DEPARTMENT OF ECOLOGY
State of Washington

Port Gamble Upland Mill Site Supplemental Remedial Investigation and Feasibility Study, Cleanup Action Plan, and Related Documents

Responsiveness Summary

Ecology's response to stakeholder and public comments

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This document is available on the Department of Ecology's website at:

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For more information contact:

Toxics Cleanup Program
PO Box 47600
Olympia, WA 98504-7600
Phone: 360-407-7170

Washington State Department of Ecology — www.ecology.wa.gov

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300
- Central Regional Office, Union Gap 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

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Toxics Cleanup Program

Washington State Department of Ecology

Olympia, Washington

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Puget Sound Initiative

Protecting and Restoring Puget Sound

The Puget Sound Initiative, established by the Washington State Legislature, is a collaborative effort between local, tribal, state and federal governments, businesses, agricultural and environmental interests, and the public to restore and protect Puget Sound.

Contaminated sites around the shorelines are a leading source of pollution to the Puget Sound. Ecology has accelerated its efforts to clean and restore these contaminated sites within priority bays. Within these bays, Ecology is cleaning up 50-60 sites within one half mile of the Sound. Cleanup actions will help to reduce pollution and restore habitat and shorelines in Puget Sound, resulting in larger areas of usable shoreline habitat for fish, wildlife and people.

Figure 1 Map of the Puget Sound Initiative baywide cleanup areas to reduce pollution and restore shorelines in Puget Sound.

Port Gamble Baywide Cleanup

Port Gamble Bay and Mill Site was selected as a Puget Sound Initiative cleanup site due, in part, to its high-quality natural resources, such as shellfish, crab, and other fisheryresources. Cleanup combined with large-scale habitat preservation and restoration activities in the watershed has made giant leaps toward improving the Bay for recreation, subsistence harvest, and supporting a healthy place to work, live, and play for tribal and community members, and visitors alike.

The Port Gamble baywide cleanup is one of the largest creosote-treated piling removal projects in Puget Sound. It has removed over 8,500 creosote-treated pilings and tons of contaminated wood waste from historic mill operations. Creosote leaches from treated pilings and structures, and is found in surrounding sediment and water. Shellfish, such as mussels and clams that are consumed by humans and fish, can accumulate this leached contamination. Wood waste from log rafting, chipping, and other mill activities built up on the sediment surface. Breakdown of wood waste can release chemicals into the environment and makes an inhospitable environment for bottom-dwelling creatures, which are important prey for salmon, other fish, and shorebirds. Removal of pilings, wood waste, and contaminated sediment improve conditions for humans and the aquatic environment.

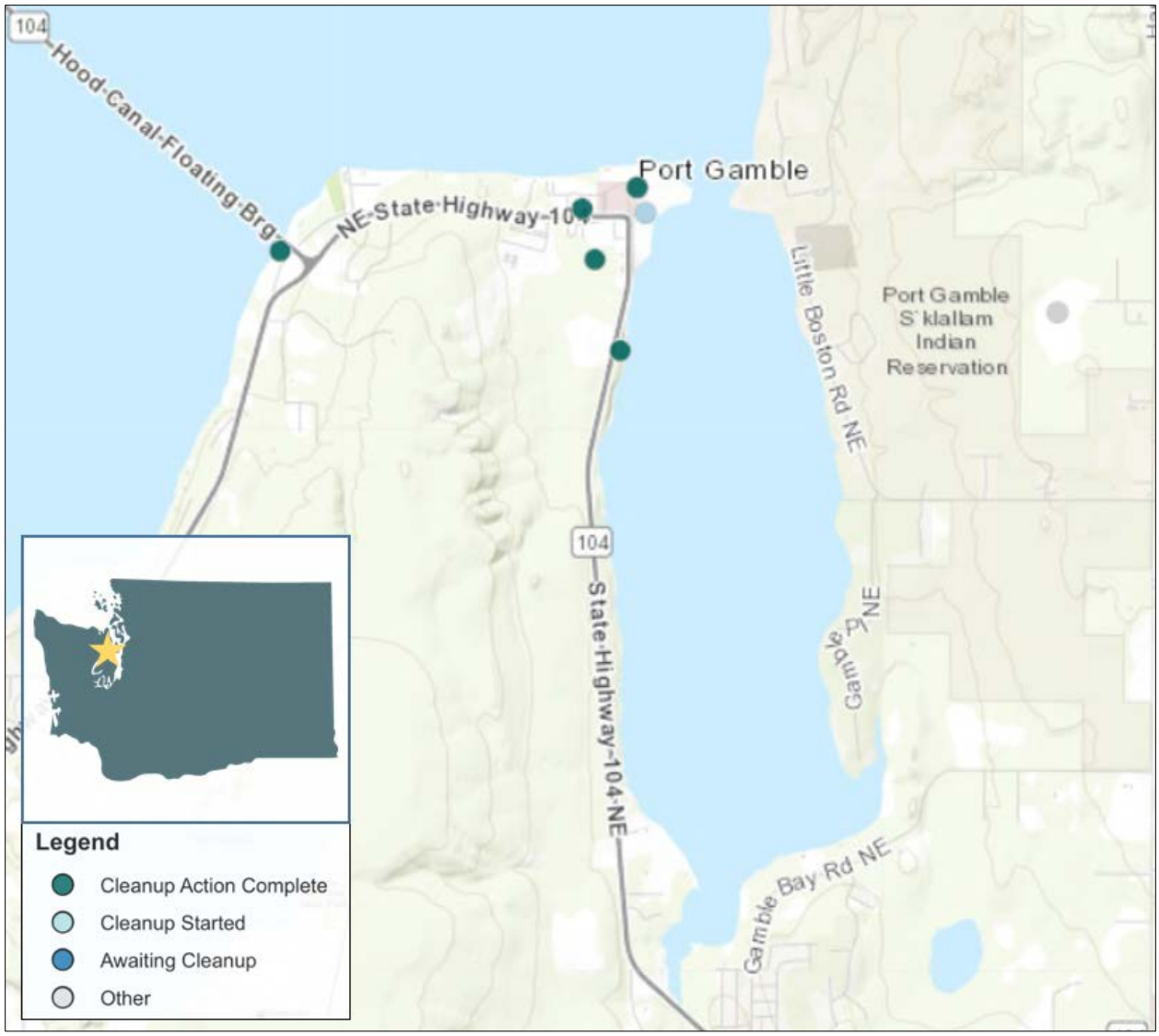

Figure 2: Port Gamble baywide area cleanup sites under the Puget Sound Initiative.

For more information on the Port Gamble sites, visit: https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Cleanup-sites/Toxic-cleanup-sites/Puget-Sound/Port-Gamble-baywide

Port Gamble Upland Mill Site

Site Background

The Port Gamble Bay and Mill Site was owned and operated by Pope & Talbot, Inc. and their corporate predecessors as a sawmill to manufacture forest products from 1853 to 1995. It is located across the bay from the Port Gamble S'Klallam (nəxʷqʼíyt nəxʷsƛayəˀm) Tribe. Much of the facility was removed in 1997, then the area was leased for log sorting, wood chipping, marine research and other light industrial activities.

Historical sampling on the uplands portion of the site identified pollutants from wood product manufacturing and treatment activities, including metals, petroleum hydrocarbons, carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans.

The in-water portion of the cleanup was successfully completed from 2015 to 2017. The in-water action included transferring sediment stockpiles through the upland mill property and disposing of the stockpiles in approved off-site landfills in 2018. Periodic monitoring will occur in the in-water portion of Port Gamble Bay through 2030. The upland portion of the site is generally located on the west shore of Port Gamble Bay, east of North Rainier Avenue in Port Gamble, Kitsap County, Washington. Cleanup Status

Proposed plans for cleanup were available for public comment from April 23 – May 25, 2020. Those plans included drafts of the following documents:

- Remedial Investigation
- Feasibility Study
- Cleanup Action Plan
- Consent Decree
- State Environmental Protection Act checklist and determination of non-significance

Proposed Cleanup

The following documents were available for public comment April 23 – May 25, 2020, for the Port Gamble Upland Mill Site. The original comment period was extended by ten days to allow additional time for document review and comment.

Overview of the Supplemental Remedial Investigation

The Supplemental Remedial Investigation characterizes the nature and extent of upland contamination, describes earlier cleanup actions, and presents an evaluation of final cleanup alternatives. It builds on the partial Remedial Investigation completed in 2015.

Overview of the Feasibility Study

The Feasibility Study defines the broad goals of the cleanup, then describes and evaluates cleanup alternatives based on a collection of factors. These factors include: protectiveness, permanence of the cleanup actions, cost, effectiveness over the long term, short term risks of the cleanup action, whether or not the alternative is possible given available technical and administrative limitations, and public concerns. Lastly, the Feasibility Study presents a preferred alternative based on the results of the evaluation.

Overview of the Cleanup Action Plan

The draft Cleanup Action Plan (DCAP) describes the cleanup standards and goals for the site, the proposed upland cleanup action for the site, and outlines requirements for the cleanup.

For this site, the cleanup actions listed include:

- Excavating soil in one area (area 2B) to 15 feet below ground surface
- Disposing of excavated soil that exceeds cleanup levels for dioxins and furans at an appropriate facility
- Capping remaining areas that exceed dioxin and furan levels in the soil with a permeable soil cap at least two feet thick
- Monitoring groundwater in the north eastern part of the site to ensure compliance with cleanup levels
- Recording environmental covenants that restrict future use of groundwater for drinking water, and that protect the integrity of soil caps in the case of future development.

Overview of the Consent Decree

The draft Consent Decree is a formal legal document between Ecology and the potentially liable parties, or PLPs (Pope Resources and OPG Properties LLC), that requires the PLPs to carry out the actions identified in the Cleanup Action Plan.

Overview of the Draft SEPA Determination of Non-Significance

The State Environmental Protection Act (SEPA) Determination of Non-Significance explains the possible environmental consequences of this cleanup plan and the determination that impacts likely will not result in significant adverse effect on the environment.

Introduction to Summary Response

A significant milestone was reached recently with the issuance of the following draft documents for the Port Gamble Upland Mill Site:

- Supplemental Remedial Investigation
- Feasibility Study
- Cleanup Action Plan
- Consent Decree
- State Environmental Protection Act checklist and determination of non-significance

These draft documents were released for a public comment period from April 23, 2020, through May 25, 2020. During the public comment period, Ecology provided the following public involvement materials and opportunities:

1. Distributed a mailed fact sheet describing the site and the documents to addresses in the area and other interested parties.
2. Published a paid display ad in *The Kingston Community News, Kitsap Sun,* and the *North Kitsap Herald.*
3. Published a notice in the Toxics Cleanup Program Site Register.
4. Posted draft documents on the Ecology website.
5. Hosted an online open house webinar on April 30th, 2020.
6. Provided copies of the documents through information repositories online at Ecology's Port Gamble cleanup website. Office closures and other limitations presented by Washington State's *Stay Home, Stay Healthy* order prevented in-person document review locations.

This summary response to public comment provides information about the Port Gamble Upland Mill Site and responds to comments received during the public comment period. Ecology has reviewed and carefully considered all comments received on the draft documents and updated the State Environmental Protection Act (SEPA) documents accordingly.

Comments and Responses

This Responsiveness Summary consolidates comments that either ask the same question or express similar concerns. Ecology has carefully considered each public comment and responded to the comments consolidated according to major themes.

Each comment is provided in full, followed by Ecology's response.

A total of four people provided comments regarding the draft documents.

List of Commenters

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1	Richard Kelbon	Self	7
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Comment 1, Richard Kelbon

John Evered, Port Gamble Site Manager,

I saw the Port Gamble Bay Toxic Cleanup Program flyer. The pamphlet mentioned similar toxins that the Navy at the Torpedo Station, Keyport, use to dump in a land fill by the bay starting in the early 1900's and ending maybe around the 1970's. Eventually this became a Superfund site. Instead of disturbing the area which had been left fallow for a number of years, the Navy in coordination with a university, I don't remember which one, ran an experiment for earlier observed data derived from the fact that some selected trees have a propensity to absorb the mentioned toxins. I believe the trees were a specific type of poplar tree. These were planted and the area fenced off and monitored. The last I heard, the trees were performing as expected and the area was becoming toxin free. You could inquire with the Naval Station, Keyport, for specifics and whether the toxin clean up goals were met. Maybe this cleanup method could

save you a whole butt load of money over disturbing the toxins and spreading them further around.

Thanks,

Richard Kelbon

Response 1

Dear Richard Kelbon:

Thank you for your comment regarding the proposed cleanup at Port Gamble. The site you mention is Naval Base Kitsap Keyport, where poplar trees were planted in 1999 to work in concert with monitored natural attenuation, to remove volatile organic compounds in groundwater, specifically trichloroethylene (TCE). This is a different chemical than dioxins, the major contaminant in the former mill uplands. Although tree plantings have shown that TCE concentrations in groundwater are slowly decreasing, contaminant levels in groundwater are still above cleanup goals. We would expect the option you mentioned not to work for several reasons.

The intent behind this approach is that the trees reduce contamination when they pull contaminants from the groundwater during their natural process of pulling water from the ground. The dioxin contamination present on site at Port Gamble is tightly bound to the soils, rather than the groundwater. As such, the planting of poplar trees would likely be ineffective and was therefore not evaluated as a cleanup alternative. In addition, natural attenuation of dioxins, the breakdown of one chemical into other less toxic compounds, would take hundreds of years; and, in that time may re-contaminate the recently completed in-water cleanup. For this reason, the PLP and Ecology have agreed that active removal of areas of dioxin contamination is important.

Comment 2, Bruce B. McCain

Dear Mr. Evered:

Overall, I am pleased that the DOE, Pope Resources, and OPG Properties are continuing to clean

up the Port Gamble's Old Mill Site. Port Gamble Bay is among Puget Sound's most ecologically important embayments. For example, up until about 2000 the bay had one of the largest populations of Pacific herring in Puget Sound. Strong herring populations are critical to the survival of salmon. Since 2000, the herring population in the bay have been in steep decline, and it possible that contaminants from the mill site have contributed to this decline.

Evidence for the mill's role in this decline in herring was reported by West et.al. 2015 (*Toxic contaminants in embryonic and adult Pacific herring (Clupea pallasii) from Port Gamble Bay, Washington: extent and magnitude of contamination by PAHs and other toxic contaminants*. A report by the Washington Department of Fish and Wildlife). They conducted in vivo studies of herring embryos deployed in numerous sites in Port Gamble Bay and a reference site in Hood Canal. They found that survival of the embryos was significantly lower (compared to the Hood Canal site) at all sites along the western shore of Port Gamble Bay. The only site in the bay with embryo survival similar to the reference site was a site in the center of the bay. The authors did not know the cause of these mortalities; however, they reported that the mean concentrations of polycyclic aromatic hydrocarbons (PAHs) were substantially higher in embryos from the sites next to the Mill Site.

Although the Draft Supplemental Remedial Investigation and Feasibility Study does not report significant concentrations of PAHs in the soil or groundwater from the Mill Site, concentrations of PAHs and other contaminants sufficient to cause toxic effects in embryos may be entering the intertidal areas where herring spawn.

I strongly recommend that similar in vivo studies with herring embryos be conducted to monitor the success of the cleanup efforts. The return of healthy stocks of herring to Port Gamble Bay would be a strong sign that progress has been made to restore the Mill Site to pre-mill conditions.

Sincerely,

Bruce B. McCain, PhD

Response 2

Dear Dr. McCain:

Thank you for your comment on the proposed cleanup at Port Gamble. A study is in preparation for publication by West et al. that addresses your request. The study is titled, *Assessing the effectiveness of cleanup efforts at a Puget Sound remediation site using Pacific herring (Clupea pallasii) embryos to track polycyclic aromatic hydrocarbons and other organic contaminants*.

Dr. West and colleagues measured PAHs in herring embryos post construction completion in 2017. They found that, after cleanup, the PAH levels in the embryos from the site were statistically indistinguishable from those at the rural reference site, leading to the conclusion that cleanup goals were met at the Mill Site following in water cleanup. Dr. West is planning to submit the work to the *Marine Pollution Bulletin*, as well as publishing on the Washington

Department of Fish and Wildlife webpage. Continued long-term monitoring of the in-water cleanup is required post construction to ensure that the cleanup remains protective.

Comment 3, Thomas Garrett

I am requesting the location map and coordinates for the upland disposal area. I am requesting this information to verify the area(s) to identify as follows: 1. How close the upland disposal area is to my property and stream? Can the disposal area contaminate my ground water? I'm also requesting a map showing the upland disposal area and my property at 27449 State Highway 104 NE on one map with distances between the two locations.

Response 3

Dear Thomas Garrett:

Thank you for your comment on the proposed cleanup at Port Gamble. Currently, the location of the upland disposal area has not been identified. The Engineering Design Report (EDR), which is currently scheduled to be completed in the fall of 2020, will finalize disposal options. Excavated materials will have to be placed in an approved engineered landfill that is designed to prevent migration of contaminants into adjacent waterbodies and groundwater.

The closest landfill to your property that may receive excavated soils is the former Model Airplane Field (MAF), which received a portion of the dredged contaminated sediments from the in water cleanup completed in 2018. This landfill is located approximately 2.5 miles from your property, and poses no threat to the groundwater either at its location or your property. More information on the groundwater monitoring that was completed during the landfill design process can be found in the document titled, *'Appendix E Groundwater Monitoring Plan - Model Airplane Field Limited Purpose Landfill',* at: https://apps.ecology.wa.gov/gsp/CleanupSiteDocuments.aspx?csid=3444. This landfill was independently permitted by Kitsap County to ensure that the landfill would not pose a threat to local surroundings. The maximum allowed concentrations for dioxins, a major chemical of concern in the uplands, to be placed in the MAF landfill is considerably lower than concentrations in mill site soils targeted for removal. Alternative disposal locations outside of the Port Gamble area, for example at a specialized landfill accepting contaminated soils, are likely to be seriously considered.

Comment 4, Timothy Goodman

The Washington State Department of Natural Recourses appreciates the opportunity to comment on the Draft Cleanup Action Plan and Supplemental Remedial Investigation and Feasibility Study for the Upland Area of the Port Gamble Bay and Mill Site. Please add a figure and text to communicate ownership of the study area and remedial action areas. It appears that certain of the areas proposed for capping are very close to the State owned aquatic lands (SOAL) boundary line and it is difficult to definitely discern ownership with the available figures. If areas designated for capping are on SOAL, then the cleanup proponent will need to coordinate with DNR on access. One of the primary concerns of DNR is that the preferred remedy does not result in long-term mobilization and re-adsorption of contamination in adjacent sediment on SOAL. DNR is pleased to read that tidal pumping studies were completed and the cleanup proponent performed some degree of fate and transport modeling based on reasonably conservative assumptions. Since the DCAP and RI/FS presented limited descriptions of the modeling, DNR would appreciate the opportunity to review or be briefed on the detailed technical aspects of fate and transport assumptions and calculations. Additionally, DNR looks forward to reviewing the engineering design details of the upland caps when available.

Response 4

Dear Timothy Goodman:

Thank you for your comments on the proposed cleanup at the Port Gamble Mill Site. Exhibit B of the draft in-water environmental covenant (which is attached to this letter as Appendix A) shows the boundary of State Owned Aquatic Land that is based on the current land survey. The proposed areas to be capped in the uplands are not located on State Owned Aquatic Lands.

The project team spent significant time analyzing the potential for dioxin to move from the upland soils, through groundwater, and re-contaminate sediments cleaned up during the in-water cleanup. Based on the results of the Reible steady state model, in addition to the results of the onsite groundwater monitoring and shellfish tissue monitoring in the sediments, it was concluded that the risk of significant dioxin movement was minimal. I have attached to this letter as Appendix B a copy of the summary of the Reible steady-state dioxin transport spreadsheet model (inputs and outputs). More information can also be found at: https://www.depts.ttu.edu/ceweb/research/reiblesgroup/publications.php

Please let me know if you would like to discuss the technical details further, I would be happy to set up a meeting with the PLP's technical consultant to discuss the rationale behind the modeling assumptions. Furthermore, dioxins in sediments will be monitored as part of the long term monitoring requirements for the completed in water cleanup, to ensure concentrations are not increasing.

Comment 5, Paul McCollum

Dear John,

On behalf of the Port Gamble S'Klallam Tribe (PGST), I am providing the following preliminary comments regarding the Port Gamble Uplands Consent Decree and Draft Cleanup Action Plan for your consideration before finalizing the documents for the public comment period.

Cultural Resources Survey Report Addendum

With regard to the Cultural Resources Survey Report Addendum, the report concludes that ground disturbance for the Port Gamble Upland Mill Site Cleanup Action (Project) is unlikely to disturb historic or cultural resources and that no further investigation or monitoring is recommended. Due to the proximity of the remedial actions to areas of high sensitivity for encountering cultural resources, the PGST recommends that its Tribal Historic Preservation Officer (THPO) and/or anthropologist have the opportunity to monitor the Project activities in areas of the Tribe's concern. The Tribe requests access to areas it has identified as high priority for cultural monitoring during ground disturbance. In addition, the report states that an Inadvertent Discovery Plan (IDP) will be in place during construction. The PGST should have the opportunity to review and comment on the draft IDP as soon as it is available.

Shoreline Restoration as a Future Use on the Project Site

As we commented previously, the PGST has serious concerns with regard to the lack of information provided in the DCAP about restoration of the mill site shoreline. The PGST was awarded ESRP, WWRP and ALEA grant funds for the purchase of development rights on 16 acres of the mill site, adjacent tidelands and bluff, for the purpose of restoring upland, riparian, intertidal and subtidal areas, and providing public access.

We are concerned that a restrictive covenant under MTCA will limit the Tribe's ability to complete any restoration on the mill site in the future. Prior to investing resources for restoration planning and permitting, the Tribe would like assurance from Ecology that such activity would be able to move forward. The WAC 173-340-440(9) requirements make it clear that any interference with a cleanup action under a restrictive covenant is prohibited. The PGST therefore requests a direct response from Ecology with regard to the feasibility of future habitat restoration activities by PGST or others in coordination with the landowner in the area of the MTCA restrictive covenant.

The DCAP provides little information regarding a future open space and habitat restoration land use action on the Mill Site. It states that shoreline excavation actions under such action would be coordinated "as practicable with construction of upland and in-water caps to achieve a protective and cost-effective integrated remedy" but does not provide any detail. The habitat restoration actions will be coordinated with remedial actions in the Remedial Design Work Plan and concept-level engineering designs, in Summer 2020 or later. In the meantime, PGST would

like more certainty and more information with regard to the specifics of coordination between cleanup actions and shoreline restoration. We recommend 1) a more detailed DCAP section regarding future open space and habitat restoration land use actions in coordination with remedial actions, and 2) assurance from Ecology that restoration in areas under the MTCA restrictive covenant would be allowed.

Historic Landfills on Port Gamble Bay Shoreline

During the operation of the sawmill four landfills were established at different times in the immediate area of the town of Port Gamble and shoreline of Port Gamble Bay. The four landfills include Landfill 1, Landfill 2, Landfill 3, and Landfill 4 (containing Landfill 4a and 4b units). Ecology issued determinations that no further remedial actions were required for Landfills 2 and 3 in 2002 and Landfills 4a and 4b in 2004. However, these determinations did not consider potential exposures to individuals consuming contaminated biota from nearshore sediments impacted by the landfills. The determinations did not evaluate the presence of chemicals known to be present in Port Gamble Bay, including dioxins and furans. The tidelands are currently open for recreational harvest but have not been evaluated for tribal subsistence harvest. The PGST has remaining questions about the potential risks to human health from these exposures and whether Ecology has any plans to conduct additional sampling of sediment and shellfish tissue in these areas.

Thank you for your consideration of these comments.

Sincerely,

Paul McCollum

Director, Natural Resources Dept.

Response 5

Dear Paul McCollum:

Thank you for your comments on the proposed cleanup at the Port Gamble Mill Site. As is discussed in the Cultural Resources Survey Report Addendum, which is Appendix B of the Cleanup Action Plan, an Inadvertent Discovery Plan (IDP) will be kept on site during the construction phase. The Tribe will have the opportunity to review the IDP before it is finalized, and to the extent that it is safe and feasible, a tribal monitor will be permitted to monitor construction activities. A pre-construction meeting will be held with the contractor, project archaeologist, tribal and state representatives, and the property owner to review the IDP, discuss concerns, and determine permitting requirements

With regards any restrictive covenant placed on the uplands, it will not preclude any restoration activities that are planned by the Tribe. Ecology is not planning to revise the DCAP to include

potential restoration as cleanup alternatives as these plans have not been finalized either through natural resource damage assessment negotiations or otherwise. Given the importance of effectively integrating cleanup and restoration efforts, Ecology will invite and consider feedback from PGST on the uplands restrictive covenant before it is finalized.

At present, Ecology is not planning any additional sediment or shellfish sampling in the vicinity of the former landfills. As stated in your comment, these areas were removed from further consideration in 2002 and 2004, as all dioxin sediment and tissue sampling in the vicinity of the landfills has indicated that there is no risk to tribal subsistence harvest. If the Tribe has any information regarding elevated dioxin concentration in either tissues or sediments in these areas, we invite you to send these results to Ecology for review.

Ecology Contact Information

For more information on the Port Gamble Upland Mill Site, contact:

John Evered, Site Manager
Toxics Cleanup Program
PO Box 47600
Olympia, WA 98504-7600

To review documents:

Department of Ecology Headquarters
300 Desmond Drive SE
Lacey, WA 98503
By appointment only:
Contact: Carol Dorn
Phone: (360) 407-7224
Email: carol.dorn@ecy.wa.gov

Ecology's Port Gamble cleanup website

https://apps.ecology.wa.gov/gsp/Sitepage.aspx?csid=3444

Appendices

Appendix A. (Exhibit B from the draft in-water environmental covenant)

DRAFT

SOURCE: Aerial from Google Maps.
Parcel Linework From ROS FOR BLA
REC. NO. 201905100190
HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.

LEGEND:
Cap Boundary
Parcel B

0 200
Feet

Publish Date: 2020/05/19 4:48 PM | User: tgriga
Filepath: K:\Projects\0388-Pope Resources\Port Gamble Sediment Cleanup RI-FS\2020 Long Term Monitoring\0388-RP-001 Cap Exhibits.dwg Exhibit B

ANCHOR QEA

Exhibit B
Port Gamble Bay Tidelands Property Map and Restricted Areas

Appendix B. (Reible steady-state dioxin transport model)

Port Gamble Mill Site Cleanup and Remediation Level Summary					
Parameter	Value	Units	Notes		
Soil					
Practical Quantititaiton Limiit (PQL)	5	ng/kg TEQ	Developed by Ecology in the Port Gamble Bay remedial investigation		
Natural Background Level	?	ng/kg TEQ	Not yet calculated by Ecology		
Applicable or Relevant and Appropriate Requirement	50	ng/kg TEQ	ATSDR Policy Guideline for Residential Soil; not an ARAR		
MTCA Method B Human Health Protection Calculation	12	ng/kg TEQ	Ecology CLARC II Tables for unrestricted site use (incl. residential)		
MTCA Method B Ecological Protection Calculation	260	ng/kg TEQ	Incorporating site-specific biota accumulation factor into MTCA risk equations		
Soil Cleanup Level	12	ng/kg TEQ	Method B human health risk calculation determines the MTCA soil cleanup level		
Soil Remediation Level	530	ng/kg TEQ	Steady-state Reible model output for sediment protection; also see below		
Groundwater					
Practical Quantititaiton Limiit (PQL)	4.4	pg/L TEQ	Ten times the ARI/Axys method detection limit (MDL); below the PQL specified in EPA Method 1613B		
Natural Background Level	?	pg/L TEQ	Not yet calculated by Ecology		
Applicable or Relevant and Appropriate Requirement	30	pg/L TEQ	WA Drinking Water Maximum Contaminant Level		
MTCA Method B Human Health Protection Calculation	0.67	pg/L TEQ	Ecology CLARC II Tables for unrestricted use (incl. drinking water); unadjusted for PQL		
Groundwater Cleanup Level	4.4	pg/L TEQ	PQL determines the MTCA groundwater cleanup level		
Maximum Groundwater Concentration at Soil Remedia	2.2	pg/L TEQ	Calculated using Reible model assuming implementation of soil remediation level		
Surface Water					
Practical Quantititaiton Limiit (PQL)	4.4	pg/L TEQ	Ten times the ARI/Axys method detection limit (MDL); below the PQL specified in EPA Method 1613B		
Natural Background Level	?	pg/L TEQ	Not yet calculated by Ecology		
Applicable or Relevant and Appropriate Requirement	0.014	pg/L TEQ	EPA National Toxics Rule; unadjusted for PQL		
MTCA Method B Human Health Protection Calculation	0.010	pg/L TEQ	Ecology CLARC II Tables for unrestricted use (incl. fish consumption); unadjusted for PQL		
Surface Water Cleanup Level	4.4	pg/L TEQ	PQL determines the MTCA surface water cleanup level		
Maximum Surface Water Concentration at Soil Remed	0.33	pg/L TEQ	Calculated using Reible model assuming implementation of soil remediation level		
Sediment					
Practical Quantititaiton Limiit (PQL)	5.0	ng/kg TEQ	Developed by Ecology in the Port Gamble Bay remedial investigation		
Natural Background Level	4.4	ng/kg TEQ	Developed by Ecology in the Port Gamble Bay remedial investigation		
Applicable or Relevant and Appropriate Requirement	?	ng/kg TEQ	No sediment ARARs available for dioxins/furans		
MTCA Method B Human Health Protection Calculation	< 4.4	ng/kg TEQ	Appreoximated by Ecology in the Port Gamble Bay remedial investigation based on shellfish consumption		
Sediment Cleanup Level	5.0	ng/kg TEQ	PQL determines the MTCA/SMS sediment cleanup level, developed by Ecology in the Port Gamble Bay Clanup Action Plan		
Maximum Sediment Concentration at Soil Remediatio	5.0	ng/kg TEQ	Calculated using Reible model assuming implementation of soil remediation level		

STEADY-STATE CAP DESIGN MODEL -- Array/Multiple Contaminant Worksheet

Instructions: Copy column "C" to create multiple solution rows; then change the parameters/chemical of interest.

Scenario B: Identify maximum concentration (Cell D11) to meet 5 ng/kg in 2 foot bioturbation zone (Cell D44).

Inputs		
Parameter	Units	Value
Octanol-water partition coefficient, log K_{ow}		7.32
Water Diffusivity, D_w	cm^2/s	4.3E-06
Cap Decay Rate, λ_1	yr^{-1}	0
Bioturbation Layer Decay Rate, λ_2	yr^{-1}	0
Contaminant Concentration, C_0	ug/kg	0.528
Nearshore Soil TOC	%	1.48%
Contaminant Pore Water Concentration, C_0	**ug/L**	**2.25E-06**
Biological Active Zone fraction organic carbon, $(f_{oc})_{bio}$		0.02%
Colloidal Organic Carbon Concentration, ρ_{DOC}	mg/L	0
Darcy Velocity, V (positive is upwelling)	cm/yr	2577
Depositional Velocity, V_{dep}	cm/yr	0
Bioturbation Layer Thickness, h_{bio}	cm	60.96
Pore Water Biodiffusion Coefficient, D_{bio}^{pw}	cm^2/yr	100
Particle Biodiffusion Coefficient, D_{bio}^{p}	cm^2/yr	1
Conventional Cap placed depth	in	24
Conventional Cap placed depth	cm	60.96
Cap Materials -Granular (G) or Consolidated (C)		G
Cap consolidation depth	cm	0
Underlying sediment consolidation	cm	0
Porosity, ε		0.4
Particle Density, ρ_P	g/cm^3	2.60
fraction organic carbon, $(f_{oc})_{eff}$		0.02%
Depth of Interest, z	cm	60.96
Fraction organic carbon at depth of interest, $f_{oc}(z)$		0.02%
Estimates		
Organic Carbon Partition Coefficient, log K_{oc}	log L/kg	7.20
Colloidal Organic Carbon Partition Coefficient, log K	log L/kg	6.83
Boundary Layer Mass Transfer Coefficient, k_{bl}	cm/hr	2.00
Dispersivity Percent of Domain length	%	50%
Dispersivity, α	**cm**	**30.48**
Effective Cap Layer Diffusion/Dispersion Coeff., D_1	cm^2/yr	78586
Bioturbation Layer Diffusion/Dispersion Coeff., D_2	cm^2/yr	83631
Outputs		
Pore Water Concentration at Depth, $C(z)$	**ug/L**	**2.25E-06**
Loading at Depth, $W(z)$	**ug/kg**	**0.007**
Average Bioturbation Layer Loading, $(W_{bio})_{avg}$	**ug/kg**	**0.005**
TARGET CONCENTRATION	*ug/kg*	*0.005*
Flux to Overlying Water Column, J	$ug/m^2/yr$	0
Cap-Bioturbation Interface Concentration, C_{bio}/C_0		100.00%
Cap-Water Interface Concentration, C_{bl}/C_0		14.79%
Average Bioturbation Concentration, $(C_{bio})_{avg}/C_0$, $(C_{bio})_{avg}$		70.01%
Characteristic Time to ~1% of pre-cap, $t_{adv/diff}$	**yr**	**0.00**
Effective Cap Layer Peclet No., Pe_1		0.00
Effective Cap Layer Damkohler No., Da_1		0.00
β = SQRT($Pe_1^2/4+Da$)		0.00
Bioturbation Layer Peclet No., Pe_2		1.88
Bioturbation Layer Damkohler No., Da_2		0.00
γ = SQRT($Pe_1^2/4+Da$)		0.939
Sherwood Number at Interface, Sh		12.8
Cap final thickness, h_{cap}	cm	60.96
Cap Effective Depth, h_{eff}	cm	0
Containment Layer Retardation Factor, R_1		4945
Bioturbation Layer Retardation Factor, R_2		4945
Effective Advective Velocity, U	cm/yr	2577.00
Characteristic Advection Time-cap layer, t_{adv}	yr	0.0
Characteristic Diffusion Time-cap layer, t_{diff}	yr	0.0

		Average Porewater ug/L		**Average Sorbed Phase**	
Segment Interval (% of total thickness)	Depth (cm)	Scenario A	Scenario B	Scenario A	Scenario B
0	0.00	4.12E-06	3.33E-07	1.31E-02	1.06E-03
0.005	0.30	4.38E-06	3.54E-07	1.39E-02	1.12E-03
0.01	0.61	4.64E-06	3.75E-07	1.47E-02	1.19E-03
0.015	0.91	4.90E-06	3.96E-07	1.55E-02	1.25E-03
0.02	1.22	5.15E-06	4.16E-07	1.63E-02	1.32E-03
0.025	1.52	5.40E-06	4.37E-07	1.71E-02	1.38E-03
0.03	1.83	5.65E-06	4.57E-07	1.79E-02	1.45E-03
0.035	2.13	5.90E-06	4.77E-07	1.87E-02	1.51E-03
0.04	2.44	6.15E-06	4.97E-07	1.95E-02	1.57E-03
0.045	2.74	6.39E-06	5.17E-07	2.02E-02	1.64E-03
0.05	3.05	6.63E-06	5.36E-07	2.10E-02	1.70E-03
0.055	3.35	6.87E-06	5.55E-07	2.18E-02	1.76E-03
0.06	3.66	7.10E-06	5.74E-07	2.25E-02	1.82E-03
0.065	3.96	7.34E-06	5.93E-07	2.33E-02	1.88E-03
0.07	4.27	7.57E-06	6.12E-07	2.40E-02	1.94E-03
0.075	4.57	7.80E-06	6.31E-07	2.47E-02	2.00E-03
0.08	4.88	8.03E-06	6.49E-07	2.54E-02	2.06E-03
0.085	5.18	8.25E-06	6.67E-07	2.62E-02	2.11E-03
0.09	5.49	8.47E-06	6.85E-07	2.69E-02	2.17E-03
0.095	5.79	8.69E-06	7.03E-07	2.76E-02	2.23E-03
0.1	6.10	8.91E-06	7.21E-07	2.83E-02	2.28E-03
0.105	6.40	9.13E-06	7.38E-07	2.89E-02	2.34E-03
0.11	6.71	9.35E-06	7.56E-07	2.96E-02	2.40E-03
0.115	7.01	9.56E-06	7.73E-07	3.03E-02	2.45E-03
0.12	7.32	9.77E-06	7.90E-07	3.10E-02	2.50E-03
0.125	7.62	9.98E-06	8.07E-07	3.16E-02	2.56E-03
0.13	7.92	1.02E-05	8.24E-07	3.23E-02	2.61E-03
0.135	8.23	1.04E-05	8.40E-07	3.29E-02	2.66E-03
0.14	8.53	1.06E-05	8.57E-07	3.36E-02	2.72E-03
0.145	8.84	1.08E-05	8.73E-07	3.42E-02	2.77E-03
0.15	9.14	1.10E-05	8.89E-07	3.48E-02	2.82E-03
0.155	9.45	1.12E-05	9.05E-07	3.55E-02	2.87E-03
0.16	9.75	1.14E-05	9.21E-07	3.61E-02	2.92E-03
0.165	10.06	1.16E-05	9.36E-07	3.67E-02	2.97E-03
0.17	10.36	1.18E-05	9.52E-07	3.73E-02	3.02E-03
0.175	10.67	1.20E-05	9.67E-07	3.79E-02	3.07E-03
0.18	10.97	1.22E-05	9.83E-07	3.85E-02	3.11E-03
0.185	11.28	1.23E-05	9.98E-07	3.91E-02	3.16E-03
0.19	11.58	1.25E-05	1.01E-06	3.97E-02	3.21E-03
0.195	11.89	1.27E-05	1.03E-06	4.03E-02	3.26E-03
0.2	12.19	1.29E-05	1.04E-06	4.08E-02	3.30E-03
0.205	12.50	1.31E-05	1.06E-06	4.14E-02	3.35E-03
0.21	12.80	1.32E-05	1.07E-06	4.20E-02	3.39E-03
0.215	13.11	1.34E-05	1.09E-06	4.25E-02	3.44E-03
0.22	13.41	1.36E-05	1.10E-06	4.31E-02	3.48E-03
0.225	13.72	1.38E-05	1.11E-06	4.36E-02	3.53E-03
0.23	14.02	1.39E-05	1.13E-06	4.42E-02	3.57E-03
0.235	14.33	1.41E-05	1.14E-06	4.47E-02	3.62E-03
0.24	14.63	1.43E-05	1.15E-06	4.53E-02	3.66E-03
0.245	14.94	1.44E-05	1.17E-06	4.58E-02	3.70E-03
0.25	15.24	1.46E-05	1.18E-06	4.63E-02	3.74E-03
0.255	15.54	1.48E-05	1.19E-06	4.68E-02	3.79E-03
0.26	15.85	1.49E-05	1.21E-06	4.73E-02	3.83E-03
0.265	16.15	1.51E-05	1.22E-06	4.79E-02	3.87E-03
0.27	16.46	1.53E-05	1.23E-06	4.84E-02	3.91E-03
0.275	16.76	1.54E-05	1.25E-06	4.89E-02	3.95E-03
0.28	17.07	1.56E-05	1.26E-06	4.94E-02	3.99E-03
0.285	17.37	1.57E-05	1.27E-06	4.98E-02	4.03E-03

Characteristic Reaction Time-cap layer, t_{decay}	yr	infinity

0.29	17.68	1.59E-05	1.28E-06	5.03E-02	4.07E-03
0.295	17.98	1.60E-05	1.30E-06	5.08E-02	4.11E-03
0.3	18.29	1.62E-05	1.31E-06	5.13E-02	4.15E-03
0.305	18.59	1.63E-05	1.32E-06	5.18E-02	4.19E-03
0.31	18.90	1.65E-05	1.33E-06	5.22E-02	4.22E-03
0.315	19.20	1.66E-05	1.34E-06	5.27E-02	4.26E-03
0.32	19.51	1.68E-05	1.36E-06	5.32E-02	4.30E-03
0.325	19.81	1.69E-05	1.37E-06	5.36E-02	4.33E-03
0.33	20.12	1.71E-05	1.38E-06	5.41E-02	4.37E-03
0.335	20.42	1.72E-05	1.39E-06	5.45E-02	4.41E-03
0.34	20.73	1.73E-05	1.40E-06	5.49E-02	4.44E-03
0.345	21.03	1.75E-05	1.41E-06	5.54E-02	4.48E-03
0.35	21.34	1.76E-05	1.42E-06	5.58E-02	4.51E-03
0.355	21.64	1.77E-05	1.43E-06	5.62E-02	4.55E-03
0.36	21.95	1.79E-05	1.45E-06	5.67E-02	4.58E-03
0.365	22.25	1.80E-05	1.46E-06	5.71E-02	4.62E-03
0.37	22.56	1.81E-05	1.47E-06	5.75E-02	4.65E-03
0.375	22.86	1.83E-05	1.48E-06	5.79E-02	4.68E-03
0.38	23.16	1.84E-05	1.49E-06	5.83E-02	4.72E-03
0.385	23.47	1.85E-05	1.50E-06	5.87E-02	4.75E-03
0.39	23.77	1.87E-05	1.51E-06	5.91E-02	4.78E-03
0.395	24.08	1.88E-05	1.52E-06	5.95E-02	4.81E-03
0.4	24.38	1.89E-05	1.53E-06	5.99E-02	4.85E-03
0.405	24.69	1.90E-05	1.54E-06	6.03E-02	4.88E-03
0.41	24.99	1.92E-05	1.55E-06	6.07E-02	4.91E-03
0.415	25.30	1.93E-05	1.56E-06	6.11E-02	4.94E-03
0.42	25.60	1.94E-05	1.57E-06	6.15E-02	4.97E-03
0.425	25.91	1.95E-05	1.58E-06	6.19E-02	5.00E-03
0.43	26.21	1.96E-05	1.59E-06	6.22E-02	5.03E-03
0.435	26.52	1.98E-05	1.60E-06	6.26E-02	5.06E-03
0.44	26.82	1.99E-05	1.61E-06	6.30E-02	5.09E-03
0.445	27.13	2.00E-05	1.62E-06	6.33E-02	5.12E-03
0.45	27.43	2.01E-05	1.62E-06	6.37E-02	5.15E-03
0.455	27.74	2.02E-05	1.63E-06	6.40E-02	5.18E-03
0.46	28.04	2.03E-05	1.64E-06	6.44E-02	5.21E-03
0.465	28.35	2.04E-05	1.65E-06	6.48E-02	5.24E-03
0.47	28.65	2.05E-05	1.66E-06	6.51E-02	5.26E-03
0.475	28.96	2.06E-05	1.67E-06	6.54E-02	5.29E-03
0.48	29.26	2.08E-05	1.68E-06	6.58E-02	5.32E-03
0.485	29.57	2.09E-05	1.69E-06	6.61E-02	5.35E-03
0.49	29.87	2.10E-05	1.70E-06	6.65E-02	5.37E-03
0.495	30.18	2.11E-05	1.70E-06	6.68E-02	5.40E-03
0.5	30.48	2.12E-05	1.71E-06	6.71E-02	5.43E-03
0.505	30.78	2.13E-05	1.72E-06	6.74E-02	5.45E-03
0.51	31.09	2.14E-05	1.73E-06	6.78E-02	5.48E-03
0.515	31.39	2.15E-05	1.74E-06	6.81E-02	5.50E-03
0.52	31.70	2.16E-05	1.74E-06	6.84E-02	5.53E-03
0.525	32.00	2.17E-05	1.75E-06	6.87E-02	5.56E-03
0.53	32.31	2.18E-05	1.76E-06	6.90E-02	5.58E-03
0.535	32.61	2.19E-05	1.77E-06	6.93E-02	5.60E-03
0.54	32.92	2.20E-05	1.78E-06	6.96E-02	5.63E-03
0.545	33.22	2.21E-05	1.78E-06	6.99E-02	5.65E-03
0.55	33.53	2.22E-05	1.79E-06	7.02E-02	5.68E-03
0.555	33.83	2.22E-05	1.80E-06	7.05E-02	5.70E-03
0.56	34.14	2.23E-05	1.81E-06	7.08E-02	5.73E-03
0.565	34.44	2.24E-05	1.81E-06	7.11E-02	5.75E-03
0.57	34.75	2.25E-05	1.82E-06	7.14E-02	5.77E-03
0.575	35.05	2.26E-05	1.83E-06	7.17E-02	5.80E-03
0.58	35.36	2.27E-05	1.84E-06	7.20E-02	5.82E-03
0.585	35.66	2.28E-05	1.84E-06	7.22E-02	5.84E-03
0.59	35.97	2.29E-05	1.85E-06	7.25E-02	5.86E-03
0.595	36.27	2.30E-05	1.86E-06	7.28E-02	5.88E-03
0.6	36.58	2.30E-05	1.86E-06	7.31E-02	5.91E-03
0.605	36.88	2.31E-05	1.87E-06	7.33E-02	5.93E-03
0.61	37.19	2.32E-05	1.88E-06	7.36E-02	5.95E-03
0.615	37.49	2.33E-05	1.88E-06	7.39E-02	5.97E-03
0.62	37.80	2.34E-05	1.89E-06	7.41E-02	5.99E-03
0.625	38.10	2.35E-05	1.90E-06	7.44E-02	6.01E-03
0.63	38.40	2.35E-05	1.90E-06	7.46E-02	6.03E-03
0.635	38.71	2.36E-05	1.91E-06	7.49E-02	6.05E-03
0.64	39.01	2.37E-05	1.92E-06	7.51E-02	6.08E-03
0.645	39.32	2.38E-05	1.92E-06	7.54E-02	6.10E-03

0.65	39.62	2.39E-05	1.93E-06	7.56E-02	6.12E-03
0.655	39.93	2.39E-05	1.94E-06	7.59E-02	6.14E-03
0.66	40.23	2.40E-05	1.94E-06	7.61E-02	6.15E-03
0.665	40.54	2.41E-05	1.95E-06	7.64E-02	6.17E-03
0.67	40.84	2.42E-05	1.95E-06	7.66E-02	6.19E-03
0.675	41.15	2.42E-05	1.96E-06	7.68E-02	6.21E-03
0.68	41.45	2.43E-05	1.97E-06	7.71E-02	6.23E-03
0.685	41.76	2.44E-05	1.97E-06	7.73E-02	6.25E-03
0.69	42.06	2.45E-05	1.98E-06	7.75E-02	6.27E-03
0.695	42.37	2.45E-05	1.98E-06	7.78E-02	6.29E-03
0.7	42.67	2.46E-05	1.99E-06	7.80E-02	6.30E-03
0.705	42.98	2.47E-05	1.99E-06	7.82E-02	6.32E-03
0.71	43.28	2.47E-05	2.00E-06	7.84E-02	6.34E-03
0.715	43.59	2.48E-05	2.01E-06	7.86E-02	6.36E-03
0.72	43.89	2.49E-05	2.01E-06	7.89E-02	6.38E-03
0.725	44.20	2.49E-05	2.02E-06	7.91E-02	6.39E-03
0.73	44.50	2.50E-05	2.02E-06	7.93E-02	6.41E-03
0.735	44.81	2.51E-05	2.03E-06	7.95E-02	6.43E-03
0.74	45.11	2.51E-05	2.03E-06	7.97E-02	6.44E-03
0.745	45.42	2.52E-05	2.04E-06	7.99E-02	6.46E-03
0.75	45.72	2.53E-05	2.04E-06	8.01E-02	6.48E-03
0.755	46.02	2.53E-05	2.05E-06	8.03E-02	6.49E-03
0.76	46.33	2.54E-05	2.05E-06	8.05E-02	6.51E-03
0.765	46.63	2.55E-05	2.06E-06	8.07E-02	6.53E-03
0.77	46.94	2.55E-05	2.06E-06	8.09E-02	6.54E-03
0.775	47.24	2.56E-05	2.07E-06	8.11E-02	6.56E-03
0.78	47.55	2.56E-05	2.07E-06	8.13E-02	6.57E-03
0.785	47.85	2.57E-05	2.08E-06	8.15E-02	6.59E-03
0.79	48.16	2.58E-05	2.08E-06	8.17E-02	6.60E-03
0.795	48.46	2.58E-05	2.09E-06	8.19E-02	6.62E-03
0.8	48.77	2.59E-05	2.09E-06	8.21E-02	6.63E-03
0.805	49.07	2.59E-05	2.10E-06	8.22E-02	6.65E-03
0.81	49.38	2.60E-05	2.10E-06	8.24E-02	6.66E-03
0.815	49.68	2.61E-05	2.11E-06	8.26E-02	6.68E-03
0.82	49.99	2.61E-05	2.11E-06	8.28E-02	6.69E-03
0.825	50.29	2.62E-05	2.12E-06	8.30E-02	6.71E-03
0.83	50.60	2.62E-05	2.12E-06	8.31E-02	6.72E-03
0.835	50.90	2.63E-05	2.13E-06	8.33E-02	6.74E-03
0.84	51.21	2.63E-05	2.13E-06	8.35E-02	6.75E-03
0.845	51.51	2.64E-05	2.13E-06	8.37E-02	6.76E-03
0.85	51.82	2.64E-05	2.14E-06	8.38E-02	6.78E-03
0.855	52.12	2.65E-05	2.14E-06	8.40E-02	6.79E-03
0.86	52.43	2.66E-05	2.15E-06	8.42E-02	6.81E-03
0.865	52.73	2.66E-05	2.15E-06	8.43E-02	6.82E-03
0.87	53.04	2.67E-05	2.16E-06	8.45E-02	6.83E-03
0.875	53.34	2.67E-05	2.16E-06	8.47E-02	6.84E-03
0.88	53.64	2.68E-05	2.16E-06	8.48E-02	6.86E-03
0.885	53.95	2.68E-05	2.17E-06	8.50E-02	6.87E-03
0.89	54.25	2.69E-05	2.17E-06	8.51E-02	6.88E-03
0.895	54.56	2.69E-05	2.18E-06	8.53E-02	6.90E-03
0.9	54.86	2.70E-05	2.18E-06	8.54E-02	6.91E-03
0.905	55.17	2.70E-05	2.18E-06	8.56E-02	6.92E-03
0.91	55.47	2.71E-05	2.19E-06	8.57E-02	6.93E-03
0.915	55.78	2.71E-05	2.19E-06	8.59E-02	6.95E-03
0.92	56.08	2.71E-05	2.19E-06	8.60E-02	6.96E-03
0.925	56.39	2.72E-05	2.20E-06	8.62E-02	6.97E-03
0.93	56.69	2.72E-05	2.20E-06	8.63E-02	6.98E-03
0.935	57.00	2.73E-05	2.21E-06	8.65E-02	6.99E-03
0.94	57.30	2.73E-05	2.21E-06	8.66E-02	7.00E-03
0.945	57.61	2.74E-05	2.21E-06	8.68E-02	7.02E-03
0.95	57.91	2.74E-05	2.22E-06	8.69E-02	7.03E-03
0.955	58.22	2.75E-05	2.22E-06	8.70E-02	7.04E-03
0.96	58.52	2.75E-05	2.22E-06	8.72E-02	7.05E-03
0.965	58.83	2.75E-05	2.23E-06	8.73E-02	7.06E-03
0.97	59.13	2.76E-05	2.23E-06	8.75E-02	7.07E-03
0.975	59.44	2.76E-05	2.23E-06	8.76E-02	7.08E-03
0.98	59.74	2.77E-05	2.24E-06	8.77E-02	7.09E-03
0.985	60.05	2.77E-05	2.24E-06	8.79E-02	7.10E-03
0.99	60.35	2.78E-05	2.24E-06	8.80E-02	7.11E-03
0.995	60.66	2.78E-05	2.25E-06	8.81E-02	7.12E-03
1	60.96	2.78E-05	2.25E-06	8.82E-02	7.14E-03

Table 1. STEADY-STATE REIBLE MODEL Array Worksheet

Inputs	**Units**	**Value**
Octanol-water partition coefficient, log K_{ow}		7.32
Water Diffusivity, D_w	cm^2/s	4.3E-06
Cap Decay Rate, λ_1	yr^{-1}	0
Bioturbation Layer Decay Rate, λ_2	yr^{-1}	0
Nearshore Soil TOC	%	1.48%
Colloidal Organic Carbon Concentration, ρ_{DOC}	mg/L	0
Darcy Velocity, *V (* positive is upwelling)	cm/yr	2,577
Depositional Velocity, V_{dep}	cm/yr	0
Bioturbation Layer Thickness, h_{bio}	cm	60.96
Pore Water Biodiffusion Coefficient, D_{bio}^{pw}	cm^2/yr	100
Particle Biodiffusion Coefficient, D_{bio}^{p}	cm^2/yr	1
Conventional Cap placed depth	in	24
Conventional Cap placed depth	cm	60.96
Cap Materials -Granular (G) or Consolidated (C)		G
Porosity, ε		0.4
Particle Density, ρ_P	g/cm^3	2.60
fraction organic carbon, $(f_{oc})_{eff}$		0.02%
Estimates		
Organic Carbon Partition Coefficient, log K_{oc}	log L/kg	7.20
Colloidal Organic Carbon Partition Coefficient, log *K*	log L/kg	6.83
Boundary Layer Mass Transfer Coefficient, k_{bl}	cm/hr	2.00
Dispersivity Percent of Domain length	%	50%
Dispersivity, *α*	cm	30.48
Effective Cap Layer Diffusion/Dispersion Coeff., D_1	cm^2/yr	78,586
Bioturbation Layer Diffusion/Dispersion Coeff., D_2	cm^2/yr	83,631
Outputs		
γ = SQRT(Pe_1^2/4+*Da*)		0.939
Sherwood Number at Interface, *Sh*		12.8
Containment Layer Retardation Factor, R_1		4,945
Bioturbation Layer Retardation Factor, R_2		4,945
Effective Advective Velocity, *U*	cm/yr	2,577
Characteristic Reaction Time-cap layer, t_{decay}	yr	infinity