximum concentrations were PCE at 79.8 micrograms/kilogram (µg/kg) and TCE at 9.6 µg/kg. For finfish, the highest concentrations were detected in liver tissue. These maximum concentrations were PCE at 9.3 µg/kg and TCE at 5.24 µg/kg. Vinyl chloride was not detected; however, EPA believes that this is most likely a result of it not being present as a contaminant in the immediate area where the tissue samples were collected (EPA, 2009).

During a recent long-term monitoring effort in Europe, surface water and fish tissue samples were collected and analyzed for concentrations of PCE to study the impacts of contaminated groundwater to a river ecosystem. Fish tissue collected in the contaminated areas of the river had concentrations of PCE ranging from 9 to 140 µg/kg. Once groundwater remediation was in place and had been functioning for several years, levels of PCE in both surface water and fish tissue began to decrease; however, the study revealed that decreases in levels of contamination in surface water and reduced levels in fish tissue were not directly related. The study supported the thinking that bioconcentration of VOCs is influenced by a combination of conditions including concentrations of PCE in the external environment as well as age, weight, and length of the fish (Wittlingerová et al., 2015).

4.0 Screening Level Benchmarks for VOCs

While the toxic effects of TCE, PCE, and vinyl chloride to aquatic organisms is similar to their toxic effects to humans, there are currently no federal or Washington state numeric water quality criteria for the protection of aquatic life for any of these contaminants (EPA, 2016b). State water quality standards do however include narrative criteria for toxic substances [WAC 173-201A-240(1)] that include the following:

> *Toxic substances shall not be introduced above natural background levels in waters of the state which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the department.*

In 1980, EPA identified criteria for TCE and PCE for both fresh and marine aquatic environments, but those values have since been withdrawn. Prior to being withdrawn, the TCE acute toxicity value was 45,000 µg/L for freshwater aquatic life and 2,000 µg/L for marine water aquatic life (EPA, 1980a). For PCE, the former acute toxicity value for freshwater aquatic life was 5,280 µg/L,

and the chronic value was 840 µg/L (EPA, 1980b). For marine water aquatic life, the acute toxicity value for PCE was 10,200 µg/L, and the chronic toxicity value was 450 µg/L (EPA, 1980b). No criteria were developed for vinyl chloride (EPA, 1980c).

While federal and state designated criteria or standards for protection of aquatic life are lacking for these compounds, there are several regional and international screening level benchmarks which you can refer to when assessing toxicity and impacts to aquatic natural resources (ESdat, 2015). For example, the National Oceanic and Atmospheric Administration (NOAA) developed a set of Screening Quick Reference Tables (SQuiRTs) that includes various screening level benchmarks for these VOCs. While the SQuiRTs are no longer updated and maintained by NOAA, they provide information that is useful in assessing potential impacts at contaminated sites (Buchman, M.F., 2008). EPA and EPA Region V also have values that are applicable for screening level assessments (Buchman, M.F., 2008). Internationally, the Canadian government, including British Columbia, the Dutch government, and the European Commission have established ecological standards for these compounds (ESdat, 2015). Table 1, which is attached to this memorandum, provides a summary of available screening level benchmarks that can be used to screen and assess a site like the Occidental Site (Buchman, M.F., 2008; ESdat, 2015).

5.0 Ecotoxicity of VOCs

Standards, such as those mentioned above and shown in Table 1, are typically derived from toxicity studies that in turn can provide natural resource managers in the U.S. with additional information and tools for screening and assessing threats to aquatic resources. The existing studies that revealed toxic effects on fish and other aquatic organisms from acute and chronic exposure to these VOCs are limited to a few studies, and the majority of these studies were conducted in the 1980s and 1990s. The following discussion provides a general summary of a few of the existing studies. The studies summarized and referenced below cite additional studies for reference; however, these additional studies are not included in this memorandum. While these studies were conducted in freshwater environments and may not be directly comparable to a dynamic marine environment such as the Hylebos Waterway, they do provide insight on the toxicity of TCE, PCE, and VC to aquatic organisms.

In 1984, a natural pond was contaminated with TCE with an initial concentration levels of 25 milligrams/L (mg/L). This contamination resulted in reduced zooplankton abundance and phytoplankton richness and abundance for 43 days, although 98 percent of the TCE had dissipated within 15 days (Lay et al., 1984).

In another study (Kaiser, et al., 1995), rainbow trout fingerlings were exposed to low concentrations of organic compounds in a flow-through system for an hour to observe changes in ventilation rates, swimming patterns, and general activity according to electric fields generated by the fish. The lowest level of response was found at a TCE concentration of 5 µg/L. The study found that after 20 minutes of exposure to 10 µg/L, the ventilator frequency was

highly irregular (strong coughs and erratic movements), and the fish repeatedly bumped into the glass side walls and appeared generally irritated. These results were comparable to response levels and types found in similar exposure studies (Kaiser, et al., 1995).

In 2004, a study was conducted on the effects of PCE and TCE to embryos of four North American amphibian species, including frog, toad, and salamander. The study found that both VOCs were teratogenic, resulting in developmental deformities in wood frogs, green frogs, and spotted salamanders at median effective concentrations (EC50) ranging from 11.8 to 18.0 mg/L for PCE and 33.6 to 60.0 mg/L for TCE. The EC50 for American toad was 45 mg/L for PCE and 85 mg/L for TCE. The study also noted that survival of embryos was not affected at these concentrations (McDaniel et al. 2004).

In 2010, a study was conducted on the ecotoxicity of vinyl chloride. The study tested the toxicity of vinyl chloride to green algae *(P. subcapitata*) and nematode (*C. elegans*) using a closed system with no headspace. Results of the study showed that vinyl chloride inhibited growth in the algae about 80 to 90 percent at all exposure concentrations used in the study. The 48-hour no-observed-effects concentration (NOEC) and lowest-observed-effects concentration (LOEC) values for algae exposed to vinyl chloride were calculated to be 2.5 mg/L and 5 mg/L, respectively. The 48-hour inhibitory concentration (IC50) value for algae exposed to vinyl chloride was determined to be 5.15 mg/L. It was also shown that survival of nematode, exposed to concentrations of 60 mg/L vinyl chloride, was not affected; however, this concentration did adversely affect reproduction and induced stress at the genetic level (Sun-Hwa Nam and Youn-Joo An, 2010).

6.0 Conclusions and Recommendations

VOCs have been measured in shallow groundwater potentially discharging to the Hylebos Waterway at concentrations several orders of magnitude higher than applicable water quality criteria for the protection of human health based on the consumption of fish and shellfish.

Groundwater discharging to sediments in the area is highly contaminated with PCE, TCE, and vinyl chloride. PCE and TCE were detected in porewater samples collected from the Occidental Site at concentrations of 15,000 µg/L and 180,000 µg/L, respectively (EPA, 2009). Vinyl chloride was detected in shallow groundwater collected from the Occidental Site at a maximum concentration of 20,000 µg/L (Conestoga-Rovers & Associates, 2014). PCE and TCE have also been detected in fish and shellfish tissue in the area affected by releases of VOCs from the Occidental Site.

The concentrations of PCE, TCE, and vinyl chloride detected in shallow groundwater at the Occidental Site exceed the screening level benchmarks for protection of aquatic life – presented in Table 1 for groundwater, freshwater, and marine water – by several orders of magnitude.

These detected concentrations are also higher than those revealed in the sampling of toxicity studies presented in this technical memorandum.

To better determine the impacts of VOCs to aquatic resources and organisms at the Occidental Site, a field sampling effort was conducted in late summer of 2016. During this field investigation, additional sediment and porewater samples were collected and analyzed. Results from the field investigation are expected to be available in fall of 2016. Based on the findings, EPA may decide to conduct a fish tissue sampling effort in the Hylebos Waterway to further assess the impacts of VOCs to aquatic resources and organisms. It is recommended that the results of these analyses be compared to the various screening level benchmarks provided in Table 1.

It should be noted that state water quality standards provide guidance on where and when to apply marine and/or freshwater criteria [WAC 173-201A-260(3)(e)]. Marine toxics criteria apply to any waters with greater than 1 part per thousand salinity. The contaminated groundwater at the Occidental Site is probably discharging into marine waters in the Hylebos Waterway. Most of the available ecological screening level benchmarks are less stringent than the human health criteria for consumption of organisms only; therefore, applying groundwater cleanup levels based on human health water quality criteria for consumption of organisms would also be protective of ecological receptors.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 2016a. *ToxFAQs for Tetrachloroethylene (PERC).* http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=264&tid=48.

Agency for Toxic Substances and Disease Registry (ATSDR). 2016b. *ToxFAQs for Trichloroethylene (TCE).* http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=172&tid=30.

Agency for Toxic Substances and Disease Registry (ATSDR). 2016c. *ToxFAQs for* vinyl chloride. http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=51.

Buchman, M.F., 2008. *NOAA Screening Quick Reference Tables*. NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division. National Oceanic and Atmospheric Administration.

California Environmental Protection Agency (CEPA). 2015. *State Water Resources Controls Board Chemicals of Concern Groundwater Information Sheets – PCE and TCE*. http://www.waterboards.ca.gov/water_issues/programs/gama/resources.shtml#coc.

Canadian Council of Ministers of the Environment (CCME). 1999. *Canadian water quality guidelines for the protection of aquatic life: Chlorinated ethenes – 1,1,2-Trichloroethene (trichloroethylene)*. In: Canadian environmental quality guidelines.

Conestoga-Rovers & Associates. 2014. *Draft Report: Site Characterization Report, Groundwater and Sediment Remediation, Occidental Chemical Corporation, Tacoma, Washington.* August.

ESdat Specialist Environmental Database System (ESdat). 2015. *Environmental Guidelines and Standards*. http://esdat.net/Environmental_Standards.aspx.

Environmental Protection Agency (EPA). 1980a. *Ambient Water Quality Criteria for Trichloroethylene.*

Environmental Protection Agency (EPA). 1980b. *Ambient Water Quality Criteria for Tetrachloroethylene.*

Environmental Protection Agency (EPA). 1980c. *Ambient Water Quality Criteria for Vinyl Chloride.*

Environmental Protection Agency (EPA). 2009. *Measurement of Volatile Organic Chemicals (VOCs) in Finfish and Shellfish Harvested from Commencement Bay, Washington*. 2009 National Forum on Contaminants in Fish, Portland, Oregon

Environmental Protection Agency (EPA). 2016a. *National Recommended Human Health Water Quality Criteria*. http://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table

Environmental Protection Agency (EPA). 2016b. *National Recommended Aquatic Live Water Quality Criteria*. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable.

Kaiser, K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett. 1995. *Response Threshold Levels of Selected Organic Compounds for Rainbow Trout (Oncorhynchus MyKiss)*. Environmental Toxicology and Chemistry, Vol 14, No 12, pp. 2107-2113.

Lawrence, S.J., 2006*, Description, properties, and degradation of selected volatile organic compounds detected in ground water - A Review of Selected Literature*. Atlanta, Georgia, U. S. Geological Survey, Open-File Report 2006-1338, 62 p., a Web-only publication at http://pubs.usgs.gov/ofr/2006/1338/.

Lay, J.P., W. Schauerte, and W. Klein. 1984. *Effects of trichloroethylene on the population dynamics of phyto- and zooplankton in compartments of a natural pond*. Environ. Pollut. Ser. A. Ecol. Biol. 33:75–91.

McDaniel TV, Martin PA, Ross N, Brown S, Lesage S, Pauli BD. 2004. *Effects of Chlorinated Solvents on Four Species of North American Amphibians*. Arch Environ Contam Toxicol 47: 101-109.

Sun-Hwa Nam and Youn-Joo An. 2010. *Assessing the ecotoxicity of vinyl chloride using green alga P. subcapitata, nematode C. elegans, and the SOS chromotest in a closed system without headspace*. Science of the Total Environment, 408 (2010) 3148–3152.

Wittlingerová, Z., Macháčková, J., Petruželková A., and Zimová, M. *Occurrence of perchloroethylene in surface water and fish in a river ecosystem affected by groundwater contamination*. Environmental Science and Pollution Research, ISSN 0944-1344, DOI 10.1007/s11356-015-5806-7.

Table 1. General summary of available screening level benchmarks for protection of aquatic life for TCE, PCE, and vinyl chloride (ESdat, 2015; Buchman, M.F., 2008)

Media	Regulatory Agency	TCE (CAS # 79016)	PCE (CAS # 127184)	Vinyl Chloride (CAS # 75014)
Groundwater	Dutch Target (T)/Intervention (I)	24 µg/l (T); 500 µg/L (I)	0.01 µg/L (T); 40 µg/L (I)	0.01µg/L (T); 5 µg/L (I)
	EPA MCL	5 µg/L	5 µg/L	2 µg/L
Freshwater	European Commission	10 µg/L	10µg/L	-
	Canadian chronic	21 µg/L	110 µg/L	-
	British Columbia	200 µg/L	1,100 µg/L	-
	Tier II SAVs acute	440 µg/L	830 µg/L	-
	Tier II SAVs chronic	-	98 µg/L	-
	EPA 1980 acute	45,000 µg/L	5,280 µg/L	-
	EPA 1980 chronic	-	840 µg/L	
	EPA Region V	-	45 µg/L	930 µg/L
Marine Water	European Commission	10 µg/L	10 µg/L	-
	British Columbia	200 µg/L	1,100 µg/L	-
	Tier II SAVs acute	-	10,000 µg/L	-
	Tier II SAVs chronic	-	450 µg/L	-
	EPA 1980 acute	2,000 µg/L	10,200 µg/L	-
	EPA 1980 chronic	-	450 µg/L	-
Sediment	Dutch Target (T)/Intervention (I)	0.1 mg/kg (T); 60 mg/kg (I)	0.002 mg/kg (T); 4 mg/kg (I)	0.01 mg/kg (T); 0.1 mg/kg (I)
	EPA EcoTox Thresholds	1.6 mg/kg	0.530 mg/kg	-
	PS AET neanthes (N)/Infaunal (I)	0.041 mg/kg (N)	0.057 mg/kg (I)	-

Notes for Table 1:

CAS # = Chemical Abstracts Services Registry Number

TCE = trichloroethylene or trichloroethene

PCE = tetrachloroethylene

" - "= none identified

µg/L = micrograms per liter

mg/kg = milligrams per kilogram

EPA = U.S. Environmental Protection Agency

SAV = Secondary Acute Value

PS AET = Puget Sound Apparent Effects Threshold Values

References for Table 1:

Buchman, M.F., 2008. NOAA Screening Quick Reference Tables NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division. National Oceanic and Atmospheric Administration.

ESdat Specialist Environmental Database System (ESdat). 2015. Environmental Guidelines and Standards. http://esdat.net/Environmental_Standards.aspx.

RIDOLFI Environmental

Attachment E

M E M O R A N D U M

DATE: October 1, 2016

TO: Kerry Graber, Washington Department of Ecology
Hazardous Waste and Toxics Reduction Program

FROM: Bill Beckley and Sherrie Duncan – RIDOLFI

SUBJECT: **Review and Evaluation of Commencement Bay Fish Tissue Studies**

1.0 Purpose and Scope of Review

This technical memorandum was prepared to support the Department of Ecology (Ecology) Hazardous Waste and Toxics Reduction Program in overseeing ongoing investigation and remediation efforts at the Occidental Chemical Corporation (Occidental Site) Corrective Action Site in Tacoma, Washington, as well as responding to public comments on the Remedial Investigation (RI) prepared for the Site.

The objective of this memorandum is to provide a summary of available studies of contaminants in fish and shellfish from Commencement Bay, including an evaluation and summary of risk assessment information related to the consumption of fish and shellfish from Commencement Bay.

Available fish and shellfish contaminant data evaluated were included in four studies completed between 2007 and 2014. While three of the four studies evaluated fish or shellfish data from throughout Puget Sound, the discussion of the studies in this memorandum is focused specifically on data collected in and around Commencement Bay, including the Hylebos and Thea Foss Waterways.

Each of the studies evaluated is generally summarized with the discussion focusing on the results specific to Commencement Bay and its tributary waterways. To the extent possible, an evaluation of risks to fish and shellfish consumers is included.

The four studies evaluated include:

- *Human Health Evaluation of Contaminants in Puget Sound Fish*. Washington Department of Health (WDOH). 2007.

- *Toxic Contaminants in Puget Sound's Nearshore Biota: A Large-Scale Synoptic Survey Using Transplanted Mussels (Mytilus trossulus)*. Washington Department of Fish and Wildlife (WDFW). 2014a.

- *Toxic Contaminants in Dungeness crab (Metacarcinus magister) and Spot Prawn (Pandalus platyceros) from Puget Sound, Washington, USA*. Washington Department of Fish and Wildlife (WDFW). 2014b.

- *Measurement of Volatile Organic Chemicals (VOCs) in Finfish and Shellfish Harvested from Commencement Bay, Washington*. Marcia L. Bailey, Michael Hiatt, Dave Terpening, and Jean Zodrow. 2009.

2.0 Summary of Studies Reviewed

2.1 *Human Health Evaluation of Contaminants in Puget Sound Fish*. Washington Department of Health (WDOH). 2007

2.1.1 Purpose and Objectives

Since 1989, the Washington State Department of Fish and Wildlife (WDFW) has collected fish tissue data from Puget Sound in an effort to determine long-term trends in contaminant levels. The Washington Department of Health (WDOH) was asked to assess these data to address potential health impacts to humans who eat marine fish from Puget Sound.

The purpose of the 2007 WDOH study was to review and evaluate potential health risks that may result from exposure to bioaccumulative contaminants through the consumption of Puget Sound fish, based on data collected by the WDFW as part of the Puget Sound Assessment and Monitoring Program (PSAMP). Following an initial evaluation of tissue concentrations, frequency of detection, and toxicity, WDOH concluded that two of the contaminants, polychlorinated biphenyls (PCBs) and mercury, are of potential public health concern.

2.1.2 Species Sampled

Tissue samples from rockfish (brown, copper, quillback, and yelloweye), English sole, and Chinook and coho salmon were collected from Puget Sound as part of PSAMP. Within Commencement Bay, English sole were sampled from six locations, and rockfish were sampled at five locations. Salmon were not collected from within Commencement Bay.

2.1.3 Contaminants Analyzed

PSAMP analyzed fish muscle tissue for over 100 chemicals found on the USEPA Priority Pollutant List or Hazardous Substance List. Chemicals included chlorinated pesticides, polychlorinated biphenyls (PCBs), other organic compounds (phenols and substituted phenols, aromatic hydrocarbons, chlorinated aromatic hydrocarbons, phthalates, and others), and metals such as mercury, lead, copper, and arsenic. Based on analytical results, WDOH concluded that only PCBs and mercury were detected with sufficient frequency and at high enough levels to warrant an assessment of human health risk. These chemicals are frequently observed in aquatic organisms due to their persistence, toxicity, and their ability to bioaccumulate and/or biomagnify.

PCBs were assessed for cancer and non-cancer endpoints, while mercury was assessed only for non-cancer effects. Consideration was given to fish life history, chemical toxicity, potential exposure to contaminants by fish consumers (based on estimated consumption), consumer body weight, comparison of contaminant levels with fish from other regions, and the overall health benefits of eating fish. These factors were weighed by WDOH to provide guidance for consuming Puget Sound fish.

2.1.4 Locations Sampled

Samples of both rockfish and English sole were collected from multiple locations within Commencement Bay, with the outermost samples located near the Ruston waterfront on the west and near Brown's Point on the east. One of the sample locations was within the Thea Foss Waterway. Sample locations for rockfish are shown in Figure 1 and sample locations for English sole are shown in Figure 2.

2.1.5 Results

Based on contaminant concentrations detected in fish and on estimates of consumption by recreational anglers, tribal members, and consumers of fish from the Asian Pacific Islander (API) community, WDOH determined that frequent consumers of certain fish species may be exposed to contaminants above a level of concern.

General findings of the study included:

- Mercury contamination of rockfish species in Puget Sound was primarily related to where they live and to fish age.
- Mercury concentrations were highest in yelloweye rockfish.
- Age-adjusted mercury levels were higher in rockfish from urban areas of central Puget Sound than in those from non-urban areas of Puget Sound.
- PCB concentrations were higher in rockfish from urban bays than from near-urban and non-urban areas.
- English sole from urban areas had higher contaminant levels (i.e., PCBs and mercury) than those from near-urban and non-urban areas.

PCBs in Rockfish

PCBs in urban rockfish are elevated to the point where average Suquamish Tribal members and API consumers of rockfish exceed a hazard quotient of one [i.e., PCB Hazard Quotient (HQ) greater than 1]. Thus, PCBs in urban area rockfish may be at levels that result in PCB exposure above known "safe" levels for some populations.

PCBs in English sole

Only the calculated exposures to high-end API consumers of urban flatfish reached a PCB HQ greater than 1. Species-specific consumption rates were used to estimate exposure doses from consumption of English sole. Consequently, the exposure from consumption of all types of Puget Sound flatfish may be underestimated for some people.

Mercury in Rockfish

Regardless of location, mercury levels in rockfish were sufficiently high to result in mercury HQs greater than 1 for high-end rockfish consumers from the Suquamish Tribe and the API community. However, average consumers from all communities, except the API, are not likely to be exposed to mercury at levels of concern from rockfish consumption.

Mercury in English sole

No consumers of Puget Sound English sole exceed a mercury HQ greater than 1. All average and high-end fish consumers are not likely to exceed a "safe" mercury dose from consumption of Puget Sound English sole.

Meal Limits for Commencement Bay Rockfish

WDOH recommends no consumption of yelloweye rockfish caught anywhere in Puget Sound. This advice, although derived from a small sample size, is based on public health concerns due to high mercury concentrations in these fish. Furthermore, due to their Endangered Species Act (ESA) threatened status, WDFW currently restricts nontribal harvest of Puget Sound yelloweye and canary rockfish.

Rockfish sampled in Commencement Bay were relatively young (4.5 years), yet contained more PCBs than similarly-aged fish in non-urban areas. Older quillback rockfish sampled near Old Town (see Figure 1; Comm Bay 4) had relatively high levels of both mercury and PCBs; therefore, WDOH recommended meal limits for Commencement Bay rockfish are two meals per month. (Note that the recommendation of no consumption, above, only applies to yelloweye rockfish.)

This recommendation applies to Commencement Bay "southeast of an imaginary boundary between Sperry Ocean dock and the Cliff House Restaurant."

Meal Limits for Commencement Bay English sole

WDOH developed separate meal limit recommendations for English sole in Inner and Outer Commencement Bay.

- For Inner Commencement Bay, defined as southeast of an imaginary boundary between Sperry Ocean dock and the Cliff House Restaurant: Recommend no more than two meals per month.

- For Outer Commencement Bay, defined as southeast of an imaginary boundary between Boathouse Marina and Brown's Point: Recommend no more than one meal per week.

2.1.6 Discussion

This study described WDOH's evaluation of fish contaminant data to determine whether or not broad health advice is necessary for Puget Sound. The study also addressed consumption of Puget Sound fish on a species-specific basis.

WDOH developed recommended meal limits for individual Puget Sound fish species based on the U.S. Environmental Protection Agency's (EPA) reference doses (RfDs), an individual's body weight, and the known contaminant concentration in fish. The RfD was used to calculate the quantity of fish a person of a given body weight could safely consume, given varying contaminant concentrations found in fish tissue. Meal limits were calculated based on non-cancer endpoints of mercury and PCBs.

Calculations used to quantify health risks and site specific meal limits do not account for other important factors such as the presence of contaminants in other fish or other foods, or the known health benefits of fish consumption.

In addition to recommending meal limits based on non-cancer health effects of PCBs and mercury, WDOH also calculated PCB cancer risk estimates by species and location based on a range of tribal, API, and recreational angler fish consumption rates. Based on a high-end, species-specific tribal consumption rate (Suquamish Tribe 90^{th} percentile), calculated cancer risks for rockfish exceeded 1×10^{-5} at all Commencement Bay locations, and exceeded 1×10^{-4} at three locations, including Brown's Point, Commencement Bay 4, and Commencement Bay 5 (Figure 1). Using the same exposure assumptions, calculated cancer risks for English sole exceeded 1×10^{-5} for all Commencement Bay locations, with the highest risk occurring at locations Commencement Bay 2 and Thea Foss (Figure 2).

The data evaluated in this study represent concentrations of contaminants in fish collected and analyzed between 1989 and 2001, and may not necessarily represent current conditions or risks. While existing data do not show clear trends, levels of PCBs in sediment and other media, including fish tissue, have generally been declining since production of PCBs was banned in the U.S. in 1977. It is possible that sediment cleanup actions taken in and around Commencement Bay have resulted in the reduction of concentrations of contaminants, including PCBs in sediments and tissue.

2.2 Toxic Contaminants in Puget Sound's Nearshore Biota: A Large-Scale Synoptic Survey Using Transplanted Mussels (Mytilus trossulus). Washington Department of Fish and Wildlife (WDFW). 2014.

2.2.1 Purpose and Objectives

In the winter of 2012-2013, WDFW, with the help of citizen science volunteers, other agencies, tribes, and non-governmental organizations, conducted the first synoptic, Puget Sound-wide assessment of toxic contaminants in nearshore biota. The study focused on toxic contaminants generated primarily from terrestrial sources, and conveyed to Puget Sound nearshore habitats via stormwater and other hydraulic watershed processes.

As a "sub-project" to this study, the Tacoma-Pierce County Health Department (TPCHD), sponsored an additional study along the Hylebos Waterway and the Tacoma Ruston Waterfront called the Mussel Watch Gradient Project. For that study, the TPCHD placed nine cages, averaging about 100 meters apart from one another, along the length of the beach at each site. The high density of cages at these two sites was intended to help answer the question, "what is the length of shoreline that represents a site for mussel contamination sampling". Results from the TPCHD's analysis are available in a separate report.

Overall, the project was designed to be a qualitative reconnaissance survey to provide data on the current extent and magnitude of contamination in the nearshore environment of greater Puget Sound, across a wide range of upland land-use types (including rural, undeveloped, agricultural, urban, and industrial), and to provide recommendations for developing a long-term, regional nearshore monitoring plan for Washington State.

The objectives of the survey were to:

- Evaluate the geographic extent of chemical contamination in shoreline biota, using Pacific blue mussels (*Mytilus trossulus*) as the primary indicator organism.
- Measure the magnitude of contamination where it occurs.
- Compare contamination patterns in mussels with adjacent shoreline land-use, covering a wide range of land-use types.
- Analyze patterns of polycyclic aromatic hydrocarbon (PAHs) and PCBs to help infer potential sources.

- Provide recommendations for long-term status and trends monitoring.

2.2.2 Species Sampled

In this study native Pacific blue mussels (*Mytilus trossulus*) were used as indicators of the degree of contamination of nearshore habitats. Relatively uncontaminated mussels were transplanted from an aquaculture source to 108 locations along the Salish Sea shoreline, covering a broad range of upland land-use types from rural to highly urban. At the end of the study, three biological endpoints were determined (mortality, growth, and condition index) as well as the concentration of several major contaminant classes.

Within the Hylebos Waterway, wild native mussels were also collected from within the area where caged mussels were transplanted. Native mussel samples were processed and were made into composites using the same methods as for the transplanted mussels. Although this study was not specifically designed for this purpose, the study compared tissue contaminant concentrations between co-located transplanted and wild mussel sites at the Hylebos Waterway site.

2.2.3 Contaminants Analyzed

The organic contaminants analyzed for this study included PCBs, polybrominated diphenyl ethers (PBDEs), DDTs, PAHs, hexachlorocyclohexanes (HCHs), chlordanes, hexachlorobenzene (HCB), aldrin, dieldrin, endosulfan, and Mirex. Metals analysis included arsenic, cadmium, copper, mercury, lead, and zinc.

2.2.4 Locations Sampled

As shown in Figure 3, caged mussel samples were collected along the Tacoma Ruston waterfront (nine locations), in the Thea Foss Waterway (one location), near the Commencement Bay Skookum Wulge site (one location, just outside the mouth of the Hylebos Waterway), and from within the Hylebos Waterway (nine locations). In addition to the caged mussel locations, wild native mussels were also collected in the vicinity of the Hylebos Waterway samples.

2.2.5 Results

Results presented here are specific to the samples collected from within Commencement Bay and its tributary waterways. Further, while all six metals were found in mussels from all the study sites, their concentrations were relatively low and did not vary greatly from "baseline" values, so

the results presented are focused only on the organic pollutants. Analytical results of the study were presented as both wet weight and dry weight concentrations for all analytes; however, since risk assessments typically use wet weight concentrations, only wet weight tissue concentrations are discussed here.

The pesticides aldrin, endosulfan, and the HCHs were not detected at any sites. All of the other organic contaminants were detected in at least one of the Commencement Bay samples, with the highest concentrations routinely found in the Hylebos Waterway or Hylebos Waterway "native" samples.

PAHs

PAHs were detected at all the Commencement Bay and waterway sites. The highest concentrations were detected in the Hylebos Waterway samples, which were approximately three times higher than the Ruston Waterfront samples. Based on PAH pattern analysis, the majority of PAH concentrations in the overall study area were attributable to pyrogenic sources (either from combustion of fossil fuels or from creosote). However, the Thea Foss Waterway and the Hylebos Waterway were two of four locations in the study area determined to represent dominantly petroleum PAH sources.

Hexachlorobenzene (HCB)

HCB was detected at two locations in the entire study. One of those locations was the Hylebos Waterway, where HCH was detected in both the caged and native mussel samples.

Dieldrin

The pesticide dieldrin was detected in about 10 percent of all samples from the study. Dieldrin was detected in samples from both the Commencement Bay Skookum Wulge site and in the Hylebos Waterway site. The caged mussel sample from the Hylebos Waterway had the highest concentration of dieldrin in the entire study.

Mirex

The pesticide Mirex was detected at two locations. One of those locations was the Hylebos Waterway, where the native sample had the highest concentration of Mirex in the entire study.

Chlordanes

Chlordanes, a group of pesticides, were detected at about 20 percent of the study locations, which included all of the Commencement Bay and waterway locations. The highest concentrations of chlordanes in the study were found in the Hylebos Waterway native samples.

DDTs

DDTs were detected at a majority of study locations, including all of the Commencement Bay and waterway locations. Similar to the chlordanes, the highest concentrations in the study were found at the Hylebos Waterway native and Hylebos Waterway caged locations. Although EPA banned the use of DDT in 1972, this pesticide is very persistent and can still be found in soils and groundwater at sites surrounding Commencement Bay.

Total PCBs

PCBs were detected at virtually all locations sampled in the study, including all of the Commencement Bay and Waterway sites. The highest concentrations of total PCBs in the entire study, by far, were found in the Hylebos Waterway native and Hylebos Waterway caged samples.

PBDEs

PBDEs were detected at all locations sampled in the study. The highest concentrations in the entire study, by far, were again found at the Hylebos Waterway native and Hylebos Waterway caged locations.

2.2.6 Discussion

With the exception of PAHs, concentrations of all other detected organic contaminants in the Hylebos Waterway samples were either the highest or among the highest of any of the study locations. For nearly all contaminant groups, concentrations at the Commencement Bay sites tended to fall in a similar pattern, with concentrations going from highest to lowest in this order: Hylebos Waterway natives, Hylebos Waterway caged, Commencement Bay Skookum Wulge, Thea Foss Waterway, and Ruston Waterfront. Qualitatively, health risks to consumers of nearshore shellfish from the contaminants included in this study would tend to follow this same pattern, with the highest relative carcinogenic risk from shellfish in the Hylebos Waterway and the lowest relative risk from shellfish from the Tacoma Ruston Waterfront.

Because several of the contaminant classes measured in the study are presented as summations of individual chemicals (the raw data were not included in the study), and because not all chemicals were detected at all Commencement Bay locations, a quantitative evaluation of risk to shellfish consumers was only possible for selected contaminants at selected locations. Consumption of nearshore shellfish probably represents only a portion of a fish consumer's diet, and consumption rates may vary significantly between individuals and populations. We therefore elected to initially evaluate carcinogenic risk by applying a fish consumption rate of 175 grams per day. This rate has been proposed by EPA and by the State of Washington as a basis for developing water quality criteria for the protection of human health. (Note that this rate may significantly overestimate consumption of mussels alone.)

Using this fish consumption rate (175 grams per day), assuming a lifetime (70-year) exposure, and using the measured concentrations from the study, the calculated combined cancer risk for consumption of mussels from the Hylebos Waterway would be approximately 3×10^{-4}, with the majority of risk attributable to PCBs. Comparing cancer risk from PCBs at the various locations, risks ranged from a high of 2.6×10^{-4} for the Hylebos Waterway to a low of 1.4×10^{-5} for the Tacoma Ruston Waterfront. Both of these risk values exceed the acceptable risk thresholds under Washington State cleanup regulations, including the Model Toxics Control Act (MTCA) and the Sediment Management Standards (SMS).

For most organic contaminants, concentrations in the Hylebos native mussels were higher than concentrations in the Hylebos caged (transplanted) mussels, and for certain contaminants, including PCBs and PBDEs, the native mussel concentrations were more than twice as high. While the caged mussel data are useful in comparing relative concentrations between sites, these data likely underestimate the concentrations in native biota. If caged mussel data are used to evaluate risk, it may result in underestimation of risk relative to native biota.

2.3 Toxic Contaminants in Dungeness crab (Metacarcinus magister) and Spot Prawn (Pandalus platyceros) from Puget Sound, Washington, USA. Washington Department of Fish and Wildlife (WDFW). 2014

2.3.1 Purpose and Objectives

In 2011 and 2012, WDFW conducted a Puget Sound-wide assessment of toxic contaminants in Dungeness crab and spot prawn. The purpose of the assessment was to evaluate the geographic extent and magnitude of toxic contaminants in these two shellfish species in Puget Sound and to provide contaminant data to WDOH to conduct a human health risk assessment. The study

was designed to sample species typically taken in fisheries, across areas typically fished, and using typical sport-fishery gear.

2.3.2 Species Sampled

Species sampled in this study included Dungeness crab (*Metacarcinus magister*) and spot prawn (*Pandalus platyceros*). Contaminants in Dungeness crab and spot prawn are of particular interest in Puget Sound because of the high importance of these species to commercial, subsistence, and recreational fisheries.

A total of 134 composite samples of Dungeness crab and spot prawn were prepared for this study. Dungeness crab specimens were collected at 54 stations generating 56 crab muscle and 19 crab hepatopancreas composite samples. Spot prawn specimens were collected at 42 stations generating 43 spot prawn muscle and 16 spot prawn head-tissue composite samples.

2.3.3 Contaminants Analyzed

All samples were analyzed for persistent organic pollutants (POPs) and metals. POPs included PCBs, PBDEs, DDTs, PAHs, HCHs, chlordanes, and HCB. Metals included mercury, arsenic, cadmium, copper, lead, and zinc.

Results for the POP analyte groups, including PCBs, PBDEs, DDTs, PAHs, HCHs, and chlordanes, were presented as summed concentrations of multiple chemicals. An estimated total PCB concentration was calculated by summing the detected values for 18 commonly detected congeners and multiplying the result by two.

2.3.4 Locations Sampled

Dungeness Crabs

A total of 12 sample areas were included in this study. At least five crab muscle tissue composites were made from each of seven sampling areas; however, in the following five sampling areas the target of five composite samples was not achieved: Marine Area (MA) 6 (one sample); Sinclair Inlet, Commencement Bay, and MA 11 (three samples each); and MA 13 (four samples).

Dungeness crab sampling locations from within Commencement Bay are shown on Figure 4.

Spot Prawn

Of the 12 sample areas in the study, no spot prawn specimens were collected from Commencement Bay or Sinclair Inlet.

2.3.5 Results

According to WDFW, the most important conclusions from this study were:

- Overall, PCBs were the most abundant POPs in both Dungeness crab and spot prawn, followed by PAHs, PBDEs, and DDTs in Dungeness crab and PAHs and DDTs in spot prawn. PBDEs were rarely detected in spot prawn.

- Highest POP concentrations for both species were observed in urban areas such as Elliott Bay, Sinclair Inlet, and Commencement Bay compared to the less urban areas of Puget Sound.

- Mercury is the only metal that showed a strong (positive) correlation with urban areas, and only in Dungeness crab. Arsenic, copper, and zinc in both species and mercury in spot prawn were distributed more equally across all Marine Areas and urban areas.

- With the exception of a few metals, contaminant concentrations in the hepatopancreas of Dungeness crab and head tissue of spot prawn were consistently higher (by as much as 36 times higher) than the concentrations reported in the corresponding muscle tissue for each species. (Most POPs tend to be lipophilic, meaning that they concentrate in fatty tissue, like the tissue of the head or hepatopancreas. The hepatopancreas is an organ in the crab that combines the functions of the liver and the pancreas.)

Commencement Bay Results

Samples of Dungeness crab were collected from three locations within Commencement Bay (Figure 4). Muscle tissue from all three locations was analyzed, and hepatopancreas was analyzed for two of the three samples.

Commencement Bay was one of three urban embayments sampled as part of this study, in addition to Elliott Bay in Seattle and Sinclair Inlet near the Puget Sound Naval Shipyard. For

most contaminants, concentrations in Commencement Bay were similar to those in the other urban embayments.

Differences between Commencement Bay and other urban embayments included the following:

- HCB was not detected in any Dungeness crab muscle tissue sample except for one location in Commencement Bay. Crab hepatopancreas from Commencement Bay had the highest HCB concentration in the study.

- The highest concentrations of chlordanes in both Dungeness crab muscle tissue and hepatopancreas were found in Commencement Bay.

- The highest concentration of DDTs in Dungeness crab muscle tissue were from Commencement Bay and Elliot Bay, and the highest concentration in hepatopancreas was from Commencement Bay.

- Concentrations of PCBs in both Dungeness crab muscle and hepatopancreas tissue in Commencement Bay were the second highest in the study, behind Elliot Bay.

- Concentrations of PBDEs in both Dungeness crab muscle and hepatopancreas were highest in the Commencement Bay samples.

- Concentrations of PAHs in Dungeness crab muscle tissue from Commencement Bay were highly variable, but the highest concentration in Dungeness crab muscle was found in Commencement Bay.

2.3.6 Discussion

It is not possible based on this study to relate the levels of contamination found in Dungeness crab to any specific source. Generally, the highest concentrations of most organic contaminants were found in the sample nearest the mouth of the Hylebos Waterway (COMMBAY_P23) with the exception of PAHs, where concentrations were highest in the sample near the Thea Foss Waterway (COMMBAY). (Figure 4.)

While the data from this study is limited, an evaluation of human health risk from the consumption of Dungeness crab from Commencement Bay was made based on the following assumptions:

- Total PCBs account for the majority of cancer risk from Dungeness crab consumption.

- The exposure point concentration is based on an averaged whole body concentration, assuming that it is composed of 75 percent muscle tissue and 25 percent hepatopancreas to account for individuals who consume the whole crab.

- The exposure scenario is based on an 80-kilogram adult consuming one 8-ounce meal per month (227 grams per month, or 7.5 grams per day) over a 70-year lifetime.

Based on these assumptions, the excess cancer risk from total PCBs would be approximately 5 x 10^{-5} or higher than would be allowed under the cancer risk thresholds included in MTCA and the SMS.

It is our understanding that WDOH will be using data from this study, in combination with other data, to develop a human health risk assessment.

2.4 Measurement of Volatile Organic Chemicals (VOCs) in Finfish and Shellfish Harvested from Commencement Bay, Washington. Marcia L. Bailey, Michael Hiatt, Dave Terpening, and Jean Zodrow. 2009.

This section summarizes information presented by EPA at the 2009 National Forum on Contaminants in Fish held in Portland, Oregon. A formal report was not published, so the following sections summarize information prepared by EPA Region 10 and provided to RIDOLFI by EPA Region 10 staff involved in the project.

2.4.1 Purpose and Objectives

In 2005, EPA was asked to collaborate with Ecology to develop a Resource Conservation and Recovery Act (RCRA) Corrective Action Environmental Indicator (EI) Determination for Human

Health Exposure for the former Occidental Chemical facility located in Commencement Bay, Tacoma, Washington. Because the only potential significant exposure pathway for the Site was determined to be through the consumption of fish and shellfish contaminated by site releases, measurement of site-related chemicals in resident fish and shellfish was deemed necessary.

WDFW provided EPA with samples of demersal (bottom-dwelling) finfish and crab harvested from a specific area in the Hylebos Waterway demonstrated to be affected by releases of chlorinated VOCs from the former Occidental Chemical facility.

2.4.2 Species Sampled

WDFW provided EPA with 23 resident demersal finfish and crab harvested from an area affected by releases of VOCs from the Occidental Site through groundwater discharge. The specimens included five English sole, five starry flounder, two white spotted greenling, one sand sole, three rock sole, two red rock crab, and five Dungeness crab.

2.4.3 Contaminants Analyzed

The contaminants of interest in this study included tetrachloroethylene (PCE), trichloroethylene (TCE), vinyl chloride, and hexachlorobutadiene (HCBD).

2.4.4 Locations Sampled

The fish and crab harvested for this study were described as "residing in the central bottom of the Hylebos Waterway near where the dredging occurred" and "in an area affected by releases of VOCs from the Occidental Site through groundwater discharge."

2.4.5 Results

While vinyl chloride was not detected in any of the samples or blanks, at least one of the other compounds of interest was detected in all tissue samples. PCE, TCE and HCBD were detected in 90 percent, 83 percent, and 40 percent of tissue samples, respectively.

Trichloroethylene (TCE)

- TCE concentrations in finfish tissue ranged from 0.119 to 2.48 micrograms/kilogram (µg/kg).
- TCE concentrations in finfish liver ranged from 0.894 to 5.24 µg/kg
- TCE concentrations in crab muscle tissue ranged from 0.507 to 5.46 µg/kg
- TCE concentrations in crab hepatopancreas ranged from 1.54 to 9.3 µg/kg

Tetrachloroethylene (PCE)

- PCE concentrations in finfish tissue ranged from 0.053 to 3.56 µg/kg.
- PCE concentrations in finfish liver ranged from 0.132 to 9.3 µg/kg
- PCE concentrations in crab muscle tissue ranged from 0.402 to 10.5 µg/kg
- PCE concentrations in crab hepatopancreas ranged from 1.73 to 79.8 µg/kg

Hexachlorobutadiene (HCBD)

- HCBD concentrations in finfish tissue ranged from 0.431 to 7.43 µg/kg.
- HCBD concentrations in finfish liver ranged from 2.47 to 41.3 µg/kg
- HCBD was not detected in crab muscle tissue or hepatopancreas.

Vinyl Chloride

- Vinyl Chloride was not detected in finfish of crab samples.

Analytical Results are provided in Tables 1 through 5.

2.4.6 Discussion

This study, while limited, demonstrates that VOCs may be present in fish or shellfish tissue where VOCs have been released to sediments and surface waters. Because local anadromous species, particularly salmon, were not included in this study, this remains a data gap.

Ecology concluded, based on these results and a fish and shellfish consumption rate of 54 grams per day, half of which was assumed to be affected by site releases (effectively 27 grams per day), that, at the present time, the risk to human health is not unacceptable, because it does not exceed 1 x 10^{-5} excess individual lifetime cancer risk.

It's important to note that the assumptions used to evaluate risk for sediment cleanup actions have been updated based on revisions to the Washington State Sediment Management Standards.

For comparison purposes, human health risk levels for fish tissue were calculated using the following assumptions:

Fish Consumption Rate	175 grams per day
Exposure Duration	70 years
Exposure Frequency	365 days per year
Body Weight	80 kilograms

Averaging Time	70 years
Target Cancer Risk Level	1 x 10^{-6}

Note: These are the same exposure assumptions that both EPA and the State of Washington have proposed for developing human health water quality criteria for Washington State.

Table 1. Maximum Concentrations of HCBD, PCE, TCE, and Vinyl Chloride in Finfish and Crab Tissue

Chemical	Risk-Based Tissue Concentration (µg/kg)	Maximum Fish Tissue Concentration (µg/kg)	Maximum Fish Liver Concentration (µg/kg)	Maximum Crab Muscle Concentration (µg/kg)	Maximum Crab Hepatopancreas Concentration (µg/kg)
Hexachlorobutadiene (HCBD)	5.86	**7.43**	**41.3**	ND	ND
Tetrachloroethylene (PCE)	218	3.56	9.3	10.5	79.8
Trichloroethylene (TCE)	9.94	2.48	5.24	5.46	9.3
Vinyl Chloride	.635	ND	ND	ND	ND

ND = not detected
µg/kg = micrograms/kilogram
Bold indicates a concentration exceeding the risk-based concentration (RBC)

Based on this comparison, only HCBD in fish tissue and fish liver had maximum concentrations that exceeded the corresponding risk-based tissue concentration (RBC). The mean and 95 percent upper confidence limit (UCL) concentrations of HCBD in fish tissue did not exceed the RBC value, while both the mean and 95 percent UCL concentrations in fish liver did exceed the RBC value. An exceedance of the RBC represents an exceedance of a 1 x 10^{-6} cancer risk based on the exposure assumptions. While the mean concentration of HCBD in fish liver exceeded the RBC value, it is unlikely that an individual would consume that amount of fish liver.

Table 2. Concentrations of TCE, PCE, and HCBD in Finfish Tissue

Tissue Sample	Fish Species	TCE (µg/kg)	PCE (µg/kg)	HCBD (µg/kg)
4252	Flounder	0.342	0.413	ND
4253	Flounder	0.762	0.843	0.668
4259	English sole	0.367	0.318	6.27
4260	English sole	ND	0.917	1.4
4261	English sole	0.119	0.552	ND
4262	English sole	0.285	0.513	0.473
4263	English sole	0.274	0.51	1.01
4264	Greenling	0.52	1.14	2.89
4265	Greenling	0.444	1	7.43
4266	Sand sole	2.48	3.56	0.447
4268	Rock sole	0.289	0.406	0.523

4269	Rock sole	0.212	0.477	0.431
4270	Rock sole	0.398	0.723	2.92
4271	Flatfish	ND	0.053	ND

ND = not detected

µg/kg = micrograms/kilogram

Table 3. Concentrations of TCE, PCE, and HCBD in Finfish Liver

Liver Sample	Fish species	TCE (µg/kg)	PCE (µg/kg)	HCB (µg/kg)
4251	Flounder	4.44	4.17	ND
4254	Flounder	5.23	9.3	9.9
4255	Flounder	4.59	4.18	3.11
4262	English sole	3.33	3.92	3.28
4264	Greenling	5.24	6.42	11.4
4265	Greenling	3.15	3.86	41.3
4266	Sand sole	1.74	1.59	3.98
4268	Rock sole	1.59	1.99	ND
4269	Rock sole	0.894	1.24	2.47
4270	Rock sole	2.88	4.04	16.9
4271	Flatfish	ND	0.132	ND

ND = not detected

µg/kg = micrograms/kilogram

Table 4. Concentrations of TCE, PCE, and HCBD in Crab tissue

Tissue Sample	Crab species	TCE (µg/kg)	PCE (µg/kg)	HCBD (µg/kg)
4272	Dungeness	0.507	0.402	ND
4273	Dungeness	0.743	1.85	ND
4274	Dungeness	0.689	0.578	ND
4275	Dungeness	0.743	0.948	ND
4276	Dungeness	0.512	0.457	ND
4277	Rock crab	1.24	10.5	ND
4278	Rock crab	5.46	1.38	ND

ND = not detected

µg/kg = micrograms/kilogram

Table 5. Concentrations of TCE, PCE, and HCBD in Crab Hepatopancreas

Hepatopancreas Sample	Crab species	TCE (µg/kg)	PCE (µg/kg)	HCB (µg/kg)
4272	Dungeness	1.54	1.78	ND
4273	Dungeness	4.69	10.7	ND
4274	Dungeness	1.73	1.73	ND
4275	Dungeness	2.33	1.92	ND
4276	Dungeness	1.62	1.83	ND
4277	Rock crab	9.3	79.8	ND
4278	Rock crab	4.59	11.3	ND

ND = not detected

µg/kg = micrograms/kilogram

3.0 Summary and Conclusions

Available contaminant data for fish and shellfish species collected from Commencement Bay and its adjacent waterways were summarized and evaluated. The data evaluated were presented in four studies completed by state and federal resource agencies between 2007 and 2014. While three of the four studies evaluated fish or shellfish data from throughout Puget Sound, the discussion in this memorandum is focused specifically on data collected in and around Commencement Bay, including the Hylebos and Thea Foss Waterways.

The four studies evaluated included:

- *Human Health Evaluation of Contaminants in Puget Sound Fish*. Washington Department of Health (WDOH). 2007.

- *Toxic Contaminants in Puget Sound's Nearshore Biota: A Large-Scale Synoptic Survey Using Transplanted Mussels (Mytilus trossulus)*. Washington Department of Fish and Wildlife (WDFW). 2014a.

- *Toxic Contaminants in Dungeness crab (Metacarcinus magister) and Spot Prawn (Pandalus platyceros) from Puget Sound, Washington, USA*. Washington Department of Fish and Wildlife (WDFW). 2014b.

- *Measurement of Volatile Organic Chemicals (VOCs) in Finfish and Shellfish Harvested from Commencement Bay, Washington*. Marcia L. Bailey, Michael Hiatt, Dave Terpening, and Jean Zodrow. (EPA) 2009.

While all of the studies provided information relevant to contaminant concentrations in fish or shellfish species collected from in and around Commencement Bay, each of the studies was limited either by species, geographic coverage, or contaminants, and none of the studies provided a comprehensive view of current conditions throughout Commencement Bay and its adjacent waterways.

Based on PCB and mercury data collected from Commencement Bay finfish for the Puget Sound Assessment and Monitoring Program (PSAMP) between 1989 and 2001, WDOH recommended the following consumption limits:

- No more than two meals per month of rockfish from Commencement Bay.
- No more than two meals per month of flatfish from inner Commencement Bay.
- No more than one meal per week of flatfish from inner Commencement Bay.

Only one study specifically targeted the area impacted by groundwater discharge from the Occidental Site (EPA 2009). Based on VOC data from fish and crab collected in the area of groundwater discharge adjacent to the Occidental Site, at least one of the site-related VOCs was detected in all finfish and crab samples analyzed by EPA. EPA concluded that the results of this study "demonstrated that common assumptions that chlorinated VOCs will not be present in fish or shellfish tissue in areas where VOCs are released to surface waters is not necessarily true."

The most recent data evaluated for this memo were collected between 2011 and 2013 and presented in two studies completed by WDFW in 2014. It is our understanding that an updated evaluation of human health risk and associated consumption recommendations will be completed by WDOH based on these data.

Generally, these studies indicate that concentrations of several organic contaminants are higher in shellfish collected from within the two waterways sampled, and particularly within the Hylebos Waterway, than from within Commencement Bay. Relative to other sites sampled throughout Puget Sound, nearshore biota (Pacific mussels) collected from the Hylebos Waterway had among the highest concentrations of organic contaminants, including PCBs, of any area sampled in the study.

Prepared and reviewed by:

Bill Beckley
Senior Environmental Scientist

Sherrie Duncan
Senior Fisheries Biologist

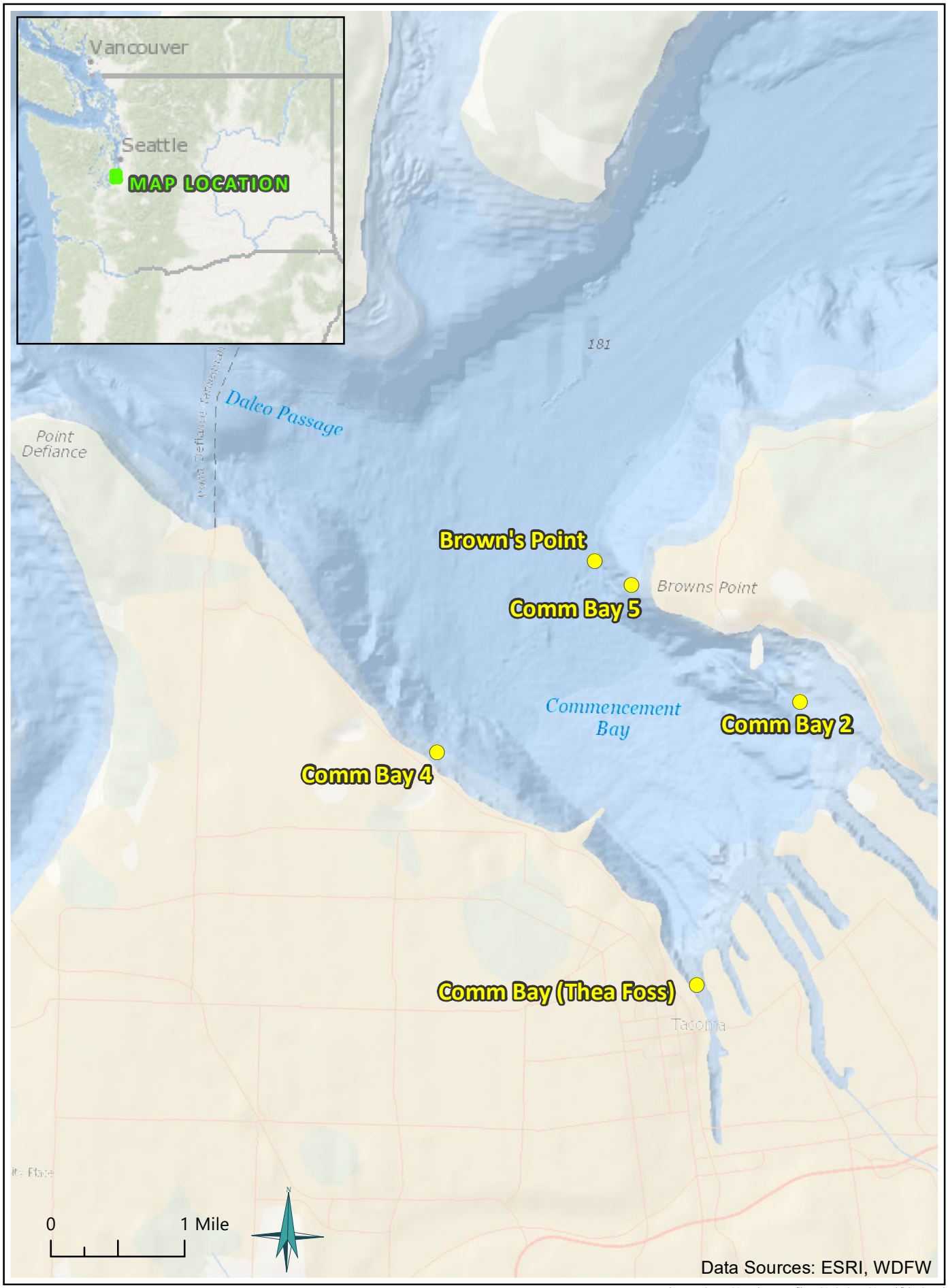

Figure 1: Commencement Bay sites where rockfish were sampled by WDFW for the Puget Sound Assessment and Monitoring Program.

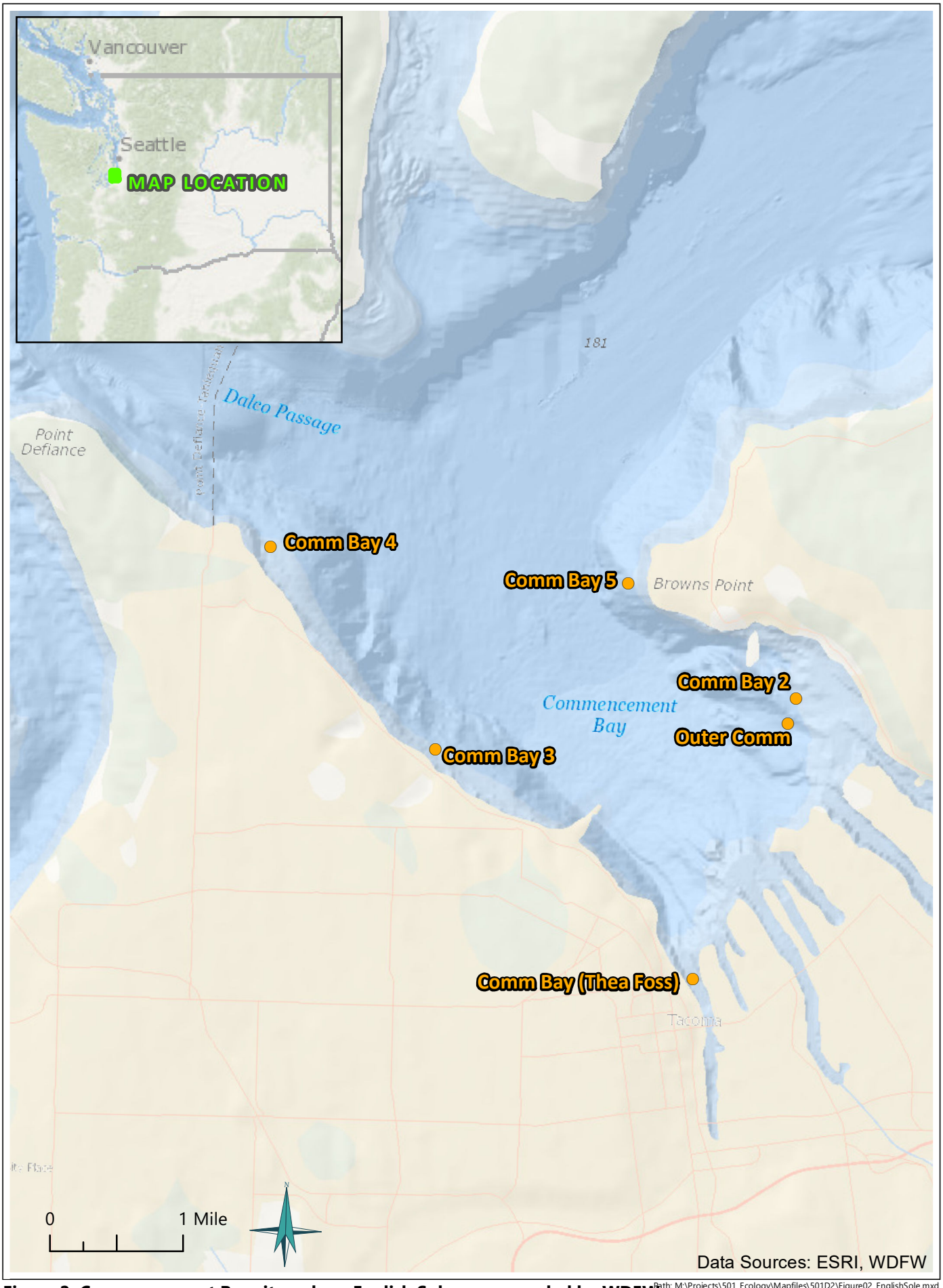

Figure 2: Commencement Bay sites where English Sole were sampled by WDFW for the Puget Sound Assessment and Monitoring Program.

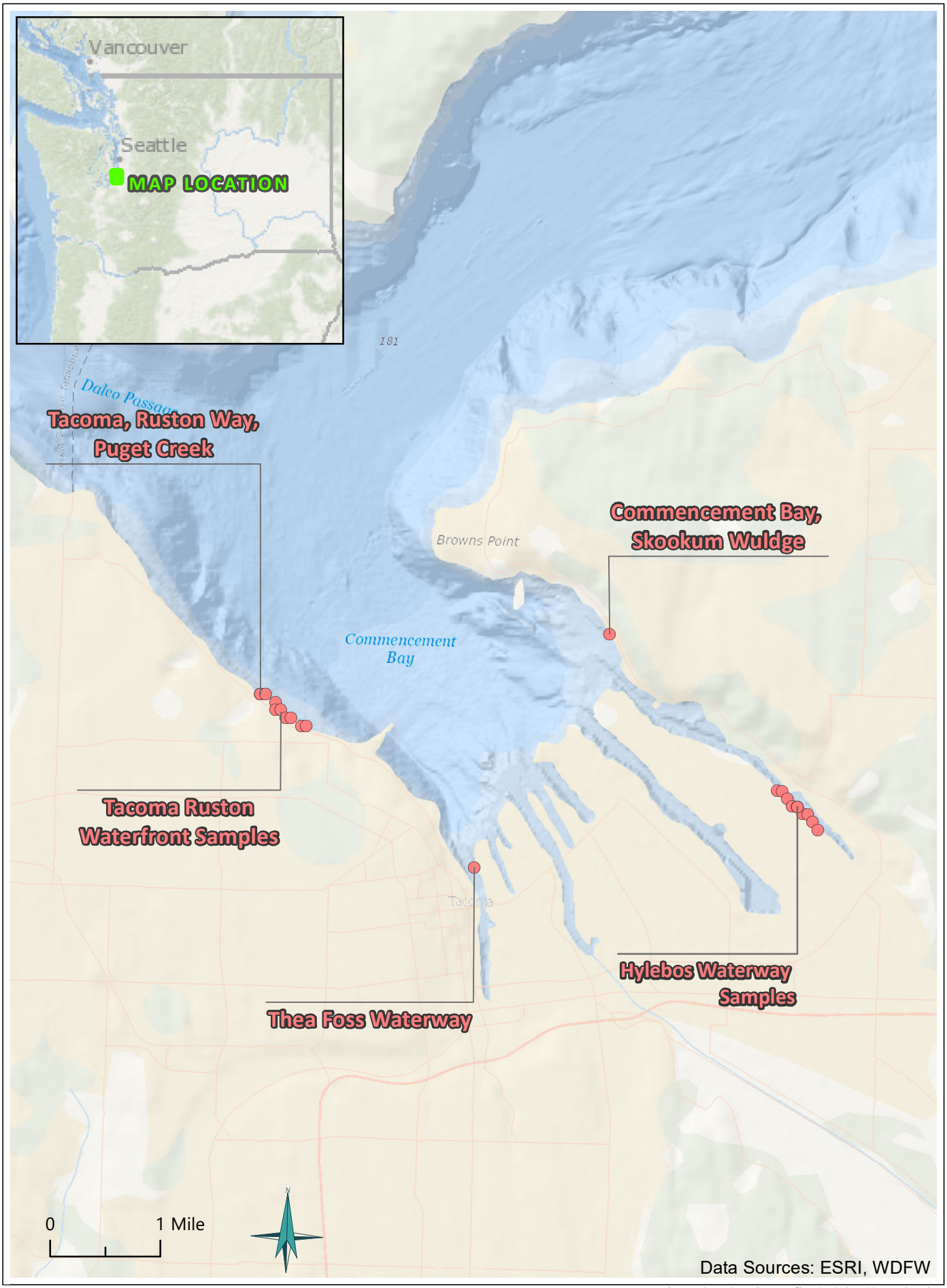

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Figure 3: Commencement Bay sites where transplanted mussels were placed.

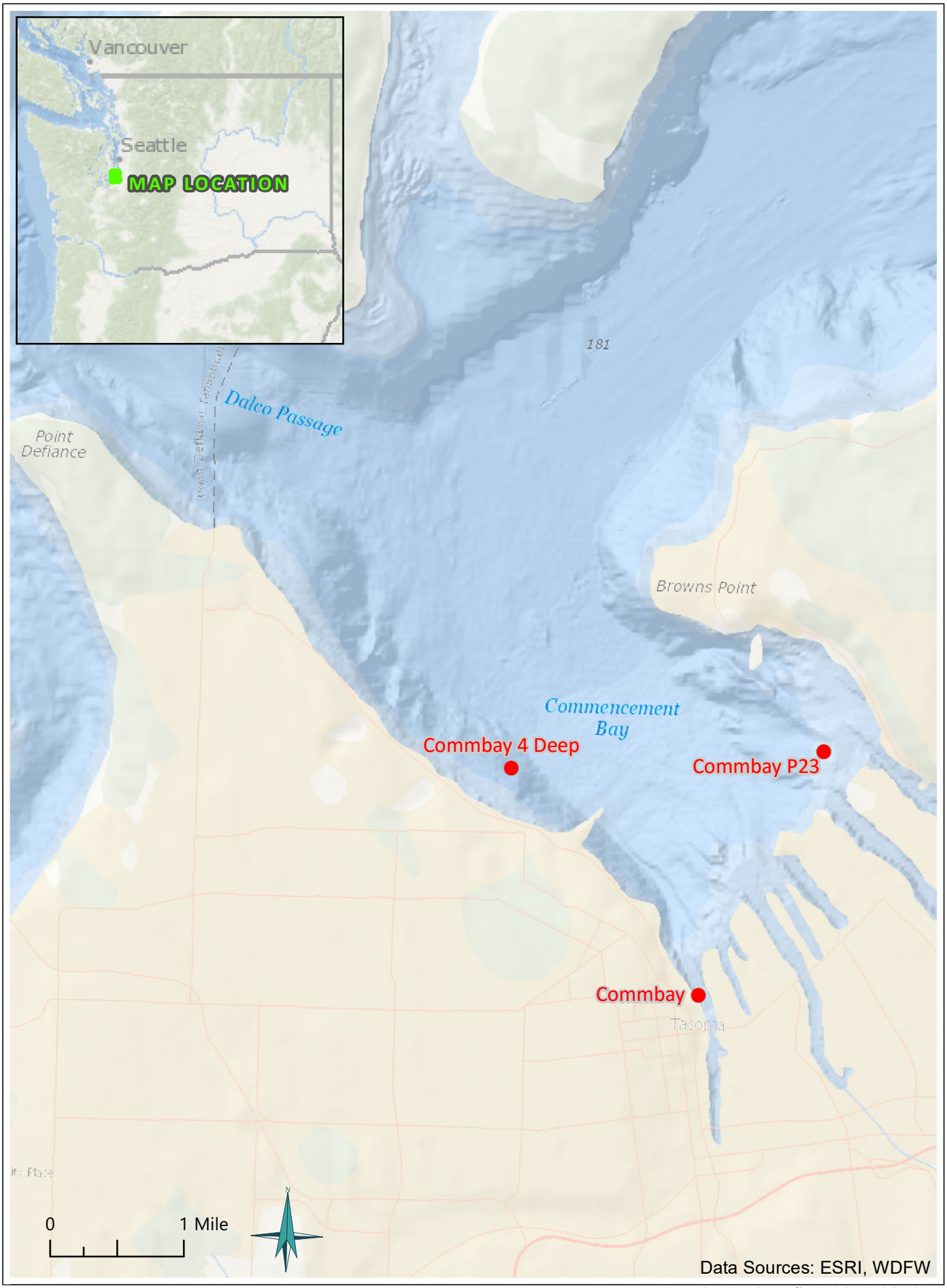

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Figure 4: Commencement Bay sites where Dungeness Crabs were sampled.

Attachment F

TRANSCRIPTION OF AUDIO

OCCIDENTAL CHEMICAL COMPANY SITE CORRECTIVE ACTION PUBLIC HEARING

Let the record show the time is 10:53 o'clock Saturday morning on January 30, 2016. This public hearing is held in the Center at Norpoint, 4818 Nassau Avenue NE in Tacoma. The purpose of this public hearing is to record public comments about the Remedial Investigation (RI) report prepared by Occidental Chemical concerning the site at 605 Alexander Avenue in Tacoma. So I will call three (3) names, please come up to the front of the room, one person at a time in the sequence called please step up to the microphone. When you come to the microphone please state your name and address and the group you represent or your primary interest. Tell how the RI report affects your interest and advise us of any information that should be added for Ecology's consideration. You may pose a question as your comment. No one will answer while we are recording today, but it will be addressed in a formal response to all comments published after the comment period ends. Limit your time at the microphone to five minutes or less (and Stephanie will signal you if needed).

First names are: Melissa Malott, Dean Burke, and Dorothy Burt:

Melissa Malott -

Hello, my name is Melissa Malott, I'm the executive director of Citizens for a Healthy Bay (CHB), whose mission is dedicated to representing and engaging people in the cleanup and restoration of Commencement Bay. Thank you for providing us the opportunity to comment on the draft remedial investigation for the Occidental Chemical Corporation site. Experts that we work with through staff, our board and our volunteer committee of policy and technical experts, have reviewed this and given us information based on their in-depth review and they've identified several issues and deficiencies with the remedial investigation, primarily related to the conceptual site model and risk assessments. In general, we find that the remedial investigation is incomplete. CHB finds that human and ecological risk assessment to be fatally flawed and while the remedial investigation does determine some detail site characteristics, it fails to properly evaluate the potential impacts of the contamination on both human health and the environment. It also fails to properly establish cleanup criteria.

First, the Remedial Investigation (RI) is intended to provide a summary of the history of the site, investigations done to date, major identified data gaps and evaluation and assessment of potential exposure pathways and risks to humans and ecological resources. This information directs the feasibility study and clean up action plan including the development of cleanup objectives and criteria for contaminated media at the site. However, this reports spends substantial time and effort denouncing the toxicity of chemicals found at the site and making inappropriate risk management decisions. Screening level risk assessments are not a platform to debunk and debate eco-toxicity screening values and it is not appropriate to make risk management decisions or judgments on level of risks and screening level risk assessments. Rather, risk assessments are intended to evaluate and screen potential risk of exposure pathways to humans and ecological resources using criteria identified and applicable or relevant in appropriate requirements. In several instances, the RI uses Commencement Bay and Hylebos cleanup numbers instead of using appropriate eco-toxicity screening values to calculate screening portions which provide information as to where exposures and risk may occur and where future evaluation is needed.

Further, the RI provides little to no information to regard in the natural resources including habitat species and their life histories that are present at the site and the surrounding area. The reports do not adequately describe the human activities that occur in the area. This lack of information and misrepresentation of the surrounding area and results in the major gaps in the risk assessments and associated conceptual site models leading to inadequate selection and assessment of exposure pathways receptors and endpoints. Further, the reports do not adequately evaluate the contaminants at the site. Since contamination remains in the sediments and embankment area of Hylebos waterway, including contamination resulting from biocumulative chemicals and has or will potentially reach Commencement Bay, the risk assessments, if conducted, should be revised to adequately assess the potential exposure pathways and risk to human health and the environment. While the site and surrounding areas are not pristine, they are certainly not devoid of life as reports suggest. Commencement Bay and the Hylebos waterway provide important rearing, foraging, migratory and adult habitat for numerous aquatic and in terrestrial species. These estuarine waters are an important transitional area for juvenile salmonid

species, bottom fish, forage fish, crab, bivalves and many other resident marine species. All of these species are found in these waters every month of the year. The riparian buffers, salt marshes and mud flats in the area provide important habitats for these aquatic species, including plants, birds and mammals.

Commencement Bay and the Hylebos waterways also provide recreational access and opportunities to communities residing in and outside of the area. Our written comments will get to further comments and recommendations. Thank you so much for your time today. Thank you.

Dean Burke -

My name is Dean Burke, I'm the Executive Director for the Tacoma-Pierce County Sports Commission, resident of north part of Tacoma. I'm here to speak briefly about way that the Bay is being used that may not have been the case years ago before these studies began. I represent, among other things all of the various human powered paddle craft that are in use at the Bay at this point, which represent Dragon boat, outrigger canoe, rowing, stand up paddling, recreational kayak and Olympic sprint canoe and kayak as well. We have five (5) different competitive clubs that use the waters around the Bay, primarily out of the Foss Waterway and along the Ruston Way area coming across into Brown's Point as well. Human powered paddle activity has grown tremendously over the last just few years in Tacoma, as a result of our postindustrial identity and how people are relating to use the water. That they have access to the water they didn't before. We've seen just in the recreational business alone along the waterway, just in rentals business, the numbers almost doubling year on year almost doubling over the last three (3) to four (4) years.

In 2015, we estimate over 4000 rental hours of consumers along between Owen Beach and Foss Waterway just renting hourly paddle craft of some sort whether it be a kayak or stand up paddle board, those being the two primaries. Over 4000 hours, those are people that are just renting so they are typically first timers trying something, having a new experience that doesn't include all the hours of competitive clubs that use the water or just recreational owners who come down and use the water as well. I think we could see probably 10 or 12,000 hours of human contact to the

Bay through some kind of paddle craft just in that season and we typically look at a season at a thirteen (13) week summer as the core and then the more dedicated in the shoulder season. So, we're definitely seeing an uptake, a tremendous uptake and don't see any signs of slowing of human contact to the water, human interest to the water. Certainly, while paddlers aren't particularly using the Hylebos waterway for the obvious reasons, certainly that waters contamination breach and leaking into the rest of the bay has its risks against humanity, human use and health. So, wanted to speak to that today, and thank you for the opportunity. Thanks.

Dorothy Burt -

Thanks a lot, my name is Dorothy Burt, I actually live in Federal Way at 1842 South 285th Place, however, I'm deeply concerned about the well-being of the Salmon fingerlings that my students put into the Hylebos that come down the water way and I had some good news today but I still would like to be really sure that these fish will be back and they will be healthy. I'm also from the historical society of Federal Way and we learn a lot of interesting things. For example, the East Hylebos and the West Hylebos are two main branches of the streams that flows into the Hylebos water and both of them are part of Federal Way. The West Hylebos waterway flows into the current city limits of Federal Way and the East Hylebos, the watershed is part of the Federal Way potential Annexation area. So, the city has an interest itself, in all of its wetlands, it's been very active it has improved the quality of the fish habitat in the West Hylebos but it can't work on the East Hylebos until they annex it. So, in the recent past, Federal Way has acquired additional wetlands, this is part of their long range planning. They now have Brooke Lake and the Brooke Lake Community Club building which is the heart of the early settlement in the area and a marvelous building. Before at least Federal Way the West Hylebos also flows through Gethsemane Cemetery, which is the site where Father Peter Francis Hylebos toiled to nourish and educate the Native Americans, who had a reservation there until 1907, when the land was annexed to Tacoma after being swapped out of King County into Pierce County. An interesting procedure, somewhat unprecedented. After the joining of the two main branches, the Hylebos flows by five (5) slower Hylebos Nature Park and then enters the waterway.

So, how did I get into this? The children come every year in May and this year will be in the second and third weeks in May when they come to put their fingerlings, their Salmon Fingerlings

into the sound. They have a program which you can look at on line on face book "Storming the Sound with Salmon" and they're really into it. They've rolled out their program until this year, every school in Federal Way is bring their fingerlings and I just want to know that the children aren't going to be disappointed down the road when the Salmon come back. And thank you very much for the opportunity.

Next I would like Shirley Lowe, Sheri Tonn, and Lorna Mauren to come to the microphone.

Shirley Lowe -

My name is Shirley Lowe, and I live in north Tacoma 3043 44th Avenue NE. I live very close to the Hylebos waterway. I sometimes get to look out over that waterway from one of the bluffs up there. I'm very concerned about at the environmental and ecological effects of this, I'm also concerned about the effects this contamination has on human health and I would like to urge Ecology to use the latest information that is available in the cleanup of this site and also to adopt a cleanup plan that is the most protective. All of the issues that are surrounding the Hylebos waterway and the many sites that require cleanup. It's a very complex situation and there could be affects that we don't see when we're looking at just a single item. The combination of all of these things I think makes a big difference and those are things we can't necessarily put specific numbers to, but I think in totality those are things we should be concerned about.

Sheri Tonn -

Good Morning, I'm Sheri Tonn, I live at 7312 Eastside Drive on Brown's Point, about 3 minutes' drive from here. I've been involved with this OxyChem site as well as surrounding waters for about 35 years now. I have a Phd in biochemistry and have been following the biota in the Hylebos water as well as other sites during that period of time. My sailboat for many years was moored just across the way at Charlie and O'Williams Marina until the Marina closed. So, I came in contact with the water there I'm sure a number of times. Although, I have to admit I never fell off my sailboat there. I will be providing much more extensive technical comments in writing but I wanted to make 3 points today.

1) The cleanup process has taken far too long, I was involved in the 1990's in the Occidental Chemical Company responsible care program when there was an effort to begin cleanup. Clearly, it didn't have much of an effect. In the meanwhile, the chemicals have continued to enter Commencement Bay and most of the site characterization to date has been terrestrial, those 12000 points are under the ground not under the water. There has been inadequate characterization of the marine waters as in the water column, as well as in the settlements and the biota in the Hylebos waterway and in Commencement Bay off of the end of the Hylebos. That characterization needs to take place and needs to be part of the overall planning for cleanup.

2) Natural attenuation is clearly or the chemical breakdown is clearly not happening rapidly enough for those chemicals to be gone in my lifetime and as I said I spent 35 years and there are quite a few years more that I hope to be paying attention to it. But that breakdown and dilution of chemicals is taking far too long. The chemicals are going to need to be removed rather than wait for natural breakdown.

3) Thirdly, it appears that this site is being treated differently than what's happening in the Duwamish in Seattle, right now. Clearly there's been action at this site for many more years than there's been in the Duwamish, but that said the standards that are being applied in the Duwamish waterway in Seattle, need to be applied to the Hylebos waterway. And I'm sure Ecology and EPA can figure out good ways to make that happen.

I implore EPA and Ecology to do a thorough cleanup here, so these chemicals are not entering our waterways and not affecting our biota so that these standards are protective of human health and are protective of our environment. Thank you very much for the opportunity to comment here today.

Lorna Mauren -

Good Morning, my name is Lorna Mauren and I'm Assistant Division Manager here with Tacoma's Environmental Services department. Staff at Environmental Services has completed a review of the remedial investigation documents, they are available on Ecology's website and

we've had conversations with Ecology staff as well. We've compiled our comments into a letter and that letter was sent to Ecology earlier this week. Thank you for moving this project forward and thank you also for the opportunity to comment.
This is Dolores Mitchell, Hearings Officer speaking, Bruce Hoeft, please come forward. This is the last card I have, does anyone wish to comment? Would you please fill out a card so we have contact information?

Bruce Hoeft -
My name is Bruce Hoeft and I live at 508 North 11th Street in Old Town, I'm fortunate in that I live close to Commencement Bay and have the opportunity to spend time there to recreate and to be refreshed spiritually by what a clean place it is. I'm here speaking on behalf of Tahoma Audubon which has 1400 members in Pierce County. I basically would like to make 3 points. Aside from thanking Department of Ecology, EPA and everybody here from putting on this presentation to help educate all of us, me in particular because 3000 pages of review was more than the band width that I have available. Nonetheless, for Audubon, I don't think there's anybody out there, I don't want to brag. I know we get, I love going out with Audubon people and watching people look through a spotting scope at some stupid bird a quarter mile away and auguring is it a Pectoral Sandpiper or a Semipalmated Sandpiper. It's just a laugh, it's a laugh riot how much geeks we can become. We are an army of people who are outside all the time with binoculars observing nature and observing who is out there in nature. And I can tell you we see a lot of people at the mouth of the Hylebos of the log bones out there are a fabulous place for looking at and identifying species of gulls as well as the sea lions and the harbor seals and cormorants and ducks, they also see otters and all the other critters you can see out there.

Gog-le-hi-te Wetlands is on the Puyallup itself, it's an absolutely fantastic birding spot that people visit on a weekly basis as is the Thea Foss waterway. As our old town dock, people making viewings from Brown's Point on boats. There's a lot of people who are out there looking at birds but also seeing how many other people using these waters. It includes as Dean mentioned, a lot of folks who are in small craft, on paddle boards and kayaks, they're exposed to the water that is there and;

Point #1, I would encourage the Department of Ecology or the people who are conducting remedial investigation to expand their investigation to include the human impact. There's a lot of people out there that are eating fish, eating shell fish, eating mollusk, who are exposed to the water and one way of another exposed to the dirt and exposed to the air and I don't see that the remedial investigation (RI) exactly assesses what the humans who are using that waterway.

Secondly, I don't feel that the RI adequately assesses the ecological impact. We also do a lot of birding upstream of the Hylebos, all the way up to the West Hylebos wetlands to Surprise Lake. There's a lot of areas up there that are also impacted by prey species that migrate through the Hylebos waterway, up the various creeks and tributaries to the Hylebos. That spreads any contaminants that are in the water up into that ecosystem and that's something we also worried about.

And I guess **lastly**, maybe I haven't read the documents thoroughly enough, but I don't see and I'm greatly concerned and Audubon is concerned about the pathways by which contaminants migrate from the plume, from the site that Occidental contaminated into the immediate environment to the waterways into the air and I would definitely encourage the Department of Ecology to mandate the most stringent review be conducted and on-going in recent sampling in order to determine what are the mechanisms by which those pathways or by which those contaminants can get into the environment, so we can design adequate mitigation to stop that from happening. Thank you.

Justin Lytle -

This is Justin Lytle…I'm Justin Lytle, I am a professor of Chemistry at Pacific Lutheran University (PLU), my address is 7808 117th Street Court East in Puyallup, Washington. I'm a member of Citizen's for a Healthy Bay, my comments will reflect my responsibility to that organization and this community. As we heard, and I thank the Department of Ecology for hosting this event. They have sampled porewater and sediments and vapor intrusion test. I would like further information as a chemist to know what steps are planned to understand the impact these chemicals on living organisms and human beings on this site. I think I'm basically

repeating what people have already said before me. I'd also like to add at the current flow rates at this plume, where do you think this plume will be at the year 2050 or 2100? That's something that I'm not sure I've heard yet. How successfully can a plume that is moving be contained? And how much more of a challenge will the plume be to clean or contain then, and I also wonder which ecological habitats and species might be impacted as the plume is spreading. Thank you.

Audience

Question – Do you have an idea of how the pH is buried over time?
Answer – I don't.
Any final offers of comments?

Documents/Copies and Distribution of Notices

Okay I have some information to read into the record about what methods we use to let you know about the documents availability and about this hearing today.

Copies of the Occidental Remedial Investigation were made available for reading at:
The Mary Kobetich Library in Tacoma;
The Department of Ecology Southwest Regional Office in Lacey;
The Citizen's for a Healthy Bay Office on October 23, 2015.

Legal notices were published in the Washington State Site Register, the Tacoma News Tribune Display, and the Tacoma Weekly.

The public comment period began October 23, 2015 and was extended beyond the original end date to accommodate this public hearing at public request.

Hearing notices were published in the Tacoma News Tribune Display, the Tacoma Weekly, and the Washington Site Register.

Post cards were sent to addresses within a 1 mile radius of the site and to mailing list of 4000 people.

Notices were distributed on 2 listservs, notices were published on Ecology's Public Events Calendar and facebook page.

Flyers were delivered to area Marinas and local Community Centers and finally Ecology issued a press release on January 19, 2016.

Upon reaching a decision, Ecology will announce it and publish a notice that the responsive summary is available. The summary will announce concerns and questions and show how public comments influenced Ecology's decision.

If you provided written or spoken comment, you will automatically receive notice. If you did not provide formal comments you may ask Bridgette after the hearing closes to add your name to the list of people to receive notice when it's issued.

Thank you for voicing your views and for listening to your neighbors comments about the Occidental Chemical Corporation Remedial Investigation Report. We appreciate your involvement.

Let the record show this hearing adjourned at 11:23.

January 22, 2016

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, Wa 98504-7600
Kerry.Graber@ecy.wa.gov

Re: Occidental Chemical Corporation - Draft Remedial Investigation

Dear Ms Kerry Graber,

Thank you for providing the opportunity to comment on the Draft Remedial Investigation for Occidental Chemical Corp's Tacoma site. My husband and I are residents and commercial property owners in the Dome District of Tacoma overlooking the Foss Waterway. As a retired Landscape Architect I am also very involved in urban design and economic issues in the Downtown and along the Foss.

Recently, We found that a new water contamination/crabbing study was done of 3 sites, the Hylebos Waterway, the Foss Waterway and along Ruston Way. The findings were telling in how truly cleaning up a site can make a world of a difference. The Foss came in as the cleanest, while the Hylebos shows such massive contamination that it will most likely close down the entire Commencement Bay for crabbing.

We do not think the draft RI will lead to an adequate cleanup of the Hylebos Waterway and the Occidental site. The RI does not show how the contamination will effect Commencement Bay, nor the impacts on the fishing and crabbing that goes on along the waterways, nor the fact that people actually *do* fish and crab the Hylebos as well as *all* of Commencement Bay. What are the impacts on lower income people and minority populations including the Tribes that regularly use the shoreline for fishing and crabbing?

In addition the RI does not sufficiently address impacts to the natural environment, including the full range of fish, crabs, birds, and mammals using the waterway and moving out into Commencement Bay AND into areas like the Foss that have been adequately cleaned and monitored, so that fish and crab *can* be eaten out of its waters.

We are designing a park in the Foss Waterway that will be for human-powered boats, with a Boathouse for racing sculls, dragon boats and outriggers as well as recreational canoes, kayaks, and stand up paddle boards. These people, like my husband, will be out and about enjoying *all* of Commencement Bay as well as the Waterways in their boats. The impacts and risks need to be assessed for these uses. And what about the future? Dredging/shipping activities and methods of remediation need to be assessed for future recontamination of the Waterway.

We would like to see the most current and protective standards used for the Occidental site cleanup. We are deeply troubled by the differences between the more updated and stringent standards used for the lower Duwamish Waterway (LDW) cleanup and those outlined in the Occidental site draft RI.
For example, the EPA believes that the sediment cleanup standard for PCB's of 300 ppm (parts per billion) is protective of the Hylebos Waterway, yet the LDW's cleanup level is set at only 2 ppm Why should the Hylebos Waterway be held to a less rigorous standard?

The following, used for the LDW Record of Decision, should also be taken into account for Occidental:

- The evaluation of risks from the consumption of fish and shellfish, as well as from direct contact with the water from beach play, net-fishings and clamming.
- The evaluation of risks to benthic invertebrates, fish and wildlife
- A discussion of existing and potential future dredging and shipping in the Hylebos
- A discussion of existing and potential future habitat restoration sites in the Hylebos

The EPA must hold the Occidental cleanup to equally protective standards as others in the area, such as the LDW and Portland Harbor. The unequal application of cleanup standards makes it seem as though the health of Tacoma and Pierce County residents is less important than those in Seattle and King County. Tacoma's waters deserve every protection afforded to those in Seattle. Our community deserves equitable protection from toxic contamination with known carcinogens. The final RI must include current and protective cleanup standards for the protection of human and wildlife heath and vitality.

The Occidental Chemical Corp does not need to be subsidized by the citizens of Tacoma nor by Washington State. The citizens of Tacoma and the region should be able to enjoy the abundant shoreline and clean water around their city.

Thank you for the opportunity to provide feedback for the draft Remedial Investigation, please contact us if you have any questions about our comments.

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Kerry Graber January 30th, 2016
Southwest Regional Office, HWTR Program
PO Box 47600, Olympia, WA 98504-7600

Thank you for the opportunity to review and comment on the draft Remedial Investigation for the Occidental Chemical Corporation site in Tacoma, Washington.

I live in Tacoma, and spend a lot of my time on the beaches of Commencement Bay, Dalco Passage, East Passage, and the Waterways at the mouth of the Puyallup River. I am Co-Chair of the Conservation Committee of Tahoma Audubon, which has 1400 members in Pierce County. I honestly can't tell you how many people regularly view our native birds in Commencement Bay, nor how many places they use for citizen science, and for recreational observations. I have personally participated in multiple Tahoma Audubon field trips to view the log booms at the mouth of the Hylebos, a great place to study gulls, as well as the cormorants, herons, ducks, alcids, terns, and the seals and sea lions that haul out on the booms and barges. Gog-le-hi-te Wetlands, near the mouth of the Puyallup, is a prized park visited weekly by birders year-round, as is Thea Foss Waterway. I have taken field trips at numerous locations along the Hylebos drainage, to the headwaters in a spruce stand in West Hylebos Wetlands Park in Federal Way, to Surprise Lake in Milton, to Lake Killarney near the Weyerhauser property. Many birders make observations from boats on Commencement Bay, and Audubon members survey the surrounding waters from the shoreline on a daily basis.

We are hugely concerned about the toxic legacy of industrial activity on our waterfront. We greatly appreciate the work to clean up polluted land and waterways, but want to ensure that those efforts are comprehensive, and that their results are long-lasting. We are thankful that the State is addressing the contamination produced by the Occidental Chemical Company on the Hylebos. We hope that your review of the complex pathways by which toxins leave the site will be as thorough as possible. We are not convinced that the sampling done so far adequately reveals transmission pathways directly to the air, into the groundwater, upstream into the Hylebos drainage, as well as downstream into Commencement Bay. Mitigations should be based on comprehensive assays. Sampling involved in those assessments should be sequential, performed frequently, and include recent data, in order to determine the current and projected future rate of contaminant migration.

We do not see evidence that the Remedial Investigation adequately describes and analyzes the use of the Hylebos habitat by **wildlife**: salmon and seals, by forage fish and the birds that feed on them, and the critters upstream who may be poisoned by prey that pass through the toxic environment surrounding the plume of Occidental's contamination. We do not see that habitat critical to the recovery of native species has been identified. We do not see that the role by which Occidental pollutants prevent the recovery of endangered species has been addressed. Hylebos has definitely been an industrial waterway. But the historical use does not define its ecological identity today,

and in the future. Biological organisms, from the bottom to the top of the food web, transit and use the inlet. The Remedial Investigation references a reliance on bacterial breakdown of chlorinated hydrocarbons into harmless products. These micro-organisms are a part of a Hylebos ecosystem that warrants further study. Contaminants to which these critters are exposed travel far and wide. This transmission pathway for pollutants should be thoroughly examined, as it impacts wildlife both upstream, and in The Sound. Adequate cleanup measures to prevent the spread of these toxins must be based on comprehensive scientific understanding.

We do not see evidence that the Remedial Investigation adequately describes the direct, non-commercial **human** use of the Hylebos and the immediate vicinity in Commencement Bay. Trust me: there is nobody who is in a better position to identify human uses than birders. Yes, we may have an odd avocation, but that passion is directed at on-the-ground, daily observation of what's happening on the most obscure streams, beaches, and bodies of water. We not only see birds and boats, but also the kayakers and fishermen, clam diggers and crabbers, scuba divers and beach combers who are on the shorelines and waterways (often disturbing the birds we're looking at – a petty annoyance on our part, but one that gets our attention). Many of these uses, which include direct exposure to water, and eating marine food, are not adequately addressed in the Remedial Investigation. We ask that the document take a far more comprehensive look at the direct impacts that the toxic plume has on the people who use Commencement Bay.

The Remedial Investigation **does** identify the locations of residual toxins, but does not adequately assess pathways by which those contaminants might enter the air, the groundwater, and Hylebos waters over time. That's where the rubber meets the road, folks. We remain particularly concerned about the potential for toxic releases should future dredging, or other industrial activities, occur on The Port's property or its waters.

We request that you use the most stringent guidelines in your evaluation of impact of the Occidental Site. We urge you to take the most comprehensive measures to isolate and protect our environment from further exposure to Occidental's pollutants.

Tahoma Audubon has taken a leading role in local habitat protection and restoration over many decades. We are proud of our successes, and those of the many stakeholders who have contributed to the recovery of the Tideflats and Commencement Bay. We do not want to see that effort squandered. Please expand the Remedial Investigation's analysis to ensure that it affords the comprehensive protection the Hylebos deserves.

Make no mistake about it: we are grateful that the Department of Ecology is taking the lead in cleaning up Occidental's toxic legacy. We encourage your continued efforts, and we thank you. If you have any questions, or if I might be able to contribute to your work, please do not hesitate to contact me.

Bruce Hoeft
Co-Chair, Conservation Committee
Tahoma Audubon
253-439-0776, brucehoeft3@gmail.com

From: Bruce Hoeft [mailto:brucehoeft3@gmail.com]
Sent: Monday, February 01, 2016 12:52 PM
To: Graber, Kerry (ECY)
Subject: Occidental RI

Attached you will find comments I am submitting on behalf of Tahoma Audubon concerning the Remedial Investigation of the Occidental Chemical Corporation site on the Hylebos Waterway in Tacoma.

I want to thank the Department of Ecology for sponsoring the Norpoint hearing last Saturday! You clearly did a lot of work to effectively present information which was illuminating to many concerned community members.

Thanks! Bruce Hoeft

January 30, 2016
Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, WA 98504-7600
Kerry.Graber@ecy.wa.gov
Re: Occidental Chemical Corporation – Draft Remedial Investigation
Dear Kerry Graber:
Thank you for providing me the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation site in Tacoma, Washington.

I am a Federal Way resident and Historical Society of Federal Way Board member concerned about the toxicity of the environment in the Hylebos Waterway. Commencement Bay, including the Waterway, is important to Federal Way. The East Hylebos flows through the Federal Way's Potential Annexation Area [PAA] East of I-5 while the West Hylebos Wetlands occupy lower Federal Way. The Federal Way School District serves both watersheds. The City of Federal Way is actively upgrading the quality of fish habitat in the West Hylebos and acquiring addition wetlands including Brook Lake and the Brooklake Community Club building, the heart of early settlement in the area. Before it leaves Federal Way, the West Hylebos flows through Gethsemane Cemetery where Father Peter Francis Hylebos toiled to nourish and educate the Native Americans who had a reservation there until 1907 when the land was annexed by Tacoma. After the joining of its two main branches, the Hylebos flows by Fife's Lower Hylebos Nature Park and then enters the Waterway.

I do NOT believe that the released draft Remedial Investigation adequately describes the full human and wildlife use of the area. The Federal Way School District is actively involved in "Storming the Sound with Salmon" https://www.facebook.com/stormingthesoundwithsalmon and in the 2nd and 3rd weeks of May 2016 will send many busloads of children from 26 Federal Way Schools to plant salmon fingerlings in the West Hylebos. What will be their fate in the Hylebos Waterway both going to sea and returning to spawn?

Below are deficiencies in the draft that I would like to see fully and accurately covered in the final Remedial Investigation document:

- The ways people use the Hylebos Waterway, including tribal and recreational fishing and crabbing, boating, kayaking, paddle boarding, beach play, and bird and wildlife viewing.
- The wildlife of the Hylebos Waterway, including salmon and other fish, birds including waterfowl, raptors and song birds, and whales, porpoises, seals, sea lions and river otters.
- The fishing and crabbing resources in the Hylebos and Commencement Bay, which provide food and important economic benefits for residents.

Please contact me if there are questions regarding my comments. Thank you for the opportunity to provide feedback for the draft Remedial Investigation.

Sincerely,
Dorothy Burt
1842 S 285th Pl, Apt D
Federal Way, WA 98003
burt.dorothy@yahoo.com
Dorothy C Burt

From: charles joy [mailto:1147suzi@gmail.com]
Sent: Saturday, January 30, 2016 10:50 AM
To: Graber, Kerry (ECY)
Subject: Re: Occidental Chemical Corporation-Draft Remedial Investigation

Dear Kerry Graber,

Thank you for considering the following comment on the draft Remedial Investigation.

I am a Northwest native born in Seattle an now a Tacoma resident and have been for 17 years, and I intend to stay. I own and moor a sailboat at the Foss Harbor Marina. I ride the esplanade along the Foss to Point Defiance and return regularly, for the exercise as well as the tremendous sense of belonging to the natural world along my path. The water in the Foss can be startlingly clear depending on the tide and the shoreline clean as well offering many gathering places for the pelagic waterfowl.

I am concerned about the toxic pollution from the Occidental Chemical site. Commencement Bay and the Hylebos Waterway are intimately connected with all of the tideflats, the bay, on into the grand estuary that is the Puget Sound. I have visited the Hylebos Marina and my heart goes out to those moored there as well as those that use the waterway as the long clean up process will undoubtedly interrupt their lives.

There are inefficiencies in the draft with regard to all of us citizens, those like myself who use and enjoy the area as well as those Tacoma residents to whom the Hylebos and the Bay are a source of pride, enhancing their quality of life. A clear understanding should be written regarding;

How do people use the Waterway how often and with what sort of recreational devices for their enjoyment.

A detailed account of the biological diversity within the area as well as those migratory animals, via water or air.

The commercial opportunities available and their potential value in economic terms must be detailed.

There is a lot of work unfinished and I believe that addressing the above will not only inform and satisfy the concerned citizens but will also provide much needed suggestions for attaining the proper path to a successful long term clean up.

Thank you for this opportunity to comment on the draft Remedial Investigation.

Sincerely,
Charles Joy
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February 1, 2016

Kerry Graber, Department of Ecology
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Kerry.graber@ecy.wa.gov

Re: Comments on the Draft Remedial Investigation for the Occidental Chemical Superfund Site

Dear Ms. Graber:

Thank you for providing Citizens for a Healthy Bay the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation (Occidental) site (the Site).

Citizens for a Healthy Bay (CHB) is a 25-year-old environmental organization whose mission is to represent and engage citizens in the cleanup, restoration and protection of Commencement Bay, and surrounding waters and natural habitat. We are a 501(c)3 nonprofit corporation providing practical, solutions-based environmental leadership in the Puget Sound area. We work side-by-side with local citizens, businesses and governments to prevent water pollution and make our community more sustainable. CHB has been involved in the Occidental cleanup process for the last 15 years and we are committed to pursuing an adequate cleanup in order to ensure a sustainable future for Tacoma and our waters.

Staff and expert members of the Policy and Technical Advisory Committee with CHB have reviewed the draft RI and supporting documents, including the Conceptual Site Model (CSM) and Risk Assessments [2011 Streamlined Risk Assessment and 2014 Exposure Pathway Assessment (Appendix V of the RI)]. Through our review process, we have met with concerned community members and project stakeholders, including representatives from the Washington State

Department of Ecology (Ecology), Occidental representatives and consultants and the City of Tacoma. Our comments are outlined below.

Background

The Occidental site, situated on the Hylebos Waterway in Commencement Bay, was used to manufacture chlorine, sodium hydroxide, bleach and other chemicals between 1929 and 2005. Decades of poor housekeeping practices, including discharging wastes to the ground and directly to the Hylebos Waterway, has resulted in groundwater, soil and sediments being contaminated by numerous hazardous products, including dry cleaning fluids, metals and poly-chlorinated Biphenyls (PCBs). From the former facility, a groundwater plume of contamination extends deep and wide, reaching a staggering 160 feet below sea level to far beyond the property, extending under and across the Hylebos Waterway to Marine View Drive and out towards the Bay. The primary contaminants are chlorinated volatile organic compounds (CVOCs), sodium hydroxide, sodium chloride (salt), metals, PCBs, dioxins/furans and byproducts of chlorinated solvent production.

Toxic contamination can enter humans in several ways: breathing dust; touching contaminated soil, sediments or water; and/or swallowing contaminated soil, sediments or water. People who consume fish or shellfish from the Hylebos Waterway or Commencement Bay also have a risk of exposure. The plants, fish, birds and mammals of the exposed area may suffer negative health effects. Some of the toxins may be absorbed, concentrated and passed up the food chain to higher trophic level predator species including salmon, seals, whales and, finally, people.

Occidental Chemical Corps is still in business, operating throughout the United States and internationally. The company's pre-tax profits for the last quarter were $136 million, yet the site remains to be cleaned-up and continues to contaminate important natural resources.

General Comments

Through our review of the draft RI, CHB has identified several issues and deficiencies with these project reports, primarily related to the CSM and risk assessments. In general, the RI is incomplete. CHB finds the human and ecological risk assessment to be fatally flawed. While the RI does provide some detailed site characteristics, it fails to properly evaluate the potential impacts of the contamination on both human health and the environment. It also fails to properly identify and establish cleanup criteria.

In general, the RI (including the CSM and screening level risk assessments) is intended to provide a summary of the history of the Site, investigations done to date, major identified data gaps and an evaluation and assessment of potential exposure pathways and risks to humans and ecological resources. This information and evaluation is intended to inform and direct a Feasibility Study and Cleanup Action Plan, including development of cleanup objectives and criteria for contaminated media at the Site.

However, the reports spend substantial time and effort denouncing the toxicity of chemicals found at the Site and making inappropriate risk management decisions. Screening level risk assessments are not a platform to debunk and debate ecotoxicity screening values and it is not appropriate to make risk management decisions or judgements on level of risk in screening level risk assessments. Rather, screening level risk assessments are intended to evaluate and screen potential risks and exposure pathways to humans and ecological resources using criteria identified in Applicable or Relevant and Appropriate Requirements (ARARs).[1] Screening level risk assessments should not use site-specific cleanup numbers, sediment quality objectives, which are generally less protective than screening criteria/ARARs, in place of protective screening criteria for their evaluations. In several instances, the RI uses the Commencement Bay/Hylebos cleanup numbers instead of using appropriate ecotoxicity screening values (identified in ARARs) to calculate screening quotients, which provide information as to where exposures and risk may occur and where further evaluation is needed.

In addition to the deficiencies of the risk assessments, the RI provides little to no information regarding the natural resources, including habitats and species and their life histories, that are present at the Site and in the surrounding area. The reports do not adequately describe the human activities that occur in the area. This lack of information and misrepresentation of the surrounding area results in major gaps in the risk assessments and the associated CSMs, leading to inadequate selection and assessment of exposure pathways, receptors and endpoints. Further, the reports do not adequately evaluate the contaminants at the Site. Since contamination remains in the sediments and embankment area of Hylebos Waterway, including contamination resulting from bioaccumulative chemicals, and has or will potentially reach Commencement Bay, the risk assessments should be revised to adequately assess the potential exposure pathways and risks to human health and the environment.

While the Site and surrounding areas are not pristine, they are certainly not devoid of life as the reports suggest. Commencement Bay and the Hylebos Waterway provide important rearing, foraging, migratory and adult habitat for numerous aquatic and terrestrial species. These estuarine waters are an important transitional area for juvenile salmonid species, bottom fish,

[1] WAC-173-340-710

forage fish, crab, bivalves and many other resident marine species. All of these species are found in these waters during every month of the year. The riparian buffers, salt marshes and mudflats in the area provide important habitats for these aquatic species, including plants, birds and mammals. Commencement Bay and the Hylebos Waterway also provide recreational access and opportunities to the communities residing in and outside of the area.

The 2000 Explanation of Significant Differences (ESD) added the Endangered Species Act (ESA) as an ARAR to the Commencement Bay Nearshore / Tide Flats (CB/NT) Record of Decision (ROD), which includes the Hylebos Waterway and Commencement Bay. The Hylebos Waterway and Commencement Bay provide habitat for federally listed species. For several of these species, critical habitat has been designated in both the Hylebos Waterway and Commencement Bay.[2] Additionally, the area is home to several non-listed species, including forage fish, flatfish, crab, bivalves and other inshore resident marine fish and benthic species. These additional species provide important prey resources to the federally listed fish, bird and mammal species. Federally listed species supported by the area include: Chinook salmon, steelhead trout, bull trout, three rockfish species, two whale species such as Southern resident orca, marbled murrelet and streaked horned lark. Several bird and mammal species are also found in the area, including, but not limited to: purple martin, great blue heron, osprey, bald eagle, peregrine falcon, raccoon, river otter, seal and sea lion.

The RI does not provide adequate information regarding the existing and proposed mitigation and habitat restoration that has, is, and will continue to occur in the Hylebos Waterway, in the vicinity of the Site and in Commencement Bay.[3] Aside from the habitat restoration related to the Commencement Bay Natural Resource Damage Assessment (NRDA) settlement and mitigation related to Port development, millions of dollars have been and continue to be spent on salmon recovery efforts in the Puyallup River Watershed, which includes habitat restoration in the nearshore areas of Commencement Bay and its tributaries. As shown in Figure 3-1 of the Fourth Five-Year Review Report for CB/NT, several of the mitigation and restoration sites in Commencement Bay and the Hylebos Waterway are in the vicinity of the Site. These areas are backed by undeveloped wooded bluffs and green belts, providing terrestrial habitat for several bird species and mammals. These sites provide important terrestrial, riparian, and aquatic habitat to the species discussed above, several of which have been observed in the Hylebos Waterway, and at the habitat restoration and mitigation areas and wooded bluffs and green belts across from the site.

[2] Federal designations made under the Endangered Species Act by National Oceanic and Atmospheric Administration (NOAA) Fisheries and U.S. Fish and Wildlife Services.
[3] WAC-173-340-350 and Sediment Cleanup Users Manual II (SCUM II)

The RI does not provide adequate information about the human uses of Commencement Bay and the Hylebos Waterway. Human uses in the area include recreational and tribal fishing, crabbing, marina use, boating, sailing, diving, kayaking, paddle boarding, playing on the beach, bird and wildlife viewing, etc. Commencement Bay supports hatchery, listed- and non-listed salmon species, including Chinook, Coho and pink salmon for which have run sizes have increased in recent years. These salmon species support a robust recreational fishery and provide food and sustenance to sport and tribal fishers in the area. Crabbing, both recreational and tribal, occurs in these waters. The area is also in a tribal Usual and Accustomed fishing area.[4] The reports do not consider that it is unknown what development and future use will occur on the tribal properties across from the Site on the Hylebos Waterway and it should be assumed that humans will continue to access the beaches and riparian areas along the Hylebos Waterway across from the Site.

The RI fails to use the most current ARARs, which results in a deficient and inadequate assessment of the Site. According to the Washington State Model Toxic Control Act (MTCA) Cleanup, the use of the most current ARARs[5] should be applied in order to be protective of human health and the environment and to be in compliance with MTCA. A number of criteria that are considered ARARs, some of which are included in the RI, have recently been updated and have generally become more protective. These new and more protective criteria that are now in place should be the basis for evaluations of risk and development of cleanup levels for the final Cleanup Action Plan and the alternatives that will be proposed in the Feasibility Study. These ARARs include, but are not limited to: the revised Washington State Sediment Management Standards (SMS) and supporting guidance in the Sediment Cleanup Users Manual II (SCUM II), the recently updated Section 304 of the Clean Water Act, the National Toxics Rule, the Endangered Species Act and appropriate fish consumption and exposure rates.

Overarching Recommendations

The following provides a summary of high level comments and recommendations to ensure the Site is adequately and appropriately evaluated and that the cleanup is protective of human health and the environment. To be in compliance with MTCA, the Site must be adequately and appropriately evaluated using the most current ARARs and guidance. An adequate evaluation of the Site will facilitate and support decades of stakeholder efforts that have already been accomplished in the cleanup and restoration of Commencement Bay and its waterways to ensure that these efforts and the money expended to date is not wasted or compromised with

[4] Treaty of Medicine Creek
[5] WAC-173-340-710

this last major cleanup. An adequate evaluation of the Site using appropriate ARARs should provide information to develop a cleanup plan that will provide Tacoma and its citizens with a clean and healthy environment to work, play, recreate and forage in. The citizens of Tacoma and Pierce County should be treated equally to and be provided an equivalent evaluation to that which was conducted at the Lower Duwamish Waterway Site in Seattle, King County.

Our overarching recommendations for the final Occidental RI are outlined below:

1. Use and reference the most current regulations (ARARs) and guidance.

2. Thoroughly describe and evaluate the environment and ecological resources of the Hylebos Waterway and Commencement Bay, including ESA-listed species, designated critical habitat, higher trophic level species, and restoration, mitigation and salmon recovery efforts.

3. Thoroughly describe and evaluate the human and ecological use of the area, including fishers, recreational users and higher trophic level species that currently utilize, may potentially inhabit, or have historically inhabited the Site.[6]

4. Thoroughly describe and evaluate the potential exposure pathways (working at the Site, fishing, paddle boarding, playing on the beach, etc.) to humans and ecological resources using applicable regulations and guidance.

5. Thoroughly describe and evaluate total site risk to human health through all exposure pathways.

6. Thoroughly describe and discuss the relevant regulatory points of compliance for soil, groundwater, surface water and sediment.

Specific Comments

The following section outlines key deficiencies of the RI as identified by CHB. The major categories of concern are: 1) Environment and Natural Resources; 2) Human Use Services; 3) Adequate Assessment of Risks; 4) Future Development and Shipping/Dredging; 5) Appropriate Use of ARARs; and 6) Discrepancies between Occidental and the Lower Duwamish Waterway.

[6] WAC-173-204-564

The Environment and Natural Resources

- RI does not adequately describe the environment and natural resources of Hylebos Waterway and Commencement Bay, which provide critical aquatic and riparian habitat for rearing, foraging, refugia, migratory and transitional/acclimatization needs for both adult and juvenile aquatic and terrestrial species. These species include, but are not limited to: anadromous salmon and trout species (Chinook, coho, pink, chum, steelhead trout, bull trout); resident marine aquatic species (forage fish, flatfish, bivalves, crabs, benthic invertebrates); birds (waterfowl/raptors/song birds - robins, swallows, marbled murrelet, purple martin, kingfisher, merganser, great blue heron, osprey, bald eagle, peregrine falcon); and mammals (whales, porpoise, seal, sea lion, river otter, raccoon, deer).
- RI does not adequately describe the numerous species listed for protection under the ESA, for which critical habitat has been designated in both the Hylebos Waterway and Commencement Bay. Reports must include information for ESA-listed species and associated critical habitats and Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species.
- In addition to providing more robust information on ESA-listed species, designated critical habitats and human uses, the RI should include additional descriptive information for the area and reference the following: State designated uses and criteria for the Hylebos Waterway and Commencement Bay[7], which includes criteria for pH and temperature among other parameters.
- RI does not adequately describe existing and proposed restoration and mitigation projects in the vicinity of the Site in Hylebos Waterway and Commencement Bay, which provide important aquatic, riparian and terrestrial habitats to the species listed above and also provides recreational users with shoreline access.

Adequate Description of Human Use Services

- Draft RI does not adequately describe the human use services that Hylebos Waterway and Commencement Bay provide including, but not limited to: tribal and recreational fishing and crabbing, marina use, boating, sailing, diving, kayaking, paddle boarding, beach play, and bird and wildlife viewing.
- Reports do not adequately describe the fishing and crabbing resources in Commencement Bay, which support robust fisheries that provide sustenance to tribal and recreational fishers, including low-income and racially diverse communities. These fisheries also provide an important economic boost to the Puyallup Watershed.

[7] WAC-173-201A-210; WAC-173-201A-612

Adequate Assessment of Risks

- Draft RI does not include adequate assessment of exposure and risks to tribal fishers, recreational fishers and/or recreational users that may be exposed to contaminants through consumption of fish or shellfish that have tissue impacted by contaminated sediments or via direct contact or ingestion of contaminated sediments or contaminated groundwater/surface water during fishing, crabbing and recreational activities.
- Reports do not include adequate assessment of risks to higher trophic level species including birds, fish and mammals for both the aquatic and terrestrial environments.
- RI does not include an adequate assessment of exposure and risks to Commencement Bay, because the assessment focuses only on areas of the Hylebos Waterway immediately adjacent to the Occidental site.
- Reports use several Occidental Site Sediment Quality Objectives (SQO) as ecotoxicity screening values (ESVs) to calculate screening quotients (SQs). These SQOs are cleanup levels and are not risk-based. The reports should be revised to use the state water quality criteria and SMS criteria for ESVs to more adequately assess potential risks to human health and the environment related to the site.
- Reports make judgements on level of risk related to the SQs. This a screening level risk assessment; therefore, SQs greater than one should be further evaluated.
- RI spends a lot of time and effort denouncing toxicity of the chemicals and making risk management decisions. Risk management decisions should not be included in a screening level risk assessment. Additionally, the reports make assumptions about no exposure pathways existing and negate risks based on the inadequate descriptions of the habitats and species found in the area as well as the recreational and human uses that occur in the area. The RI should be revised to include an adequate description of the habitats and species in the area as well as recreational and human uses in the area. A screening level risk assessment should be conducted by the methods provided in the SCUM II manual.
- Draft RI does not evaluate total site risk to human health as required by state law.[8]
- Reports write off risks to the terrestrial environment by stating the Site is paved and developed. As required by state law[9], the reports should, at a minimum, include the simple screening process for terrestrial ecological evaluation.
- As required by the SMS[10], the RI need to consider risks to higher trophic levels, including birds, fish and mammals. The assessment must evaluate higher trophic level species that currently utilize, may potentially inhabit, or have historically inhabited the site. Higher

[8] WAC 173-340-708
[9] WAC 173-340-7490
[10] WAC 173-204-564

trophic level species should be included in the CSM and evaluated in the risk assessments.

- The reports must include an evaluation of bioaccumulative impacts to human health and higher trophic level species for the chemicals on the Washington State Department of Ecology's persistent, bioaccumulative toxin (PBT) chemicals list[11].
- Based on the information provided above and the need to evaluate higher trophic level species and bioaccumlative impacts, additional wildlife receptors should be included in the assessment. Species to consider for inclusion include: insectivorous birds, crab, flatfish, sculpin, great blue heron, belted kingfisher, hooded merganser, bald eagle, osprey, river otter and harbor seal. Additional information can be found in Chapters 3, 4, 9 and in Appendices E and K of the SCUM II manual. The Lower Duwamish Waterway CSM and risk assessments can also be referenced for more guidance.

Consideration of Future Development or Dredging/Shipping

- Reports do not fully consider potential impacts related to future development, such as what development or use will occur at the former Ole and Charlie's Marina, owned by the Puyallup Tribe, across the Hylebos Waterway from the Occidental Site.
- RI does not fully consider impacts related to future dredging or ship scour that may bring contaminated sediments to the surface or re-suspend them in Hylebos Waterway and Commencement Bay. As stated in the reports, the area is in an active shipping and industrial area. Therefore, more information should be provided on the potential for contaminated sediments below the biologically active zone (0-10 cm) to be brought to the surface as a result of dredging activities and scouring related to shipping.

Appropriate Use of Applicable or Relevant and Appropriate Requirements (ARARs)

- Reports do not use the appropriate ARARs such as the revised Washington State Sediment Management Standards and supporting guidance in the Sediment Cleanup Users Manual II (SCUM II), the recently updated Section 304 of the Clean Water Act, the National Toxics Rule, appropriate fish consumption and exposure rates, the Endangered Species Act, etc.
- Reports do not provide adequate descriptions of the points of compliance for the various media (soil, groundwater, surface water and sediment) used in the assessments.
- The revised Sediment Management Standards (SMS) have not been cited in the references for the risk assessments. Because the revised SMS are an ARAR for the Site, the reports should be updated to include the current marine sediment chemical criteria

[11] WAC 173-333-310

to ensure that risks to human health and the environment are adequately assessed at the Site.

- The most current Sediment Cleanup Users Manual II (SCUM II) has not be cited in the references. The SCUM II manual should be referenced and the reports should be revised to include the appropriate methods and procedures for assessing risks to human health and the environment, which are presented in Chapters 8, 9 and Appendices E and K of the SCUM II manual. It should also be noted that the SCUM II manual suggests reviewing the Lower Duwamish Waterway and Portland Harbor risk assessments for additional guidance. The Lower Duwamish Waterway conceptual site models are included as examples in the SCUM II manual. The SCUM II manual should be referenced for guidance on how to develop an adequate CSM for risk assessments.

Discrepancy between Occidental and the Lower Duwamish Waterway

CHB is gravely concerned about the significant discrepancies in the cleanup standards utilized for the Hylebos Waterway as opposed to those applied to the Lower Duwamish Waterway (LDW). The following summarizes the differences between the Commencement Bay Nearshore/Tideflats Record of Decision [(ROD); including updates and sediments in the Hylebos Waterway] and the Lower Duwamish Waterway Record of Decision.

- For LDW, the EPA-approved sediment cleanup level for PCBs is 2 micrograms per kilogram (µg/kg).
- For Commencement Bay, including the Hylebos Waterway, the EPA approved Sediment Quality Objective (SQO) for PCBs is 300 µg/kg.
- For LDW, risks to higher trophic level species were considered when setting a PCB cleanup level for aquatic mammals. The Occidental risk assessments did not evaluate higher trophic level species.
- For LDW, cleanup levels for the protection of human health and benthic invertebrates are also protective of higher trophic level species. The Occidental risk assessments did not evaluate higher trophic level species.

The section below lists additional deficiencies of the Occidental risk assessments as compared to the LDW ROD (the following shows what was done at LDW which equals what was not done in the Occidental risk assessments):

- Followed Sediment Cleanup User Manual II guidance.
- Evaluated risks from consumption of seafood.
- Evaluated risks from direct contact from net-fishing, clamming, beach play, etc.

- Evaluated risks to benthic invertebrates and fish and wildlife (higher trophic level species).
- Conducted toxicity tests and tissue sampling during the RI.
- Used revised Sediment Management Standards criteria and toxicity reference values.
- Discussed and presented state designated uses and criteria for the waterbody.
- Discussed and presented WDFW Priority Habitats and Species information and ESA-listed species and designated critical habitat information.
- Discussed restoration that has occurred in the project site, in surrounding areas and that will occur in the area.
- Discussed recreational, subsistence, commercial use and activities that have occurred or is expected to occur in the project site and surrounding areas.
- Discussed the existing and the potential for future dredging, shipping and scour related to tugs and ships.

The stark differences between the standards used for the Hylebos Waterway and the LDW clearly portray Tacoma and Pierce County as a non-priority compared to Seattle and King County. The final RI must include protective and stringent screening criteria in order to inform the development of protective cleanup standards for the protection of human health and wildlife populations.

Please contact our office if there are questions regarding our comments. Thank you for the opportunity to provide feedback on the draft RI. We look forward to a thorough, robust and stringent cleanup of Occidental Chemical's legacy of toxic contamination.

Sincerely,

Melissa Malott
Executive Director, Citizens for a Healthy Bay

From: Joy Caddock [mailto:joycaddock@gmail.com]
Sent: Monday, February 01, 2016 11:54 AM
To: Graber, Kerry (ECY)
Subject: Occidental Chemical draft remedial investigation letter-Joy Caddock/Tacoma resident

February 1, 2016

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, WA 98504-7600
Kerry.Graber@ecy.wa.gov

Re: Occidental Chemical Corporation – Draft Remedial Investigation

Dear Kerry Graber:

Thank you for providing the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation site in Tacoma, Washington.

I am a Tacoma resident and property owner concerned about the toxic pollution from the Occidental Chemical site. Commencement Bay, including the Hylebos Waterway, is a source of pride for both the Tacoma community and myself and it deserves a sound cleanup plan. I grew up living and fishing on the Puget Sound near Colvos Passage. My parents still live there and are still able to see Orca whales from time to time. I chose 10 years ago to buy a house in Tacoma because of the view of the beautiful mountain, closeness to the Puget Sound and the promise I feel this city holds. I enjoy this diverse community and it's history of good working class people trying to make a good life for their family.

I do not believe that the released draft Remedial Investigation adequately describes the full human and wildlife use of the area. My son (2 years old) and I often go and watch the people who fish and squid our waterway. In Olalla (Colvos Passage where my folks still live) I will eat the fish we catch—but I won't let my family eat the fish that come from Commencement Bay/Hylebos Waterway. I am too worried about the state of the fish and shellfish that come from these contaminated waters.
I'm concerned about other families who depend on this fishing for food. I worry about the Puyallup Reservation which is in close proximity to this contaminated site and for the fish and shellfish that community consumes. They are situated at the mouth of one of the most urbanized watersheds in Washington State with most of the basins industrial users upstream. Inadequate cleanup of the Hylebos waterway affects the chemical, physical and biological integrity of all connecting waterways including Puyallup river system waters. We are all connected but this connection with the Puyallup tribe seems like another case of people who are poor and of color being disproportionally affected by industrial contamination.
I want my son to be able to safely play on the beaches of Commencement Bay. With the known sore of Occidental Chemical permeating the waters and surrounding soil at an alarming depth by

known carcinogens I hesitate to let him explore like I used to explore as a kid in more pristine areas.
Cleaning up this site will help ensure our wonderful culture of recreation and food on these waterways without having to worry that down the line it maybe was the cause of our cancers. Cleaning up these beautiful waterways will protect our salmon, myriad fish, waterfowl, raptors and songbirds, whales, porpoises, seals, sea lions and river otters. We have a responsibility to them and they lend immeasurably to our ecosystem. If Occidental has an adequate and thorough site cleanup we have the opportunity to reclaim the sacred nature of this beautiful region and reverse some of the shortsightedness this city has experienced by letting irresponsible companies desecrate our beautiful backyard and life force.

“There are no unsacred places; There are only sacred places and desecrated places” ---Wendell Berry

Please contact me if there are questions regarding my comments. Thank you for the opportunity to provide feedback for the draft Remedial Investigation.

Sincerely,

Joy Caddock
(253)970.3018

FOSS WATERWAY DEVELOPMENT AUTHORITY
535 Dock Street, Suite 204 – Tacoma, WA 98402-4630
Phone: (253) 597-8122 www.theafoss.com

January 27, 2016

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, WA 98504-7600
Kerry.Graber@ecy.wa.gov

Re: Occidental Chemical Corporation – Draft Remedial Investigation

Dear Kerry Graber:

Thank you for providing the Foss Waterway Development Authority (FWDA) the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation Superfund site in Tacoma, Washington.

The FWDA has invested two decades in the revitalization of Tacoma's downtown waterfront, the Foss Waterway. The Superfund cleanup of the Foss has resulted in the restoration of fish and wildlife and activated human use of the Foss and all of Commencement Bay. The Foss has a significant residential community and is a tourist attraction with its museums and access to the water. The protection of our waters and human and aquatic health is of paramount importance to the FWDA.
The Foss Waterway and Hylebos Waterway are inextricably linked, so the fate of one carries heavy ramifications for the other. Because of this, we are gravely concerned about the shortcomings of the draft RI for the Occidental site.

Part of what makes the Foss Waterway and Commencement Bay so special is its history of overcoming a legacy of toxic contamination and polluted waterways to becoming a community re-establishing its vital connection to its waters. Tacoma's waterfront, including both the Foss and Hylebos Waterways, is a source of pride and identity for the FWDA and the broader Tacoma community and it deserves a solid and thorough cleanup plan.

Our concerns and comments are outlined below.

1. Human Health - The FWDA is concerned that the released RI does not adequately describe the full human and wildlife use of the area. Many people regularly go fishing, crabbing, boating, diving, kayaking and paddle boarding in the Hylebos Waterway and

Commencement Bay. The cleanup plan, including the final RI, needs to take the current and future human use and development into consideration. Our greatest concern is the impact to the water which knows no boundary. The Occidental Chemical site's growing plume under the Hylebos Waterway constitutes a risk to Commencement Bay and the Foss Waterway. We cannot over stress the importance of protecting the health of our community.

2. Aquatic Health - Healthy and vibrant wildlife populations are a vital component to the preservation of Tacoma's waterfront. In addition to the human uses of the waterway, we would also like to see the final RI include a full and accurate description of wildlife use of the area as well as thorough consideration of risk for birds, fish and mammals. These wildlife populations include salmon and other fish, shellfish, whales, and birds. The RI should, at a minimum, include all species listed for protection under the Endangered Species Act and the State Department of Fish & Wildlife's listed species and candidate species.

3. Cleanup Standards - The FWDA would like to see protective standards used for the Occidental site cleanup that can ensure the necessary protections for our community. The success story of the Foss Waterway should be continued in the Hylebos for in-water water cleanup. We should all strive to achieve cleanup standards that result in maximum protection of human, aquatic and wildlife health even if it requires cutting edge technologies to achieve the cleanup. It is time to perform.

The following, used for the LDW Record of Decision, should also be taken into account for Occidental Chemical:

- The evaluation of risks from the consumption of fish and shellfish, as well as from direct contact with the water from beach play, net-fishing and clamming
- The evaluation of risks to benthic invertebrates, fish and wildlife
- Existing and potential future dredging and shipping in the Hylebos
- Existing and potential future habitat restoration sites

Please contact me if there are questions regarding our comments. Thank you for the opportunity to provide feedback for the draft Remedial Investigation. We look forward to a robust and thorough cleanup of the Occidental Chemical site.

Sincerely,

Su Dowie

Su Dowie
Executive Director
Foss Waterway Development Authority

Cc: FWDA Board of Directors

January 31, 2016

Kerry Graber, Department of Ecology
Hazardous Wastes and Toxics Reduction Program - SWRO
PO Box 47775, Olympia, WA 98504-7775
E-mailed to: Kerry.graber@ecy.wa.gov

Re: Public Comment on the Remedial Investigation of Occidental Chemical Corporation

Dear Ms. Graber:

We would like to comment on the draft remedial investigation for Occidental Chemical Corporation (OxyChem). As residents of Northeast Tacoma for over 30 years, we have enjoyed the unique opportunity to enjoy the natural beauty of Commencement Bay and the Hylebos Waterway juxtaposed against the industry of the Port of Tacoma. With the ongoing progress of the superfund cleanup, we have also witnessed the return of more wildlife to the bay and tide flats including the Hylebos Waterway. We would like to have the following issues addressed in the OxyChem Remediation Investigation to make sure the full range of protection of humans and wildlife is considered and addressed in the cleanup of the site.

We enjoy viewing wildlife that have returned to the tideflats including, but not limited to:

- bald eagles feeding in the Hylebos Waterway and nesting in Northeast Tacoma;
- beaver activity in the marshes northwest of the OxyChem site;
- otters in the bay and the marshes;
- blue heron and other birds flying and feeding throughout the tideflats and bay; and
- seals in the bay.

We also boat, fish, walk the beaches in the areas of Commencement Bay just outside of the Hylebos Waterway and throughout Commencement Bay. As you know, this area has been part of the superfund cleanup. We have observed the return of wildlife as the area begins to recover from the pollution and want to add our voice to make sure that all activity to clean up the OxyChem site does not negatively impact this recovery. There are currently bald eagles living in our neighborhood that likely feed in the Hylebos Waterway. This includes wildlife that migrate from upstream of the site such as in the West and East Hylebos and downstream from the site including Commencement Bay and Puget Sound. It is important to note that killer whales feed in the Point Defiance area.

Among other deficiencies, the current draft does not adequately describe or address the uses of the Hylebos Waterway or the impact on humans and the many species of wildlife. Please consider:

- Has fish migration from the Hylebos Waterway been considered and the potential impact on killer whales sited in the area?
- Are all species and their habitat utilizing the Hylebos Waterway, Commencement Bay, and Puget Sound being considered in the cleanup to make sure that there is no negative impact on them or their habitat as the plan is undertaken?
- Are upstream and downstream impacts being considered for wildlife?
- Has the risk to humans that use Commencement Bay and Hylebos Waterway for recreation and fishing been fully considered?

We would like to be kept informed of the cleanup efforts as they continue. Thank you for your work to make sure that the OxyChem site is cleaned up without a negative impact on the environment or humans.

Sincerely,

Kelli & Kevin O'Donnell
2930 38th Ave NE
Tacoma, WA 98422 kelli.odonnell7@gmail.com

From: Ken_Zirinsky_ [mailto:ellenkenab@yahoo.com]
Sent: Saturday, January 30, 2016 12:04 AM
To: Graber, Kerry (ECY)
Subject: Re: Occidental Chemical Corporation – Draft Remedial Investigation

January 23, 2016
Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, WA 98504-7600
Kerry.Graber@ecy.wa.gov
Re: Occidental Chemical Corporation – Draft Remedial Investigation

Dear Kerry Graber:

Thank you for providing the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation site in Tacoma, Washington. I am a Tacoma resident concerned about the toxic pollution from the Occidental Chemical site.

Commencement Bay, including the Hylebos Waterway, is a source of pride for both myself and the Tacoma community and it deserves a sound cleanup plan.

I do not believe that the released draft Remedial Investigation adequately describes the full human and wildlife use of the area.

Below are deficiencies in the draft that I would like to see fully and accurately covered in the final RI:

- The ways people use the Hylebos Waterway, including tribal and recreational fishing and crabbing, boating, kayaking, paddle boarding, beach play, and bird and wildlife viewing.

- The wildlife of the Hylebos Waterway, including salmon and other fish, birds including waterfowl, raptors and song birds, and whales, porpoises, seals, sea lions and river otters.

- The fishing and crabbing resources in the Hylebos and Commencement Bay, which provide food and important economic benefits for residents.

Please contact me if there are questions regarding my comments. Thank you for the opportunity to provide feedback for the draft Remedial Investigation.

Sincerely,

Ken Zirinsky

-----Original Message-----
From: sem3@u.washington.edu [mailto:sem3@u.washington.edu]
Sent: Saturday, January 30, 2016 12:23 PM
To: Graber, Kerry (ECY)
Subject: Comment on Occidental Chemical Clean-up

TO: Site Manager, Kerry Graber

FROM: Susanne Marten

RE: Comment on proposed methodology for Occidental Chemical Clean-up

I would first like to introduce myself. I am a fourth generation resident of Tacoma. In the early 1900's our family held title to 140 acres of the Tacoma Tide-flats that were condemned and later parceled off to private industry. Our family lineage and cultural values represent First Nation communities. Accordingly, we are concerned that the proposed clean-up does not adequately account for water toxicity containment. Our family and our Vietnamese and Cambodian neighbors fish and crab within the area that surrounds the Occidental Chemical property. What methods are planned for implementation to reliably identify the affected waters and to monitor the containment of involved chemicals?

Tacoma Waterfront Association
PO Box 7931
Tacoma, WA 98417
Phone (253) 777-3301
director@tacomawaterfront.org
tacomwaterfront.org

January 25, 2016

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600
Olympia, WA 98504-7600
Kerry.Graber@ecy.wa.gov

Re: Occidental Chemical Corporation – Draft Remedial Investigation

Dear Kerry Graber:

Thank you for providing the Tacoma Waterfront Association the opportunity to review and comment on the draft Remedial Investigation (RI) for the Occidental Chemical Corporation Superfund site in Tacoma, Washington.

Formed in 2006, the Tacoma Waterfront Association (TWA) is a 501(c)4 non-profit organization that unites a dynamic waterfront community to educate, promote and provide leadership on issues important to Tacoma's unique 46 miles of Puget Sound shoreline. TWA has grown to represent more than 100 business, non-profit groups and citizens from Brown's Point to Point Defiance all interested in preserving, promoting and improving Tacoma's unique waterfront.

Part of what makes Tacoma's waterfront so special is its history of overcoming a legacy of toxic contamination and polluted waterways and becoming a community re-establishing its vital connection to its waters. Tacoma's waterfront, including the Hylebos Waterway, is a source of pride and identity for both TWA and the broader Tacoma community and it deserves a solid and thorough cleanup plan.

TWA members have reviewed the draft Remedial Investigation. Our concerns and comments are outlined below.

Human Use of the Waterway and Bay

The TWA is concerned that the released draft Remedial Investigation does not adequately describe the full human and wildlife use of the area. TWA members, our families, our friends and our neighbors regularly go fishing, crabbing, boating, diving, kayaking and paddle boarding in the Hylebos Waterway and Commencement Bay. The cleanup plan, including the final Remedial Investigation, must take the consistent current and future human use and development of both the Hylebos Waterway and Commencement Bay into full account in order to adequately protect the health of our communities.

Wildlife Use of the Waterway

Healthy and vibrant wildlife populations are a vital component to the preservation of Tacoma's waterfront. In addition to the human uses of the waterway, we would also like to see the final RI include a full and accurate description of wildlife use of the area as well as thorough consideration of risk for birds, fish and mammals. These wildlife populations include salmon (Chinook, Coho, pink and chum) and other fish, shellfish, whales, porpoises, seals, sea lions, river otters and birds, including waterfowl, raptors and song birds. The RI should also include all species listed for protection under the Endangered Species Act.

Updated Cleanup Standards

The TWA would like to see the most current and protective standards used for the Occidental site cleanup. We are very concerned about the discrepancies between the more updated and stringent standards used for the Lower Duwamish Waterway (LDW) cleanup and those outlined in the Occidental draft RI.

For example, the EPA believes that the sediment cleanup standard for PCB's of 300 ppb (parts per billion) is protective of the Hylebos Waterway, yet the LDW's cleanup level is set at only 2 ppb. Why does the Hylebos deserve a staggeringly less protective standard?

The following, used for the LDW Record of Decision, should also be taken into account for Occidental:

- The evaluation of risks from the consumption of fish and shellfish, as well as from direct contact with the water from beach play, net-fishing and clamming
- The evaluation of risks to benthic invertebrates, fish and wildlife
- A discussion of existing and potential future dredging and shipping in the Hylebos
- A discussion of existing and potential future habitat restoration sites

The U.S. Environmental Protection Agency (EPA) cannot allow these outdated and less protective standards to continue to be used as the cleanup process moves forward. The unequal application of standards between the Hylebos Waterway and the Lower Duwamish Waterway gives credence to the appearance that the well-being of Tacoma residents is secondary to those in the Seattle area. Tacoma's waterways deserve every protection afforded those in Seattle and it is the job of the EPA to ensure equitable protection for our communities. The final RI must include protective and stringent screening criteria in order to inform the development of protective cleanup standards for the protection of human health and wildlife populations.

Please contact me if there are questions regarding our comments. Thank you for the opportunity to provide feedback for the draft Remedial Investigation. We look forward to a sound cleanup of the Occidental Chemical site.

Sincerely,

Scott Knox
Board President, Tacoma Waterfront Association

7311 East Side Drive NE
Tacoma, WA 98422
February 1, 2016

Kerry Graber, Department of Ecology
Hazardous Wastes and Toxics Reduction Program - SWRO
PO Box 47775
Olympia, WA 98504-7775
Kerry.graber@ecy.wa.gov

Re: Comments on the Draft Remedial Investigation for the Occidental Chemical Superfund Site

Dear Ms. Graber:

Thank you for providing the opportunity to comment on the draft Remedial Investigation for the Occidental Chemical Corporation cleanup site in the Tacoma tide flats and adjacent waters. I have reviewed the Remedial Investigation/Site Characterization Report as well as the appendices to this report.

While I chair the Policy and Technical Committee for Citizens for a Healthy Bay, these comments are my own, and have not been reviewed by any organization. While I fully support the CHB comment, and I think I have a unique perspective on this site and wish to add two additional points.

I base these comments on my involvement in this site for 35 years as an environmental chemist and a concerned resident of Pierce County. EPA and NOAA first identified contaminated sediments and the link with biota in the early 1980's. Occidental Chemical recognized the contamination when they installed the "pump and treat" well system and established a "Responsible Care Committee." After the facility closed, the buildings were demolished and a surface cleanup was carried out. In addition, some dredging took place. Nearly all of this action involved either the terrestrial or sediment surface. Even though contamination was acknowledged, a plan for subsurface cleanup has been slow to be developed. In the meanwhile, contamination has continued to spread in an ever-growing plume, and continues to contaminate the Hylebos Waterway and properties beyond the Occidental site.. It is clear that the solution is not "natural recovery" as is well documented by the 12,000 samples that were collected and analyzed. It is long past time for action. It is with mixed feelings that I make the following comments, because they are likely to mean that even more time will pass before a real cleanup is undertaken. I implore you to make expeditious site analysis and cleanup a top priority.

First, the human health and environmental risk assessments are completely flawed and inadequate. For example, while pages are spent arguing that the Apparent Effect Thresholds (AETs) are not the right measure for chemical concentrations (developed in the 1980's) for risk assessment, It is likely that these numbers are flawed because they are far too high. Given nearly 30 years of sediment cleanup work, it is now clear that the AETs are actually not protective enough. The current Washington State Sediment Management Standards (SMS) should be the standards used for in water sediment risk assessments. They have been applied in the Lower Duwamish Waterway, and indicate the need for much lower levels of allowable chemical contamination. Even more recently, EPA published draft revised water quality standards for the State of Washington. These reflect chemical standards for fish consumption, and are orders of magnitude more protective than existing standards. In addition, this property is contaminating tribal property and the Water Quality Standards of the Puyallup Tribe should apply to this analysis. MTCA requires that all Applicable or Relevant and Appropriate Requirements (ARARs) be met. This document must be completely revised to meet all applicable ARARs.

Secondly, one agency should have the lead responsibility for the entire site. A few years ago EPA and the Washington State Department of Ecology divided responsibility for this cleanup, with Ecology taking the lead on the terrestrial cleanup and EPA taking responsibility for the marine portion. Unfortunately, the contamination plume has no such artificial delineation. While the chemical plume originated mostly on land, it now extends under and across the Hylebos Waterway and to the outer reaches of the peninsula on which Occidental was located. (This plume has grown while cleanup planning has languished.) The RI has some information about the extent of the plume, but it has been clearly indicated by the agencies that the Feasibility Study document will address the terrestrial portion of the cleanup and the sediment remediation may or may not happen in a later phase. Making decisions about the terrestrial cleanup without an understanding of the marine contamination and effects is short-sighted and may well lead to decisions that have adverse effects on the marine cleanup. While limited chemical analysis is now planned, there is still no plan for analysis of the marine biota – either chemical or ecological. As the RI is redrafted, full lead authority should be transferred to the Washington State Department of Ecology so an integrated cleanup scheme is developed. I am certain that EPA will provide good advice based on the work underway on the Lower Duwamish in Seattle.

My overriding goal is to stop contamination from entering the Hylebos Waterway and to stop exposing biota (including humans) to the chemicals. This site is contiguous with Commencement Bay and the green belt along Marine View Drive. It is not isolated in some industrial wasteland, and it can be remediated. Timeliness is essential.

Thank you to Department of Ecology for regular communication with the Citizens for a Healthy Bay Policy and Technical Advisory Committee, and for holding a public information meeting and

a hearing. Both events helped the public become more aware of the site contamination, the remedial investigation and the potential steps that can lead to a clean site.

Sincerely yours,

Sheri Jeanne Tonn, PhD

Our assessment of the draft documents indicates that the following critical assessments do not exist and must be completed before the RI can be considered complete:

1. Fully define the northern edges of the contamination plumes so that the fate and transport mechanisms can be fully assessed. As indicated in the report, the plumes are moving toward Commencement Bay at depth in the sediment column. Figures in the report in places show question marks on the northern boundary indicating that the limits are unknown. In addition, the report shows that the dense plume is migrating at depth along the glacial till layer, but the cross sections do not extend far enough North to show what happens to the glacial till layer or plume in the deeper part of Commencement Bay. The report does not describe the timeframe or location/depth when the plumes will potentially "daylight" or discharge into the bay. The profiles need to be extended and the processes fully understood so the potential risk and exposure pathways in this area can be evaluated and sediment and water column impacts in this zone identified.
2. Perform biological testing for the specific site contaminants present to determine contaminant levels and potential for bioaccumulation and human impacts.
3. Sample the sediment, porewater and water column at the sediment/water interface throughout the plume area to determine chemical effects on both in water close to the sediment surface and in the biologically active zone in the sediments.
4. The Exposure Pathway Assessment does not appear to adequately take into account public usage of the Hylebos waterway. Air monitoring at the water surface should be performed to ensure that there are no exposure concerns.
5. Any impact on the greater Commencement Bay and beneficial use must be fully documented and published. This impact must be updated to determine plume fate and transport. Projections should be modeled to predict future changes in impact and calibrated against actual data.

Tacoma appreciates Ecology's intent to move the RI for the Occidental site forward. While we acknowledge the complexity and challenges of this site, we agree that it is past time to begin implementation, to the extent feasible, of a containment and cleanup plan. We urge Ecology, however, to insist on continued investigation, study and reporting even as this draft RI is finalized until full containment is achieved and exposure pathways are eliminated.

Sincerely,

Michael P. Slevin III, P.E.
Environmental Services Director

cc: Mark Lauzier, Assistant City Manager
Chris Bacha, Deputy City Attorney
Geoffrey M. Smyth, Science & Engineering Division Manager

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600, Olympia, WA 98504-7600

January 25th, 2016

Concerns related to the Draft Remedial Investigation of the Occidental Chemical Corporation

I am a Tacoma resident, SCUBA Diver, sailor, kayaker, polar plunger, beach goer and overall enjoyer of the Puget Sound. My full time work is for an environmental education program, Harbor WildWatch, based in Gig Harbor. I am writing, however, in my capacity as a member of the executive committee of the South Sound Chapter of The Surfrider Foundation. We are a volunteer community group that organizes a variety of activities to promote recreation and marine health in the Tacoma area. We sponsor on-the-water paddleboard and kayak trainings and competitions at public facilities, including Thea Foss Waterway at the mouth of the Puyallup, Jack Hyde Park on Commencement Bay, and other locations in the nearby South Sound. We conduct monthly cleanups of beaches, including Yowkwala Beach at the mouth of the Hylebos Waterway along Commencement Bay, and other public beaches from Maury Island to Steilacoom. In collaboration with Lindsay Tuttle of the Pierce Health Department, and Debby Sargeant at the Department of Ecology, we conduct a monthly sampling of public beaches for bacterial pollution. The collection includes Thea Foss Waterway, and both Jack Hyde Park and the Marine Park scuba dive site on Commencement Bay. The samples are assayed at the Science and Math Institute of Tacoma Public Schools.

We are on the water, a lot, and are greatly concerned with maintaining its health, and the exposure our members receive during their recreation in Commencement Bay. We understand that the Draft Remedial Investigation of the Occidental Chemical Company's pollution plume on the Hylebos Waterway has done insufficient analysis of human impacts. We also would like to see that impacts on wildlife, with whom we share the waters, be thoroughly studied. We request that the Investigation be revisited to address these issues.

Thank you for identifying where the contaminants are located. But can you tell us how they might get into the environment? Into the water? The air? We swim in this water (yes, it's cold), and we breathe this air. The Draft Remedial Investigation does not adequately address the pathways that might allow Occidental's pollutants to get into the water, and it should. It should also propose measures to prevent that pollutant migration from happening. How far has the plume of pollution moved since it was last sampled and where will that plume be in another ten years? 50 years? 100 years?

The protective measures should also consider changes that will occur over time. Will new docks be installed on the Hylebos? Will derelict ships, like the Kalakala, be taken apart? Will new industries, like the LNG plant, be constructed? Will the channel be dredged? What will happen to the waterway in 20 years? Given our inability to predict future use, what steps should be taken to ensure that Occidental's poisons will not be released into the waters we use when those changes occur?

You should investigate the economic value of recreation on Commencement Bay. During our beach cleanups and paddleboard expeditions we see people using the Bay, directly in front of

Hylebos Waterway. How much more use would the Bay experience if citizens had more confidence that the waters were clean? There's an economic price that's paid for the aversion people feel for the polluted waters in front of the Port.

You should investigate the exposure to contaminants in the waters we are exposed to when we play in Commencement Bay. What is the health value of this exposure? What's the medical price we pay?

And what about the wildlife? The seals, the salmon, the birds, the clams and worms? The Draft Remedial Investigation should identify what biological resources inhabit and use the Hylebos, and what steps need to be taken to protect these organisms from Occidental's toxins. Which species are most endangered, and how do we protect them if they live next to the plume? Which habitats are most critical for recovery, and how do we ensure that the pollutants are adequately isolated? What mitigations should be used to protect threatened species?

We hope that the Department of Ecology will use the most comprehensive, up-to-date, and demanding guidelines for evaluating the threats posed by Occidental's contamination. And we hope that you will impose the most stringent measures to protect us from these toxins. We also expect that Occidental Chemical Corporation, which still draws billions of dollars in revenue, will pay for cleaning up the mess they left us.

Thank you for your consideration.

Stena Troyer

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406-679-0615

Kerry Graber
Southwest Regional Office, HWTR Program
PO Box 47600, Olympia, WA 98504-7600

January 25th, 2016

Concerns related to the Draft Remedial Investigation of the Occidental Chemical Corporation

I am a Tacoma resident, SCUBA Diver, sailor, kayaker, polar plunger, beach goer and overall enjoyer of the Puget Sound. My full time work is for an environmental education program, Harbor WildWatch, based in Gig Harbor. I am writing, however, in my capacity as a member of the executive committee of the South Sound Chapter of The Surfrider Foundation. We are a volunteer community group that organizes a variety of activities to promote recreation and marine health in the Tacoma area. We sponsor on-the-water paddleboard and kayak trainings and competitions at public facilities, including Thea Foss Waterway at the mouth of the Puyallup, Jack Hyde Park on Commencement Bay, and other locations in the nearby South Sound. We conduct monthly cleanups of beaches, including Yowkwala Beach at the mouth of the Hylebos Waterway along Commencement Bay, and other public beaches from Maury Island to Steilacoom. In collaboration with Lindsay Tuttle of the Pierce Health Department, and Debby Sargeant at the Department of Ecology, we conduct a monthly sampling of public beaches for bacterial pollution. The collection includes Thea Foss Waterway, and both Jack Hyde Park and the Marine Park scuba dive site on Commencement Bay. The samples are assayed at the Science and Math Institute of Tacoma Public Schools.

We are on the water, a lot, and are greatly concerned with maintaining its health, and the exposure our members receive during their recreation in Commencement Bay. We understand that the Draft Remedial Investigation of the Occidental Chemical Company's pollution plume on the Hylebos Waterway has done insufficient analysis of human impacts. We also would like to see that impacts on wildlife, with whom we share the waters, be thoroughly studied. We request that the Investigation be revisited to address these issues.

Thank you for identifying where the contaminants are located. But can you tell us how they might get into the environment? Into the water? The air? We swim in this water (yes, it's cold), and we breathe this air. The Draft Remedial Investigation does not adequately address the pathways that might allow Occidental's pollutants to get into the water, and it should. It should also propose measures to prevent that pollutant migration from happening. How far has the plume of pollution moved since it was last sampled and where will that plume be in another ten years? 50 years? 100 years?

The protective measures should also consider changes that will occur over time. Will new docks be installed on the Hylebos? Will derelict ships, like the Kalakala, be taken apart? Will new industries, like the LNG plant, be constructed? Will the channel be dredged? What will happen to the waterway in 20 years? Given our inability to predict future use, what steps should be taken to ensure that Occidental's poisons will not be released into the waters we use when those changes occur?

You should investigate the economic value of recreation on Commencement Bay. During our beach cleanups and paddleboard expeditions we see people using the Bay, directly in front of

Hylebos Waterway. How much more use would the Bay experience if citizens had more confidence that the waters were clean? There's an economic price that's paid for the aversion people feel for the polluted waters in front of the Port.

You should investigate the exposure to contaminants in the waters we are exposed to when we play in Commencement Bay. What is the health value of this exposure? What's the medical price we pay?

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Thank you for your consideration.

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February 1, 2016

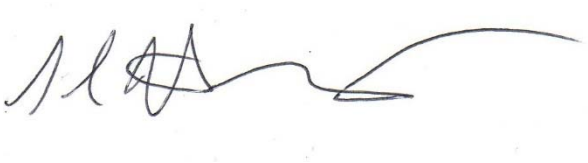
Kerry Graber
Site Manager – Occidental Chemical Corp.
Washington Department of Ecology
Tacoma, Washington
kerry.graber@ecy.wa.gov

Dear Mr. Graber,

Please find below my comments on the Appendix V, *Exposure Pathway Assessment Report* (EPAR) of the Site Characterization Report for the Occidental Chemical Corp. site located at 605 Alexander Ave, Tacoma, WA.

I appreciate the opportunity to provide public comment on this report.

Sincerely,



Steve Huntley

General – Title of Report

Comment 1: To call this report an Exposure Pathway Assessment Report is misleading as it is in fact a screening level risk assessment. It does much more that simply assess exposure pathways.

General – Human Life Stages

Comment 2: With the exception of "Adolescent" for the trespasser scenario, there is no discussion or evaluation of human life stages. In fact, there is no discussion of why Adolescent was selected for the trespasser scenario. Certainly for the two Worker scenarios it is obvious that these workers are adults. However, for the Fisher scenario, which was evaluated following MTCA Method B for surface water exposures, it appears from the default Method B exposure parameter values that only the adult Fisher was considered. The main focus here should not be

on who catches the fish, but who consumes the fish. Fish consumers could be adults, pregnant women, adolescents, or children. As discussed in another comment below, fishers and consumers could also be Native Americans, including subsistence Native Americans. The transparency of the assessment would be greatly improved by discussing in some detail the possible subpopulations that may consume fish from the site and then provide justification for the subpopulation that was selected for evaluation and explanation as to why risk-based concentrations (RBCs) based on the selected subpopulation are protective of the other subpopulations.

Pg. 5, first partial paragraph. Line 4 of this paragraph states, "…users that may use the water body for recreational purposes, as well as fishermen who may consume…"

Comment 3: I would recommend using a gender neutral term such as "anglers" or "fishers" since women and children may also fish and consume fish they have caught, not just fishermen.

Pg. 18, second to last paragraph. It is stated that, "The ultimate RBC was determined to be the lower of RBCs for carcinogenic and non-carcinogenic health impacts. While MTCA specifies the use of a cancer risk level of 1.0×10^{-5} for industrial sites, it is important to note that this risk level applies to both individual constituents and the cumulative effect from exposure to multiple carcinogenic constituents. Because multiple COCs were frequently identified at a number of locations at the Site, a cancer risk level of 1.0×10^{-6} was used to address potential cumulative effects."

Comment 4**:** While the approach used to address cumulative cancer risk associated with exposure to multiple chemicals is not uncommon, it should be noted that this screening approach is only valid without further assessment if there are no more than 10 carcinogenic COPCs present in a given media. This should be verified for each media evaluated. If more than 10 carcinogenic COPCs are present in a given media then it is possible that the cumulative cancer risk could exceed the industrial risk level of 1×10^{-5} even if none of the individual COPCs exceeded a risk of 1×10^{-6}. For example, 20 carcinogenic COPCs each with an individual risk of 9×10^{-7} (all less than 1×10^{-6}) would result in a cumulative risk of 2×10^{-5}.

Comment 5: The very same approach used to evaluate cumulative cancer risk should also be applied to the noncancer effects whereby the appropriate benchmark would be an individual COPC hazard quotient (HQ) of 0.1. For reference, refer to the current USEPA Regional Screening Levels (RSLs) which present RSL tables based on both HQ=1 for single chemical exposure and HQ=0.1 for multiple chemical exposure to account for cumulative effects. It should be noted that when applying this approach that consideration can also be given to toxic mode of action and target organ such that cumulative noncancer effects may be grouped by mode of action and/or target organ, following USEPA (1989) guidance; e.g., cumulative noncancer effects are only relevant when each chemical acts through a similar mode of action or on the same target organ.

Pg. 28, Section 3.4.4 Fisher. This section describes the Exposure Scenario Factors for the Fisher. It states, "As stated in Section 3.3.5, because groundwater at the Site is considered to be non-potable and shallow groundwater discharges to the Hylebos Waterway via seeps and subtidal discharge along the embankment adjacent to the Hylebos Waterway, the preliminary groundwater cleanup levels presented in the SCR were based on the surface water cleanup levels. The surface water cleanup levels were developed in accordance with MTCA Method B to be protective of human health for the consumption of organisms. Specifically, they consider COC partitioning to, or bioaccumulating in, fish tissue with subsequent human consumption of

impacted fish tissue. As such, these groundwater cleanup levels reflect surface water concentrations that are protective of the fish consumption pathway."

Comment 6: The primary concern with the Fisher exposure pathway is exposure to lipophilic COPCs that have the propensity to bioaccumulate in fish tissue. In the aquatic environment, such as the Hylebos Waterway, these lipophilic COPCs will largely be found in sediments, not groundwater or surface water. Moreover, they will generally be found at relatively higher concentrations in sediments than in the dissolved (bioavailable) phase in groundwater and surface water. Most importantly, certain key COPCs identified in sediment but not in groundwater appear to have been completely excluded from the evaluation for the Fisher exposure. Most notably, dioxins and furans were excluded from the fish consumption pathway, yet dioxins and furans are among the most toxic of the COPCs identified in sediments, have the greatest bioaccumulation potential, and are among the chemicals most commonly found as contaminants in fish tissue. The primary media that results in the bioaccumulation of dioxins and furans in fish is the ingestion of sediment dwelling organisms, such as benthic invertebrates, not direct exposure to water.

This pathway should also consider the consumption of shellfish that inhabit the sediment environment. While the MTCA Method B surface water cleanup levels should account for bioaccumulation of COPCs from surface water into fish tissue by application of bioconcentration factors (BCFs) if done correctly, it is not reasonable to assume that there is a direct relationship between groundwater COPCs concentrations and surface water concentrations from which to then estimate fish tissue concentrations. This is a substantial stretch that cannot be verified, especially for the dioxins and furans in light of the very large differences in the relative groundwater dioxin/furan concentrations and sediment dioxin/furan concentrations, especially given the very large sediment dioxin/furan database that is available for this site. While it can be argued that MTCA Method B was correctly followed, I would argue that it was not done so within the statutory intent of the regulation and the overall approach of extrapolating groundwater concentrations to Fisher risks certainly lacks an appropriate level of scientific credibility.

Comment 7: It is unclear whether the MTCA Method B surface water cleanup level methods were followed exactly as stated in the method, specifically as pertaining to exposure parameter values. The EPAR lacks transparency on this matter.

Comment 8: If MTCA Method B surface water cleanup level methods were applied exactly as stated in the method, then the fish consumption rate used to derive the surface water cleanup level would have been 54 grams per day (g/day). According to the EPAR (see pg. 4), the Puyallup Tribe of Indians utilizes a portion of the property for two marinas that are used for the storage and berthing of private boats. Thus, it is reasonable to assume that such Native Americans may be the primary fishers of interest at his site. DOE (2013) recently published a report that suggests that certain Native American subpopulations in Washington State may have substantially higher fish consumption rates than was assumed in MTCA Method B. DOE (2013) reports mean fish consumption rates for three tribes on the Puget Sound ranging from 60 to 165 g/day.

Table 3.11, Derivation of risk-based concentrations (RBCs) for ambient air from groundwater – trespasser inhalation exposure. This table presents the exposure parameter values, toxicity values, and the ambient air RBCs for the adolescent trespasser.

Comment 9: Footnotes 2 and 3 indicate that the fraction of time spent outdoors and the exposure frequency are based on a child aged 6-11 years, not an adolescent. However, the

actual data used from USEPA (2008) *Child-Specific Exposure Factors Handbook* (CSEFH) appears to be for an adolescent aged 11- <16 years. It appears that reference to 6-11 years may be a typo.

Comment 10: Footnote 2 states, "The basis for the FT is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total). The time spent outdoors for 6-11 years old of 100 min/day equates to 1.7 hrs (CT) [100/60]. The RME is double the CT value for 3.4 hrs." First, the value 100 min/day taken from Table 16-1 of the CSEFH is not the 50^{th} percentile value, it is the mean value. The 50^{th} percentile value is equivalent to the median value, and is not the same as the mean. Second, nowhere in the EPAR is there any discussion or referenced basis for the assumption that the "RME is double the CT value." I find no statistical rationale for taking this approach since the only information available is the mean value. The actual distribution of the data is not known (at least from the CSEFH), and if it was available then the RME could be calculated directly from those data. I would recommend using the mean value as it is (e.g., 1.7 hours/24 hours) rather than trying to make up data.

Comment 11: The same comment as above also applies to Footnote 3 for Exposure Frequency (EF) in all respects.

Comment 12: The use of both FT and EF in the RBC equation appears to be double counting as they appear to be the same thing; e.g., fraction of time spent outdoors, just calculated differently, but giving the same resulting RME value of 0.14 (unitless).

References

DOE. 2013. Fish Consumption Rates, Technical Support Manual.

USEPA. 1989. Risk Assessment Guidance for Superfund. Volume 1, Human Health Evaluation Manual.

USEPA. 2008. Child-Specific Exposure Factors Handbook.

Attachment H