# Kenmore Area Sediment & Water Characterization Environmental Evaluation Report

**Kenmore and Lake Forest Park,**
**Northeast Lake Washington and Sammamish River,**
**Kenmore Area, King County, Washington**

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# Abstract/Executive Summary

The Washington State Department of Ecology (Ecology) Environmental Evaluation Report for the Kenmore Area Sediment and Water Characterization summarizes the sediment and surface water results with a focus on human health and environmental evaluation. This report represents the work conducted by Anchor QEA and Ecology for the City of Kenmore in November 2012.

The sediment and water results have two general purposes. First, is to assist the City of Kenmore for dredge planning for the Kenmore Navigation Channel with the US Army Corps of Engineers. The second purpose is for human health and environmental evaluation to assess current conditions at the near shore waterfront at the Cities of Kenmore and Lake Forest Park. The report compares the results with the state's cleanup requirements including the new Sediment Management Standards Amendments (SMS).

In general, this work represents an important and successful step in evaluating the current conditions of the near shore northeast waterfront at Lake Washington and the lower reaches of the Sammamish River. The surface water results are significantly below protection levels for human health and aquatic life representing Log Boom Park and northeast Lake Washington reference sample. The sediment and water characterization results indicate there are no significant environmental issues at the two public parks – Log Boom Park and Lyon Creek Park. Most of the sediment results are below SMS freshwater criteria except for samples at the two private marinas.

The Kenmore Navigation Channel sediment results show that the channel would not be classified as a MTCA cleanup site. All Navigation Channel sediment results are below the Freshwater Cleanup Screening Level (CSL). Likewise, the near shore Lakepointe aka Kenmore Industrial Park (KIP) site sediment results show no contamination above the screening values in the sediment adjacent to the KIP site at the north, west, and south waterfront. The two public parks, KIP site, and Navigation Channel report a relatively healthy near shore environment.

Overall, the sediment results compared to state cleanup criteria show no exceedance for metals, poly-aromatic hydrocarbons (PAHs), pesticides, and miscellaneous extractables (benzoic acid and benzyl alcohol), and only one occurrence of PCBs. There are multiple occurrences of phthalates and dioxin at low levels. The sediment dioxin levels range from 0.3 to 71 parts per trillion at the Kenmore area with the two private marina results, and from 0.3 to 10 parts per trillion without the marina results. One comparison is the Seattle urban neighborhood dioxin levels, which range from 1.7 to 115 parts per trillion. With or without the two private marinas, the Kenmore sediment dioxin levels are lower than the Seattle neighborhood soil dioxin levels. The MTCA soil dioxin cleanup level is 11 parts per trillion, so without the two private marina results, all Kenmore sediment dioxin results are below the state soil dioxin cleanup requirements.

Ecology has met with the marina owners and we have agreed to work together for the next steps in dredge planning and environmental evaluation. Also, more work will be required to identify the dioxin source or sources. Ecology will follow up on possible dioxin sources when funds become available.

# Acronyms and Abbreviations

ARAR Applicable or Relevant and Appropriate Requirements also called ARARs for federal, State and tribal requirements for environmental requirements.

ATSDR Agency for Toxic Substances Disease Registry is a federal agency.

Benthic community is the bottom dwelling organisms that live on a lake bottom or river bed.

CLARC Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulations and see weblink at: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

DMMP Dredged Material Management Program including the US Army Corps of Engineers, EPA, WDNR and Ecology.

EPA Environmental Protection Agency is a federal agency.

MTCA Model Toxics Control Act are the Washington State environmental cleanup regulations under Chapter 70D RCW, Chapter 64.70 RCW, and Chapter 173-340 WAC.

QA/QC Quality assurance and quality control is an evaluation process to confirm the quality of the sampling and laboratory results.

PAHs Polycyclic Aromatic Hydrocarbons.
PCBs Polychlorinated biphenyls and also called Aroclors.

SMS CSL and SCO Sediment Management Standards promulgated under WAC 173-340-760 with two screening levels –SCO called sediment cleanup objectives and CSL called cleanup screening levels.

SQV Sediment quality values developed for screening pollutants in a water system.

SSAP Sediment Sampling and Analysis Plan

TBT Tributyltin
TEQ Toxicity Equivalency values used with dioxin/furans and defined by World Health Organization 2005.

USACE US Army Corps of Engineers

VOCs Volatile Organic Compounds

WDFW Washington State Department of Fish and Wildlife
WDNR Washington State Department of Natural Resources
WDOH Washington State Department of Health

# Kenmore Area Sediment Sampling and Water Characterization Environmental Evaluation Report

## 1. Introduction

This report, prepared by Ecology, summarizes the sediment sampling and surface water characterization results with a focus on human health and environmental evaluation. The sediment and water results represent the work conducted by Anchor QEA and Ecology for the City of Kenmore in November 2012. The work focused on the near shore sediment and surface water in northeast Lake Washington, Kenmore Navigation Channel, and the lower reaches of the Sammamish River in Kenmore and Lake Forest Park, King County, WA as shown on figure 1.

This work is the result of the Sediment Sampling and Analysis Plan (SSAP) that was finalized on November 6, 2012. The final SSAP is attached in Appendix A. The draft SSAP was prepared by Anchor QEA (October 2012) for the City of Kenmore and Ecology, with input from the Dredged Material Management Program (DMMP), and Washington State Department of Health (DOH). Ecology conducted a 15-day public comment period (October 15-29, 2012) for the SSAP for the public to review and make suggestions and comments. Ecology received 15 comments and recommended to revise the SSAP, incorporating many of the comments. Anchor QEA revised the SSAP and the City, Ecology and DMMP approved the final SSAP in close consultation with DOH. Sampling was conducted November 8, 9 and 10, 2012. For more details, see the final SSAP (November 6, 2012) in Appendix A, and Ecology's Responsiveness Summary for the Kenmore Area SSAP Public Comment Period in Appendix B, and the Anchor QEA Results Memorandum in Appendix C.

## 2. Purpose

The SSAP has two general purposes. First purpose is to assist the City of Kenmore for dredge planning for the Kenmore Navigation Channel with the US Army Corps of Engineers (USACE). This sampling event was a screening effort for dredge planning and budget estimation, rather than the final sampling conducted for support of the dredge permit application. Evaluation of the results for the purposes of dredge is briefly discussed in this Ecology report. The second purpose is for human health and environmental evaluation to assess current conditions for both sediment and surface water at the near shore Kenmore Area waterfront including the Cities of Kenmore and Lake Forest Park, and especially the public access locations.

This environmental evaluation is one step in the Ecology screening process to evaluate the lateral extent of chemical conditions in sediment and surface water at the near shore waterfront where children could easily access and play. For the dredging evaluation, vibracore sampling required for full dredge prism analysis is very expensive, so this preliminary screening dredge material evaluation focused on the shallow, biologically active zone and not the deeper sampling used to acquire a formal determination on suitability of dredge material for open water disposal.

The environmental evaluation includes comparison of the laboratory results with Ecology's cleanup requirements under the state Model Toxics Control Act (MTCA) and Chapter 70.105D RCW. The MTCA requirements include cleanup levels for soil, water, air and sediment. The SMS have recently been amended (Ecology February 23, 2013) and go into effect on September 1, 2013. The SMS amendments are more fully described below in Section 5 - B. The evaluation includes surface water quality criteria, and DMMP screening levels, and comparison with recent urban results for selected chemicals in Seattle area and the state.

In addition, DOH and DMMP are preparing documents based on these sediment and water quality results. The DOH is completing a Health Consultation for the Kenmore area waterfront including Lakepointe also called the Kenmore Industrial Park site and Log Boom Park. The Health Consultation will be a separate report later this spring. The DMMP is preparing a dredge screening guidance memo and it will be posted on the web link below when it is available at:

http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/SuitabilityDetermination.aspx

Ecology participated financially with the City of Kenmore and contributed funds from the state's Clean Sites Initiative to assist with funding for a portion of this sampling effort. Ecology would like to express thanks and appreciation to the City and citizens of Kenmore for their commitment and involvement in the wellness of the waterfront area. Ecology also appreciates the diligent work and rapid turn-around provided by Anchor AEQ in finalizing the SSAP and publishing the SSAP Results Memorandum.

## 3. SSAP Work Plan

The Anchor QEA SSAP outlines the methods, procedures, sampling locations, testing and analyses, quality assurance, reporting and schedule. In general the two purposes utilized two different sampling methods. For dredge planning, the samples were collected using a box core sampler and collected 0-25 centimeters (0-10 inches) below mudline to better represent deeper sediment that would be removed during dredging. However, full dredge prism analysis (0-3.3 meters or 0-4 feet) will be needed for final characterization of the material for dredge purposes. For assessing the potential threat to human health and the environment, shallow samples were collected 0-10 centimeters (0-4 inches) using a hand trowel or grab sampler to represent the biologically active zone. This report focuses more on the second purpose: to evaluate human health and the environment.

Twenty eight sediment samples were collected at eight locations and four water samples were collected at three locations. The sampling locations are shown in Figure 1 and the sediment locations include:

- Kenmore Navigation Channel
- Log Boom Park at the waterfront in City of Kenmore
- Lyon Creek Park at the waterfront in the City of Lake Forest Park
- Washington Department of Fish and Wildlife (WDFW) Sammamish River Boat Launch at the 68$^{th}$ Avenue NE bridge

- Sammamish River at lower reaches
- Lakepointe aka Kenmore Industrial Park site at nearshore
- Harbour Village Marina
- North Lake Marina

The surface water samples were conducted at Log Boom Park and a reference sample was taken offshore at northeast Lake Washington. These samples were collected following Ecology's Standard Operating Procedure (Ecology 2006) and following protocols for Beach Environmental Assessment, Communication, and Health (Schneider 2004). Samples were collected using a dipper attached to an extended rod at a depth of 15-30 cm (6-12 inches) below water surface. The reference or background water sample was collected from boatside following the same method of the shoreline sample collection. For details, see Anchor QEA SSAP Plan in Appendix A, and Anchor QEA SSAP Results Memorandum in Appendix C.

The dredge planning samples for the Navigation Channel and one marina –North Lake Marina were collected from surface to 25 cm depth (0 – 10 inches) with care to represent each depth interval equally. These samples were homogenized, and pebbles, shells, root and wood debris were removed. The samples were analyzed for the full suite of dredge chemical analyses including conventional parameters, metals, tributyltin (TBT), polycyclic aromatic hydrocarbons (PAHs), chlorinated hydrocarbons, phthalates, phenols, miscellaneous extractables, pesticides, polychlorinated biphenyls or PCBs Aroclors, and dioxin/furans (dioxin). We did not test for volatile organic compounds (VOCs) because there is no DMMP and no other SMS Freshwater criteria for them and they were not a suspected chemical of concern. Note that the results for each chemical group are reported in different units. For example, metals are reported in milligrams per kilogram, mg/kg or parts per million; phthalates are reported in micrograms per kilogram, µg/kg or parts per billion; and dioxin/furans are reported in Toxicity Equivalency (TEQ) values in nanograms per kilogram, ng/kg or parts per trillion. TBT was measured in porewater for dredge characterization samples (micrograms per liter, µg/L) and in bulk sediment dry weight for other samples (µg/kg).

The human health and environmental evaluation samples were collected using a hand trowel (labeled HT) or sediment grab sampler (labeled SG). These samples were collected from the surface to 10 cm (0 – 4 inches) depth, representing the biologically active zone and the zone most likely accessible during near shore wading and play. During sampling, care was given to represent each depth interval equally (so the sample represented a column and not a cone). These samples were homogenized, and pebbles, shells, root and wood debris were removed. The sediment samples were analyzed for the same suite of chemical analyses with the exception of tributyltin that was analyzed only where there is an option for dredging.

The water sample analyses included conventional parameters, total and dissolved metals, polycyclic aromatic hydrocarbons, chlorinated hydrocarbons, phthalates, phenols and miscellaneous extractables. The water sample analyses did not include tributyltin, pesticides, PCBs Aroclors, and dioxin/furans. The excluded analytes are generally not found in water, and tend to adhere to sediment. Ecology made the recommendation to exclude these analyses at this time. If any of these chemicals occur in the sediment results, then future sampling will consider and evaluate the appropriate analyses for future evaluation and if any of these excluded analyses should be added to the sampling plan for future evaluation.

The samples were transported under chain-of-custody and were submitted to Analytical Resources, Inc. in Tukwila, WA for laboratory analyses. The laboratory results were reviewed and compared to quality assurance/quality control (QA/QC) parameters by Anchor QEA using EPA Stage 2A for all analyses except dioxin/furans. The QA/QC review for dioxin/furans was performed by Laboratory Data Consultants, Inc (LDC) of Carlsbad, California using EPA Stage 4 validation. The quality assurance review is to confirm custody procedures and laboratory precision, accuracy, representativeness, completeness, and comparability. One water and two sediment sample duplicates were collected and analyzed for the full suite of analyses for each medium (sediment or water). The duplicate results are reported and marked "D" as a duplicate sample. For more details, see the Anchor QEA SSAP Plan in Appendix A, and the laboratory data sheets and QA/QC review in the SSAP Results Memorandum in Appendix C.

# 4. SSAP Results Memorandum

The "Sampling and Analysis Results Memorandum for Kenmore Sediment and Water Characterization" was prepared by Anchor QEA and dated March 2013. The Memorandum summarizes the sediment and water characterization results for the Navigation Channel screening and the environmental evaluation compared to Ecology's interim sediment screening criteria. Since this time, Ecology has adopted the new SMS Amendments and the SMS Amended screening criteria are reported below in this Evaluation Report.

The Anchor QEA memorandum lists the sediment sample collection summary on Table 1, and the water quality collection on Table 2. Table 3 compares the sediment results to dredge criteria specified by the DMMP. Table 4 shows the sediment results compared with Ecology's Interim 2006 Sediment Evaluation Framework. Table 5 lists the surface water quality results and a reference sample at northeast Lake Washington. The Memorandum is a comprehensive overview of the results for the SSAP work, and is attached as Appendix C.

# 5. Environmental Evaluation Framework

## A. Report Framework

This report compares the Kenmore area sediment and water sampling results with the state's cleanup requirements. These cleanup requirements include the MTCA, the state's water quality requirements, and Ecology's new SMS Amendments and other regulatory guidelines. The chemical results are listed on each table in bold when the chemical concentration detected is above the laboratory reporting limit.

Chemical results that showed no detection are listed with a U based on the laboratory reporting limit, also called the practical quantification limit or PQL. Hundreds of chemicals were tested and if all results were no detection at the laboratory reporting limit, then they are not listed on the tables in this report. For the full suite of chemicals tested, see the Anchor QEA Results Memorandum in Appendix C.

This review presents the general results, and describes the minimum and maximum levels for each chemical analyzed and detected at one or more sample sites, as well as the results for each sampling location. The Navigation Channel results are compared with the DMMP guidance for open water disposal, and all results are compared with the state cleanup requirement for SMS freshwater screening criteria. In addition, the Kenmore area sediment dioxin results are contrasted with Seattle and Washington urban and rural soil background levels for dioxin (Ecology 2011 and Hart Crowser 2011) and the Puget Sound sediment results reported by the Ocean Survey Vessel (OSV) *BOLD* Summer 2008 Survey (DMMP 2009) in Sections 7 and 8. This report closes with conclusions and recommendations in Sections 9 and 10.

## B. Sediment Management Standards Amendments

The SMS Amendments were signed by Ecology on February 23, 2013, and go into effect on September 1, 2013. The Anchor QEA Memorandum cites the 2003 interim freshwater Screening Levels. This report uses the new SMS freshwater criteria.

Figure 2 illustrates a flow diagram for the new freshwater screening criteria and how they relate with setting cleanup levels including human health, ecological risk, Applicable or Relevant and Appropriate Requirements also called ARARs for federal, state and tribal requirements. The diagram reads from right to left with changes to the previous rule are highlighted in red. Under the old rule, MTCA cleanup requirements for human health was a single tier system that set a cleanup level at a hazard quotient equal to one, or a $10^{-6}$ risk level, or natural background, whichever is higher. The new SMS rule uses a two or multiple tier system to achieve the same hazard quotient, $10^{-6}$ risk level, or natural background, or laboratory practical quantification level whichever is higher. The new SMS rule includes freshwater screening criteria for toxicity to the benthic community (bottom dwelling organisms). The freshwater criteria establish two categories as:

- <u>Sediment Cleanup Objectives</u> (SCO) establish a no adverse effects level including acute and chronic adverse effects on the benthic community. Chemical concentrations at or below the SCO correspond to sediment quality that results in no adverse effects to benthic community.

- <u>Cleanup Screening Levels</u> (CSL) establish a minor adverse effects level, including acute or chronic effects on the benthic community. Chemical concentrations at or below the CSL but greater than the SCO correspond to sediment quality that results in minor adverse effects to the benthic community.

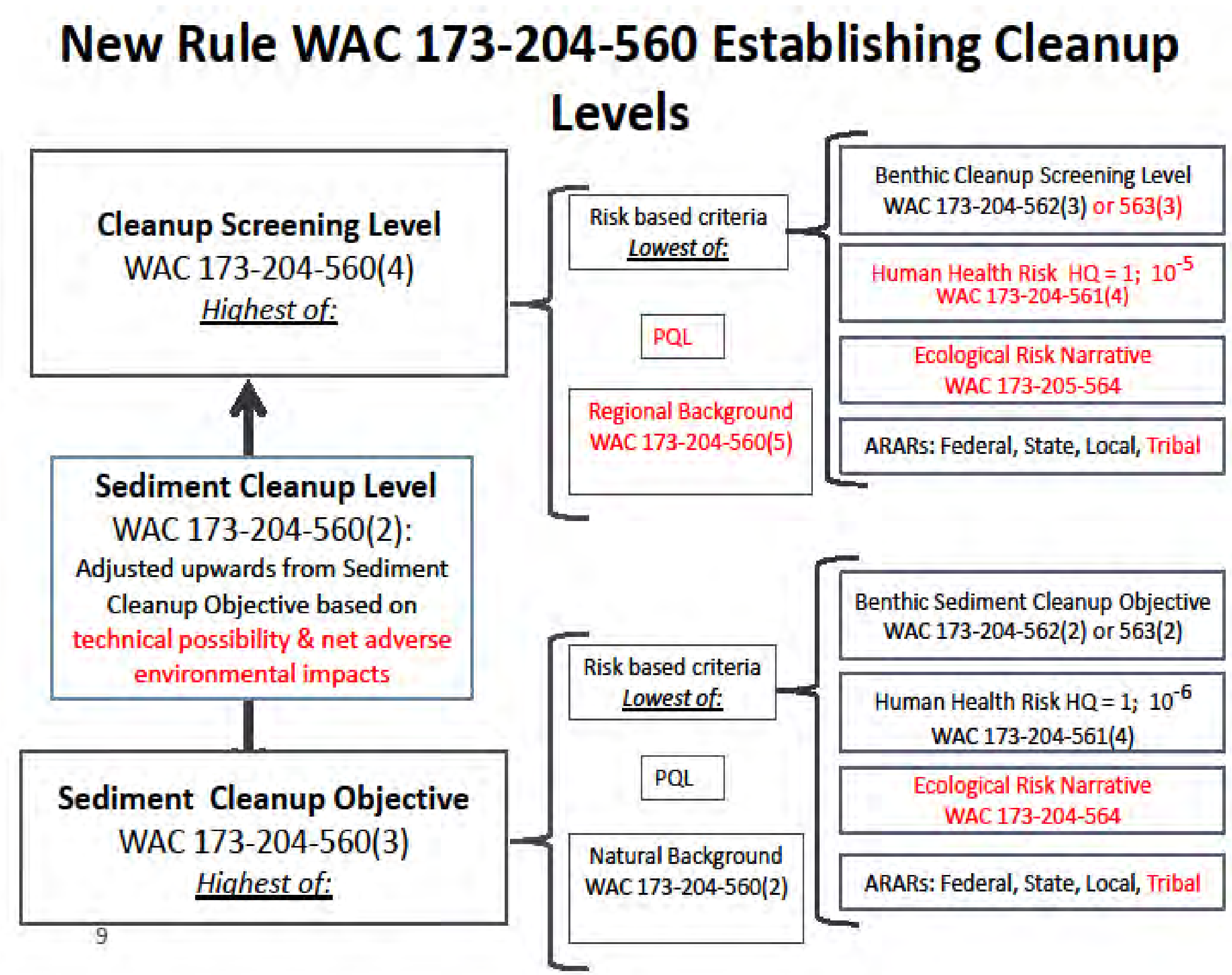


Figure 2. MTCA Sediment Management Standards New Rule WAC 173-204-560 establishing cleanup levels. Black shows existing rule and red highlights new rule changes.

The chemical and biological CSLs establish minor adverse effects as the level above which station clusters of potential concern are defined and may be defined as potential cleanup sites for benthic community toxicity and at or below which station clusters of low concern are defined per procedures identified in WAC 173-204-510.

The CSL chemical criteria are exceeded when the sediment chemical concentration for a single chemical is above the CSL as listed on the tables (SCO in yellow CSL in blue). Where the chemical criteria represent more than one chemical or a sum of individual compounds or isomers, then there are specific methods to be applied, and see SMS Rule at WAC 173-204-563(2)(f).

Ecology recognizes that for some freshwater environments, the SCO and CSL criteria may not be predictive of benthic toxicity. Sediment environments with unique geochemical characteristics may require alternative methods. When unusual characteristics are present in sediment environments -- such as bogs, wetlands, unusual pH, or places affected by metals mining, milling or smelting -- then other methods for characterizing the benthic toxicity shall be required such as biological criteria or other approaches in accordance with WAC 173-204-130 and approval by Ecology.

The SMS amendments incorporated information from a document called “Development of Benthic Sediment Quality Guidelines for Freshwater Sediments in Washington, Oregon and Idaho” (Ecology 2011). This report proposes sediment quality values (SQV) for conventional pollutants, metals, organic chemicals and petroleum hydrocarbons using two screening levels. It notes that there are significant differences in variability of water characteristics between marine and freshwater systems, and these impact bioavailability of some chemicals. Due to greater variability in some of these factors between freshwater systems, the mathematical model used to calculate marine standards did not work for developing freshwater SQVs. Because of these differences, a different mathematical model is used to calculate the freshwater SQV values.

The new SMS freshwater criteria are listed in two categories and reported as dry weight normalized as SCO and as the CSL, and for more details, see SMS Rule WAC 173-204.

# 6. Kenmore Area Sediment & Water Evaluation

## A. Overview of Kenmore Area Sediment Results

The Kenmore area sediment sampling sites cluster around specific locations such as a public park, the Navigation Channel, a marina, or Washington State Department of Natural Resources (WDNR) Aquatic Lands associated with adjacent upland property. The sediment results are grouped following these locations. The results are discussed in general and then by location.

Table 1 summarizes the detected sediment results compared to the screening criteria and lists the detected chemicals in bold, and the minimum and maximum levels reported. Overall, the Kenmore area sediment results represent 28 sediment samples (plus two field duplicates) including analyses for 11 chemical groups, and more than 120 analytical results per sample. Most results show no detection or very low levels of detection and are significantly below the Washington State SMS freshwater screening criteria, and see Appendix C for full suite of chemicals tested. Note that the freshwater criteria do not specify screening criteria for dioxin/furans (dioxin). However, the two private marinas show some elevated results.

Specifically, the two marinas show elevated phthalates, miscellaneous extractables (benzoic acid and benzyl alcohol), dioxin, and one occurrence of polychlorinated biphenyls (PCBs) and tributyltin (TBT) above one or more screening criteria. The marina sediment results are discussed below in Section 6 - G. In general, the sediment results represent an important step and worthwhile investment in evaluating the current conditions of the near shore waterfront at Lake Washington and Sammamish River in the Kenmore Area.

The Kenmore Area sediment results show almost all analyses are below Ecology’s MTCA cleanup requirements for SMS freshwater criteria with the exception of two phthalates, and one occurrence of PCBs. Note that the SMS freshwater criteria do not specify screening criteria for dioxin/furans.  Aside from the two private marinas, these results represent a relatively healthy near shore environment and natural background levels.

The Kenmore Navigation Channel sediment results show that the channel would not be classified as a MTCA cleanup site.  All Navigation Channel sediment results are below the Freshwater CSL.  Two substances were below CSL and above SCO:  two phthalates (bis(2-ethylhexyl) phthalate and di-n-octyl phthalate).  When compared to the DMMP screening guidance, there were no exceedances reported for metals, PAHs, pesticides, and PCBs.  However, the channel results showed two miscellaneous extractables and one occurrence of dioxin exceeding the dredge DMMP screening guidance.  These results are slightly above the Freshwater SCO and below the CSL criteria.  Note these are screening results for planning and do not provide full dredge characterization sampling, which will be accomplished at a later date with a dredge application.  For further details, DMMP is preparing a "Screening Level Evaluation for Kenmore Navigation Channel Dredge Planning" and see web link in Section 2.

Likewise, the near shore Lakepointe aka Kenmore Industrial Park site sediment results show no contamination above the screening values in the sediment adjacent to the KIP site at the north, west, and south waterfront.  All sediments tested adjacent to the KIP site show very low detection and are significantly below MTCA freshwater cleanup screening criteria.  So the KIP site and the Navigation Channel report a relatively healthy near shore environment.

In general, the sediment results compared to state cleanup criteria show no exceedance for metals, poly-aromatic hydrocarbons (PAHs), pesticides, and miscellaneous extractables (benzoic acid and benzyl alcohol), and only one occurrence of PCBs.  There are multiple occurrences of phthalates and dioxin.  The phthalates are present at most sampling sites and specifically three phthalates are identified:

- bis(2ethylhexyl) phthalate
- dimethyl phthalate
- di-n-octyl phthalate

Phthalates are common urban background substances, some of which have screening and cleanup level requirements.

Dioxin/furans (dioxin) were detected at all 28 sample locations, and mostly at low urban background levels except at the two private marinas.  Dioxin concentration ranged from 0.25 to 71.0 TEQ (toxicity equivalency values) in parts per trillion (pptr) and the median is 3.1 TEQ parts per trillion.  The state soil cleanup standard for dioxin is 11 parts per trillion.  Six of the study's samples were above 11 parts per trillion and 82 percent of the samples were below 11 parts per trillion.  For more detail on the dioxin results, see Sections 7 and 8 below.

The source or sources of dioxin in this area are unknown at this time.  The dioxin results suggest that this chemical does not originate from the Navigation Channel, the Lakepointe aka Kenmore Industrial Park site, nor the Sammamish River as concentrations at these three locations were significantly below the concentration at the two marinas.  The sediment results also suggest that the source of dioxin is not ongoing, nor continuous, and may have been an historic release, as these results represent a much lower concentration compared with the 2011 marina results for Harbour Village Marina (Harbour Village Marina Dredging 2011 Characterization, 2011).

Note the Harbour Village Marina 2011 sample results represent composite samples (two or three discrete samples homogenized together to represent one sample), so the Harbour Village Marina 2011 results camouflage the sample source location. Specifically, a composite sample represents an average based on sample materials from two, three or more locations, so the results cannot be traced to one sample location. More work will be required to identify the dioxin source or sources. Ecology will follow up on possible sources for the dioxin when funds become available.

## B. Overview Kenmore Area Water Characterization Results

The four surface water samples representing Log Boom Park and northeast Lake Washington reference or background show all results as very low levels of detection and significantly below cleanup and water quality criteria and listed on Table 2. The testing included total and dissolved metals, poly-aromatic hydrocarbons, chlorinated hydrocarbons, phthalates, phenols and miscellaneous extractables. Nine total metals and eight dissolved metals and pentachlorophenol were the only chemicals detected. The metals and phenol showed very low concentration levels, significantly below MTCA water quality standards, and do not represent a risk to human health nor aquatic life and the environment.

The surface water results for pentachlorophenol report very low levels of concentration ranging from 0.020 to 0.024 J µg/L or parts per billion, significantly below the cleanup level. Note symbol J represents that the analyte is present and the concentration level is estimated. The reference water sample results for northeast Lake Washington offshore show no detection and are below the laboratory practical detection level for pentachlorophenol at 0.025 U µg/L or parts per billion. Note symbol U represents that the analyte is not detected at or above the laboratory practical quantification level. When compared to the MTCA surface water cleanup level for protection of human health in freshwater, the level for pentachlorophenol is 0.27 µg/L under the Clean Water Act §304 and 0.28 µg/L under National Toxics Rule -40 CFR 131. For comparison with protection for aquatic life the level is 19 µg/L for freshwater acute under the Clean Water Act §304 and 20 µg/L under National Toxics Rule -40 CFR 1312. This information and more detail may be viewed at CLARC (Ecology 2013) online at:

https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

So the Log Boom Park and northeast Lake Washington water reference results are significantly below protection levels for human health and aquatic life. Note that the pentachlorophenol level is pH dependent, and a pH level of 7.8 was used to calculate the standard. The pH values for Lake Washington water samples varied from 7.5 to 7.9 and are similar to the calculated standard. These Lake Washington surface water results are more than an order of magnitude below MTCA and CLARC levels, and do not represent a known risk to human health nor the environment.

## C. Public Parks and Boat Launch Location Sediment Results

The sediment results for the public parks and boat launch location show all chemicals are below the state cleanup action level. Table 3 lists the sediment results for the parks – Log Boom Park in Kenmore and Lyon Creek Park in Lake Forest Park -- and the WDFW boat launch area at the Sammamish River and 68th Avenue NE bridge in the City of Kenmore. These results are compared with the SMS freshwater screening criteria.

The public parks results show that the waterfront areas do not represent a risk to human health and the environment based on state cleanup SMS freshwater screening criteria. The boat launch location shows all substances below state cleanup requirements. There is no SMS screening criterion for dimethyl phthalate, and at this time we do not know the toxicity of dimethyl phthalate. Ecology recommends that it be considered a possible chemical of concern at this location, and include it in future evaluation. Ecology has notified the WDFW about the boat launch results. Pesticides and PCBs were below laboratory detection levels. Four metals – cadmium, chromium, copper and zinc -- were detected at low levels and significantly below SMS freshwater screening criteria. Likewise, PAHs, miscellaneous extractables, and PCBs were at low concentrations and significantly below screening criteria.

Dioxins at the public locations were detected at low levels ranging from 0.30 to 7.9 TEQ parts per trillion and the median is at 0.92 TEQ parts per trillion. These results show that the near shore sediments at these parks and boat launch location are well within what would be considered natural background for dioxin. No further evaluation is required by Ecology at these parks and the boat launch location. Ecology has notified WDFW about the boat launch results.

## D. Kenmore Navigation Channel Sediment Results

The Navigation Channel results are listed on Table 4 and compared to the Dredge Materials Management Program (DMMP) open water disposal guidance and the SMS freshwater criteria. For DMMP open water disposal guidance, three chemicals are reported above screening level 1 (SL) and they are two miscellaneous extractables (benzoic acid and benzyl alcohol) and dioxin. For further details on dredge evaluation see DMMP memorandum "Screening Level Evaluation for Kenmore Navigation Channel Dredge Planning" and see web link in Section 2.

Table 4 includes all samples collected at the Kenmore Channel. Note the U.S. Army Corps of Engineers (USACE) classifies the Navigation Channel as sample #SG-04 to SG-09 shown in white lines on Figure 1, and in this report Ecology includes sample #SG-14 located at the northeast area of the channel.

When comparing the Navigation Channel results with the SMS freshwater criteria, almost all results show no detection and are significantly below freshwater criteria with the exception of two chemicals. The chemicals are bis(2-ehtylhexyl)phthalate and di-n-octyl phthalate which were above their respective SCOs but well below their respective CSLs. Several metals, several other phthalates, and all pesticides were not detected above the laboratory reporting limit. There are two occurrences of PCBs compared to eight sample results and the detected concentrations are 20 and 22 parts per billion, and are significantly below the freshwater SCO screening criterion of 110 parts per billion.

Freshwater criteria for dioxin/furans are not available at this time. The Navigation Channel (including the Kenmore Harbor sample SG-14) dioxin sediment concentrations range from 1.6 to 10.1 TEQ parts per trillion, and the median is 4.6 TEQ parts per trillion. For general comparison, the MTCA soil dioxin cleanup level is 11 parts per trillion and although soil is a different medium compared to sediment, all the Navigation Channel sediment results are below the dioxin soil cleanup level, and are similar to natural background levels. For more details on dioxin see Sections 7 and 8 below.

### E. Lakepointe aka Kenmore Industrial Park Site Sediment Results

The Lakepointe, also called the Kenmore Industrial Park site is surrounded by water on three sides of this 50-acre site. Sediment samples were collected to the north at the Kenmore Navigation Channel, to the west at Lake Washington, and to the south at the lower reaches of the Sammamish River. The sediment samples were collected at nearshore WDNR Aquatic Lands. The KIP site is located at the 6500 - 6800 blocks of NE 175$^{th}$ Street in Kenmore, King County, Washington. The sediment results are listed on Table 5. Note that one sample in this group is part of the Navigational Channel results (#SG-04) and is included in this section for a more complete characterization of the KIP location.

The KIP location sediment results show all chemical groups tested are significantly below SMS freshwater screening criteria. These sediment results show no detection for several metals, pesticides and PCBs (except one occurrence at low level). All phthalates and miscellaneous extractables are below freshwater screening criteria. Dioxin is detected and ranges from 0.36 to 10.1 TEQ parts per trillion and the median is 1.6 TEQ pptr. There are no SMS freshwater screening criteria for dioxin at this time. So, the KIP site near shore sediment results represent natural background and do not represent a risk to the freshwater benthic community. No further evaluation is required.

### F. Sammamish River Location Sediment Results

The lower reaches of the Sammamish River location included five sediment samples and the results are listed on Table 6. The sediment results show that most chemicals are reported below laboratory detection, and no chemical is reported above the SMS freshwater screening criteria. There is no SMS screening criterion for dimethyl phthalate. At this time we do not know the toxicity of dimethyl phthalate, and recommend that it be considered a possible chemical of concern at this location, and to be included in future evaluation. Dioxin results range from 0.36 to 2.3 TEQ parts per trillion, and the median is 0.56 TEQ parts per trillion. All dioxin results are below the state soil cleanup level at 11 TEQ parts per trillion. No further evaluation is required.

### G. Private Marina Location Sediment Results

The two private marinas list elevated sediment results for four specific chemicals shown on Table 7. Harbour Village Marina includes five sediment samples with a depth of 0 – 10 cm (0 – 4 inches), representing the biologically active zone. The North Lake Marina lists two sediment samples with a depth of 0 - 25 cm (0 – 10 inches) for dredge planning. When comparing these results, please note that the sediment samples represent varying depths. Harbour Village Marina is located at 6155 NE 175$^{th}$ Avenue, and the North Lake Marina is located east towards the Navigation Channel at 6201 NE 175$^{th}$ Avenue, in Kenmore, Washington. The Washington Department of Natural Resources holds Aquatics Land lease agreements with each marina.

The Harbour Village Marina sediment results show two phthalates above the state cleanup requirements for freshwater criteria. TBT ranged from 3.6 to 12 µg/kg or parts per billion, which is below the freshwater Sediment Cleanup Objective (SCO) criterion of 47 parts per billion. Bis(2-ethylhexyl) phthalate and di-n-octyl phthalate results ranged two to three times above the respective freshwater CSL. Dioxin sediment results range from 6.6 to 71 TEQ pptr and the median is 26.6 TEQ pptr. Further testing will be required for evaluation and dredge planning.

The North Lake Marina sediment results show the same two phthalates above SMS freshwater criteria and similar exceedence as the Harbour Village Marina, plus one occurrence of PCBs. However, the TBT results at North Lake Marina are for porewater, not bulk sediment, and are not comparable with the freshwater criteria. This is because the samples were taken for dredge planning purposes, and the DMMP open water disposal guidance is based on porewater, not bulk concentrations. Note that the porewater concentration for one of the two samples exceeded DMMP's open water guidance.

North Lake Marina showed PCBs ranging from 22 to 121 parts per billion which is slightly above the freshwater Sediment Cleanup Objective (110 parts per billion) and significantly below the freshwater CSL (2500 parts per billion). The freshwater SCO shows no adverse effects to benthic (bottom dwelling) organisms compared to CSL with minor adverse effects to the benthic community. NOAA has a fish screening level for PCBs at 76 parts per billion, and one of two sample results at North Lake Marina is above this level. Dioxin sediment results list concentrations ranging from 20.3 to 37 TEQ parts per trillion, and the mean is 28.7 TEQ pptr at North Lake Marina.

All other chemicals tested at the two marinas were below laboratory detection levels and do not represent a risk to human health and the environment. Ecology has met with the marina owners and WDNR, and we have agreed to work together for the next steps in dredge planning and environmental evaluation.

## 7. Kenmore Area Sediment Dioxin Results Comparisons

The Kenmore area sediment results for dioxin are listed on Table 8 and compared with the Seattle urban neighborhood soil dioxin results (Ecology 2011) and the Washington State background soil dioxin levels including urban and rural parks (Hart Crowser 2011). These results are compared with state and federal regulatory limits. The Seattle neighborhood dioxin results are attached in Appendix D.

The three studies represent two different environmental media, one being sediment in the Kenmore area and the other soils. Each medium (soil or sediment) has different characteristics and properties. Cleanup and screening criteria involve multiple evaluations for each medium related to health risk, pathways and exposures. Information in this section is available for background information. The reader should consider these differences when comparing Kenmore area sediment results with Seattle, other cities and/or rural background soil results.

Table 8 lists the results from the three studies including urban neighborhoods, urban and rural parks, and open and forested areas. The dioxin results are all reported in dry weight toxicity equivalency (TEQ) values in parts per trillion (pptr). The results are compared with state and federal regulatory cleanup and screening levels. The regulatory levels show a range of limits for dioxin from 4 parts per trillion for dredge screening for open water disposal to 72 parts per trillion for the EPA proposed soil dioxin cleanup level.

The Kenmore area sediment dioxin levels range from 0.3 to 71 parts per trillion with the two private marina results, and from 0.3 to 10 parts per trillion without the marina results, while the Seattle urban neighborhood levels range from 1.7 to 115 parts per trillion. With or without the two private marina results, the Kenmore sediment dioxin levels are lower than the Seattle urban neighborhood soil dioxin levels.

At the Kenmore area with the two private marina results, 18 percent of the samples are above the state MTCA soil cleanup level for dioxin as compared with 53 percent of the Seattle urban soil dioxin samples. At the Kenmore area without the two private marina results, there are no sample locations above the MTCA soil cleanup level at 11 parts per trillion. The MTCA method B soil dioxin cleanup level represents cleanup level protective for unrestricted land use.

The third study analyzes Washington urban and rural parks soil dioxin background levels, including open and forest soil results, range from 0.03 to 19 parts per trillion. The Washington parks soil dioxin results are significantly lower than the Kenmore sediment dioxin results with the two private marinas (range 0.3 to 71 pptr). However, the Kenmore results without the two marinas (range 0.3 to 10 pptr) are lower than the Washington urban and rural parks soil level.

Similarly, the Washington urban and rural park dioxin soil results show an estimated 8 out of 30 samples above MTCA soil dioxin cleanup level, or approximately 27 percent. The open and forest park areas are all below the state MTCA soil cleanup level.

The federal Agency for Toxic Substances Disease Registry (ATSDR) is a screening level set at 50 parts per trillion to identify when more study is needed, and it is not a cleanup level. In comparing the number of Kenmore samples above the ATSDR screening level, there are two Kenmore results from one private marina, and no other Kenmore sediment result is above this level. For Seattle neighborhoods, there are nine sample results above the ATSDR screening level. The urban or rural parks show all results below the ATSDR screening level.

The proposed EPA draft soil dioxin cleanup level at 72 parts per trillion, when compared with the Kenmore dioxin results, show that no Kenmore area sediment dioxin result is above this EPA cleanup level. For the Seattle neighborhood soil results, three of the 120 results are above this EPA cleanup level representing 2.5 percent of the sample results. The Washington urban and rural park soil dioxin results are all below the proposed EPA limit. Again, Table 8 represents two different media (sediment and soil) and it is provided for background information. The Kenmore sediment results are significantly lower compared with the Seattle urban soil results, and are similar and slightly lower when compared with the Washington urban and rural parks background information.

Specifically, when you compare Log Boom Park and Lyon Creek Park results ranging from 0.30 to 7.9 parts per trillion with urban park soil results ranging from 0.13 to 19 pptr and rural open and forested park soil results ranging from 0.03 to 5.2 pptr, one sees that Log Boom Park and Lyon Creek Park results are lower compared to urban parks, and on par with rural open and forested park background soil levels. This suggests that whatever the causes are for the Seattle neighborhood soil dioxin levels, these causes have not impacted the near shore Lake Washington park environment at Kenmore and Lake Forest Park.

# 8. Kenmore Sediment Comparison with the OSV *Bold* Survey

The DMMP agencies (US Army Corps of Engineers, EPA, WDNR and Ecology) conducted a survey to evaluate the Puget Sound sediment to set guidelines for several persistent organic substances and prepared the "Ocean Survey Vessel *Bold* Summer 2008 Survey Report" (DMMP 2009). The survey includes sediment results for dioxin/furans in addition to other substances. This dataset allows comparison of dioxins concentrations found in marine sediments that can be considered background.

The survey shows that overall dioxin concentration ranged from 0.05 to 11.6 TEQ parts per trillion with a median value of 0.86 TEQ pptr (Table 9). The Kenmore freshwater sediment results show a dioxin range from 0.3 to 71 TEQ pptr with a median value of 3.1 TEQ pptr with the private marina results included, and a range from 0.3 to 10 TEQ pptr and median value of 1.4 TEQ pptr without the two private marina results. Excluding the two private marina results, the Kenmore dioxin sediment results show very similar dioxin concentrations as found in Puget Sound background.

The OSV *Bold* survey data indicate no correlation between dioxin concentrations and the total organic carbon (TOC) in sediment or the percent of fine particles within the sediment samples (percent of clay and silt size particles). This lack of correlation was likely due to the low concentrations of dioxins, which makes correlations and trend analysis difficult.

# 9. Kenmore Area Sediment & Water Evaluation Conclusions

The Kenmore area sediment and water characterization results show that both sediment and water at northeast Lake Washington and the lower reaches of the Sammamish River are below the state cleanup requirements with the exceptions of the two private marinas. Elevated dioxin concentrations were detected at two private marinas. The marina sediment results show two chemicals above SMS freshwater CSL and three chemicals above freshwater SCO. Ecology, the marina owners and WDNR have agreed to work together for future testing and dredge planning.

The surface water evaluation at the Log Boom Park and northeast Lake Washington water reference results are significantly below protection levels for human health and aquatic life.

The sediment sample locations include a variety of land use from public parks and a boat launch to private marinas and commercial-industrial land use. There are no sediment results above the freshwater SCO and CSL screening criteria at the public parks. The boat launch and the lower Sammamish River sediment results show natural background levels and no environmental risk compared to SMS freshwater criteria. Elevated dimethyl phthalate was detected at the boat launch and its toxicity is unknown at this time. Ecology recommends that this chemical would be carried forward as a chemical of concern and to be included in future evaluation.

The Navigation Channel shows no chemicals above the SMS freshwater CSL and two chemicals above freshwater SCO. The KIP site shows no chemical above freshwater CSL and one chemical above freshwater SCO. The Kenmore Navigation Channel and the Lakepointe aka Kenmore Industrial Park site show all results are below state cleanup requirements except two phthalates at the channel. All other chemicals tested report detections significantly below state cleanup requirements, and no further evaluation is required by Ecology. These results confirm that the former landfill underlying part of the KIP site is not causing chemicals of concern to migrate into the sediments at the adjacent waterways –Navigation Channel, Lake Washington and the lower reaches of the Sammamish River.

This sediment and water characterization work provides an important step in the screening process. The results indicate there are no significant environmental issues at the two public parks. Most of the sediment results are below SMS freshwater criteria except the two private marinas. One sample containing dimethyl phthalate was present at the boat launch location, and the toxicity of this substance is not known. The sediment results compared to state cleanup criteria show no exceedance for metals, poly-aromatic hydrocarbons (PAHs), pesticides, and miscellaneous extractables (benzoic acid and benzyl alcohol), and only one occurrence of PCBs, and multiple occurrences of phthalates and dioxin at low concentrations.

# 10. Kenmore Area Sediment & Water Evaluation Recommendations

Based on the sediment and water characterization results for the Kenmore area, Ecology will not require further environmental testing except at the two private marinas. Additional environmental testing is recommended for the sediment beneath the two private marinas. Ecology has met with the marina owners and Washington Department of Natural Resources Aquatics Land manager. All parties have agreed to work together for dredge planning and future evaluation.

For the boat launch location, Ecology has forwarded these results to WDFW, the agency who maintains the boat launch facilities to notify them of the occurrence of one chemical and that its toxicity is unknown. Ecology recommends that this chemical -dimethyl phthalate would be carried forward as a chemical of concern at this location and to be included in future evaluation.

For any future sampling or evaluation, Ecology recommends that additional sampling efforts to consider including testing for tributyltin, phthalates, miscellaneous extractables, and dioxin for future surface water evaluation because these substances were detected in sediment at a nearby waterfront location. These analytical methods were excluded in the surface water testing for this work.

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# Figure


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ANCHOR QEA

**Figure 2**
Sample Locations
Sampling and Analysis Plan
Kenmore Sediment Characterization

# Tables

## Kenmore Area Sediment Sampling Results - November 2012

### Table 1. Kenmore Area Sediment Results - Minimum & Maximum Levels Compared to Screening Criteria.

| Screening Criteria | SMS Freshwater[a] | | All Locations Environ'l Evaluation | | DMMP Guidance | | Navigation Channel Dredge Planning | |
|---|---|---|---|---|---|---|---|---|
| Analyte | SCO | CSL | Min | Max | DMMP SL | DMMP ML | Min | Max |
| Sample Depth, cm | | | 0-10 cm | 0-10 & 0-25 cm | | | 0-25 cm | 0-25 cm |
| Metals, mg/kg, ppm | | | | | | | | |
| Cadmium | 2.1 | 5.4 | 0.2U | **1.3** | 5.1 | 14 | **0.3** | **0.8** |
| Chromium | 72 | 88 | **17.8J** | **56** | 260 | -- | **35** | **57** |
| Copper | 400 | 1200 | **4.3** | **220** | 390 | 1300 | **14.6** | **111J** |
| Zinc | 3200 | >4200 | **34** | **377** | 410 | 3800 | **49** | **182J** |
| Tributyltin* ug/L or ug/kg | 47 ug/kg[a] | 320 ug/kg[a] | no sample | no sample | 0.15ug/L | | 0.005U ug/L | **0.049 ug/L** |
| | | | | | | | | |
| Polycyclic Aromatic Hydrocarbons, ug/kg, ppb | | | | | | | | |
| Total Light PAHs, U=1/2 | not specified | | 4.8U | **3,600** | 5200 | 29,000 | **78J** | **1500** |
| Total High PAHs, U=1/2 | 7,000 | 30,000 | **3.1J** | **2,000** | 12,000 | 69,000 | **600J** | **4,200** |
| Phthalates, ug/kg, ppb | | | | | | | | |
| Bis(2-ethylhexyl) Phthalate | 500 | 22,000 | **16J** | **740** | 1300 | 8300 | 62U | **540** |
| Dimethyl Phthalate** | not specified** | | 19U | **970** | | | 19U | 20U |
| Di-n-octyl Phthalate | 39 | >1100 | **11J** | **87** | 6200 | 6200 | 19U | **41J** |
| Miscellaneous Extractables, ppb | | | | | | | | |
| Benzoic acid | 2900 | 3800 | **140J** | **1500** | 650 | 760 | **300J** | **1300** |
| Benzyl alcohol | not specified | | 18U | **530** | 57 | 870 | 20U | **190** |
| | | | | | | | | |
| PCBs Total, ug/kg, ppb | 110 | 2500 | 17U | **121** | 130 | 3100 | 18U | **22** |
| | | | | | | | | |
| Dioxin TEQ ng/kg,pptr,U=1/2 | not specified | | **0.30J** | **71.0J** | 4 | 10 | **1.6J** | **10.1J** |

MTCA Sediment Freshwater Benthic Community
Sediment Cleanup Objectives & Cleanup Screening L:
Freshwater SCO = No adverse effects benthic comm
Freshwater CSLevel = Establishes a minor adverse effects level including acute or chronic effects & maybe defined as potential cleanup for benthic community see Rule Chapter 173-204 WAC.
Dredge DMMP Screening Level 1 (SL1).
Dredge DMMP Marine Maximum Level (MML).

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.
U = Laboratory analysis shows chemical is not detected (is not present) at the reporting limit.
* Tribytyltin = Reported for DMMP as porewater in ug/L or ppb; or SMS reported as bulk in ug/kg or ppb.
PAH-TH = Total High Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total Low PAHs.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.
Phthalate DNOP = Di-n-octyl phthalate. PCBs = Total 7 Polychlorinated biphenyls (Aroclors).
**Dimethyl phthalate toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency (TEQ) values for 2005 World Health Organization.
SMS Freshwater[a] =criteria reported in parts per billion dry weight see WAC 173-204-563(2)(g) or as specified.

# Kenmore Area Sediment & Water Results - November 2012

## Table 2. Kenmore Area Surface Water Results Compared to MTCA Method B and Surface Water ARARs - other cleanup requirements.

| Kenmore Area Detected Chemicals | MTCA Screening Criteria | | Log Boom Park Surface Water Results | | | NE Lake Washington Reference |
|---|---|---|---|---|---|---|
| Analyte | Method B | ARARs[1] | HT-01W | HT-04W | HT-04WDup | WS-10 |
| | Surface | acute/chronic | | | | |
| Total Metals, ug/L, ppb | | | | | | |
| Arsenic | 5* | 360/190 | **2** | **2** | **1.2** | **0.9** |
| Barium | 560** | | **11** | **9** | **8.7** | **6.2** |
| Copper | 2660 | 13.04/8.92 | **2.8** | **2.6** | **3.2** | **1.6** |
| Lead | 15* | 47.43/1.85 | **0.5** | 0.5U | **0.3** | 0.1U |
| Nickel | 1100 | 1114/123 | **2** | **1** | **1.2** | **0.7** |
| Zinc | 16,500 | 90/82 | 20U | 20U | 4U | 4U |
| Dissolved Metals, ug/L, ppb | | | | | | |
| Arsenic | 5* | 360/190 | **0.8** | **1.0** | **1.0** | **0.8** |
| Barium | 560** | | **7.4** | **7.8** | **7.7** | **6.0** |
| Copper | 2660 | 13.04/8.92 | **1.9** | **2.1** | **2.0** | **1.2** |
| Lead | 15* | 47.43/1.85 | **0.1** | **0.1** | 0.1U | 0.1U |
| Nickel | 1100 | 1114/123 | **1.1** | **1.1** | **1.0** | **0.8** |
| Zinc | 16,500 | 90/82 | **6** | 4U | 4U | 4U |
| Phenols, ug/L, ppb | | | | | | |
| Pentachlorophenol | 4.91 | 0.28 | **0.024J** | **0.022J** | **0.020J** | 0.025U |

*Ecology 4/30/13*

Model Toxics Control Act method B for surface water standard formula values see CLARC (Ecology 2013), and
ARARs[1] = Ambient Water Quality Criteria for protection of aquatic life from WAC 173-201A-040 see CLARC link at: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

* = MTCA method A groundwater for arsenic set on Washington background level, for lead set on applicable state and federal law (40 C.F.R. 141.80).

** = Method B groundwater for barium set on barium and compounds.

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.

U = Laboratory analysis shows chemical is not detected.

# Kenmore Area Lake Washington & Sammamish River Sediment Sampling Results - November 2012

## Table 3. Public Parks and Boat Launch Sediment Results and note units vary by chemical group.

| Analyses | Screening Criteria SMS Freshwater[a] | | Lyon Creek Park | | Log Boom Park | | | | | | Samm Boat Launch | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte/Sample # | SCO | CSL | #HT-10 | #HT-11 | #HT-01 | #HT-02 | #HT-03 | #HT-04 | #HT-05 | #HT-06 | #HT-08 | #HT-09 |
| Sampe Depth, cm | | | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm |
| Metals, mg/kg, ppm | | | | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | **0.3** | **0.3** | 0.2U | 0.3U | **0.3** | **0.5** | **0.4** | **0.3** | **0.3** | **0.4** |
| Chromium | 72 | 88 | **24.3J** | **22.6J** | **17.8J** | **23.3J** | **23J** | **27J** | **20.3J** | **25.5J** | **29.6J** | **28.8J** |
| Copper | 400 | 1200 | **8.9** | **8.9** | **4.3** | **5.6** | **7.6** | **15.2** | **220** | **9.9** | **38.2** | **21.9** |
| Zinc | 3200 | >4200 | **59** | **55** | **34** | **41** | **58** | **117** | **69** | **53** | **54** | **64** |
| Polycyclic Aromatic Hydrocarbons, ppb | | | | | | | | | | | | |
| Total Light PAHs, U=1/2 | | | **43** | 4.8U | **17J** | **47J** | **590J** | **2000** | **24J** | **83J** | **28J** | **71J** |
| Total High PAHs,U=1/2 | 7,000 | 30,000 | **240J** | **30J** | **23J** | **77J** | **860** | **3600** | **98J** | **450** | **130** | **330J** |
| | | | | | | | | | | | | |
| Phthalate, ppb | | | | | | | | | | | | |
| Bis(2ehtylhexyl) Phth | 500 | 22,000 | **31** | **21J** | **16J** | **18J** | **66** | **460** | **23** | **110** | **72** | **130** |
| Dimethyl Phthalate* | not specified* | | 19U | 20U | 19U | 20U | 19U | 20U | 18U | 19U | **97** | **970** |
| DNO Phth | 39 | >1100 | 19U | 20U | 19U | 20U | 19U | 20U | 18U | 19U | 18U | **15J** |
| Misc Extractables, ppb | | | | | | | | | | | | |
| Benzoic acid | 2900 | 3800 | 390U | 390U | 380U | 390U | 390U | **390J** | 370U | 380U | 370U | **140J** |
| Benzyl alcohol | not specified | | 19U | 20U | 19U | 20U | **20** | **210** | 18U | **37** | 18U | **23** |
| | | | | | | | | | | | | |
| PCBs Total, ppb | 110 | 2500 | 19U | 19U | 18U | 19U | 19U | **28J** | 17U | 17U | 17U | 19U |
| | | | | | | | | | | | | |
| Dioxin TEQ,pptr, U=1/2 | not specified | | **0.54J** | **0.37J** | **0.30J** | **0.630J** | **2.2J** | **7.9J** | **1.2J** | **1.3J** | **0.56J** | **1.4J** |

*Ecology April 30, 2013*

MTCA Sediment Management Standards for Freshwater Benthic:
Sediment Cleanup Objectives (SCO) & Cleanup Screening Levels (CSL):
Freshwater SCO = No adverse effects to benthic community.
Freshwater CSL = Establishes a minor adverse effects level including acute or chronic effects and may be defined as potential cleanup for benthic community see Rule WAC 173-204 Sediment Management Standards.

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.
U = Laboratory analysis shows chemical is not detected (is not present) at detection reporting limit.
PAH-TH = Total High Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total Low PAHs.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.
Phthalate DNOP = Di-n-octyl phthalate. PCBs Total = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency (TEQ) values 2005 World Health Organization.
ppm = parts per million. ppb = parts per billion. pptr = parts per trillion.

* Dimethyl phthalate toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.

SMS Freshwater[a] = Feshwater screening critieria reported in parts per billion dry weight from WAC 173-204-563(2)(g) or as specified.

# Kenmore Area Lake Washington & Sammamish River Sediment Sampling Results - November 2012

**Table 4. Navigation Channel results are compared with MTCA Sediment Freshwater criteria[a] and Dredge DMMP screening guidance.**
Note sample depth varies and results are reported in different units -parts per million (ppm), parts per billion (ppb) and parts per trillion (pptr).

| Screening Criteria | SMS Freshwater[a] | | DMMP Planning | | East KNC[b] | Kenmore Navigation Channel Results - NE to SW | | | | | | | Range | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte/Sample # | SCO | CSL | SL | ML | #SG-14 | #SG-04 | #SG-05 | #SG-06 | #SG-07 | #SG-07 Dupl | #SG-08 | #SG-09 | Min | Max |
| Sample depth, cm | | | | | 0-10 cm | 0-15 cm | 0-23 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm | | |
| Metals, mg/kg, ppm | | | | | | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | 5.1 | 14 | **0.7** | **0.3** | **0.7** | **0.8** | **0.6** | **0.6** | **0.6** | **0.6** | **0.3** | **0.8** |
| Chromium | 72 | 88 | 260 | -- | **36** | **35** | **43** | **57** | **41** | **44** | **44** | **48** | **35** | **57** |
| Copper | 400 | 1200 | 390 | 1300 | **111J** | **14.6** | **35.6** | **43.6** | **30** | **28.7** | **28** | **31.1** | **14.6** | **111J** |
| Zinc | 3200 | >4200 | 410 | 3800 | **182J** | **49** | **143** | **164** | **126** | **123** | **113** | **130** | **49** | **182J** |
| Tributyltin** ug/L or ug/kg | 47 ug/kg[a] | 320 ug/kg[a] | 0.15ug/L | 0.15ug/L | **0.010** | **0.049** | **0.008** | **0.023** | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | **0.049** |
| <u>Polycyclic Aromatic Hydrocarbons, ppb</u> | | | | | | | | | | | | | | |
| Total Light PAHs, U=1/2 | not specified | | 5200 | 29,000 | **1500** | **190J** | **330** | **250J** | **120J** | **103J** | **78J** | **83** | **78J** | **1500** |
| Total Heavy PAHs, U=1/2 | 17,000 | 30,000 | 12,000 | 69,000 | **4200** | **900J** | **1340** | **1510** | **860J** | **690J** | **620J** | **600J** | **600J** | **4200** |
| <u>Phthalates, ppb</u> | | | | | | | | | | | | | | |
| Bis(2-ethylhexyl)Phthalate | 500 | 22,000 | 1300 | 8300 | **280** | 62U | **260** | **540** | **330** | **300** | **240** | **240** | 62U | **540** |
| Dimethyl Phthalate* | not specified* | | | | 19U | 20U | 20U | 20U | 20U | 19U | 19U | 20U | 19U | 20U |
| DNOP | 39 | >1100 | 6200 | 6200 | **24** | 20U | **22J** | **41J** | **22J** | 19U | 19U | 20U | 19U | **41J** |
| <u>Miscellaneous Extractables, ppb</u> | | | | | | | | | | | | | | |
| Benzoic acid | 2900 | 3800 | 650 | 760 | **610** | 390U | **1300** | **1100** | **430** | **480** | **300J** | **510** | **300J** | **1300** |
| Benzyl alcohol | not specified | | 57 | 870 | **100** | 20U | **160** | **190** | **120** | **100** | **61** | **110** | 20U | **190** |
| | | | | | | | | | | | | | | |
| PCBs Total, ppb | 110 | 2500 | 130 | 3100 | **20** | 20U | 29U | 28U | 19U | **22** | 18U | 20U | 18U | **22** |
| | | | | | | | | | | | | | | |
| Dioxin TEQ, pptr, U=1/2 | not specified | | 4 | 10 | **10.1J** | **1.6J** | **6.8J** | **8.4J** | **4.2J** | **4.0J** | **3.9J** | **4.9J** | **1.6J** | **10.1J** |

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MTCA Sediment Management Standards for Freshwater Benthic:
Sediment Cleanup Objectives (SCO) & Cleanup Screening Levels (CSL):
Freshwater SCO = No adverse effects to benthic community.
Freshwater CSL = Establishes a minor advers effects level including acute or chronic effects and maybe defined as potential cleanup for benthic community see Rule.
Dredge DMMP Screen Level 1 (SL).
Dredge DMMP Marine Maximum Level (ML).

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.
U = Laboratory analysis shows chemical is not detected (is not present) at the laboratory detection reporting limit.
East KNC[b] = sample location at northeast of USACE defined Kenmore Navigation Channel.
Tributyltin** testing for DMMP reported in porewater as ug/L, and SMS reported as dry weight normalized in ug/kg or parts per billion.
PAH-TH = Total High Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total Low PAHs.
Phthalate DNOP = Di-n-octyl phthalate. PCBs Total = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency (TEQ) values as of 2005 World Health Organization.
[a]SMS Freshwater screening criteria reported in parts per billion dry weight from WAC 173-204-563(2)(g) or as specified.

* Dimethyl phthalate reported levels are higher than interim freshwater criteria, toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.

## Kenmore Area Lake Washington & Sammamish River Sediment Sampling Results - November 2012

### Table 5. Lakepointe aka Kenmore Industrial Park Site results compared with SMS Freshwater screening criteria.

Note sample depth varies and results are reported in different units -parts per million (ppm), parts per billion (ppb) and parts per trillion (pptr).

| Screening Criteria | SMS Freshwater[a] | | Kenmore Industrial Park Site - NE to West to SE | | | | | Range | |
|---|---|---|---|---|---|---|---|---|---|
| Analyte/Sample # | SCO | CSL | #SG-14 | #SG-04 | #SG-15 | #SG-16 | #SG-17 | Min | Max |
| Sample depth, cm | | | 0-10 cm | 0-15 cm | 0-10 cm | 0-10 cm | 0-10 cm | | |
| Metals, ppm | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | **0.7** | **0.3** | 0.3U | 0.2U | 0.4U | 0.2U | **0.7** |
| Chromium | 72 | 88 | **36** | **35** | **20.9** | **29.9** | **54** | **20.9** | **54** |
| Copper | 400 | 1200 | **111J** | **14.6** | **5.5J** | **5.4J** | **13.5J** | **5.4J** | **111J** |
| Zinc | 3200 | >4200 | **182J** | **49** | **57J** | **43J** | **64J** | **43J** | **182J** |
| Tributyltin[b] | 47ug/kg | 320 ug/kg | ns | ns | ns | ns | ns | ns | ns |
| | | | | | | | | | |
| Polycyclic Aromatic Hydrocarbons, ppb | | | | | | | | | |
| Total Light PAHs, U=1/2 | not specified | | **1500** | **190J** | **35J** | **17J** | **120J** | **17J** | **1500** |
| Total Heavy PAHs, U=1/2 | 17,000 | 30,000 | **4200** | **900J** | **56J** | **44J** | **540** | **44J** | **4200** |
| | | | | | | | | | |
| Phthalates, ppb | | | | | | | | | |
| Bis(2-ethylhexyl)Phthalate | 500 | 22,000 | **280** | 62U | **21J** | **19J** | **150** | **19J** | **280** |
| Dimethyl Phthalate* | not specified* | | 19U | 20U | 19U | 19U | **38** | 19U | **38** |
| DNOP | 39 | >1100 | **24** | 20U | 19U | 19U | **11J** | **11J** | **24** |
| | | | | | | | | | |
| Miscellaneous Extractables, ppb | | | | | | | | | |
| Benzoic acid | 2900 | 3800 | **610** | 390U | 370U | 390U | **430** | 370U | **610** |
| Benzyl alcohol | not specified | | **100** | 20U | 19U | 19U | **62** | 19U | **100** |
| | | | | | | | | | |
| PCBs Total, ppb | 110 | 2500 | **20** | 20U | 18U | 18U | 19U | 18U | **20** |
| | | | | | | | | | |
| Dioxin TEQ, pptr, U=1/2 | not specified | | **10.1J** | **1.6J** | **0.65J** | **0.36J** | **2.3J** | **0.36J** | **10.1J** |

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MTCA Sediment Management Standards for Freshwater Benthic:
Sediment Cleanup Objectives (SCO) & Cleanup Screening Levels (CSL):
Freshwater SCO = No adverse effects to benthic community.
Freshwater CSL = Establishes a minor advers effects level including acute or chronic effects and maybe defined as potential cleanup for benthic community see Rule.

PCBs Total = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total dioxin/Furan Toxicity Equvalency values as of 2005 World Health Organization.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.

[a]SMS Freshwater screening criteria reported in parts per billion dry weight from WAC 173-204-563(2)(g) or as specified. ns = no sample in SMS freshwater units.
Tributyltin[b] = SMS testing reported in dry weight in ug/kg or parts per billion. DMMP tributyltin testing is porewater in ug/L.
* Dimethyl phthalate reported levels are higher than interim freshwater criteria, toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.

# Kenmore Area Lake Washington & Sammamish River Sediment Sampling Results - Nov 2012

**Table 6. Sammamish River lower reaches sediment results are compared with SMS Freshwater criteria.**

Note sample results are reported in different units -parts per million (ppm), parts per billion (ppb) and parts per trillion (pptr).

| Screening Criteria | SMS Freshwater[a] | | Sammamish River Results | | | | | Range | |
|---|---|---|---|---|---|---|---|---|---|
| Analyte/Sample # | SCO | CSL | #SG-01 | #SG-16 | #SG-17 | #HT-08 | #HT-09 | Min | Max |
| Sample depth, cm | | | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | | |
| Metals, ppm | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | 0.2U | 0.2U | 0.4U | 0.3 | **0.4** | 0.2U | **0.4** |
| Chromium | 72 | 88 | **29.3** | **29.9** | **54** | **29.6J** | **28.8J** | **28.8J** | **54** |
| Copper | 400 | 1200 | **5.9J** | **5.4J** | **13.5J** | **38.2** | **21.9** | **5.4J** | **38.2** |
| Zinc | 3200 | >4200 | **43J** | **43J** | **64J** | **54** | **64** | **43J** | **64** |
| | | | | | | | | | |
| Polycyclic Aromatic Hydrocarbons, ppb | | | | | | | | | |
| Total Light PAHs, U=1/2 | not specified | | **40** | **17J** | **120J** | **28J** | **71J** | **17J** | **120J** |
| Total High PAHs, U=1/2 | 17,000 | 30,000 | **180J** | **44J** | **540** | **130** | **330J** | **44J** | **540** |
| | | | | | | | | | |
| Phthalates, ppb | | | | | | | | | |
| Bis(2-ethylhexyl)Phthalate | 500 | 22,000 | **28** | **19J** | **150** | **72** | **130** | **19J** | **150** |
| Dimethyl Phthalate* | not specified* | | 19U | 19U | **38** | **97** | **970** | 19U | **970** |
| DNOP | 39 | >1100 | 19U | 19U | **11J** | 18U | **15J** | **11J** | 19U |
| | | | | | | | | | |
| Miscellaneous Extractables, ppb | | | | | | | | | |
| Benzoic acid | 2900 | 3800 | 380U | 390U | **430** | 370U | **140J** | **140J** | **430** |
| Benzyl alcohol | not specified | | 19U | 19U | **62** | 18U | **23** | 18U | **62** |
| | | | | | | | | | |
| PCBs Total, ppb | 110 | 2500 | 17U | 18U | 19U | 17U | 19U | 17U | 19U |
| | | | | | | | | | |
| Dioxin TEQ, pptr, U=1/2 | not specified | | **0.47J** | **0.36J** | **2.3J** | **0.56J** | **1.4J** | **0.36J** | **2.3J** |

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MTCA Sediment Management Standards for Freshwater Benthic:
Sediment Cleanup Objectives (SCO) & Cleanup Screening Levels (CSL):
Freshwater SCO = No adverse effects to benthic community.
Freshwater CSL = Establishes a minor advers effects level including acute or chronic effects and maybe defined as potential cleanup for benthic community.

PAH-TH = Total high Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total light PAHs.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 undetected reporting limit.
PCBs Total = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total Dioxin/Furan Toxicity Equvalency values- 2005 World Health Organization.

[a]SMS Freshwater screening criteria reported in parts per billion dry weight from WAC 173-204-563(2)(g) or as specified.

* Dimethyl phthalate reported levels are higher than interim freshwater criteria, toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.

# Kenmore Area Lake Washington & Sammamish River Sediment Sampling Results - November 2012

**Table 7. Private Marina Results Compared to SMS Freshwater & Dredge DMMP Screening Criteria and concentration varies by chemical group.**

| Screening Criteria | SMS Freshwater[a] | | DMMP Planning | | Harbour Village Marina | | | | | North Lake Marina | | Range | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte | SCO | CSL | SL | ML | #SG-10 | #SG-11 | #SG-12 | #SG-13 | #SG-13 D | #SG-02 | #SG-03 | Min | Max |
| Sample Depth, cm | | | | | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-22 cm | 0-25 cm | | |
| Metals, mg/kg, ppm | | | | | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | 5.1 | 14 | 0.4 | 1U | 0.7U | 0.9U | 0.9U | 1.3 | 1.2 | 0.4 | 1.3 |
| Chromium | 72 | 88 | 260 | -- | 29.8 | 52 | 44 | 54 | 55 | 56 | 55 | 29.8 | 56 |
| Copper | 400 | 1200 | 390 | 1300 | 18.8J | 97J | 47.5J | 62.1J | 62.8J | 92.4 | 88.1 | 18.8J | 97J |
| Zinc | 3200 | >4200 | 410 | 3800 | 97J | 377J | 185J | 205J | 205J | 231 | 267 | 97J | 377J |
| Tributyltin* ug/L or ug/kg | 47ug/kg | 320ug/kg | 0.15ug/L | 0.15ug/L | 3.6Uug/kg | 9.8ug/kg | 6.8ug/kg | 12ug/kg | 12ug/kg | 0.67ug/L | 0.058ug/L | different units | |
| | | | | | | | | | | | | | |
| Polycyclic Aromatic Hydrocarbons, ug/kg, ppb | | | | | | | | | | | | | |
| Total Low PAHs, U=1/2 | 6600 | 9200 | 5200 | 29,000 | 410J | 450J | 350J | 390J | 320J | 760 | 410J | 320J | 760 |
| Total High PAHs, U=1/2 | 31,000 | 55,000 | 12,000 | 69,000 | 2600 | 2500 | 1500 | 1800 | 1500 | 2,820 | 2,260 | 1500 | 2,820 |
| Phthalates, ug/kg, ppb | | | | | | | | | | | | | |
| Bis(2-ethylhexyl)Phthalate | 220 | 320 | 1300 | 8300 | 480 | 740 | 360 | 560 | 430 | 680 | 510 | 360 | 740 |
| Dimethyl Phthalate[b] | not specified[b] | | | | 20U | 20U | 20U | 20U | 20U | 28 | 20U | 20U | 28 |
| Di-n-octyl Phthalate | 26 | 45 | 6200 | 6200 | 20U | 87 | 20U | 73J | 42 | 19U | 58J | 19U | 87 |
| Misc Extractables, ug/kg, ppb | | | | | | | | | | | | | |
| Benzoic acid | 2900 | 3800 | 650 | 760 | 520 | 1400 | 1500 | 1600 | 1700 | 960 | 1300 | 520 | 1700 |
| Benzyl alcohol | not specified | | 57 | 870 | 200 | 530 | 300 | 360 | 380 | 82 | 130 | 82 | 530 |
| | | | | | | | | | | | | | |
| PCBs Total, ug/kg, ppb | 110 | 2500 | 130 | 3100 | 32U | 29J | 49U | 50U | 35U | 121 | 22 | 22 | 121 |
| | | | | | | | | | | | | | |
| Dioxin TEQ pptr, U=1/2 | not specified | | 4 | 10 | 6.6J | 71.0J | 26.6J | 50.0J | 19.0J | 37.0J | 20.3J | 6.6J | 71.0J |

*Ecology April 30, 2013*

MTCA Sediment Management Standards for Feshwater Benthic:
Sediment Cleanup Objectives & Cleanup Screening Levels:
Freshwater SCO = No adverse effects to benthic community.
Freshwater CSL = Establishs a minor adverse effects level
including acute or chronic effects and may be defined
as potential cleanup for benthic community see Rule.
Dredge MMP Screen Level 1 (SL)
Dredge MMP Marine Maximum Level (ML)

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.
U = Laboratory analysis shows chemical is not detected (is not present) at the detection reporting limit.
PAH-TH = Total High Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total Low PAHs.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency (TEQ) values as of 2005 World Health Organization.
* Tributyltin = Reported for DMMP as porewater in ug/L or ppb; or SMS reported as dry weight in ug/kg or ppb.
Phthalate DNOP = Di-n-octyl phthalate. PCBs Total = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency values as of 2005 World Heath Organization.

[a]SMS Freshwater screening criteria reported in parts per billion dry weight from WAC 173-204-563(2)(g) or as specified.

[b] = Dimethyl phthalate reported levels are higher than interim freshwater criteria, toxicity is unknown and recommend substance be considered a chemical of concern for future evaluation.

**Table 8. Kenmore Area Sediment Results for Dioxin Compared with Seattle and other Urban & Rural Soil Dioxin Results with different regulatory limits.**

These results represent three different studies and two different sampling media -one being sediment and the second being soil, and four different cleanup or screening criteria. Cleanup and screening criteria involve multiple evaluations related to health risk, pathways and exposures. This information is available for background information, and be aware of these differences when you compare Kenmore area sediment results and Seattle and Washington background soil results.

**Dioxin Concentrations compared to State and Federal Regulatory Limits*.**

| Location | Range- Parts per trillion (pptr) | Average (pptr) | Number of samples abo State MTCA Method B so cleanup leve (11 pptr) | Number of samples abo Federal ATSDR screening lev (50 pptr) | Number of samples abo EPA draft cleanup level (72 pptr) | Number of samples above DMMP screening level - SL 1 (4 pptr) |
|---|---|---|---|---|---|---|
| **Kenmore Sediment Results** | | | | | | |
| **Public Parks & Boat Launch** | | | | | | |
| Lyon Creek Park | **0.4 - 0.5** | **0.45** | 0 | 0 | 0 | Not Applicable |
| Log Boom Park | **0.3 - 7.9** | **2.4** | 0 | 0 | 0 | |
| Samm R Boat Launch | **0.6 - 1.4** | **1.0** | 0 | 0 | 0 | |
| **K Navigation Channel** | **1.6 - 10** | **5.5** | 0 | 0 | 0 | 5 |
| **Private Site & Marinas** | | | | | | |
| Harbour Village Marina | **6.6 - 71** | **35** | 3 | 2 | 0 | 5 |
| North Lake Marina | **20 - 37** | **29** | 2 | 0 | 0 | 2 |
| **Lakepointe -KIP Site** | **0.4 - 10** | **3.0** | 0 | 0 | 0 | 1 |
| **Waterways** | | | | | | |
| Lake Washington near sho | **0.5 - 0.7** | **0.6** | 0 | 0 | 0 | 0 |
| Samm River near shore | **0.4 - 2.3** | **1.0** | 0 | 0 | 0 | 0 |
| Kenmore Area -30 results | **0.3 - 71** | **12.5** | 5 17% | 2 | 0 | 14 |
| Kenmore Area without mar | **0.3 - 10** | **3.03** | 0 0% | 0 | 0 | Not applicable |
| **Seattle Neighborhood Urban Soil Dioxin Results**** | | | | | | |
| Ballard | **1.9 - 62** | **26.1** | 17 | 2 | 0 | Not Applicable |
| Capitol Hill | **3.2 - 96** | **18.2** | 8 | 3 | 1 | |
| Georgetown | **5.3 - 115** | **35.5** | 17 | 4 | 2 | |
| Ravenna | **5.2 - 50** | **14.7** | 7 | 0 | 0 | |
| South Park | **3.5 - 23** | **12.4** | 12 | 0 | 0 | |
| West Seattle | **1.7 - 33** | **7.5** | 2 | 0 | 0 | |
| All Seattle Areas -120 resu | **1.7 - 115** | **19.1** | 63 53% | 9 | 3 | |
| **Washington Urban, Open and Forest Soil Dioxin Background Results***** | | | | | | |
| Urban - Tri-Cities | **1.4 - 4.8** | **3.1** | 0 | 0 | 0 | Not Applicable |
| Urban - Spokane | **0.98** | 0 | 0 | 0 | 0 | |
| Urban - Tacoma | **9.5 - 19** | **15** | *estimated 5* | 0 | 0 | |
| Urban - Seattle | **0.13 - 6.0** | **2.4** | 0 | 0 | 0 | |
| Urban | **0.13 - 19** | **4.1** | *estimated 3* | 0 | 0 | |
| Open | **0.04 - 4.6** | **1.0** | 0 | 0 | 0 | |
| Forest | **0.03 - 5.2** | **2.3** | 0 | 0 | 0 | |
| Total -30 results | **0.03 - 19** | **2.8** | *est 8 27%* | 0 | 0 | |

*continued…*

**Continued - Kenmore Area Sediment Dioxin Results Compared with Seattle and other Urban and Rural Soil Dioxin Results with different regulatory limits.**

* Regulatory limits. Range of sediment data for dioxins are reported as toxic equivalents (TEQs). This means the measured concentrations have been adjusted to reflect the different levels of potency of individual dioxin and furan components. The concentrations, adjusted for potency level, are combined into a single concentration that reflects the potential toxicity of the mixture of dioxin and furan components.
State MTCA is a rule that outlines procedures for setting cleanup levels for hazardous substances.

Federal Agency for Toxic Substances Disease Registry Screening Levels. This level is used to identify areas where more study is needed and is not a cleanup level.
U.S. Environmental Protection Agency proposed soil screening levels. EPA's Superfund cleanup program published draft soil cleanup guidelines in 2009. These guidelines are used for setting cleanup levels for hazardous substances.
DMMP Screening Level. Dredged Material Management Program (USACE, EPA, WADNR, Ecology) set screening guidance for dredge solids open water disposal for dioxin/furan at 4 pptr for unrestricted open water disposal.

**Washington Soil Dioxin Study Results, Ecology Publication # 11-09-219 dated September 2011, see Appendix D.
***Washington State Background Soil Concentratiion Study in Rural State Parks by Hart Crowser, June 7, 2011.

## Table 9. Kenmore Area Sediment Results for Dioxin Compared with Ocean Survey Vessel Bold Puget Sound background sediment data -DMMP 2009.

These results are all for sediments. However, the OSV Bold survey was conducted in Puget Sound, a marine setting in Washington. The sample locations were selected to focus on sediments that were outside the influence of known sources. More information on the sampling locations can be found at http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/Dioxin/PugetSoundPCBDioxinSurvey.aspx

## Dioxin Concentrations compared to OSV Bold Sediment results.

| Location | Range-Parts per trillion (pptr) | Average (pptr) | Number of samples above State MTCA Method B soil cleanup level (11 pptr) | Number of samples above Federal ATSDR screening level (50 pptr) | Number of samples above EPA draft cleanup level (72 pptr) | Number of samples above DMMP screening level - SL 1 (4 pptr) |
|---|---|---|---|---|---|---|
| **Kenmore Sediment Results** | | | | | | |
| **Public Parks & Boat Launch** | | | | | | |
| Lyon Creek Park | **0.4 - 0.5** | **0.45** | 0 | 0 | 0 | Not Applicable |
| Log Boom Park | **0.3 - 7.9** | **2.4** | 0 | 0 | 0 | |
| Samm R Boat Launch | **0.6 - 1.4** | **1.0** | 0 | 0 | 0 | |
| **K Navigation Channel** | **1.6 - 10** | **5.5** | 0 | 0 | 0 | 5 |
| **Private Site & Marinas** | | | | | | |
| Harbour Village Marina | **6.6 - 71** | **35** | 3 | 2 | 0 | 5 |
| North Lake Marina | **20 - 37** | **29** | 2 | 0 | 0 | 2 |
| **Lakepointe -KIP Site** | **0.4 - 10** | **3.0** | 0 | 0 | 0 | 1 |
| **Waterways** | | | | | | |
| Lake Washington near shore | **0.5 - 0.7** | **0.6** | 0 | 0 | 0 | 0 |
| Samm River near shore | **0.4 - 2.3** | **1.0** | 0 | 0 | 0 | 0 |
| Kenmore Area -30 results | **0.3 - 71** | **12.5** | 5 17% | 2 | 0 | 13 |
| Kenmore Area without marinas | **0.3 - 10** | **3.03** | 0 0% | 0 | 0 | Not applicable |
| **Puget Sound OSV Bold Samples** | | | | | | |
| Hood Canal (n=5) | **0.65 - 1.15** | **0.89** | 0 | 0 | 0 | 0 |
| Outer Sound[1] (n=15) | **0.26 - 1.74** | **0.74** | 0 | 0 | 0 | 0 |
| Inner Sound[2] (n=30) | **0.26 - 11.6** | **1.91** | 1 | 0 | 0 | 2 |
| Reference bays[3] (n= 20) | **0.24 - 5.15** | **1.13** | 0 | 0 | 0 | 1 |
| Total -70 results | **0.24 - 11.6** | **1.42** | 1 0% | | | |

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[1]Outer Sound samples includes samples from Admiralty Inlet, San Juan Islands, and Straits of Juan de Fuca

[2]Inner Sound samples includes all OSV Bold sample locations other than Hood Canal, reference, and Outer Sound. These samples ranged from the northest side of Whidbey Island to Squaxin Island/Case inlet.

[3]Reference bays included Carr Inlet, Holmes Harbor, Dabob Bay, and Samish Bay

## Kenmore Area Sediment Sampling Results - November 2012

### Table 10. Kenmore Area Freshwater Sediment Results Compared with Elliott Bay Marine Surface Sediment Results.

| Screening Criteria | SMS Freshwater[a] Criteria | | Kenmore Freshwater Sample Locations Environmental Evaluation | | | | | | | | Elliott Bay Marine Surface Sediment Results Area Background | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analyte | SCO | CSL | Median | | Mean | | Minimum | | Maximum | | Median | | Mean | | Minimum | | Maximum | |
| Sample Depth, cm | | | 0-10 | 0-25 | 0-10 | 0-25 | 0-10 | 0-25 | 0-10 | 0-25 | 0-2 | 0-10 | 0-2 | 0-10 | 0-2 | 0-10 | 0-2 | 0-10 |
| Metals, mg/kg, ppm | | | | | | | | | | | | | | | | | | |
| Cadmium | 2.1 | 5.4 | **0.3** | **0.6** | **0.3** | **0.74** | **0.1** | **0.3** | **0.5** | **1.3** | **0.23** | **0.32** | **0.25** | **0.31** | 0.1U | **0.1** | **0.57** | **0.71** |
| Chromium | 72 | 88 | **29** | **44** | **32** | **47** | **17.8** | **35** | **55** | **57** | **29.1** | **41.1** | **31.7** | **40.4** | **18.5** | **21.0** | **49.9** | **69.4** |
| Copper | 400 | 1200 | **14** | **31** | **37** | **44** | **4.3** | **14.6** | **220** | **92** | **36.0** | **41.0** | **38.3** | **44.2** | **5.67** | **6.84** | **94.6** | **83.5** |
| Zinc | 3200 | >4200 | **64** | **130** | **102** | **150** | **34** | **49** | **377** | **67** | **82.5** | **97.5** | **78.1** | **89.7** | **27.0** | **26.0** | **130** | **136** |
| Polycyclic Aromatic Hydrocarbons, ug/kg, ppb | | | | | | | | | | | | | | | | | | |
| Total Light PAHs, U=1/2 | not specified | | **71** | **190** | **313** | **258** | 4.8 U | **78** | **2,000** | **760** | **649** | **724** | **1,010** | **1,040** | **21** | **20** | **5,000** | **3,450** |
| Total High PAHs, U=1/2 | 7,000 | 30,000 | **330** | **900** | **1,001** | **1,289** | **23** | **600** | **4,200** | **2,820** | **2,200** | **2,050** | **3,610** | **3070** | **55** | **72** | **13,800** | **15,800** |
| PCBs Total, ug/kg, ppb | 110 | 2500 | **9** | **14** | **14** | **26** | **8** | **9** | **29** | **121** | **65** | **63** | **88** | **119** | **9.8** | **9.4** | **195** | **317** |
| Dioxin TEQ ng/kg,pptr,U=1/2 | not specified | | **1.3** | **4.9** | **9.7** | **10.1** | **0.3** | **1.6** | **26.6** | **20.3** | **5.15** | **5.87** | **8.85** | **15.1** | **0.67** | **0.67** | **26.6** | **97.6** |

SMS Freshwater[a] =criteria reported in parts per billion dry weight see WAC 173-204-563(2)(g) or as specified.

MTCA Sediment Freshwater Benthic Community
Sediment Cleanup Objectives & Cleanup Screening L:
Freshwater SCO = No adverse effects benthic comm
Freshwater CSLevel = Establishes a minor adverse effects level including acute or chronic effects & maybe defined as potential cleanup for benthic community see Rule Chapter 173-204 WAC.

J = Laboratory analysis shows chemical is present and the concentration is an estimated value.
U = Laboratory analysis shows chemical is not detected (is not present) at the reporting limit.

PAH-TH = Total High Poly-aromatic hydrocarbons (PAHs). PAH-TL = Total Low PAHs.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.
PCBs = Total 7 Polychlorinated biphenyls (Aroclors).
Dioxin TEQ = Total Dioxin/Furan Toxicity Equivalency (TEQ) values for 2005 World Health Organization.
U=1/2 = Totals are calculated as sum of all detected results and 1/2 the undetected reporting limit.

# Ecology Evaluation Report

# Appendix A

# Anchor QEA Final Sampling and Analysis Plan – Kenmore Area Sediment and Water Characterization

## November 6, 2012

REPORT

# SAMPLING AND ANALYSIS PLAN
# KENMORE AREA SEDIMENT AND WATER CHARACTERIZATION

**Prepared for**

Washington State Department of Ecology

Dredged Material Management Program

Washington State Department of Health

**On Behalf of**

City of Kenmore

18120 68th Avenue NE

Kenmore, Washington 98028


**Prepared by**

Anchor QEA, LLC

720 Olive Way, Suite 1900

Seattle, Washington 98101


**November 2012**

# SAMPLING AND ANALYSIS PLAN
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Appendix A Field Forms and Logs

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| °C | degrees Celsius |
| µg | microgram |
| ARI | Analytical Resources, Inc. |
| BT | bioaccumulation trigger |
| CCV | continuing calibration verification |
| City | City of Kenmore |
| cm | centimeter |
| COC | chain-of-custody |
| COI | chemical of interest |
| CSL | Cleanup Screening Level |
| cy | cubic yard |
| DDT | dichlorodiphenyltrichloroethane |
| DGPS | differential global positioning system |
| DMMO | Dredged Material Management Office |
| DMMP | Dredged Material Management Program |
| DMMU | dredged material management unit |
| DOH | Washington State Department of Health |
| DQO | data quality objective |
| Ecology | Washington State Department of Ecology |
| EIM | Environmental Information Management |
| FC | field coordinator |
| GC/MS | gas chromatograph/mass spectrometer |
| g | gram |
| HDPE | high density polyethylene |
| HPAH | high-molecular-weight polycyclic aromatic hydrocarbon |
| ID | identification |
| kg | kilogram |
| KGM | Kiewit General Manson |
| KIP | Kenmore Industrial Park |
| LCS | laboratory control sample |

| | |
|---|---|
| LPAH | low-molecular-weight polycyclic aromatic hydrocarbon |
| m | meter |
| mg | milligram |
| ml | milliliter |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MTCA | Model Toxics Control Act |
| NA | not applicable |
| NAD | North American Datum |
| ng | nanogram |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PCDD/F | polychlorinated dioxins and furans |
| PSEP | Puget Sound Estuary Program |
| QA | quality assurance |
| QC | quality control |
| QAPP | Quality Assurance Project Plan |
| Results Memorandum | Sampling and Analysis Results Memorandum |
| RL | reporting limit |
| RPD | relative percent difference |
| SAP | Sampling and Analysis Plan |
| SL | Screening Level |
| SQS | Sediment Quality Standard |
| SQV | Sediment Quality Value |
| SRM | standard reference material |
| SAPA | Sediment Sampling Analysis Plan Appendix |
| SVOC | Semi-volatile organic compound |
| SQS | Sediment Quality Standard |
| TBT | tributyltin |
| TEQ | toxic equivalency |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |

# 1 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by the City of Kenmore (City) in partnership with the Washington State Department of Ecology (Ecology) to characterize sediment and water in northeastern portion of Lake Washington south of Kenmore and northwest of the mouth of the Sammamish River. The characterization effort supports a number of objectives for the City and Ecology. First, the characterization is intended to support the City's ongoing work with the U.S. Army Corps of Engineers (USACE) to support a request for federal funding for maintenance dredging of the federal Kenmore Navigation Channel (Figure 1). Second, with assistance from a grant from Ecology, the City and Ecology are conducting additional characterization activities to evaluate the presence and concentration of possible chemicals and the potential presence of contamination along the shoreline. The characterization has been designed to support Ecology's Model Toxics Control Act (MTCA) cleanup action requirements and the Health Consultations to be developed by Washington State Department of Health (DOH). Additionally, at the request of the City of Lake Forest Park, two sediment samples will be collected along the northwestern shoreline of Lake Washington adjacent to Lyon Creek Park.

This SAP describes the screening level sediment characterization to support a request for federal funding for maintenance dredging of the federal Kenmore Navigation Channel in the USACE's maintenance dredging budget. The SAP also characterizes and evaluates nearshore sediment and surface water for public health, safety, and environmental concerns. This plan represents the maximum number of samples and analyses feasible at this time, given the available Clean Sites Initiative Grant funds from Ecology and the City budget. In the future, if more sampling is necessary, additional funds will need to be secured and a new SAP developed.

## 1.1 Kenmore Navigation Channel Screening Level Characterization

The Kenmore Navigation Channel was constructed in 1981 as a USACE project authorized in Section 107 of the 1960 River and Harbors Act (Figure 1) to a depth of 15 feet below lake level. The Kenmore Navigation Channel is approximately 100 to 120 feet wide and 2,900 feet long, and primarily serves barge and other marine traffic for industrial and commercial uses. The Kenmore Navigation Channel was last sampled in 1996 for dredge characterization, dredged in 1997, and last surveyed in 2010. The recent survey conducted by the USACE in February 2010 showed shallow areas (i.e., less than 15 feet below lake level) present within the Kenmore Navigation Channel. The most recent maintenance dredging of the Kenmore Navigation Channel was prior to the City's 1998 incorporation. Currently, King County is the Local Sponsor Authority for the Kenmore Navigation Channel and the Sammamish River Small Boat Navigation Channel. The City, King County, and the USACE are presently exploring the possible transfer of the Local Sponsor Authority for the Kenmore Navigation Channel to the City. The USACE estimates that maintenance dredging would require removal of 31,700 cubic yards (cy) of sediment within the channel.


Feet

0 200 400 600 800

ANCHOR QEA

**Figure 1**

Existing Information

Sampling and Analysis Plan

Kenmore Sediment Characterization

The Dredged Material Management Office (DMMO) at the USACE has indicated that a screening level characterization will provide information about potential options for disposal of dredged sediment. A full sediment characterization according to Dredged Material Management Program (DMMP) protocols would provide information to determine if sediment is suitable for unconfined open-water disposal. However, these results are only valid for 2 years in areas ranked "High" by DMMP, which includes the Kenmore Navigation Channel. Acquisition of funding and completion of maintenance dredging will not likely occur within the next 2 years. Given the timing of the maintenance dredging, the DMMO agreed that it made sense for the City to conduct a screening level assessment to provide information to support pursuing federal funding for maintenance dredging, and hold off on a full DMMP characterization effort until within two years of the anticipated maintenance dredging event.

The owners of North Lake Marina are also participating parties in the sediment characterization efforts to assess the options for sediment disposal in the event that maintenance dredging is conducted within the marina. The marina owners are interested in privately funding the dredging of the marina in conjunction with the dredging of the Kenmore Navigation Channel to save money and share costs (e.g., dredge equipment mobilization fees) with the USACE.

Any future proposed dredging plans for Kenmore Navigation Channel, Harbour Village Marina, or North Lake Marina will be determined by each party based on navigational needs, cost, and other considerations.

## 1.2 Additional Nearshore Sediment and Surface Water Characterization

The City and Ecology will be conducting additional characterization activities to evaluate the condition of nearshore sediment and surface water in the Kenmore area waterfront. The purpose of the characterization is to determine sediment and water quality and possible health and environmental risks. This information is to assist better understanding whether potential contamination is present in sediment and surface water. The results are intended to be used by Ecology for characterization activities to evaluate the presence and concentration of chemicals and possible contamination in the lake and river waterfront areas and to continue the MTCA evaluation of nearshore sediments. The SAP results will also be used to support the Health Consultations to be developed by DOH in the vicinity of Log Boom Park and adjacent to Kenmore Industrial Park (KIP) site also referred to as Lakepointe. The results of this SAP may show that additional testing will be required to further detail source or sources of contamination. The testing parameters and sample locations have been reviewed by Ecology and DOH to support their anticipated evaluations.

## 1.3 Purpose and Objectives

Sampling for this project is intended to satisfy several objectives:

- The screening level characterization for the Kenmore Navigation Channel and North Lake Marina is intended to provide additional information on potential sediment disposal options and preliminary future dredge budget costs in order to support pursuing federal funding for maintenance dredging.
- Additional characterization activities are intended to:
  - Describe the nearshore sediment matrix, grain size, chemical characteristics and organic carbon content at the Kenmore area waterfront.
  - Evaluate the nearshore sediment and water column chemistry for human health and environmental conditions as defined under MTCA by Ecology.
  - Evaluate the next step in determining waterfront conditions and may need further testing and whether specific areas serve as sources of potential contamination.
  - Prepare Health Consultations by DOH in the vicinity of Log Boom Park and nearshore to KIP site area.

This SAP has been developed in accordance with the 2008 DMMP User's Manual (DMMO 2009) and Ecology's Sediment Sampling and Analysis Plan Appendix (SAPA 2008). For the screening level characterization in the navigation channel, sample density is lower than required for a dredge material suitability determination since this is an initial screening level investigation.

This SAP identifies specific sampling and analysis protocols for the sediment sampling activities and provides detailed information regarding the field sampling objectives; sample location and frequency, equipment, and procedures to be used during the sampling; and sample handling and analysis. The SAP also provides the basis for planning field activities and describes specific quality assurance (QA) protocols. All sample handling and analyses will follow the most recent Puget Sound Estuary Program (PSEP) protocols for collecting and handling sediment and water samples (PSEP 1986, 1997a, 1997b, 1997c) and the 2008 DMMP User's Manual (including the 2009 update) and Clarification Papers and updates (DMMO 2009; Hoffman 1998; Kendall 2001; USACE 2010; Inouye and Fox 2011).

A Health and Safety Plan for field sampling activities is also provided under separate cover and presents the guidance for field health and safety procedures and considerations.

## 1.4 Background Information

### *1.4.1 Site Setting*

The Kenmore Navigation Channel is located in the northeastern portion of Lake Washington south of the City of Kenmore and northwest of the mouth of the Sammamish River. Lake Washington is a freshwater lake that is connected to Lake Union by the Lake Washington Ship Canal and to Puget Sound by way of the Hiram M. Chittenden Locks. Historical activities in the area include lumber shipping and log booming. Current surrounding land includes commercial, industrial and residential properties, parks, recreational marinas, and a commercial float plane facility.

Washington Department of Fish and Wildlife operates a public boat launch west of the Juanita Drive (68th Avenue NE) Bridge in Kenmore. There is also shoreline access at the western portion of Log Boom Park that is used as a hand kayak launch (Figure 1).

One of the few remaining industrial ports on Lake Washington is in Kenmore at the mouth of the Sammamish River. Businesses near and at the port include:

- Rinker Materials Kenmore plant (cements and asphalts)
- Kenmore Ready-Mix, a division of the CalPortland Company (cements and asphalt)
- Kiewit General Manson (KGM; temporarily leasing property for the construction of sections for the new State Route 520 bridge at the KIP site)
- Kenmore Air Harbor (the nation's largest seaplane-only, commercial air facility)

- North Lake Marina
- Harbour Village Marina

CalPortland, Rinker Materials, and KGM rely on barge access to provide and distribute materials (e.g., sand, gravel, landscape materials, and construction materials) for their operations (ESA Adolfson 2010).

### *1.4.2 Summary of Previous Sediment Characterization and Dredging*

The sediment data and dredging information presented in this section are from readily available information. The sediment data were obtained from Washington State Department of Ecology's (Ecology) Environmental Information Management (EIM) database and from dredge material evaluations from the DMMO, which also included the dredging information. Previous suitability determinations were accessed from the DMMO website (http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/SuitabilityDeterminations.aspx).

In 1993, King County characterized and dredged 16,800 cy of sediment from the Sammamish River Small Boat Navigation Channel (Figure 1). Four dredge material management units (DMMUs) were characterized, with the DMMP Screening Level (SL) interpretive criteria for dichlorodiphenyltrichloroethane (DDT) exceeded in one DMMU. This DMMU was subsequently submitted for bioassay testing and passed, resulting in all four DMMUs determined to be suitable for open water disposal. No dioxin and furan testing was performed during this dredge characterization (USACE 1992).

Sediment from the Kenmore Navigation Channel was last characterized in 1996 (USACE 1996) and dredged in 1997. Fifteen DMMUs were analyzed for DMMP analytes (metals, polychlorinated biphenyls [PCBs], semi-volatile organic compounds [SVOCs], volatile organic compounds, pesticides, tributyltin [TBT] and conventionals) to evaluate 60,000 cy of sediment. PCB sediment concentrations from the DMMUs ranged from 17 to 88 micrograms per kilogram (μg/kg), which is below the SL of 130 μg/kg (USACE 1996). Three of the DMMUs exceeded DMMP interpretive criteria; DMMU each exceeded for polycyclic aromatic hydrocarbons (PAHs), TBT and DDT. However, the one DMMU with PAH exceedances passed biological testing and was determined to be suitable for non-dispersive open-water disposal.[1] The two other DMMUs with TBT and DDT exceedances failed the biological interpretive criteria and were unsuitable for open-water disposal (Figure 1). The unsuitable material (8,000 cy) was not dredged and 52,000 cy of sediment was dredged. No dioxin and furan testing was performed during this dredge characterization.

In 2011, in preparation for proposed maintenance dredging of Harbour Village Marina, the marina owners conducted dredge characterization sediment sampling and analysis. Three DMMUs from the Harbour Village Marina, as shown in Figure 1, were evaluated for disposal options for an anticipated 7,427 cy of sediment. From each DMMU, two or three (depending on the DMMU) cores were composited and submitted for DMMP analytes to evaluate dredge sediment. Additionally, z-samples were collected and composted for each DMMU from the underlying sediment surface that would be exposed after dredging is completed (i.e., z-layer) to evaluate the new sediment surface.

The DMMU samples from Harbour Village Marina had total PCB concentrations of 196, 237, and 277 µg/kg (parts per billion) and dioxin/furan toxic equivalency (TEQ) of 43.2, 77.3, and 92.1 nanograms per kilogram (ng/kg; or parts per trillion), respectively. Additionally, sediment within the underlying sediment surface that would be exposed after dredging is completed (z-layer) had total PCB concentrations of 104, 126, and 237 µg/kg and dioxin/furan TEQ of 0.9, 11.1, and 6 ng/kg. To address the elevated PCB and dioxin/furan concentrations in the sediment that could be exposed by dredging, the DMMP agencies will require the placement of a 1-foot cover of clean sand as a special condition to the dredging permit (USACE 2011). Further testing needs to be conducted. Dredging in Harbour Village Marina has not been completed.

In 2005, a surface sediment sample (LW-SS3-010) and field duplicate sample (LW-SS6-010) were collected adjacent to the Kenmore Navigation Channel as part of a regional background investigation. The sediment samples were analyzed for dioxin and furans, and PCBs. PCBs were not detected in either sample, however dioxin/furan TEQ, which was reported as an

---

[1] PAH exceedances were based on 1996 interpretive criteria for acenaphthene, anthracene, fluorene, and phenanthrene, which would not have been exceedances based on the current DMMP guidance.

average concentration between the sample and duplicate resulted in an estimated concentration of 13.2 ng/kg (Windward 2010).

In 2000, as part of a lake-wide sediment evaluation investigation, one sample, L18493-1, was collected near Kenmore (King County 2004). PCBs were not detected and no chemicals exceeded DMMP interpretive criteria. Dioxin and furans were not analyzed.

### 1.4.3 Potential Sediment Loading and Contamination Sources

The principal sediment loading source for the Kenmore Navigation Channel is likely from the Sammamish River and wind and wave transport on Lake Washington (including storms). The 14-mile Sammamish River drains from Lake Sammamish and flows through Redmond, Woodinville, Bothell, and Kenmore, before emptying into Lake Washington bringing suspended solids and sediment with the river. Also, westerly winds blow across Lake Washington toward the east and northeast, bringing increased wave action and suspended solids within the lake water column toward the northeast shoreline (SoundEarth Strategies and Lally Consulting 2011).

Sediment also enters the lake from small creeks and stormwater drains. Tributary 0056 discharges at the north shore at Harbour Village Marina, and Log Boom Park area. Creek 0056 diverges just before the Lake Washington shoreline, and drains to the central portion and just to the west of Harbour Village Marina. The creek drains approximately 1.85 square miles associated with State Route 522 (Northeast Bothell Way) and other residential and urban areas (Herrera 2007) and has experienced flooding and sediment loading (ESA Adolfson 2010). The City conducted investigations in 2005 and 2007 to investigate the current and historical sediment production within this creek, develop sediment management strategies, and evaluate sedimentation reduction alternatives (Herrera 2005, 2007). The City reinforced the western part of the discharge in 2010 to prevent further erosion. Other sources of sediments to the shoreline include stormwater outfalls, which are shown on Figure 1.

There are several areas with historical activities that could have contributed to contamination. One area is the KIP site located adjacent to and north of the mouth of the

Sammamish River. The 45-acre KIP site forms a peninsula that extends into Lake Washington southeast of the Kenmore Navigation Channel. Another area is a plywood mill that was formerly located north of the Kenmore Navigation Channel and east of the North Lake Marina. Other sources are various current and historic commercial and industrial activities, such as the current locations of the CalPortland Company and Cemex in Kenmore Harbor.

In the late 1970s, at the current location of CalPortland Company, there was a fire on the wharf that burned about half of the decking. The wharf was constructed of old creosote timbers and the burned wharf remained along the Kenmore shoreline for several years before the burned debris was removed (LaFlam 2012).

The KIP is currently under Consent Decree with Ecology for site cleanup and monitoring activities (Ecology 2012a). This area was submerged prior to 1916, when the USACE lowered the level of Lake Washington approximately 8 feet when the locks were installed. Subsequently, the area was filled with demolition debris in the 1950s and 1960s to form its present day configuration. It operated as a King County Landfill under permits P-69-138 and 118-72-P, primarily receiving wood construction debris. Landfilling ended in 1969, and the landfill was graded and covered with soil (AMEC 2001). Subsequently, the site has been used as an industrial yard for maritime and concrete manufacturing businesses. Extensive testing has been conducted at the KIP site including soil, groundwater, and sediment testing. Testing has confirmed neither medical wastes nor transformers at the site. Test results have shown no known chemicals of concern are migrating from the former landfill, and the five chemicals of concern are petroleum diesel and oil, and three metals (arsenic, barium, and lead). Specifically, testing in 2001, 2011, and 2012 show no PCBs detected at this site, other than one sample composed of wood chips that was dismissed based on poor quality. Hence, the KIP site does not appear to be a source for PCBs. No testing for dioxin and furans has occurred to date. The sediment sampling offshore of the KIP will be used to evaluate PCBs and dioxin and furans in addition to metals, PAHs, pesticides and semi-volatile organic compounds, and tributyltin (bulk).

Historical operations at the KIP site included assorted small storage and manufacturing industries, sand and gravel staging and support facilities, marine construction, and associated offices. Currently, the site is operated as an industrial park including SR 520 bridge reconstruction, a sand and gravel stockpile yard, Lakeshore Marine Construction, and storage and light industrial operations.

A contractor for the SR 520 bridge reconstruction, Kiewit General Manson (KGM) is temporarily leasing the 14-acre western portion of the property for the construction of sections for the new bridge and their work is estimated to be finished in 2015.

The KIP site conducts periodic groundwater monitoring to evaluate if any chemicals are migrating from the site to adjacent waterways (i.e., Lake Washington, Sammamish River, and the Kenmore Navigation Channel). Recent monitoring in 2009, 2010, and April and October 2012 show continued compliance with the 2001 Consent Decree. The 2009-2012 groundwater compliance results show all known chemicals of concern at this site (petroleum diesel and oil, arsenic, barium, and lead) are below detection level and/or below cleanup action level (Ecology 2012a). The October 2012 groundwater monitoring results (SCS Engineers 2012) confirm the earlier results and no known chemicals of concern are migrating off the KIP site. In addition, the owner also tested for copper, cadmium, zinc, and semi-volatile organic compounds, which were below detection limits and significantly below action levels.

# 2 PROJECT MANAGEMENT AND RESPONSIBILITIES

This section describes the overall project management strategy for implementing and reporting for the SAP results.

## 2.1 Project Planning and Coordination

Dan Berlin of Anchor QEA will be the overall project manager responsible for developing and completing the SAP. Following SAP approval by DMMO and Ecology, Mr. Berlin will be responsible for administrative coordination to ensure the timely and successful completion of the screening level characterization. He will provide a copy of the approved SAP to all sampling and testing subcontractors. Any significant deviation from the approved sampling plan will be coordinated with the DMMO and Ecology.

## 2.2 Field Sample Collection

David Gillingham of Anchor QEA will serve as the field coordinator (FC) and will provide overall direction to the field sampling in logistics, personnel assignments, and field operations. The FC will supervise field collection of the sediment and water samples and will be responsible for ensuring accurate positioning and recording of sample locations, depths, and identification; ensuring conformity to sampling and handling requirements, including field decontamination procedures; physical evaluation and documentation of the samples; and delivery of the samples to the laboratory. Ecology will participate in the sampling event.

Anchor QEA will ensure that sediment and water samples are stored under proper conditions in their custody until delivery to the laboratory. The FC will be responsible for summarizing field sampling activities. This summary will include details of the sampling effort, sample preparation, sample storage and transport procedures, field QA, and document any deviation from the final SAP.

The sampling and analysis will be completed with equipment owned or rented by Anchor QEA. All subconsultants, Ecology and Anchor QEA will follow the protocols established in this SAP.

## 2.3 Laboratory Preparation and Analyses

Sue Dunnihoo of Analytical Resources, Inc. (ARI), Tukwila, Washington, will be responsible for physical and chemical analyses. Ms. Dunnihoo will ensure that the submitted samples are handled and analyzed in accordance with DMMP analytical testing protocols, QA/quality control (QC) requirements, and the requirements specified in this SAP (Section 5). ARI will provide certified, pre-cleaned sample containers and sample preservatives as appropriate. ARI will prepare a data package containing all analytical and QA/QC results.

## 2.4 Quality Assurance/Quality Control Management

Delaney Peterson of Anchor QEA, or her designee, will serve as QA/QC Manager for this project and will be responsible for all coordination with the analytical laboratory. She will perform oversight for both the field sampling and laboratory programs. She will be kept fully informed of field program procedures and progress during sample collection and laboratory activities during sample preparation. She will record and correct any activities that vary from this SAP. Upon completion of the sampling and analytical program, she will review laboratory QA/QC results and incorporate findings into the Sampling and Analysis Results Memorandum (Results Memorandum). Any QA/QC problems will be brought to the attention of the DMMO and Ecology as soon as possible to discuss issues related to the problem and to evaluate potential solutions.

## 2.5 Sampling and Analysis Results Memorandum

Mr. Berlin, or his designee, will be responsible for preparation of the Results Memorandum to support the suitability determination. The Results Memorandum will summarize the sampling effort; analytical methods; QA/QC narrative; and analytical sediment results with comparison to DMMP interpretive criteria (for screening level characterization sediment samples) and Ecology's interim freshwater Sediment Quality Values (Ecology 2003) (SQV; for all sediment samples) as shown in Table 2. Ecology's 2003 SQVs are currently undergoing re-evaluation under the SMS rule revision process. If new SQVs are finalized when the sediment results are reported, then the sediment results will be compared to the new SQVs. The water sample analytical results will also be presented in the Results Memorandum. The complete content of the Results Memorandum is described in Section 6.

# 3 SAMPLE COLLECTION, PROCESSING, AND HANDLING PROCEDURES

This section addresses the sample collection, processing, and handling procedures that will be used to ensure data quality and chain-of-custody (COC).

## 3.1 Sampling Schedule

Sampling will occur within 3 weeks after approval of this SAP by DMMO and Ecology in November 2012. The Anchor QEA project manager will coordinate with the appropriate City manager and Ecology. It is anticipated that field sampling activities can be completed within three days.

## 3.2 Station and Sample Identification and Nomenclature

Figure 2 presents the proposed surface sediment and water sampling locations. Table 1 presents detailed summaries of the sediment and water sampling design including sample nomenclature for each station and sample. The sample nomenclature is described below.

Each sample will be assigned a unique alphanumeric identifier according to the following method:

- Each sample identification (ID) will be identified by *Sample Method-Location Number-Matrix-Sample Sponsor*
  - Sample method will be identified by two letters: SG for sediment grab, HT for sediment hand trowel, WS for surface water (back ground location only). Three of the water sample locations are co-located with hand trowel locations and therefore will begin with HT and the same location number to indicate that the sample is co-located and followed by W to indicate water sample.
  - Sample location number will be in order of sampling locations beginning with -01 (e.g., SG-01-S-C)
  - Sample matrix will be S for sediment and W for water
  - Sample sponsor will C for City and E for Ecology
- A field duplicate collected from a sample will be identified by the addition of "Dup" to the sample number. A duplicate sample of the above example would be SG-01-S-C-Dup.

**Table 1**

**Sample Locations, Collection Methods, and Rationale**

| Location ID | Sample ID | Sample Location Description | Collection Method | Sample Type | Collection Depth | Coordinate X[a] | Coordinate Y[a] | Ownership | Purpose | Analyses [b, c, d] |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sediment** | | | | | | | | | | |
| HT-01 | HT-01-S-C | Log Boom Park; west kayak launch pad | Hand trowel | Sediment | 0 - 10 cm | 1288073 | 279596 | City | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-02 | HT-02-S-C | Log Boom Park; east kayak launch pad | Hand trowel | Sediment | 0 - 10 cm | 1288199 | 279600 | City | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-03 | HT-03-S-C | Log Boom Park; mid nearshore | Hand trowel | Sediment | 0 - 10 cm | 1288480 | 279517 | City | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-04 | HT-04-S-C | Log Boom Park; north of northwest corner of pier | Hand trowel | Sediment | 0 - 10 cm | 1288688 | 279423 | City | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-05 | HT-05-S-C | Log Boom Park; south of pier at northeast corner of pier | Hand trowel | Sediment | 0 - 10 cm | 1288689 | 279263 | City | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-06 | HT-06-S-E | Harbour Village Marina; Pier 3, confluence Tributary 0056 | Hand trowel | Sediment | 0 - 10 cm | 1288798 | 279224 | State | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| HT-07 | HT-07-S-E | Harbour Village Marina; northwest 500-foot upgradient confluence, Creek 0056 | Hand trowel | Sediment | 0 - 10 cm | 1289073 | 279448 | City | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| HT-08 | HT-08-S-C | Sammamish River; west boat launch | Hand trowel | Sediment | 0 - 10 cm | 1291775 | 278398 | State | Preliminary investigation for COIs and concentrations | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-09 | HT-09-S-C | Sammamish River; east boat launch | Hand trowel | Sediment | 0 - 10 cm | 1291926 | 278362 | State | Preliminary investigation for COIs and concentrations | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| HT-10 | HT-10-S-LFP | Lake Forest Park; nearshore | Hand trowel | Sediment | 0 - 10 cm | TBD | TBD | City of Lake Forest Park | Preliminary investigation for COIs and concentrations | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |

| Location ID | Sample ID | Sample Location Description | Collection Method | Sample Type | Collection Depth | Coordinate | | Ownership | Purpose | Analyses [b, c ,d] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | X[a] | Y[a] | | | |
| HT-11 | HT-11-S-LFP | Lake Forest Park; offshore | Hand trowel | Sediment | 0 - 10 cm | TBD | TBD | City of Lake Forest Park | Preliminary investigation for COIs and concentrations | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| SG-01 | SG-01-S-C | Sammamish River; Small Boat Navigation Channel | Grab | Sediment | 0 - 10 cm | 1289452 | 277890 | State | Preliminary investigation for COIs and concentrations | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| SG-02 | SG-02-S-C | North Lake Marina | Grab/ Box Core | Sediment | 0 - 25 cm | 1289548 | 279178 | Private | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-03 | SG-03-S-C | North Lake Marina | Grab/ Box core | Sediment | 0 - 25 cm | 1289660 | 279175 | Private | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-04 | SG-04-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1290226 | 279112 | Private | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-05 | SG-05-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1289799 | 278863 | State | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-06 | SG-06-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1289359 | 278612 | State | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-07 | SG-07-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1289070 | 278254 | State | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| | SG-07-S-C-Dup | Field Duplicate of SG-07 | Grab/ Box core | Sediment | 0 - 25 cm | 1289070 | 278254 | State | Field duplicate | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |

| Location ID | Sample ID | Sample Location Description | Collection Method | Sample Type | Collection Depth | Coordinate X[a] | Coordinate Y[a] | Ownership | Purpose | Analyses [b, c ,d] |
|---|---|---|---|---|---|---|---|---|---|---|
| SG-08 | SG-08-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1288696 | 277759 | State | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-09 | SG-09-S-C | Kenmore Navigation Channel | Grab/ Box core | Sediment | 0 - 25 cm | 1288458 | 277396 | State | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |
| SG-10 | SG-10-S-E | Harbour Village Marina; southwest of channel 5, west of slip 501 | Grab | Sediment | 0 - 10 cm | 1288816 | 279194 | State | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| SG-11 | SG-11-S-E | Harbour Village Marina; channel 3, between slip 301 and 433 | Grab | Sediment | 0 - 10 cm | 1289047 | 279149 | State | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| SG-12 | SG-12-S-E | Harbour Village Marina; southwest of channel 5, west of slip 513 | Grab | Sediment | 0 - 10 cm | 1288782 | 278974 | State | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| SG-13 | SG-13-S-E | Harbour Village Marina; channel 1, between slip 115 and 218 | Grab | Sediment | 0 - 10 cm | 1289314 | 278856 | State | Further investigation for lateral extent, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| | SG-13-S-E-Dup | Field Duplicate of SG-13 | Grab | Sediment | 0 - 10 cm | 1289314 | 278856 | State | Field Duplicate | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| SG-14 | SG-14-S-E | Kenmore Harbor | Grab | Sediment | 0 - 25 cm | 1290608 | 279416 | Private | Pre-dredge screening for COIs and concentrations | SVOCs and metals, PCBs, TBT (porewater), D/Fs, DMMP pesticides, grain size, TS, and TOC, archive for bulk TBT |

| Location ID | Sample ID | Sample Location Description | Collection Method | Sample Type | Collection Depth | Coordinate X[a] | Coordinate Y[a] | Ownership | Purpose | Analyses [b, c ,d] |
|---|---|---|---|---|---|---|---|---|---|---|
| SG-15 | SG-15-S-E | Kenmore Industrial Park; western shoreline of site | Grab | Sediment | 0 - 10 cm | 1290070 | 278638 | State | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, TBT (bulk), D/Fs, DMMP pesticides, grain size, TS, and TOC |
| SG-16 | SG-16-S-E | Kenmore Industrial Park; Sammamish River midway between wells AW-06 and AW-11 | Grab | Sediment | 0 - 10 cm | 1290550 | 278329 | State | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| SG-17 | SG-17-S-E | Kenmore Industrial Park; Sammamish River south of well AW-010 | Grab | Sediment | 0 - 10 cm | 1291541 | 278637 | State | Location investigation for site COIs, concentrations, and source(s) | SVOCs and metals, PCBs, D/Fs, grain size, TS, and TOC |
| **Water** | | | | | | | | | | |
| HT-01 | HT-01-W-C | Log Boom Park; west kayak launch pad | hand dipped or dipper | Water | 0.6 in -3 ft below surface | 1288073 | 279596 | City | Water column investigation for chemicals of COIs; Co-located with sediment sample location | SVOCs, total and dissolved priority pollutant metals, TSS, TDS, hardness, and WQ parameters[e] |
| HT-04 | HT-04-W-C | Log Boom Park; north of northwest corner of pier | hand dipped or dipper | Water | 0.6 in -3 ft below surface | 1288688 | 279423 | City | Water column investigation for chemicals of COIs; Co-located with sediment sample location | SVOCs, total and dissolved priority pollutant metals, TSS, TDS, hardness, and WQ parameters[e] |
| | HT-04-W-C-dup | Field Duplicate of HT-04 | hand dipped or dipper | Water | 0.6 in -3 ft below surface | 1288688 | 279423 | City | Field duplicate | SVOCs, total and dissolved priority pollutant metals, TSS, TDS, hardness, and WQ parameters[e] |
| WS-10 | WS-10-W-C | Center of Lake Washington in the vicinity of Kenmore | hand dipped or dipper | Water | 0.6 in -3 ft below surface | 1287855 | 278271 | State | Water column investigation for COIs and concentrations; background | SVOCs, total and dissolved priority pollutant metals, TSS, TDS, hardness, and WQ parameters[e] |

Notes:

a – Washington North Zone, NAD 83 geographic and state plane coordinates - U.S. survey feet

b – All sediment samples will be tested for SMS and DMMP SVOCs and metals.

c – Any remaining sediment after the jars for the analyses listed are filled will be archived

d – The analyses of pesticides, PCBs, and dioxin and furans is not being conducted in the water samples at this time since these chemicals are usually not detected in water even when detected in co-located sediment because they do not readily dissolve in water. However, if these chemicals are found in sediments at significant levels, additional surface water samples may be collected and analyzed in the future.

e – Water quality parameters to be collected in the field include turbidity, conductivity, temperature, dissolved oxygen, and pH.
City = City of Kenmore
cm = centimeter
COI = chemical of interest
D/F = dioxin and furan
DMMP = Dredged Material Management Program
m = meter
ft = feet
PCB = polychlorinated biphenyl
SMS = Sediment Management Standards
SVOC = semivolatile organic compound
TOC = total organic carbon
TBT = tributyltin
TS = total solids
TDS = total dissolved solids
TSS = total suspended solids
WQ = water quality


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**Figure 2**
Proposed Sample Locations
Sampling and Analysis Plan
Kenmore Sediment Characterization

## 3.3 Station Positioning

Horizontal positioning will be determined by the onboard differential global positioning system (DGPS) based on target coordinates shown in Table 1. Measured station positions will be converted to latitudinal and longitudinal coordinates (North American Datum [NAD] 83) to the nearest 0.01 second and referenced to state plane coordinates (WAC 173-340-840 4(f)). The accuracy of measured and recorded horizontal coordinates is typically less than 1 meter and will be within 2 meters following DMMP guidance. Vertical elevation of each station will be measured using a fathometer or lead line. Lake elevations will be based the USACE's monitoring station at the Lake Washington Ship Canal Elevation at the Hiram M. Chittenden Locks and recorded each day of the sampling event.

## 3.4 Collection Methods

Thirty sediment samples (including two field duplicates) will be collected from 28 locations at the following areas: Kenmore Navigation Channel, Sammamish River, near shore at Log Boom Park, offshore of the KIP, at the public motor boat launch in the Sammamish River, from Tributary 0056, from the Harbor Village Marina and North Lake Marina, and from near shore adjacent to Lyon Creek Park in the City of Lake Forest Park. Three water samples (including a duplicate) will be collected at Log Boom Park and one background water sample will be collected offshore and south of Log Boom Park at Lake Washington.

The sediment and water sampling methods are described in greater detail below. The location ID, sample ID, collection method, and collection depth are presented on Table 1. The sample locations are shown on Figure 2.

### *3.4.1 Sediment*

Samples from the navigation channel are anticipated to be collected using a box core or power grab sampler or similar device to the maximum penetration possible (target 25 centimeter [cm] below mudline) to better represent deeper sediment that could be removed during dredging. Samples from other submerged areas away from the shoreline will be collected from the top 10 cm using a grab sampler (e.g., VanVeen or Ekman sampler) to represent the biologically active zone, consistent with guidance in Ecology's SAPA (Ecology 2008).

Samples from Log Boom Park, at the public motor boat launch, and in Tributary 0056 will be collected on foot using a hand trowel from shallow submerged sediment areas. Sample HT-10 at Lake Forest Park may be exposed due to lower lake levels at this time of year. At hand collected locations, care will be taken to prevent re-suspension of sediment prior to and during sampling. Sediment will be collected as close as possible to the target coordinates to collect fine grained material (to the extent available) to represent areas where people are likely to come in contact with the sediment. Sampling will be conducted from submerged locations as close as possible to each target location. The sediment will be collected at a uniform depth across the sample area within the top 10 cm to represent what individuals would be exposed to during swimming and/or other recreational activities.

For all other samples, sampling locations will be approached at slow boat speed with minimal wake to minimize disturbance of bottom sediments prior to sampling. Sediment samples will be handled carefully to minimize disturbance during collection, and to equally represent each depth interval (top and bottom of sample). Samples will be placed into laboratory certified containers and transported to the laboratory under COC. The sampler will be lowered over the side of the boat from a cable wire at an approximate speed of 0.3 feet per second. When the sampler reaches the mudline, the cable will be drawn taut and DGPS measurements recorded.

Each surface grab sample will be retrieved aboard the vessel and evaluated for the following acceptance criteria:

- Overlying water is present and has low turbidity
- Adequate penetration depth is achieved
- Sampler is not overfilled
- Sediment surface is undisturbed
- No signs of winnowing or leaking from sampling device

Samples not meeting these criteria will be rejected near the location of sample collection. The process will be repeated until criteria have been met. Deployments will be repeated within a 20-foot radius of the proposed sample location. If adequate penetration is not achieved after multiple attempts, less volume will be accepted and noted in the sediment sampling log form. Once accepted, overlying water will be siphoned off and a decontaminated stainless steel trowel, spoon, or equivalent will be used to collect the required sediment from inside the sampler without touching the sidewalls. The sampler will be decontaminated between stations.

After sample collection, the following information will be recorded on the Sediment Sampling daily log form:

- Date, time, and name of person logging sample
- Weather conditions
- Sample location number and coordinates
- Project designation
- Depth of water at the location and surface elevation
- Sediment penetration and depth
- Sediment sample interval
- Sample recovery
- Physical observations in general accordance with the visual-manual description procedure (ASTM D-2488 modified) such as apparent grain size, wood debris, color, odor, layering, anoxic contact, and presence of sheen, shells or other debris

### 3.4.2 Surface Water

Prior to collecting the water sample, water quality parameters will be measured in the field at each surface water sampling location using a multi-probe water quality meter (e.g., YSI). The water quality meter will be lowered 1ft below the surface and allowed to equilibrate before taking measurements of turbidity, conductivity, temperature, dissolved oxygen, and pH. Results for water quality parameters will be recorded on the water quality and sample collection form (Appendix A).

At each water sample location, water will be collected according to Ecology's Standard Operating Procedure guidance (Ecology 2006) which is consistent with the protocols of the Beach Environmental Assessment, Communication and Health (BEACH) program (Schneider 2004). Water will be collected by hand by dipping the laboratory supplied water bottle or by using a dipper attached to an extension rod to a depth of at least 6 inches below the surface (Ecology 2006). Since the water samples will be collected from a beach, Ecology recommends wading into knee deep water (2.5 feet) and avoid collecting disturbed sediment or coming in contact with the bottom substrate (Ecology 2010). The background location will be collected from Lake Washington, offshore of Log Boom Park to the south, from a boat on the same day as the shoreline water samples. The same sampling methods will be used from the boat. Care will be taken to collect the water sample from an area that is undisturbed.

The actual surface water sample location will be determined in the field, selected as the most representative accessible location to safely sample and achieve the goals of the project.
The total water depth and field parameters will be recorded on the surface water collection form (Appendix A) at each water sample location. Water samples will be placed in a cooler with ice, entered into COC and shipped or delivered on ice to the laboratory within 24 hours of collection. Water quality field measurement data, sample collection information, and ancillary information from each collection station and event will be recorded on field data forms (Appendix A). Ancillary information will include:

- Date and time of each sample/measurement collection
- Water sample collection depth and total water column depth
- Field parameter measures recorded on field data form
- Weather conditions and general observations (e.g., boating traffic, river flow for the sample in the Sammamish River, sheen, or turbid water)
- Visual observations of water and samples at each sampling location
- Field calibration check and calibration information
- Names of personnel present collecting samples and recording data
- General observations about collection procedures and any deviations from this SAP
- Condition of equipment or meters that might impact water quality data

Generally, all information pertinent to water quality will be recorded on the field data forms. Each water grab sample will be treated as a discrete sample and labeled with a unique sample number. The sample numbering scheme for each sample is provided in Table 1. Each sample collected will be clearly labeled using a waterproof label with an indelible pen. Each sample label will contain the project name and project number, the unique sample identification number, date and time of sample collection, analysis to be performed, preservative (as applicable), and the initials of the person collecting the sample.

### *3.4.3 Sample Processing*

Sediment from the sampler will be placed into a stainless steel bowl and homogenized with a stainless steel spoon. Homogenized surface sediment will be spooned immediately into appropriate pre-cleaned, pre-labeled sample containers (Table 2), placed in coolers filled with ice or equivalent, and maintained at 4°C. Debris and materials not representative of the sediment will be omitted from sample containers. Water samples will be poured directly from the sampler into appropriate pre-cleaned, pre-labeled sample containers (Table 2), placed in coolers filled with ice or equivalent, and maintained at 4°C. All samples collected will be entered into COC. All samples for chemical and physical analysis will be securely packed and hand delivered to ARI in Tukwila, Washington as described in Section 4. Archived samples will be held at the laboratory.

**Table 2**
**Guidelines for Sample Handling and Storage**

| Parameter | Sample Size | Container Size and Type[a] | Holding Time | Preservative |
|---|---|---|---|---|
| **Sediment** | | | | |
| Total metals | 50 g | 4-oz glass | 6 months; 28 days for Hg | Cool/4°C |
| | | | 3 years; 28 days for Hg | Freeze[b]/-18°C |
| Tributyltin (porewater) | 500 ml | 2 32-oz glass | 7 days until porewater extraction | Cool/4°C |
| | | | 14 days until extraction | |
| | | | 40 days after extraction | |
| Tributyltin (bulk) | 50 g | 8-oz glass | 14 days until extraction | Cool/4°C |
| Semivolatile organic compounds/ Pesticides/ Polychlorinated Biphenyls | 150 g | 16-oz glass | 14 days until extraction | Cool/4°C |
| | | | 1 year until extraction | Freeze/-18°C |
| | | | 40 days after extraction | Cool/4°C |
| Dioxins and Furans | 150 g | 8-oz glass | 1 year to extraction | Freeze -18°C |
| | | | 1 year after extraction | Freeze -18°C |
| Total solids/total volatile solids | 50 g | 8-oz glass | 14 days | Cool/4°C |
| | | | 6 months | Freeze -18°C |

| Parameter | Sample Size | Container Size and Type[a] | Holding Time | Preservative |
|---|---|---|---|---|
| Total organic carbon | 125 g | from TS/TVS container | 14 days | Cool/4°C |
| | | | 6 months | Freeze -18°C |
| Grain size | 500 g | 16-oz glass | 6 months | Cool/4°C |
| Archive | --- | 8 or 16-oz glass[c] | 14 days until extraction | Cool/4°C |
| | | | 1 year until extraction | Freeze/-18°C |
| **Surface Water** | | | | |
| Semivolatile organic compounds | 500 ml | 2 500 ml amber glass | 7 days until extraction | Cool/4°C |
| | | | 40 days after extraction | |
| Dissolved metal[d] | 100 ml | 500 ml HDPE | 6 months; 28 days for mercury | Cool/4°C |
| Total metals | 100 ml | 500 ml HDPE | 6 months; 28 days for mercury | 5.0 ml of 1:1 nitric acid |
| Total Suspended Solids | 500 ml | 1 L HDPE | 7 days | Cool/4°C |
| Total Dissolved Solids | 500 ml | 1 L HDPE | 7 days | Cool/4°C |
| Hardness | 100 ml | from total metals container | 6 months | Cool/4°C |

Notes:
a – All sample containers will have lids with Teflon inserts
b – Samples will be analyzed for mercury before freezing
c – Container size dependent on available amount of extra sediment; at a minimum 8 ounces will be archived, but not more than 16 ounces
d –Sample will be filtered in the lab with a0.45-µm filter
°C = degrees Celsius
g = gram
HDPE = high density polyethylene
mL = milliliter
oz = ounce
TS/TVS = total solids/total volatile solids

## 3.5 Equipment Decontamination Procedures

Sample containers, collection equipment, working surfaces, and other items that may come into contact with sediment and surface water must meet high standards of cleanliness. All equipment and instruments used that are in direct contact with the sediment collected for analysis will be made of glass, stainless steel, or high density polyethylene (HDPE), and will be cleaned prior to each day's use and between sample locations. Decontamination of all items will follow PSEP protocols. The decontamination procedure is as follows:

- Perform pre-wash rinse with site water
- Wash with solution of laboratory-grade, non-phosphate based soap (e.g., Alconox®)
- Rinse with site water

- Rinse three times with laboratory-grade distilled water
- Cover all decontaminated items with aluminum foil
- Store in clean area or closed container for next use

## 3.6 Field Quality Assurance/Quality Control Samples

Field QA/QC samples will be used to evaluate the efficiency of field collection and processing and decontamination procedures. All field QA/QC samples will be documented on the collection form. Two sediment and one water field duplicate samples will be collected and analyzed for the same chemical parameters as the original sample (Table 2).

## 3.7 Waste Management

All sediment and water remaining after sampling will be washed overboard at the collection station prior to moving to the next sampling station. Any sediment spilled on the deck of the sampling vessel will be washed into the surface water at the collection site.

All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy-duty garbage bags or other appropriate containers.

# 4 SAMPLE TRANSPORT AND CHAIN-OF-CUSTODY PROCEDURES

This section addresses the sampling program requirements for maintaining custody of the samples throughout the sample collection and delivery process.

## 4.1 Sample Custody Procedures

Samples are considered to be in one's custody if they are: 1) in the custodian's possession or view; 2) in a secured location (under lock) with restricted access; or 3) in a container that is secured with an official seal such that the sample cannot be reached without breaking the seal.

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample will be represented on a COC form the day it is collected. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank lines/spaces on the COC form will be lined-out and dated and initialed by the individual maintaining custody.

A COC form will accompany each cooler of samples to the analytical laboratory. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files.

## 4.2 Sample Delivery and Receipt Requirements

All samples will be hand delivered to the analytical laboratory no later than 24 hours after collection. Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the COC form and date, time, and sample condition. Upon receipt of samples at the laboratory the receiver will record the condition of the samples on a sample receipt form. COC forms will be used internally in the laboratory to track sample handling and final disposition.

# 5 CHEMICAL AND PHYSICAL ANALYTICAL TESTING

Surface sediment samples will be submitted for chemical and physical analyses for the full DMMP analyte list (DMMO 2010, 2011) for the screening level characterization. The DMMP analyte list includes laboratory analysis for metals, SVOCs, pesticides, PCBs, dioxin and furans, and TBT porewater in the navigation channel and in North Lake Marina (or bulk if insufficient porewater is available for those locations), and physical parameters including total organic carbon, grain size, and moisture content. These results will be compared to DMMP interpretive criteria for open water disposal (DMMO 2010, 2011).

The remaining sediment samples collected in nearshore areas will be tested for the Sediment Management Standards (Ecology 1995) including metals, semi-volatile organic compounds, pesticides, PCBs, and dioxin furans; and physical parameters, including total organic carbon and grain size. Bulk TBT analysis will also be conducted at these locations. These results will be compared to Ecology's Sediment Quality Values (Ecology 2003, or Sediment Evaluation Framework for fresh water, if finalized [under review]).

Ecology's SAPA (Ecology 2008) and the DMMP User's Manual (DMMO 2009) specify sampling and testing protocols for the chemical characterization of sediment, with the DMMP process designed specifically for dredged material being considered for open-water disposal. Method detection limits will be below the RLs specified in Table 3, if technically feasible. To achieve the required RLs, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract. The modifications must be approved by DMMO and Ecology prior to implementation.

Water samples will be submitted for Washington State drinking water primary and secondary metals (246-290 WAC) as total and dissolved metals, SVOCs, hardness, total suspended solids, and total dissolved solids. Surface water samples will be analyzed by ARI.

Chemical and physical testing will be conducted at ARI, which is accredited by the National Environmental Laboratories Accreditation Program and Washington Accreditation. All chemical and physical testing will adhere to the most recent PSEP analysis protocols and

QA/QC procedures (PSEP 1997b, 1997c) and follow the 2008 DMMP User's Manual (DMMO 2009) and Clarification Papers (Hoffman 1998; Kendall 2001). For dioxin/furan analysis, the information contained in the Revised Supplemental Information on Polychlorinated Dioxins and Furans (PCDD/F) for Use in Preparing a Quality Assurance Project Plan (QAPP; USACE 2010) will be followed. Porewater extraction for TBT analysis will not be performed in the field, but rather will be done in the laboratory according to standardized methods and following the most recent DMMP clarification paper (Hoffman 1998).

Table 3 provides the sediment analyte list, analytical method, and the target RL for each analyte to support Ecology and DMMP goals, where appropriate. Table 4 provides the water analyte list, analytical method, and the target RL. All sample analyses will be conducted in accordance with Ecology-approved methods.

**Table 3**
**Sediment Analyte List, Interpretive Criteria, Analytical Methods, and Reporting Limits**

| | DMMP Interpretive Criteria (Marine) | | | Sediment Quality Values (Freshwater) | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Screening Level | BT | Maximum Level | SL1 | SL2 | Analytical Method | Reporting Limit |
| **Conventional Parameters, %** | | | | | | | |
| Gravel | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Sand | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Silt | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Clay | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Fines | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Total solids | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Total volatile solids | --- | --- | --- | --- | --- | PSEP | 0.1 |
| Total organic carbon | --- | --- | --- | --- | --- | PSEP | 0.1 |
| **Metals, mg/kg dry weight** | | | | | | | |
| Antimony | 150 | --- | 200 | --- | --- | 6010B/6020 | 15 |
| Arsenic | 57 | 507.1 | 700 | 20 | 51 | 6010B/6020 | 10 |
| Cadmium | 5.1 | 11.3 | 14 | 1.1 | 1.5 | 6010B/6020 | 0.5 |
| Chromium | --- | 260 | --- | 95 | 100 | 6010B/6020 | 10 |
| Copper | 390 | 1,027 | 1,300 | 80 | 830 | 6010B/6020 | 10 |
| Lead | 450 | 975 | 1,200 | 340 | 430 | 6010B/6020 | 4 |
| Mercury | 0.41 | 1.5 | 2.3 | 0.28 | 0.75 | 7471A | 0.05 |
| Nickel | --- | --- | --- | 60 | 70 | 6010B/6020 | 0.5 |
| Selenium | --- | 3[a] | --- | --- | --- | 6010B/6020 | 0.5 |
| Silver | 6.1 | 6.1 | 8.4 | 2.0 | 2.5 | 6010B/6020 | 0.6 |

| Parameter | DMMP Interpretive Criteria (Marine) Screening Level | BT | Maximum Level | Sediment Quality Values (Freshwater) SL1 | SL2 | Analytical Method | Reporting Limit |
|---|---|---|---|---|---|---|---|
| Zinc | 410 | 2,783 | 3,800 | 130 | 400 | 6010B/6020 | 15 |
| **Organometallic Compounds** | | | | | | | |
| Tributyltin (porewater) µg/L | 0.15 | 0.15 | --- | --- | --- | GC/MS Krone | 0.15 |
| Triutyltin (bulk) µg/kg[b] | 73.2 | 73.2 | --- | 75 | 75 | GC/MS Krone | 5 |
| **Polycyclic Aromatic Hydrocarbons, µg/kg dry weight[c]** | | | | | | | |
| Total LPAH | 5,200 | --- | 29,000 | 6,600 | 9,200 | --- | --- |
| Naphthalene | 2,100 | --- | 2,400 | 500 | 1,300 | 8270D SIM<br>8270D | 5.0<br>20 |
| Acenaphthylene | 560 | --- | 1,300 | 470 | 640 | 8270D SIM<br>8270D | 5.0<br>20 |
| Acenaphthene | 500 | --- | 2,000 | 1,100 | 1,300 | 8270D SIM<br>8270D | 5.0<br>20 |
| Fluorene | 540 | --- | 3,600 | 1,000 | 3,000 | 8270D SIM<br>8270D | 5.0<br>20 |
| Phenanthrene | 1,500 | --- | 21,000 | 6,100 | 7,600- | 8270D SIM<br>8270D | 5.0<br>20 |
| Anthracene | 960 | --- | 13,000 | 1,200 | 1,600 | 8270D SIM<br>8270D | 5.0<br>20 |
| 2-Methylnaphthalene[d] | 670 | --- | 1,900 | 470 | 560 | 8270D SIM<br>8270D | 5.0<br>20 |
| Total HPAHs | 12,000 | --- | 69,000 | 31,000 | 55,000 | --- | --- |
| Fluoranthene | 1,700 | 4,600 | 30,000 | 11,000 | 15,000 | 8270D SIM<br>8270D | 5.0<br>20 |
| Pyrene | 2,600 | 11,980 | 16,000 | 8,800 | 16,000 | 8270D SIM<br>8270D | 5.0<br>20 |
| Benzo(a)anthracene | 1,300 | --- | 5,100 | 4,300 | 5,800 | 8270D SIM<br>8270D | 5.0<br>20 |
| Chrysene | 1,400 | --- | 21,000 | 5,900 | 6,400 | 8270D SIM<br>8270D | 5.0<br>20 |
| Total benzo(b+j+k)fluoranthenes | 3,200 | --- | 9,900 | 600 | 4,000 | 8270D SIM<br>8270D | 5.0<br>20 |
| Benzo(a)pyrene | 1,600 | --- | 3,600 | 3,300 | 4,800 | 8270D SIM<br>8270D | 5.0<br>20 |
| Indeno(1,2,3-cd)pyrene | 600 | --- | 4,400 | 4,100 | 5,300 | 8270D SIM<br>8270D | 5.0<br>20 |
| Dibenz(a,h)anthracene | 230 | --- | 1,900 | 800 | 840 | 8270D SIM<br>8270D | 5.0<br>20 |
| Benzo(g,h,i)perylene | 670 | --- | 3,200 | 4,000 | 5,200 | 8270D SIM<br>8270D | 5.0<br>20 |
| **Chlorinated Hydrocarbons, µg/kg dry weight** | | | | | | | |
| 1,4-Dichlorobenzene | 110 | --- | 120 | --- | --- | 8270D | 20 |
| 1,2-Dichlorobenzene | 35 | --- | 110 | --- | --- | 8270D | 20 |
| 1,2,4-Trichlorobenzene | 31 | --- | 64 | --- | --- | 8270D | 20 |
| Hexachlorobenzene | 22 | 168 | 230 | --- | --- | 8081B | 1.0 |

| Parameter | DMMP Interpretive Criteria (Marine) Screening Level | BT | Maximum Level | Sediment Quality Values (Freshwater) SL1 | SL2 | Analytical Method | Reporting Limit |
|---|---|---|---|---|---|---|---|
| **Phthalates, µg/kg dry weight** | | | | | | | |
| Dimethyl phthalate | 71 | --- | 1,400 | 46 | 400 | 8270C | 20 |
| Diethyl phthalate | 200 | --- | 1,200 | --- | --- | 8270C | 50 |
| Di-n-butyl phthalate | 1,400 | --- | 5,100 | --- | --- | 8270C | 20 |
| Butyl benzyl phthalate | 63 | --- | 970 | 260 | 370 | 8270C | 20 |
| Bis(2-ethylhexyl) phthalate | 1,300 | --- | 8,300 | 220 | 320 | 8270C | 25 |
| Di-n-octyl phthalate | 6,200 | --- | 6,200 | 26 | 45 | 8270C | 20 |
| **Phenols, µg/kg dry weight** | | | | | | | |
| Phenol | 420 | --- | 1,200 | --- | --- | 8270C | 20 |
| 2-Methylphenol | 63 | --- | 77 | --- | --- | 8270C | 20 |
| 4-Methylphenol | 670 | --- | 3,600 | --- | --- | 8270C | 40 |
| 2,4-Dimethylphenol | 29 | --- | 210 | --- | --- | 8270C | 40 |
| Pentachlorophenol | 400 | 504 | 690 | --- | --- | 8270C | 200 |
| **Miscellaneous Extractables, µg/kg dry weight** | | | | | | | |
| Benzyl Alcohol | 57 | --- | 870 | --- | --- | 8270D | 20 |
| Benzoic Acid | 650 | --- | 760 | --- | --- | 8270D | 400 |
| Dibenzofuran | 540 | --- | 1,700 | 400 | 440 | 8270D | 20 |
| Hexachlorobutadiene | 11 | --- | 270 | --- | --- | 8081B | 1.0 |
| N-Nitrosodiphenylamine | 28 | --- | 130 | --- | --- | 8270D | 20 |
| **Pesticides, µg/kg dry weight** | | | | | | | |
| 4,4'-DDD | 16 | --- | --- | --- | --- | 8081B | 6.0 |
| 4,4'-DDE | 9 | --- | --- | --- | --- | 8081B | 6.0 |
| 4,4'-DDT | 12 | --- | --- | --- | --- | 8081B | 6.0 |
| Total DDT[e] | --- | 50 | 69 | --- | --- | 8081B | 6.0 |
| Aldrin | 9.5 | --- | --- | --- | --- | 8081B | 2.0 |
| Chlordane[f] | 2.8 | 37 | --- | --- | --- | 8081B | 2.0 |
| Dieldrin | 1.9 | --- | 1,700 | 4.9 | 9.3 | 8081B | 2.0 |
| Heptachlor | 1.5 | --- | 270 | --- | --- | 8081B | 2.0 |
| **Polychlorinated Biphenyls, µg/kg dry weight** | | | | | | | |
| Total PCBs[g] | 130 | 38 (mg/kg OC) | 3,100 | 110 | 2,500 | 8082 | 20 |
| **Dioxin and Furans, ng/kg dry weight** | | | | | | | |
| Dioxin Furan TEQ[h] | 4 | --- | 10 | --- | --- | --- | --- |
| **Dioxins** | | | | | | | |
| 2,3,7,8-TCDD | --- | --- | --- | --- | --- | 1613B | 1.0 |
| 1,2,3,7,8-PeCDD | --- | --- | --- | --- | --- | 1613B | 1.0 |
| 1,2,3,4,7,8-HxCDD | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,6,7,8-HxCDD | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,7,8,9-HxCDD | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,4,6,7,8-HpCDD | --- | --- | --- | --- | --- | 1613B | 2.5 |

| Parameter | DMMP Interpretive Criteria (Marine) | | | Sediment Quality Values (Freshwater) | | Analytical Method | Reporting Limit |
|---|---|---|---|---|---|---|---|
| | Screening Level | BT | Maximum Level | SL1 | SL2 | | |
| OCDD | --- | --- | --- | --- | --- | 1613B | 5.0 |
| **Furans** | | | | | | | |
| 2,3,7,8-TCDF | --- | --- | --- | --- | --- | 1613B | 1.0 |
| 1,2,3,7,8-PeCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 2,3,4,7,8,-PeCDF | --- | --- | --- | --- | --- | 1613B | 1.0 |
| 1,2,3,4,7,8-HxCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,6,7,8-HxCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,7,8,9-HxCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 2,3,4,6,7,8-HxCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,4,6,7,8-HpCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| 1,2,3,4,7,8,9-HpCDF | --- | --- | --- | --- | --- | 1613B | 2.5 |
| OCDF | --- | --- | --- | --- | --- | 1613B | 5.0 |

Notes:
a – Because no SL value exists for toxicity testing, selenium will only be evaluated for its bioaccumulation potential
b – Bulk sediment measurement of TBT is used only when porewater extraction cannot be accomplished
c – PAHs for DMMP screening level characterization (SG-02 through SG-09) will be analyzed with method 8270D since the lower detection limit achieved with SIM is unnecessary for DMMP criteria comparison
d – 2-Methylnapthalene is not included in the sum of LPAHs
e – Total DDT consists of the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT
f – Chlordane includes all chlordane isomers, including cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane
g – Total PCBs consists of the sum of all Aroclors
h – The dioxin TEQ is calculated using the methods described in van den Berg et al. 2006. 4 ng/kg TEQ is a volume-weighted average. 10 ng/kg TEQ is a maximum level. Suitability for open water disposal can also be managed on a case-by-case basis by DMMO.
µg/kg = micrograms per kilogram
BT = bioaccumulation trigger
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
GC/MS = gas chromatography/mass spectrometry
HPAH = high-molecular-weight polycyclic hydrocarbon
LPAH = low-molecular-weight polycyclic hydrocarbon
mg/kg = milligrams per kilogram
mg-N/kg = milligrams of nitrogen per kilogram
ng/kg = nanograms per kilogram
PSEP = Puget Sound Estuary Program
SL1 = Screening Level 1
SL2 = Screening Level 2

## Table 4
## Surface Water Analyte List, Analytical Methods, and Reporting Limits

| Parameter | Analytical Method | Reporting Limit |
|---|---|---|
| **Conventionals** | | |
| Total Suspended Solids | SM 2540D | 5.0 mg/L |
| Total Dissolved Solids | SM 2540B | 10 mg/L |
| Hardness | SM 2340B | 2.0 mg/L |
| **Metals** | | |
| Antimony | 200.8/6020A | 0.2 µg/L |
| Arsenic | 200.8/6020A | 0.2 µg/L |
| Barium | 200.8/6020A | 0.5 µg/L |
| Beryllium | 200.8/6020A | 0.2 µg/L |
| Cadmium | 200.8/6020A | 0.1 µg/L |
| Chromium | 200.8/6020A | 0.5 µg/L |
| Copper | 200.8/6020A | 0.5 µg/L |
| Iron | 200.8/6020A | 20 µg/L |
| Lead | 200.8/6020A | 0.1 µg/L |
| Manganese | 200.8/6020A | 0.5 µg/L |
| Mercury | 7471A | 0.10 µg/L |
| Nickel | 200.8/6020A | 0.5 µg/L |
| Selenium | 200.8/6020A | 0.5 µg/L |
| Silver | 200.8/6020A | 0.2 µg/L |
| Thallium | 200.8/6020A | 0.2 µg/L |
| Zinc | 200.8/6020A | 4.0 µg/L |
| **SVOCs** | | |
| ***Polycyclic Aromatic Hydrocarbons*** | | |
| Naphthalene | 8270-SIM | 0.1 µg/L |
| Acenaphthylene | 8270-SIM | 0.1 µg/L |
| Acenaphthene | 8270-SIM | 0.1 µg/L |
| Fluorene | 8270-SIM | 0.1 µg/L |
| Phenanthrene | 8270-SIM | 0.1 µg/L |
| Anthracene | 8270-SIM | 0.1 µg/L |
| 2-Methylnaphthalene | 8270-SIM | 0.1 µg/L |
| Fluoranthene | 8270-SIM | 0.1 µg/L |
| Pyrene | 8270-SIM | 0.1 µg/L |
| Benz[a]anthracene | 8270-SIM | 0.1 µg/L |
| Chrysene | 8270-SIM | 0.1 µg/L |
| Total benzofluoranthenes | 8270-SIM | 0.1 µg/L |
| Benzo[a]pyrene | 8270-SIM | 0.1 µg/L |
| Indeno[1,2,3-c,d]pyrene | 8270-SIM | 0.1 µg/L |
| Dibenz[a,h]anthracene | 8270-SIM | 0.1 µg/L |

| Parameter | Analytical Method | Reporting Limit |
|---|---|---|
| Benzo[g,h,i]perylene | 8270-SIM | 0.1 µg/L |
| ***Chlorinated Benzenes*** | | |
| 1,2-Dichlorobenzene | 8270D | 1.0 µg/L |
| 1,4-Dichlorobenzene | 8270D | 1.0 µg/L |
| 1,2,4-Trichlorobenzene | 8270D | 1.0 µg/L |
| Hexachlorobenzene | 8270D | 1.0 µg/L |
| ***Phthalates*** | | |
| Dimethyl phthalate | 8270D | 1.0 µg/L |
| Diethyl phthalate | 8270D | 1.0 µg/L |
| Di-n-butyl phthalate | 8270D | 1.0 µg/L |
| Butyl benzyl phthalate | 8270D | 1.0 µg/L |
| Bis[2-ethylhexyl]phthalate | 8270D | 3.0 µg/L |
| Di-n-octyl phthalate | 8270D | 1.0 µg/L |
| ***Miscellaneous SVOCs*** | | |
| Dibenzofuran | 8270D | 1.0 µg/L |
| Hexachlorobutadiene | 8270D/8081[a] | 3.0 µg/L / 0.05 µg/L |
| N-nitrosodiphenylamine | 8270D | 1.0 µg/L |
| Phenol | 8270D | 1.0 µg/L |
| 2-Methylphenol | 8270D | 1.0 µg/L |
| 4-Methylphenol | 8270D | 2.0 µg/L |
| 2,4-Dimethylphenol | 8270D | 3.0 µg/L |
| Pentachlorophenol | 8270D/8041[b] | 10 µg/L / 0.025 µg/L |
| Benzyl alcohol | 8270D | 2.0 µg/L |
| Benzoic acid | 8270D | 20 µg/L |

Notes:
a – Method 8081 will be used to achieve lower reporting limit for samples HT-01 through HT-05.
b – Method 8041 will be used to achieve lower reporting limit for samples HT-01 through HT-05.
µg/L = micrograms per liter
SVOC = semivolatile organic compound

In completing chemical analyses for this project, the contract laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in this SAP, including methods referenced for each analytical procedure (Table 2).
- Deliver hard copy and electronic data as specified.
- Meet reporting requirements for deliverables.
- Meet turnaround times for deliverables.
- Implement QA/QC procedures including data quality objectives (DQOs), laboratory

quality control requirements and performance evaluation testing requirements (Tables 5 and 6).

- Notify the project QA/QC Manager of any QA/QC problems when they are identified to allow for quick resolution.
- Allow laboratory and data audits to be performed, if deemed necessary.

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, matrix spikes, surrogate spikes (for organic analyses), and method blanks. Table 5 lists the frequency of analysis for laboratory QA/QC samples, and Table 6 summarizes the data quality objectives for precision, accuracy, and completeness.

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. All samples are diluted and reanalyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any cleanups will be conducted prior to the dilutions. The QC sample results will be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

## Table 5
## Laboratory Quality Assurance/Quality Control Sample Analysis Summary for Sediment and Water

| Analysis Type | Initial Calibration | Ongoing Calibration | Replicates | Matrix Spikes | SRM/LCS | Matrix Spike Duplicates | Method Blanks | Surrogate Spikes |
|---|---|---|---|---|---|---|---|---|
| Grain size | Each batch[a] | NA | 1 per 20 samples | NA | NA | NA | NA | NA |
| Total solids/Total volatile solids | Each batch[b] | NA | 1 per 20 samples | NA | NA | NA | NA | NA |
| Total suspended solids/total dissolved solids | Each batch[b] | NA | 1 per 20 samples | NA | NA | NA | NA | NA |
| Hardness | Each batch[b] | NA | 1 per 20 samples | NA | NA | NA | NA | NA |
| Total organic carbon | Daily or each batch | 1 per 10 samples | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | NA | 1 per 20 samples | NA |
| Metals | Daily | 1 per 10 samples | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | NA | 1 per 20 samples | NA |
| Dioxin and Furans | As needed[c] | Every 12 hours | 1 per 20 samples | NA | 1 per 20 samples | NA | 1 per 20 samples | Every sample |
| Tributyltin | As needed[c] | Every 12 hours | NA | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | Every sample |
| Semivolatile organics | As needed[c] | Every 12 hours | NA | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | Every sample |
| Pesticides/Polychlorinated biphenyls[d] | As needed[c] | 1 per 10 samples | NA | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | 1 per 20 samples | Every sample |

Notes:
a – Calibration and certification of drying ovens and weighing scales are conducted bi-annually
b – Initial calibration verification and calibration blank must be analyzed at the beginning of each batch
c – Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed
d – Pesticides and PCBs will have all detects confirmed via second column confirmation. The second column must be of a dissimilar stationary phase from the primary column and meet all method requirements for acceptance.
NA = not applicable
SRM = standard reference material
LCS = laboratory control sample

**Table 6**
**Data Quality Objectives for Sediment and Water**

| Parameter | Precision | Accuracy | Completeness |
|---|---|---|---|
| Grain size | ± 20% RPD | NA | 95% |
| Total solids/total volatile solids | ± 20% RPD | NA | 95% |
| Total suspended solids/total dissolved solids | ± 20% RPD | NA | 95% |
| Hardness | ± 20% RPD | NA | 95% |
| Total organic carbon | ± 20% RPD | 65-135% R | 95% |
| Metals | ± 35% RPD | 75-125% R | 95% |
| Dioxin and Furans | ± 50% RPD | 50-140% R | 95% |
| Tributyltin | ± 50% RPD | 50-150% R | 95% |
| Semivolatile organic compounds | ± 50% RPD | 50-150% R | 95% |
| Pesticides/Polychlorinated biphenyls | ± 50% RPD | 50-150% R | 95% |

Notes:
R = recovery
RPD = relative percent difference

## 5.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. A calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analysis of samples. Continuing calibration verifications (CCV) will be performed daily prior to any sample analysis to track instrument performance. The frequency of CCVs varies with method. For gas chromatograph/mass spectrometer (GC/MS) methods, one will be analyzed every 12 hours. For GC, metals, and inorganic methods, one will be analyzed for every ten field samples, or daily, whichever is specified in the method. If the ongoing continuing calibration is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to, or immediately following, CCV at the instrument for each type of applicable analysis.

## 5.2 Laboratory Duplicates/Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as a separate sample.

## 5.3 Matrix Spikes/Matrix Spike Duplicates

Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate MS analyses, information on the precision of the method is also provided for organic analyses.

## 5.4 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the MRL of any single target analyte/compound. If a laboratory method blank exceeds this criterion for any analyte/compound, and the concentration of the analyte/compound in any of the samples is less than five times the concentration found in the blank (ten times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced.

## 5.5 Laboratory Control Samples

Laboratory control samples (LCS) are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The LCS is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of sample and the MSs. The LCS will provide information on the precision of the analytical process, and when analyzed in duplicate, will provide accuracy information as well.

## 5.6 Standard Reference Materials

Standard Reference Materials (SRM) is analyzed to assess possible matrix affects at all stages of sample preparation and analysis. The SRM is a matrix-matched sample that is carried through all aspects of preparation and analysis as a field sample and has a known concentration of target analytes. Puget Sound SRM will be used for dioxin and furan and PCB analyses (DMMO 2012). Performance will be evaluated using the DQOs listed in Table 6 and as outlined in DMMO (2010) and Ecology (2008).

## 5.7 Laboratory Data Package

ARI will prepare a detailed laboratory data package documenting all activities associated with the sample analyses. The following information will be included in this data package:

- **Project Narrative:** A detailed narrative that describes the samples received, analyses performed, and corrective actions undertaken.
- **COC Documentation:** Laboratory policy requires that COC documentation be available for all samples received. The COC will document basic sample demographics such as client and project names, sample identification, analyses requested, and special instructions.
- **Data Summary Form:** A tabular listing of concentrations and/or detection limits for all target analytes. The data summary form will also list other pertinent information such as amount of sample analyzed, dilution factors, sample processing dates, extract cleanups, and surrogate recoveries.
- **QC Summary:** Includes results of all QC analyses, specifically recovery information. LCSs are reported with each batch. Additional QC analyses may include laboratory replicates, MS, and SRMs.
- **Instrument Calibration Forms and Raw Data:** Includes initial and continuing calibration summaries and instrument tuning data, laboratory bench sheets, and logbook pages.

## 5.8 Data Validation and Verification

Laboratory data will be provided in both PDF and EQuIS electronic format. Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. A Stage 2A level (USEPA 2009) data quality review (equivalent to a QA1 review) will be performed by Anchor QEA (or a subconsultant), in accordance with U.S. Environmental Protection Agency (USEPA) National Functional Guidelines (USEPA 2004, 2008) by considering the following:

- Data completeness
- Holding times
- Method blanks
- Surrogate recoveries
- Detection limits
- RLs
- LCSs
- MS/MSD samples
- SRM results

The data will be validated in accordance with the project-specific DQOs (Table 6), analytical method criteria, and the laboratory's internal performance standards based on their Standard Operating Procedures. Dioxin and furan data will be validated at a Stage 4 level (USEPA 2009) by a subconsultant using the DQOs outlined in DMMO (2010) and/or the SAPA (Ecology 2008). The results of the data quality review, including text assigning qualifiers in accordance with the USEPA National Functional Guidelines and a tabular summary of qualifiers, will be generated by the Database Manager and submitted to the project QA/QC Manager for final review and confirmation of the validity of the data. A copy of the validation report will be submitted by the QA/QC Manager and will be presented as an appendix to the Results Memorandum.

Laboratory data, which will be electronically provided and loaded into the database, will undergo a 10% check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of all manually entered data will be verified by a second party. Data tables will be exported from EquIS database to Microsoft Excel tables.

# 6 SAMPLING AND ANALYSIS RESULTS MEMORANDUM

The Results Memorandum will be prepared by Anchor QEA documenting all activities associated with sample collecting, compositing, transporting, and chemically analyzing sediment and water samples. The laboratory data packages will be included as appendices and also submitted in electronic formats including Ecology's EIM format. The following will be included in the Results Memorandum:

- Summary of all field activities including a description of any deviations from the approved SAP
- Locations of sediment and water sampling stations in state plane coordinates to the nearest foot (Washington North Zone), and in latitude and longitude in degrees and minutes to four decimal places (NAD 83); all vertical elevations of mudline and water surface will be reported to the nearest 0.1-foot
- A project map with actual sampling locations
- A QA/QC narrative for laboratory results
- Summary data results tables
- Summary of comparison of chemical results with DMMP interpretive criteria (DMMO 2010, 2011) and Ecology's interim freshwater SQV (Ecology 2003) as shown in Table 2. If available and finalized, the new SQVs that are currently under review will be presented.

Hard copies of field data will be provided with the Results Memorandum and laboratory analysis results and associated QA/QC data will be available. Results of the laboratory analyses will be submitted to the DMMO in DAIS format and to Ecology in EIM format. The Results Memorandum will be submitted to DMMO, Ecology, and DOH within 12 weeks after completion of the field sampling activities. Ecology and DOH will be responsible for preparing separate reports with additional evaluations and interpretation based on the information included in the Results Memorandum.

# 7 PROJECT SCHEDULE

The estimated schedule for the sampling, analysis, and reporting activities are summarized in Table 7. Finalization of the SAP and sampling is anticipated in early November. Validated sampling results are anticipated to be available in January 2013. The Results Memorandum is anticipated to be submitted in February 2013. When the Results Memorandum is available, Ecology may participate in an informal discussion of the results.

**Table 7**
**Estimated Schedule**

| Description | Schedule |
|---|---|
| Approved Sampling and Analysis Plan | Early November 2012 |
| Field Sampling and Lab Coordination | 1 week; initiated within 2-3 weeks of SAP approval by Ecology and other agencies |
| Lab Testing | 4 weeks for chemistry testing |
| Data Validation | 4 weeks for data validation and QA/QC |
| Results Memorandum and Submittal of data to EIM | 4 weeks after receipt of validated results and completion of QA/QC |
| Evaluations Conducted by Ecology | 4-8 weeks after submittal of Results Memorandum |
| Health Consultations Conducted by DOH | Spring 2013 |

Notes:
DOH = Washington State Department of Health
Ecology = Washington State Department of Ecology
EIM = Ecology's Environmental Information Management database
QA/QC = quality assurance/quality control

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# APPENDIX A
# FIELD FORMS AND LOGS

**Chain of Custody Record & Laboratory Analysis Request**

**COC#**

ANCHOR QEA

Date: ______________________________

Laboratory : ______________________________

Project Name: ______________________________

Project Number: ______________________________

Project Manager: ______________________________

Phone Number: ______________________________

Shipment Method: ______________________________

| Line | Field Sample ID | Collection Date/Time | Matrix | No. of Containers | Dioxin and Furans | Pesticides[1] | PCB Aroclors | SVOCs[1] | Tributyltin (porewater) | Metals[1] | Ammonia, Sulfide, TOC | Grainsize, TS, TVS | Archive | Tributyltin (bulk)[2] | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | | | | |
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| 12 | | | | | | | | | | | | | | | | | | | | | | | |

1 See SAP Table 2 for analyte lists and test methods

2 Only analyzed if there is insuffcient volume for the porewater analysis

Additional notes/comments: ______________________________

| Relinquished By: | Company: Anchor QEA LLC. | Received By: | Company: |
|---|---|---|---|
| Signature/Printed Name | Date/Time | Signature/Printed Name | Date/Time |

| Relinquished By: | Company: | Received By: | Company: |
|---|---|---|---|
| Signature/Printed Name | Date/Time | Signature/Printed Name | Date/Time |

*Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.*

# Daily Log

Anchor QEA L.L.C.
720 Olive Way, Suite 1900
Seattle, WA 98101
Phone 206.287.9130 Fax 206.287.9131

**PROJECT NAME:** **DATE:**

**SITE ADDRESS:** **PERSONNEL:**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WEATHER:** | **WIND FROM:** | N | NE | E | SE | S | SW | W | NW | LIGHT | MEDIUM | HEAVY | |
| | | SUNNY | | CLOUDY | | RAIN | | | ? | **TEMPERATURE:** | ° F | . | ° C |

[Circle appropriate units]

| TIME | COMMENTS |
|---|---|
| See Field Logs for detailed logging and sampling | |
| Equipment on site: | |
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Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site
Safety infractions, Important comments/instructions to contractors

Signature: ______________________________

# Surface Sediment Field Log

| | |
|---|---|
| Job: | Station: |
| Job No: | Date: |
| Field Staff: | Sample Method: |
| Contractor: | Target Coordinates: Lat. |
| Horizontal Datum: | Long. |

Water Height
DTM Depth Sounder: ____________
DTM Lead Line: ____________

Tide Measurements
Time: ________
Height: ________

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (lower low water-large tides): calculated after sampling

Notes:

| Grab # | Time | Actual Coordinates | | Sample Accept (Y/N) | Recovery Depth (cm) | Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc |
|---|---|---|---|---|---|---|
| | | Longitude/Easting | Lattidue/ Northing | | | |
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**Sample Description:** surface cover, (density), moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Sample Containers:

Analyses:

ANCHOR QEA

720 Olive Way, Suite 1900
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131
www.anchorqea.com

## Water Quality and Sample Collection Form

| | | | |
|---|---|---|---|
| **Station ID:** | | **Date:** | **Time:** |
| **Project Name:** | | **Project Number:** | |
| **Coordinates:** Datum**:** | | | |
| Lat/Northing | | Long/Easting | |
| Sample Depth: | | Total Water Depth: | |
| Weather Observations: | | | |

**Field Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Temperature | °C | Turbidity | NTU | Others: | |
| pH | | DO | mg/L | | |
| Conductivity | | | | | |

**Sample Description**

| | | |
|---|---|---|
| Evidence of floating or suspended materials: | Y / N | |
| Evidence of oil/hydrocarbon sheen: | Y / N | |

Describe any discoloration and turbidity:

| | |
|---|---|
| Odor | none, slight, moderate, strong<br>$H_2S$, petroleum, septic |

Comments (e.g., boat activity, river flow rate, stormwater discharges in the vicinity) :

Recorded by:

# Appendix B

# The Responsiveness Summary
# Public Comment Period October 15–29, 2012
# Kenmore Area Sediment Sampling and Analysis Plan Draft

October 2012

# The Kenmore Area Sediment Sampling and Analysis Plan

## Responsiveness Summary
## Public Comment Period October 15 – 29, 2012

**Prepared by Washington Department of Ecology**
**with City of Kenmore, Washington Department of Health,**
**Dredge Material Management Program, and**
**US Army Corps of Engineers**

**November 29, 2012**

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# INTRODUCTION

This Responsiveness Summary is for the Kenmore Area Sediment Sampling and Analysis Plan and Public Comment Period held October 15 – 29, 2012. The City of Kenmore (City) in partnership with the Washington State Department of Ecology (Ecology) developed a sampling and analysis plan. The plan is to guide characterization of sediment and water in the northeastern portion of Lake Washington south of Kenmore, near the mouth of the Sammamish River, and near shore the City of Lake Forest Park. The characterization has two purposes:

- Support the City's ongoing work with the U.S. Army Corps of Engineers (USACE) for dredge planning at the Kenmore Navigation Channel.

- Evaluate the possible presence of contamination along the near shore and shoreline including public access areas.

The plan titled, "Sampling and Analysis Plan for Kenmore Area Sediment and Water Characterization" was prepared by Anchor QEA and dated October 2012. The plan was developed with the City and Ecology in consultation with the Dredge Material Management Program (DMMP), the US Army Corps of Engineers (USACE), and Washington State Department of Health (WADOH).

Ecology conducted a public comment period for the draft plan (October 2012) from October 15 through 29, 2012. During this two week period, 15 comments were received. The comments were reviewed by the four agencies: Ecology, the City of Kenmore, DMMP with USACE, and WADOH. Each comment was carefully considered and where appropriate, was incorporated into the final Sampling and Analysis Plan for Kenmore Area Sediment and Water Characterization, and dated November 6, 2012. This Responsiveness Summary lists each comment and response by the four agencies.

The Responsiveness Summary is posted on the Ecology Webpage for Lakepointe aka Kenmore Industrial Park site at:

http://ecyapps4/gsp/SitePage.aspx?csid=2134

And at the Ecology Harbour Village Marina webpage at:

http://ecyapps4/gsp/SitePage.aspx?csid=9197

The comments are listing in the order they were received and numbered in the order received. The response is listed below each comment. The original comments with attachments are provided in Appendix A.

# <u>Comment #1 from Ann Hurst</u>

**From:** Ann Hurst
**Sent:** Tuesday, October 16, 2012 12:03 PM
**To:** O'Brien, Maura (ecy); chingpi.wang@ecy.wa.gov; Warren, Bob (ECY); rkarlinsey@kenmorewa.gov; bhampson@ci.kenmore.wa.us; bhampson@kenmorewa.gov; david.r.kendall@usace.army.mil; Hardy, Joan (DOH); harbourvillage@frontier.com
**Cc:** c4sep; stedward; nlccannouncements@yahoogroups.com
**Subject:** Anchor Testing, why not Cal Portland?

Maura O'Brien, Kenmore Yard Site Manager, and Rob Karlinsey, Kenmore City Manager,
My apologies if I added to the confusion. I was mistaken; in 1996 sample S1 was in nearly same location as proposed SG4 by Anchor (I mis-read the 1996 map).

Why the Cal Portland area was not tested for contaminants in 1996 and will not be by Anchor in forthcoming tests, however, yet remains a mystery to the public. In the past and perhaps today because it is not being proposed for dredging? What about disturbing the sediments for a new dock? It was my understanding that Cal Portland will get a new dock, has a new dock? **Do I find the permits/E.I.S. or DNS on Cal Portland dock with City or Ecology?**

I have researched that a batch plant that uses fly ash may contribute significantly to Dioxins when filling the fly ash flue through faulty equipment (warning bells not activated, bags in disrepair, operator error) a repeated occurrence at this site over decades, how much is documented depends on complaints and self-reporting. I yet advocate testing the Cal Portland shore lands as it looks to me like the flue is close to the water and Cal Portland's tax info indeed says Cal Portland is on the water, though Cal Portland did self-report the latest, known incident.

**Is the attached on Dioxin extraction new, useful in cutting costs, accurate?**
All parties are moving in a good direction; I yet advocate that the turbidity at Harbour Village Marina, created by the WSDOT contractors tugs and barges as the contractors try to turn the barges 90 degrees, stop. Pretty easy to observe, pretty easy to fine, pretty awful for the residents who have repeatedly, daily been exposed to the turbid water and horrific if this exposure affects their even not yet conceived children.

**Do you really think the barge contractors will self report their turbidity violations in the future if for the past months, since March, they have not done so -- even once -- and cannot make the turn without creating turbidity?**

Best, Ann Hurst

## Agencies Response to Comment #1

1A. SSAP testing at CalPortland.

Response – Ecology requested sediment sampling at or near the CalPortland waterfront. A new sediment sample has been added and is located at the northeast end of the Navigation Channel halfway between CalPortland and KIP site and labeled as sample SG-14.

1B. New Dock at CalPortland.

Response –City of Kenmore and USACE have not received an application from CalPortland or the landowner Fuyo Leasing for a new/improved dock.

1C. Batch Plant that uses fly ash may be a source or may contribute to dioxin.

Response –Technically fly ash could be a source or contribute to dioxin or other contamination. Cal-Portland Environmental Manager reports that the plant uses fly ash; it is delivered in sealed bags, transported in closed containment, and monitored following the PSAQA requirements.

1D. Dioxin testing using extraction.

Response – See earlier responses from laboratory and Kendall's responses.

1E. Turbidity at Harbour Village Marina (HVM) caused by Washington State Department of Transportation (WSDOT) and their contractor, Kiewit General Manson (KGM) use of tugs and barges may cause/is causing contamination to Kenmore citizens and children and area.

Response – SSAP includes turbidity testing at each water sampling location and you will find turbidity testing listed under Conventional testing in the SSAP. Also issues about turbidity and violation of Washington Clean Water Act have been referred to Ecology Water Quality Program (WQP). The WQP has conducted twelve inspections at the KGM operations at KIP site to date and no violation has been witnessed. WQP is working with WSDOT and KGM for best management practices and to minimize turbidity.

## Comment #2 from Elizabeth Mooney

-----Original Message-----
From: Kendall, David R NWS [mailto:David.R.Kendall@usace.army.mil]
Sent: Thursday, October 18, 2012 11:28 AM
To: elizabeth.mooney
Cc: dbent@kenmorewa.gov; landerson@kenmorewa.gov; Barney, Phyllis (ATG); happyhaze@msn.com; aaronmsmithlaw@gmail.com; Cleve Steward; Radabaugh, David (ECY); dreitan@insleebest.com; O'Brien, Maura (ECY); Wang, Ching-Pi (ECY); Hardy, Joan (DOH); Ann Hurst; Aaron Smith
Subject: RE: UPDATE draft sampling plan (UNCLASSIFIED)

Hi Elizabeth: I have been out of office the last several days. Thank you for your observations and response. I want to stress that I do not know the PCB source for the Harbor Village Marina PCB/dioxin contamination, and would look to Ecology TCP to ultimately evaluate that question and concern.

I also have no doubt that you are observing suspension and redistribution of sediments in the area due to barge traffic in the navigation channel, and that some of these sediments may settle within the Harbor Village Marina.

My reasoning that there is another primary source of the PCBs is based on the ten-fold differences in PCB concentrations in the Harbor Village Marina and in the navigation channel. The PCB concentrations observed in the navigation channel material (detected Aroclor 1254, ranged from 15 - 27 ppb, averaging 21 ppb-dry weight, and TOC normalized concentrations ranged from 0.38 - 0.66 ppm-TOC, averaging 0.5 ppm-TOC) were well below (State Sediment Quality Standards(SQS), where they were quantitated at only 4.2% of the SQS (PCB SQS = 12 ppm-TOC. By comparison, the PCB concentrations in the Harbor Village Marina, ranged from a low of 196 ppb to a high of 277 ppb for Aroclor 1254, averaging 237 ppb, which are greater than ten times the PCB levels observed in the navigation channel based on the average concentrations. At least with the data in hand, it simply does not appear that there are enough PCBs in the navigation channel to have provided the level of contamination seen over time in the marina.

I think we will have to wait until the sediment investigation due to take place in early November provides the data to evaluate the PCB and dioxin concentrations throughout Kenmore. Hopefully that data will provide some answers. I know my interagency colleagues and I in the Dredged Material Management Program are anxious to gather the necessary data to evaluate the extent of the PCB/dioxin contamination at Kenmore, and are confident that the proposed testing strategy will be helpful to that end.

David

David R. Kendall, Ph.D.
Chief, Dredged Material Managment Office
Seattle District Corps of Engineers
Phone: 206/764-3768
email: david.r.kendall@usace.army.mil

-----Original Message-----
From: elizabeth.mooney]
Sent: Monday, October 15, 2012 1:08 PM
To: Kendall, David R NWS
Cc: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; Cleve Steward; drad461@ecy.wa.gov; dreitan@insleebest.com; mobr461@ecy.wa.gov; cwan461@ecy.wa.gov; joan hardy; Ann Hurst; Aaron Smith
Subject: Re: UPDATE draft sampling plan (UNCLASSIFIED)

David,

I have read and reread your Oct 5 2012 email to Ann Hurst; unfortunatly, I disagree with your conclusion. I'd like to explain why by sharing my personal observation of tug/barge activity and subsequent brown sediment-laden water drifting into Harbour Village Marina, and ask if you believe you might reconsider your conclusion based on new information.

Before I do that, I want to thank you for correcting the record so we now know the type of PCB in both Harbour Village Marina and in the Federal Navigation Channel are the same, Aroclor 1254. I hope that Dept of Ecology reflects that in their website information. It is important that people understand these details and that they know that the PCB type in Harbour Village Marina is the SAME type as the PCB type in the Federal Navigation Channel. That is what is important, in my opinion. I appreciate your going to the trouble to correct the record in the email attached. It makes sense.

In your Oct 5 email to Ann Hurst, you state (and I added an underline and bold for emphasis for what I believe is most important):

My email clarifying error in letter (6/6/12):

Hi all: I would like to point out that in the fifth paragraph of Attachment 1 to response letter, it states that the Corps of Engineers "determined that the PCB fingerprints were significantly different at the two sites" (Federal navigation channel and Harbor Village Marina). I would like to correct the record that that statement is in error. The Fingerprinting indicates the Aroclor quantified at both sites was the same, Aroclor 1254, as noted in attached Figure. I wanted to correct the record, as there is a lot of misinformation out there regarding the testing at these two locations. Thanks.

David
David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

The reason I (Elizabeth Mooney) disagree with your conclusion:
I have watched the barges numerous times in the navigation channel. I see them stop in front of Harbour VIllage Marina to turn their vessels. Most importantly, I've seen brown water in Harbour Village Marina AFTER the barges have departed Kenmore Navigation Channel, passed Harbour Village Marina and headed out into Lake Washington.

On the same day when Greg Wingard watched from the Hays' condo and noted a Clean Water Act violation in August 2012, I went, afterwards, to the HV Marina and talked to the Harbormaster Mike. Since that was the same day that Greg Wingard had noted the turbidity due to the tug/barge activity in the Kenmore Navigation Channel, I feel confident that what I was seeing at HVM was due to the barge activity. Additionally, the Harbormaster told me it was true. The Harbormaster told me to look out into the marina. I could easily see that brown water was in the Harbour Village Marina. Mike said that brown water enters HVM after the tug/barges pass the marina in the Navigation Channel. According to Mike, it happens all the time. Therefore, your conclusion in the email makes no logical sense to me. You stated that: "The concentrations of PCBs found in Harbor Village Marina were 10 times the concentrations found in the federal navigation channel in the 1996 characterization, and therefore, the navigation channel is not the likely source for the contamination in Harbour Village Marina." On the contrary, David, doesn't it make sense that if the barges have been churning up the bottom of the sediment in the Federal Navigation Channel, and if the wind or current drive the suspended sediment toward Harbour Village Marina, that the increase in concentrations of PCBs would build up in the Harbour Village Marina? From what I saw, I hypothesize that barge activity translocates the sediment, and that, subsequently, the sediment drifts into the marina where it can't go any further and settles onto the bottom. It builds up in the marina due to the barges churning up sediment in a Federal Navigation channel that has inadequate depth for the barges/tugs using it.

Based on my personal observation, when the barges churn up the sediment at the bottom of the too shallow Federal Navigation Channel with their too deep tugs' activities, the sediment appears to be churned up and the brown water (filled with the sediment) travels right into the Harbour Village Marina, due to wind or current or whatever. That is what I believe I saw happening.

Can you please help me understand? As you know, my goal is to protect our rights to having Clean Water. First we need to know where to test to get the answers we need. I am concerned about the method of testing. Perhaps, based on this information, there may be a reason to have Anchor QEA take a different type of sample to determine the extent/source of the dioxin and PCB at HVM. Since the Sediment Sampling draft went out today, I'd like to make sure you know about this brown water in HVM after tug/barge activity in the Navigation Channel.

Thanks very much,

Sincerely,
Elizabeth Mooney

---

From: "David R NWS Kendall" <David.R.Kendall@usace.army.mil>
To: "Ann Hurst" <annmhurst@msn.com>, "Elizabeth.Mooney" <elizabeth.mooney@comcast.net>
Cc: dbent@kenmorewa.gov, landerson@kenmorewa.gov, phyllisb@atg.wa.gov, happyhaze@msn.com, aaronmsmithlaw@gmail.com, "Cleve Steward" <cleve.steward@amec.com>, drad461@ecy.wa.gov, dreitan@insleebest.com, mobr461@ecy.wa.gov, cwan461@ecy.wa.gov, "joan hardy" <joan.hardy@doh.wa.gov>
Sent: Friday, October 5, 2012 10:40:51 AM
Subject: RE: UPDATE draft sampling plan (UNCLASSIFIED)

Hi Ann: I have to correct the statement below attributed to me in an earlier Ecology response letter to Representative Pollett. Ecology incorrectly quoted me relative to PCB fingerprinting of the Aroclors at

Harbor Village Marina and the Federal Navigation Channel. I have attached my email notifying Ecology (Maura O'Brien) of that error. The factual error was later corrected, but apparently the earlier uncorrected transmittal letter is still being circulated.
The concentrations of PCBs found in Harbour Village Marina were 10 times the concentrations found in the federal navigation channel in the 1996 characterization, and therefore, the navigation channel is not the likely source for the contamination in Harbour Village Marina.

David
David R. Kendall, Ph.D.
Chief, Dredged Material Managment Office
Seattle District Corps of Engineers
Phone: 206/764-3768
email: david.r.kendall@usace.army.mil

My email clarifying error in letter (6/6/12):

Hi all: I would like to point out that in the fifth paragraph of Attachment 1 to response letter, it states that the Corps of Engineers "determined that the PCB fingerprints were significantly different at the two sites" (Federal navigation channel and Harbour Village Marina). I would like to correct the record that that statement is in error. The Fingerprinting indicates the Aroclor quantified at both sites was the same, Aroclor 1254, as noted in attached Figure. I wanted to correct the record, as there is a lot of misinformation out there regarding the testing at these two locations. Thanks.

David
David R. Kendall, Ph.D.
Chief, Dredged Material Management Office
Seattle District Corps of Engineers
Phone: 206/764-3768
Fax: 206/764-6602
email: david.r.kendall@usace.army.mil

-----Original Message-----
From: Ann Hurst [mailto:annmhurst@msn.com]
Sent: Thursday, October 04, 2012 4:41 PM
To: Elizabeth.Mooney
Cc: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; Steward, Cleve; drad461@ecy.wa.gov; dreitan@insleebest.com; mobr461@ecy.wa.gov; cwan461@ecy.wa.gov; Kendall, David R NWS; joan.hardy@doh.wa.gov
Subject: RE: UPDATE draft sampling plan

Elizabeth and All,
The 1996 sampling is attached, and yes, the channel where the docks reside was tested in 1996, with exceedances, but of the type that dissipate except for the relatively low PCB's. In an Ecology summary on line, Ecology states that Officer Kendall states, the type of PCB's found at Harbour Village Marina last year are not the same as found in 1996. What is off shore of CalPortland in 2012 will be unknown without testing that area, and now we know with equipment failures and use of fly ash over time at the

cement companies, the cement batch plants under various ownership and various controls of fly ash could be a cumulative source of the dioxins.
As I read the RCW, and with informal info from County, since the docking area is within City Boundary, it is clearly City Responsibility; County responsibility in past.

There was no Dioxin testing in 1996, and we now know that materials containing PCBs degrade over time, so what was in 1996 would not be a footprint of what is today as I, a lay person, understand various explanations made by various scientists to me. And if there are the 1996 PCB types at Harbour Village Marina, they may be well buried, watching recently all the churning of barges at that corner of the Kenmore Navigation Channel closest to Harbour Village Marina, which may have been going on for years with cement barge traffic, it is not a surprise that the Harbour Village Marina needs dredging.

An Ecology summary also said Officer Kendall made a comment on the types of toxins in the past at Harbour Village Marina, not certain where that material resides; but as I would prefer actual source material, I am again bothering Officer Kendall by cc'ing him and hoping he can clarify. Thank you Officer Kendall.

All in all, if we don't get a good testing pattern and firm execution date, etc., I am not going to be a good sport, Phyllis and Dawn, especially today with the high barge traffic, turbidity, and other likely infractions, waiting for official reports. Our health and it appears the workers' health is not being protected.
Best, Ann

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Date: Thu, 4 Oct 2012 05:58:40 +0000
From: elizabeth.mooney@comcast.net
To: annmhurst@msn.com
CC: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; cleve.steward@amec.com; drad461@ecy.wa.gov; dreitan@insleebest.com
Subject: Re: UPDATE draft sampling plan

Ann,

Isn't it the case that the water area (navigation channel) by Calportland/Lakepointe was tested in 1996? Why would anybody spend city money and Ecology's money to test if they aren't going to test there?

I left a message for our manager, Rob Karlinsey. It certainly was my understanding that city/Ecology money was to be spent looking for the source of the dioxins/PCB's. Would it make any sense to spend all that money on the Anchor QEA sampling if there is no sampling where they found PCBs in 1996? Am I forgetting something here?

Thanks.

Elizabeth

**Agencies Response to Comment #2**

2A. SSAP and source(s) of PCBs and dioxins.

Response – This sampling plan will be testing for PCBs and dioxin/furans at all sediment sampling locations listed in this SSAP in the Kenmore Area and Lake Forest Park. The source or sources for PCBs and dioxin are UNKNOWN. Historically, PCBs sampling has occurred numerous occasions at the KIP site and the results are no detection with one exception, a wood chip that was later dismissed as poor quality. Also PCBs were tested in the Kenmore Navigation Channel (SAIC 1996) and these results were no detection or below 27 ug/kg or parts per billion. At this time, the source(s) of PCBs and dioxin/furans are unknown, and this SSAP is the next step to investigate the extent and possible source(s) of PCBs and dioxin/furans in the Kenmore area.

## Comment #3 from Ann Hurst

**From:** Ann Hurst
**Sent:** Wednesday, October 24, 2012 9:37 AM
**To:** O'Brien, Maura (ECY); Wang, Ching-Pi (ECY)
**Cc:** Barney, Phyllis (ATG); rkarlinsey@kenmorewa.gov
**Subject:** FW: [stedwards] Dioxin Levels Love Canal, Vietnam, No Kiewitt skin in game?

Maura,
I am in receipt of Anchor testing plan of Kenmore's shore lands; thank you. I am troubled that Kenmore's industries do not want their shore lands tested for Dioxin contamination. My comment is that you obtain a Court Order or whatever is necessary to test these shore lands using the most comprehensive testing methods available and require the industries pay for the testing. Ample justification is in email below, an answer that the public sought from me which I think is fair.
By now you must realize that the K/G/M barges did not stick to one barge per day! One barge per day was K/G/M's deal with WSDOT, in the FEIS, and I assume was K/G/M's deal with Ecology.
Thank you. Best, Ann Hurst, 6302 NE 151st Street, Kenmore, WA 98028

---

From: annmhurst@msn.com
To: c4sep@yahoogroups.com; stedward@lists.riseup.net; nlccannouncements@yahoogroups.com
Date: Wed, 24 Oct 2012 09:09:41 -0700
Subject: [stedwards] Dioxin Levels Love Canal, Vietnam, No Kiewitt skin in game?

To give you an idea of how 90 pptr in Kenmore sediments compares to the most egregious Vietnam contamination and Love Canal:

The U.S. will spend $68 million to clean up Vietnam dioxin hot spots due to leaching of Agent Orange from dioxin storage sites:

"The general standard in most countries is that **dioxin levels must not exceed 1,000 ppt (parts per trillion) TEQ (toxic equivalent) in soil and 100 ppt in sediments**. Levels beyond that require immediate remediation. Average dioxin contamination in the soil of industrialized nations is less than 12 ppt." At Harbour Village Marina, the Dioxin level of **90 pptr** in sediments should have triggered further investigation as the number is approaching the 100 ppt that requires immediate remediation. See source: http://www.aspeninstitute.org/policy-work/agent-orange/cleaning-dioxin-contaminated-soils

The 13.2 pptr in the sediments of the Kenmore Navigation Channel is not approaching 100 ppt but it is above the threshold of 10 ppt which requires during clean-up that it be treated as a hazardous substance and not allowed to disperse into Lake Washington. Clearly it has been allowed to disperse with barge traffic. The City of Kenmore, perhaps WSDOT, could seek damages from K/G/M.
By comparison, Love Canal had 380 pptr just in the fly ash. Fly ash is a product that in March wafted from the fly ash flue of Cal Portland in Kenmore; while it is unlikely that the recent source of fly ash used by Cal Portland is a by product of burning toxic wastes, prior fly ash sources could well have been a result of burning materials that would create a by-product with heavy dioxin contamination. Fly ash has been used at the batch plant for decades to create cement products.

Love Canal surface water sediments measured 37 ppb – perhaps someone can translate into pptr, the storm sewer sediment of Love Canal was 672 ppm, and six private sump pumps next to the industrial garbage dump measured as high as 16,500 ppm. A clear picture of the source, a dump.

Kenmore is not Love Canal, yet we are nearing the immediate remediation point at Harbour Village Marina and the source needs to be found and contained.

We are only one of four states that does not consider absorption of Dioxin through the skin to be hazardous in particular situations: "For dioxin, incidental ingestion is the dominant exposure route for unrestricted/ residential use, and four states (Delaware, Mississippi, Pennsylvania, and Washington) base their cleanup levels on this pathway alone. Most others incorporate inhalation and/or dermal exposures, but those contributions tend to be relatively small. However, under certain scenarios (such as for excavation workers), these additional exposure routes can contribute substantially to the derived cleanup level." P.19
REVIEW OF STATE SOIL CLEANUP LEVELS FOR DIOXIN, 2009

## Agencies Response to Comment #3

3A. Need for more dioxin testing.

Response – The SSAP now includes 28 sediment and four water column samples. Given the City budget and Clean Sites Initiative funding from Ecology, this represents the maximum number of samples feasible at this time for this SSAP. In the future if more sampling is necessary, then additional funds will need to be secured and a new sampling plan will be written.

3B. Need PCB and dioxin/furan testing at Kenmore industrial sites.

Response – The SSAP locates several sediment samples at or near industrial sites in Kenmore. For example, seven sediment sampling locations are listed in the Kenmore Navigation Channel; five sediment samples are located off-shore Kenmore Industrial Park site; one sediment sample is located between KIP and CalPortland sites; one sediment sample is located off-shore Kenmore Air Harbor; in addition to sample locations at and near public parks and boat launch areas.

## Comment #4 from Dennis Mendrey

**From:** Dennis mendrey
**Sent:** Wednesday, October 24, 2012 11:02 AM
**To:** O'Brien, Maura (ECY)
**Subject:** RE: Webpage and media information for Kenmore Industrial Park and Harbour Village Marina

Sound great!
*Working together for a better Kenmore,*
*Dennis*
**RISE REALTY LLC**
6410 NE 182 St
Kenmore, WA 98028
O = 206-686-8727
C = 425-681-8727
Fax = 206-686-8727
dennism@riserealtyllc.com
www.riserealtyllc.com

## Agencies Response to Comment #4

4A. Praises the SSAP.

Response – Thank you for your encouragement.

## Comment #5 from Washington State Department of Natural Resources

Comment # 5

WASHINGTON STATE DEPARTMENT OF
**Natural Resources**
Peter Goldmark - Commissioner of Public Lands

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Caring for
your natural resources
... now and forever

October 22, 2012

Maura O'Brien, Toxics Cleanup Program NWRO
Washington State Department of Ecology
3190- 160th Ave SE
Bellevue, WA 98008

Re: Draft Sampling and Analysis Plan, Kenmore Sediment and Water Characterization

Dear Ms. O'Brien:

The Washington State Department of Natural Resources (DNR) would like to thank you for the opportunity to comment on the Draft Sampling and Analysis Plan for the Kenmore Sediment and Water Characterization.

DNR's comments are based on principles of stewardship and proprietary management derived from our legislative defined goals to protect State-Owned Aquatic Lands (SOAL) and preserve them for the public's benefit. We appreciate Ecology's consideration of these and any future comments related to the characterization of these sediments.

First, in Table 1, please note that DNR does not own state owned aquatic land-it is the manager of those lands.

Secondly, since the freshwater sediment standards are draft and are still being revised, they should not be the sole standards the nearshore samples should be screened against. (p. 27)

Sincerely,

Erika A Shaffer, MS
Aquatics Division, Sediment Specialist

AQUATIC RESOURCES DIVISION | 1111 WASHINGTON ST SE | MS 47027 | OLYMPIA, WA 98504-7027
TEL (360) 902-1100 | FAX (360) 902-1786 | TTY (360) 902-1125 | TRS 711 | WWW.DNR.WA.GOV
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## Agencies Response to Comment #5

5A. Clarification Table 1 –Washington Department of Natural Resources (WDNR) does not own state aquatic land, it is the manager of those lands.

Response #5A – Clarification will be implemented on Table 1.

5B. Freshwater Sediment Standards are draft and are being revised and should not be the sole standards.

Response – The Ecology Freshwater Sediment Management Standards (SMS) are currently under revision. The SMS will be utilized when the SMS are final, and other available sediment quality guidelines will be utilized.

## Comment #6 from North Lake Marina

Comment #6

# North Lake Marina

6201 NE 175TH St, Kenmore, WA. 98028
P#425.482.9465 F# 425.482.9386
www.northlakemarina.com

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OCT 26 2012

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October 25, 2012

City of Kenmore
Rob Karlinsey
Nancy Ousley
18120 68th Ave. NE
Kenmore, WA. 98028

Department of Ecology
Maura O'Brien
3190 160th Ave. SE
Bellevue, WA. 98008

Re: *Sampling and Analysis Plan Kenmore Area Sediment and Water Characterization*

Mr. Karlinsey, Ms. Ousley, and Ms. O'Brien,

We have reviewed the Sampling and Analysis Plan (the "Plan"). Please correct the Plan at page 3, second paragraph. The owner of North Lake Marina (Johnson & McLaughlin, LLC) is not participating in the Plan; rather, the property owners are the participating parties. It is our understanding Clifford Davidson has been working with the City, as a representative of Davidson Investment Properties, LLC, and Bernie Talmas, as Edwin Davidson's representative, spoke before the City Council at an open City Council meeting as to Mr. Davidson's intent to participate. North Lake Marina has agreed to facilitate any needed access and to provide moorage at no cost for the testing vessel. Please contact the undersigned if you have any questions concerning this letter.

Thank you,

Lori Johnson
North Lake Marina
Johnson & McLaughlin, LLC

Loren McLaughlin
North Lake Marina
Johnson & McLaughlin, LLC

## Agencies Response to Comment #6

6. Clarification and correction.

Response –Clarification and correction will be implemented in SSAP.

# Comment #7 from Greg Wingard for Kenmore Action Network (KAN)

Comment #7

Comments on the Sediment Sampling and Analysis Plan – Kenmore Area Sediment and Water Characterization

October 26, 2012

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OCT 29 2012
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TCP - NWRO

Prepared by:

Greg Wingard
PO Box 4051
Seattle, WA 98194-0051

Section 1.1

The Kenmore Navigation Channel (KNC) appears to terminate, adjacent to Kenmore Air. What is the status of the remaining portion of the head of the channel to the NE? Who owns it, and can it be sampled as well?

From our recent meeting, it is my understanding that the sediments at the head of the channel, northeast of and adjacent to the Kenmore Navigation Channel are in private ownership. Further, Ecology and/or the City of Kenmore have approached these property owners, including Kenmore Air, CalPortland, and Kenmore Industrial Park, who have declined to allow sampling of these in channel sediments as part of this SSAP project.

There is a high level of community concern about the potential contamination of the sediments in this area, and the head of the channel. This is based on available information such as present and former industrial uses, a fairly substantial fire involving creosoted timber, the sinking of a tug, which released at least some amount of product/waste (according to the United States Coast Guard), to list a few.

Sampling of these sediments is a high priority in the community, with a strong preference to see this sampling done sooner, rather than later. This concern is particularly critical due to the increased tug and barge traffic in this vicinity, which as been seen causing an increase in water turbidity, from the disturbance of channel sediment from prop wash.

While I understand there are some legal limits to what Ecology can do, or require a private property owner to do, I also want to be very clear that based on a reasonable assessment of the available information there is a strong community concern that sediments in the channel head, outside the KNC, may be contaminated, are being disturbed, and may be distributed as a result. Resolution of this data gap is a critical community issue that needs to be a high priority with Ecology, and Kenmore.

According to the plan this "screening level" study will be followed by a full DMMP characterization when the proposed funding for the project is two years or less out. There is some uncertainty in the proposed time lines here. Any information Ecology/Kenmore can provide on timing of further sampling after the initial screening is completed would be useful. My current understanding is that this is dependent to a large extent on federal funding/permission being available for the KNC dredge project. The assumed target date is currently thought to be between two and four years out, with substantial additional sediment data collection being done in that time frame.

The community requests that Ecology deal with this issue, of the time frame and potential scope of additional sampling concurrent with the release of data and reports resulting from this SSAP. By addressing this matter up front and as soon as possible Ecology/Kenmore can reassure the community of your commitment to collect the necessary data to see that community health and the environment of the north Lake Washington, and related near shore area is protected.

The document states the owners of Northlake Marina are interested in coordinating their dredging project, in conjunction with the KNC dredge to optimize potential cost savings. How does this fit in with the potential dredging at the Harbor Village Marina?

It would appear that given the somewhat closely coordinated approach and timing of the dredging at each of these three sites, that particular attention should be paid to the potential for any nexus between the sites. The current sampling design does not appear to meet this objective, as there appear to be remaining data gaps in the area east of the Harbor Village Marina, north and west of the KNC, and at the head of the channel north and east of the KNC.

My understanding is that Ecology/Kenmore are investigating the possibility of moving some sampling locations to address this issue to some extent, but that there is a lack of additional funds to allow for more sampling locations to be added.

The community requests that Ecology meet with the community as soon as possible after the data from this SSAP is released to discuss a data gaps analysis, including an assessment of what the additional priorities for sampling will be, and timing of further sampling efforts.

A substantial amount of both public and private funds will be expended in dredging, or corrective actions for the identified dredge project, or known contaminated site areas. The understanding of the potential contamination nexus between these proposed project areas, as well as additional nearby areas needs to be understood, and the potential for recontamination known and addressed prior to dredging or removal actions.

Section 1.2

The exact purpose of the water sampling is not clear. The primary chemicals of concern from the community perspective are the dioxin/furan/PCB's, and metals, in particular at Log Boom Park, as the park is closely adjacent to the known dioxin/furan/PCB contamination at the Harbor Village Marina. It is highly unlikely that these particular chemicals of concern would be found dissolved in the water column. The more likely scenario is that the water column would be contaminated by sediment stirred up by human, or mechanical activity. To the extent there is a risk to public health from the water column absent disturbed, suspended sediments, based on available data to date, it is much more likely that health risk would relate to biological constituents (pathogens), rather than chemicals of concern, such as dioxin/furans/PCB's and metals.

It does not appear that the water quality samples add much value to this sampling effort. If the expense related to the proposed water quality sampling is equal to, or greater than the cost of an additional sediment sample (my understanding is that the loaded cost of adding another sediment sampling location is ~$2,200), then Ecology/Kenmore should strongly consider scrapping the water quality sampling and instead adding an additional sediment sample(s), in one of the available areas where more data would be useful. A potential priority would be the area to the east of the current Harbor Village Marina samples.

Section 1.2 (sic)

There are clearly multiple purposes related to this sampling effort. In terms of sampling collection methods and analysis, these should be as homogenous as possible between all sampling locations, so as to maximize the potential statistical and comparative use of the data across the entire area sampled. It is not clear from this section how Ecology/Kenmore are going to optimize the statistical , and comparative usefulness of the sampling data. It is understood that there are some cost concerns/limitations that may impact aspects of this issue.

There is a reference to the revision of the Ecology sediment evaluation framework for freshwater, and that revision being available when published. The relevance to this SSAP is not clear. It is my understanding that the revised framework may be available in final form by the time the data from the SSAP project is available. If that is the case the consultant will use this updated document to screen the results against. The SSAP text of this will be clarified.

Section 1.3.1

Given the information about existing industries on, or in close proximity to the channel, the upper head of the channel, northeast of the KNC should be sampled as well. As this is discussed above, I will not repeat that information here.

Section 1.3.3

In the discussion of sediment loading the SSAP, provides specific citations related to sediment loading from stream 0056. In the discussion of the Sammamish River sediment loading and wind and wave transport, there are no citations provided, just a general assumption that the river is one of two primary contributory sources. Is there an available data on potential sediment loading from the River, or its sediment distribution?

It is understood that the current priority is to get the sampling underway. As a result, additional information of Sammamish River sediment loading to Lake Washington may wait until the data evaluation phase, rather than being included in the SSAP now. There is general agreement that additional information on Sammamish River sediment loading to Lake Washington will be useful.

In Ecology's recent update, "Harbour Village Marina", the site status and previous data are reported. This information is not referenced in section 1.3.3., of the SSAP.

In short the marina was already on Ecology's MTCA site list due to petroleum contamination, including soil and groundwater. The facility previously decided to deal with this site contamination through "natural attenuation." It has since been determined this petroleum contamination originated at an adjacent site, and Ecology's files are being updated to reflect this.

At the time the petroleum contamination was evaluated, data related to nearby dioxin/furan/PCB contamination was not known. There is potential concern that since petroleum at excessive levels has been located in the shallow groundwater at this facility, there may be a potential for the petroleum to impact nearby sediments. This is of concern as petroleum, in particular the lighter fractions of petroleum has the potential of mobilizing dioxin in soil, sediment, and water. Further consideration of this potential media/contamination nexus should be a high priority.

As mentioned above, given the historic information supplied in this report, and otherwise known about the CalPortland area, and the area outside of the KNC, referred to as the head of the channel, lack of samples from this area is a clear data gap. While it is understood that this area is private property, and neither Ecology or Kenmore have the immediate ability to collect samples on private property without property owner cooperation, plugging this data gap remains a top community priority.

Table 1

The table provides detail and rationale for selected sample locations. Near shore sediment samples are described as having a collection depth of 10 cm, and are collected with a trowel. Grab/box core samples are described as having a collection depth of 25 cm. The difference in sample depth adds a variable that interferes with the ability to compare results from these two groups of samples. Sediment sample depths should be as consistent as possible across this sampling effort. From our recent meeting the issue of cost was raised as part of the rationale for differing sample depths, though how much impact having uniform sampling depth would have on the budget was not discussed in any detail.

As per previous comment, it is not clear what value the water sampling has in the context of this limited sampling plan, or how single point in time water samples would be that useful in terms of a health assessment given time loaded variability of water samples as compared to sediment samples.

Water analysis should include turbidity, as there is a specific water quality criteria for that parameter. From the meeting, it was clarified that turbidity sampling will be done as part of the conventional parameters taken at all the sample sites. The text will be modified so this information is consistent with the field sample forms at the end of the SSAP.

Figure 2

As mentioned previously given the proximity, and/or planned coordination between the three planned dredging, or cleanup projects (it is not clear whether Harbor Village Marina will proceed as a MTCA cleanup, or as a dredging project), the potential for a nexus between these three areas, the Harbor Village Marina, North Lake Marina, and KNC should be a priority of this and future sampling efforts. The sediment sampling as proposed does not address better defining the eastward lateral extent of sediment contamination from the presently known dioxin/furan/PCB contamination at the Harbor Village Marina. It does not address the potential for a nexus between that contamination and the eastward elbow of the KNC where current tug, and barge operations are at least in part making a turn and have been observed causing excessive turbidity in the water column. It also does not address the undesignated section of the channel between the northeastern extent of the DNC and the channel head, where according to the historic information supplied, some of the most likely potential sediment contaminant sources are, or were located. Ecology/Kenmore will investigate moving some of the sampling locations to address this issue, as long as that doesn't interfere too much with other data quality objectives.

Ecology mentioned in our recent meeting that the City of Lake Forest Park is siting a sediment sample in their area in addition to what was initially planned by Ecology and Kenmore. It is not clear if this sample is depicted in Figure 2.

Section 3.4

The section refers to the three planned water samples and says a single "background" sample will be collected upstream of the 68th Avenue bridge on the Sammamish River. How does this location constitute "background", as compared to Log Boom Park. Wouldn't it be preferable to take a water sample from the central part of north Lake Washington, and use that as background?

It seems the differences in the total volume of water, potential for inputs and other factors would make an upstream Sammamish River sample less than satisfactory for this purpose, and a sample from the middle of north Lake Washington would be more representative.

Ecology agreed to examine moving the "background" water quality sample, and will respond to this concern.

Section 3.4.1

The difference between grabbing a core sample and the trowel method of sampling has the potential to introduce an unnecessary variable in the sediment sampling methods. This includes a variable in the portion of sample based on depth for the trowel method, as compared to coring which would better isolate the sampled sediment and collect a more representative sample on the vertical axis to the depth sampled. Ecology agreed it is important to strictly control the sample collection to assure a representative sample is collected, and a sample collection call-out will be added to address this issue.

The rationale for the difference in sample depths is not clear. There should be some clear, consistent rationale for the sampling depth, such as the depth of contamination as seen at the Harbor Village Marina, or the depth of the biologically active zone, or the depth of planned dredging, or the depth likely to be disturbed by human contact or mechanical means. There should be at least some brief explanation of why there is a difference in sediment sampling depths.

Section 5

What is the rational for the difference in TBT sampling methodology between the near shore, and surface sediment samples?

In the KNC samples, and the Harbor Village Marina samples the TBT sample will be collected in the lab from the sample pore volume water, with bulk TBT sample analysis if enough pore water volume is not present in the sample. The rest of the collected samples will have bulk TBT sampling, apparently irrespective of whether there is enough pore water volume, or not. There should be at least a brief explanation for this variance in the sampling methodology.

Table 7

The schedule is of concern. As laid out in the schedule there will be a fairly long period of time between sample collection, and the issuance of the looked for reports from Ecology and Department of Health. It is understood that it is Ecology and Kenmore's intent to issue the data to the public as soon as the Quality Assurance/Quality Control step is completed. It is understood that this will be relatively "raw" data, without detailed explanations or conclusions, which will come later when the final reports are issued.

References

Under the Ecology citations, there is no reference to the Ecology sediment evaluation framework for freshwater. Does this mean Anchor is not using this as a reference in this SSAP?

The SSAP text will be modified to clarify under what circumstances the new framework will, or will not be used.

There is a reference of a personal communication between J. LaFlam and Bill Joyce in 2012. What is the substance of this communication and the significance of citing to it in the SSAP?

It is understood from the recent meeting that the J. LaFlam citation was a reference to a discussion between Kenmore staff, and the Kenmore Fire Department to collect additional information on the previous wharf fire of creosote treated timber, in the vicinity of the current CalPortland facility. Given the available information on this creosote timber fire, and the verification that at least a portion of the burnt and partially burnt treated timbers are still in the water and sediment in the channel adjacent to CalPortland, Ecology should likely add this site to the known and suspected contaminated sites list under MTCA authority. KAN will be discussing this in the near future, and may provide some additional input on this point.

## Agencies Response to Comment #7

Note, each paragraph represents a specific comment and is listed as A, B, C…
7A. Ownership status of NE portion of Navigation Channel (KNC).

Response – NE portion of the Navigation Channel is under private ownership by Pioneer Towing Company, Inc. and two sediment samples have been located in the northeast portion of the Channel, see sample #SG-04 and SG-14, in addition to the five samples in the central and western portion of the Channel.

7B. Potential sources of contamination may be located at NE portion of Navigation Channel and there is high community concern to request sediment sampling at the Channel.

Response –See Response 7A.

7C. Increased water turbidity and tug traffic at Navigation Channel may be causing potential contamination and re-distribution of contaminated sediment.

Response – see Response 1E above.

7D. Kenmore Navigation Channel sediments represent a critical data gap.

Response –see Response 7A above.

7E. Further sampling and full DMMP Dredge Application at Kenmore Navigation Channel (KNC).

Response – Sampling and investigation are conducted on a step by step basis. Further sampling and investigation will be based on these SSAP results. Future dredge applications for the KNC, Harbour Village Marina, or North Lake Marina will be determined by each party based on their priorities, budget, and selection.

7F. Future sampling and release of SSAP data results after QA/QC.

Response – City and Ecology agreed that the SSAP results will be made available as soon as the laboratory and Anchor QEA complete their data quality evaluation called QA/QC to confirm the sample results are valid and representative. Sampling results after QA/QC will be posted on the City and Ecology WebPages. The SSAP-QA/QC results are estimated to be posted in mid-January 2013. An informational meeting for the SSAP results will be scheduled. The SSAP report by Ecology will be available estimated March 2013 and the WDOH Health Consultations will be available in spring 2013.

Any need for future sediment sampling will be based on these results, and for a future DMMP Dredge application will be determined by respective party, and see Response to 7E.

7G. Proposed dredging applications for KNC, North Lake Shores and Harbour Village Marina (HVM) .

Response – Proposed dredging applications will be determined by each party based on their priorities, budgets, and selection. Coordination is encouraged between and among all parties.

7H. Nexus between or among dredging projects and need for coordination.

Response – This SSAP is one step, a screening step to estimate the near shore sediment and water column conditions. Further testing may be necessary based on these results. Future sampling will be required for each specific dredge application and will be determined by each party.

7I. Community request for Ecology to meet after SSAP testing results are available.

Response – Ecology will participate in an informational meeting and discussion for the SSAP results, and see Response 7F above.

7J. Need for coordination for planning, implementation, safeguards and source control for both dredging and Ecology environmental functions at these waterfront locations.

Response –Yes this is true and City and/or Ecology will work with appropriate parties as each or several of these tasks are planned.

7K. Need to clarify the purposes for surface water column sampling and why/why not specific analysis such as biological constituents (pathogens) are/are not part of the SSAP.

Response – King County Department of Public Health conducts water quality evaluation for public health including biological constituents and pathogens. This SSAP is for the purposes of dredge planning and Ecology's environmental evaluation and the Model Toxics Control Act (MTCA) cleanup requirements. Surface water column samples will give us a snap shot view of water quality at the time of sediment sampling.

7L. Question –change water column samples for additional sediment sampling.

Response – The four agencies reviewed this request and determined that the water column results will provide valuable information. Ecology and WADOH will use the water column results in their respective evaluations and proposed report and Health Consultations.

7M. Need to specify sampling methods as precise as feasible, and prepare for statistical and comparative analyses of results.

Response – Request implemented.

7N. Clarify Fresh Water Sediment Management Standards and Screening Criteria.
Response – Request implemented. The fresh water Sediment Management Standards are currently under revision and once they are approved (estimated 2013), then they will be used in the SSAP report, and see Response 5B.

7N-2. Need for additional sediment sampling for variety of industries and northeast KNC.

Response – Sample locations have been reviewed and modified to achieve best lateral extent and achieve specific site information, for example the relocation of samples SG-14, SG-15 and WS-10. This SSAP was expanded to 28 sediment and 4 water samples. Any need for future sampling will be based on these results, and or dredge application, and see Responses 3A and 3B.

7O.  Need references for sediment loading for creek 0056 and Sammamish River.

Response – Add citation "Kenmore Lake Line Lakebed Sedimentation Analysis Report" for the north Lake Washington Kenmore Area prepared by SoundEarth Strategies and Lally Consulting dated October 6, 2011.  Anchor, Ecology and others will provide additional sources of information as available.  And we concur that additional information on sediment loading to Lake Washington will be useful and will be incorporated in the SSAP report.

7P. Need to add information at section 1.3.3 to the SSAP.

Response – Request implemented.

7P-2.  Issues of Harbour Village Marina and neighboring site with former petroleum underground storage tank removal and soil and groundwater petroleum exceedance, and the questions of possible petroleum causing contaminant migration especially with nearby PCBs and dioxin/furan in sediment.

Response – Ecology will follow up with HVM and neighboring property for the petroleum issue and possible mobility of sediment contamination.

7Q.  Need for additional sediment sampling at northeast KNC and private properties, such as CalPortland and Kenmore Industrial Park sites, and suggests to plug this/these data gap(s).

Response – See Responses 1A, 3A and 3B, and 7N-2 above.

7R.  Sediment sampling methods and how best to make all results comparative and minimize variability.

Response – Request implemented.  Note, there are two sediment sampling methods.  One method is for dredge planning and uses 25 cm depth.  The second method is for environmental and health evaluation and uses 10 cm depth to evaluate the active biotic zone.  All sampling will be conducted consistent with professional standards and protocol and to be representative of each depth interval.

7R-2.  Question about water sampling and analysis within this limited sampling plan.

Response – See Response 7L above.

7S.  Water analysis should include turbidity.

Response – Note the SSAP includes conventional parameters (field parameters) including turbidity monitoring at each sample location.  Revise SSAP to clarify turbidity monitoring will be conducted at water sampling locations.

7T.  Need to coordinate among the three potential dredge locations (KNC, HVM, North Lake Marina) for planning and implementation for dredging and/or Ecology environmental tasks.

Response – The SSAP results will assist in defining the next steps both for planning for dredging and/or environmental and health tasks.  Any future proposed dredge applications for KNC, Harbour Village Marina, or North Lake Marina will be determined by each party based on their priorities, budget, and selection. Yes, parties have been working together and will be encouraged to continue working together. Also see response 7Q above to address possible data gaps.

7U. City of Lake Forest Park has requested sediment sampling at the City's public waterfront park.

Response - Two new sediment samples are proposed by the City of Lake Forest Park (LFP) near off-shore at Lyon Creek Park, approximately 2400 ft west of Log Boom Park. The water column back-ground sample has been relocated by the City and Ecology from Sammamish River to off-shore at northeast Lake Washington. The two sediment sampling costs are to be covered by LFP City. City of Kenmore, Ecology and Lake Forest Park are working together. SSAP text and figure 2 are revised.

7U-2. Question is to relocate background water column sample from Sammamish River to a location at northeast Lake Washington.

Response – Request implemented and see SSAP revised figure 2.

7V. Sediment sampling methods, depths, and consistency of sample collection for vertical axis, and see SSAP section 3.4.1.

Response – Request implemented, and see Response 7R above.

7W. Tributyltin (TBT) sampling methodology, using TBT pore water or bulk sample, and see section 5.

Response – Request implemented.

7X. Schedule for SSAP sample results, QA/QC results, and reporting.

Response – The SSAP on Table 7 lists the estimated dates for sample results, QA/QC results, and reporting. Ecology has posted this estimated schedule on the KIP and HVM webpages. The estimated schedule is:

- -November 6, 7 and 8, 2012 sample collection.
- -Mid-December 2012 estimated laboratory SSAP results.
- -Mid-January 2013 estimated QA/QC completed for SSAP results and posted on the City and Ecology WebPages and available to the public.
- -An informal meeting to discuss the SSAP results will be organized if requested.
- -Mid-February 2013 for Anchor QEA Sampling and Analysis Results Memorandum.
- -Mid-March for the Ecology SSAP report.
- -Spring 2013 for the DOH Health Consultations.

7Y. References and Ecology Revised Sediment Management Standards.

Response – Request implemented and see response 5B above.

7Z. Clarify reference to J. LaFlam, Kenmore Fire Department.

Response – City will provide information to clarify and describe reference.

# Comment #8 from Gary Sergeant via Floyd Snider

Comment #8

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | Kate Snider [Kate.Snider@floydsnider.com] |
| **Sent:** | Monday, October 29, 2012 1:50 PM |
| **To:** | O'Brien, Maura (ECY) |
| **Cc:** | Wang, Ching-Pi (ECY); Gary Sergeant |
| **Subject:** | Public comment on Sediment Sampling & Analysis Plan for Kenmore Area Sediment |

Maura,

The following comments on the Sediment Sampling & Analysis Plan for Kenmore Area Sediment are provided on behalf of Gary Sergeant and Pioneer Towing, Inc.

1. Section 1.3.3, paragraph 5, page 9: Ecology's recent Public Participation Plan (PPP) update includes a description of the KIP site history that is more accurate than this description presented in the SAP. We would appreciate substitution of your text from the PPP. Most importantly, the 6th sentence regarding reported disposal of medical wastes and transformers should be deleted, as it is an old conjecture which has since been disproven.
2. Table 1: Our understanding is that sediment samples SG-14, SG-15, SG-16 and SG-17 will be on DNR aquatic lands property, offshore of KIP. Please confirm.
3. Figure 2 and Table 1: Throughout the year, significant sediment loads are conveyed out of the Sammamish River, and are deposited throughout the north end of Lake Washington. We are surprised that the proposed sampling plan does not include samples within the depositional area of the mouth of the Sammamish River, that would analyze this material as a potential source of contamination to the area. We recommend that approximately 2 sediment grab sample locations be added at (or relocated to) the centerline of the Sammamish River Small Boat Navigation Channel, south of SG-15 and in-between SG-16 and SG-17. In addition to the proposed SG-01, these sample locations could be used to characterize Sammamish River bed load as a potential source.

Please let Gary or I know if you have any questions.

Thanks,

Kate

**Kate Snider, PE Principal**
**FLOYD | SNIDER**
Strategy * Science * Engineering
Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867
cell: 206-375-0762
www.floydsnider.com

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**From:** O'Brien, Maura (ECY) [mailto:MOBR461@ECY.WA.GOV]
**Sent:** Monday, October 15, 2012 12:51 PM
**To:** Gary Sergeant; Kate Snider; Lakey, Kevin
**Cc:** Wang, Ching-Pi (ECY)
**Subject:** FW: Webpage and media information for the Sediment Sampling and Analysis Plan for the Kenmore waterfront area.

Hello,
Here is the Kenmore Area announcement and plan. The SSAP is posted both on the Ecology's Harbour Village Marina webpage and on the Kenmore Industrial Park site webpage.

Maura

## SEDIMENT SAMPLING & ANALYSIS PLAN COMMENT PERIOD Kenmore Area Sediment & Water Characterization – Oct 15-29, 2012

Ecology is holding a two week informal public comment period for the citizens of the Kenmore Area for the proposed Sediment Sampling and Analysis Plan at the Kenmore waterfront area. The Washington Department of Ecology with the full cooperation of the City of Kenmore are working in close consultation with the Washington State Department of Health (DOH) and Dredged Materials Management Program (DMMP) on the details for the Sediment Sampling and Analysis Plan (SSAP). The SSAP will include near shoreline sediment sampling at Log Boom Park, Lake Washington northeast waterfront, Harbour Village Marina, North Lake Marina, offshore of the Kenmore

1

Industrial Park site, Kenmore Navigation Channel and Sammamish River, and water column samples at Log Boom Park. Final access arrangements have been completed.

The draft SSAP will be available for informal public review from October 15 – 29, 2012. This is not a formal state cleanup requirement (Model Toxics Control Act) for public involvement. Your review and comments are requested and please send written or email comments to Maura O'Brien at mobr461@ecy.wa.gov or Department of Ecology, 3190 – 160th Ave SE, Bellevue, WA 98008. Ecology, the City, DOH, and DMMP will review all comments received and finalize the SSAP.

SAMPLING SCHEDULE
Sampling is scheduled for early November, preliminary sediment and water column sampling results are estimated to be received in December, and a draft report with these results are estimated to be available in January 2013. This schedule is subject to change due to unforeseen circumstances, such as equipment availability and weather conditions.

Maura S. O'Brien, PG/HG #869
Professional Geologist/Hydrogeologist
Toxics Cleanup Program - NWRO
Department of Ecology
3190 - 160th Avenue SE
Bellevue, WA 98008-5452
Tele 425-649-7249
Fax 425-649-7098
Email mobr461@ecy.wa.gov

## Agencies Response to Comment #8

8A. Background description.

Response – Ecology revised the SSAP background description.

8B. The proposed four sampling locations offshore of KIP site.

Response – The three KIP sediment sample locations are located off-shore at DNR aquatic lands and outside of private property. Note sample location symbol distorts specific location on figure. Two sediment sample locations are located within the Navigation Channel with access agreement with the owner, Pioneer Towing Company, Inc. and see revised sample location figure, SSAP Figure 2.

8C. Proposed sediment sample locations at the Sammamish River mouth to characterize river bed load as a potential source.

Response – Sediment samples SG-01 and SG-16 are estimated to represent the Sammamish River bed load.

# Comment #9 from Greg Wingard for Kenmore Action Network (KAN)

On 10/29/12 2:57 PM, Greg Wingard wrote:
Maura:

My initial hope for the sampling approach was that at least the additional sampling in the Harbor Village Marina area would be consistent with the data group from the previous sampling there. I understand what that would do to the sampling budget.

Failing that, that the sample data collected as part of this SSAP project would be consistent enough across the sediment data set to allow for easy data comparison and statistical assessment of the data.

Even the deeper cores from the sediment data are fairly shallow in depth, under a foot (ten inches). The trowel samples at 10 cm, only close to four inches. Since these samples are essentially single composite samples per sample location, the difference in depth, and the very shallow nature of the near shore sediment sampling is troubling. Under four inches may not even accurately describe the depth which is likely to be disturbed in the near shore areas by human and mechanical activity, as my understanding is that much of this sediment is very soft muck.

As we discussed, it is my belief that it is important that we get additional data as soon as possible. There will also be some future data collection to address some of the shortfalls of this data set, including deeper samples at least in some locations (primarily associated with the dredging).

I tried to balance these concerns, benefits and short comings in my comments, but as you can tell remain concerned about the shallow nature of the samples, and the lack of identical sampling parameters between all sediment samples collected.

How much additional cost is involved in making all the samples 25cm? As the entire vertical profile, irrespective of depth is in essence a single composite per sample location, at the additional 15cm of vertical sampled sediment is not that much additional volume, it doesn't seem to me like there should be that much additional cost to simply collect 25cm of sample, across all sediment sampling locations.

Regards,
Greg

## Agencies Response to Comment #9

9. Recommend all sediment samples to be 25 cm in depth to make sampling and results consistent and comparable.

Response – Anchor QEA and four agencies reviewed this request and determined that the revised SSAP best accomplishes the sampling screening level characterization as specified in this SSAP. The SSAP has two purposes- one for dredge planning, and the second for environmental and health assessment. The deeper samples (25 cm) are for dredge planning and the shallower samples (10 cm) are to characterize the biotic zone for environmental and health assessment.

## Comment #10 from City of Lake Forest Park

Comment #10

*Mayor*
Mary Jane Goss

17425 Ballinger Way NE
Lake Forest Park, WA 98155-5556
Telephone: 206-368-5440
Fax: 206-364-6521
E-mail: cityhall@ci.lake-forest-park.wa.us
www.cityoflfp.com

*Councilmembers*
Don Fiene
Tom French
Jeff R. Johnson
Sandy Koppenol
Robert E. Lee
Catherine Stanford
John A. E. Wright

10/25/2012

Ms. Maura O'Brien
Department of Ecology
3190 160th Ave NE
Bellevue, WA 98008

Dear Ms. O'Brien,

Thank you for meeting with City staff to discuss the Kenmore waterfront area sediment sampling and analysis plan (SSAP). As you know, the presence of chemicals and potential presence of contamination in Lake Washington sediments is an issue of serious concern for the City of Lake Forest Park.

The proposed SSAP does not provide for sampling in Lake Forest Park despite the close proximity (~2400') of the Lake Forest Park Waterfront Park and the Civic Club to the proposed sampling area. Each of these facilities provides access to Lake Washington while the Civic Club has a popular swimming area. There are also 29 residences on the lake between Log Boom Park and Waterfront Park.

We understand that the rationale for not sampling in Lake Forest Park is based on the Kenmore Lake Line Lakebed Sedimentation Analysis study that indicates the migration of sediment is predominately to the northeast. If this were true, sediment on the Lake Forest Park waterfront would travel toward Kenmore. Unfortunately, this has not been our experience. In fact, seasonal changes in sediment migration have been observed with sediment migrating, at times, in the southwest direction taking sediment from the Kenmore waterfront area into Lake Forest Park.

As a result, the City respectfully requests that a sediment grab sample and a water sample be taken between the Lake Forest Park Waterfront Park and the Civic Club as part of the Kenmore Waterfront area SSAP. See the attached map to better understand the area. Please contact Aaron Halverson, Environmental Programs Manager at (206) 957-2836 or ahalverson@ci.lake-forest-park.wa.us if you have comments or questions.

Sincerely,

Mary Jane Goss

Mary Jane Goss
Mayor


Lake Forest Park Sampling Map
King County

## Agencies Response to Comment #10

10. Request by Lake Forest Park City (LFP) is to add one sediment and one water column sample near shore at the public park and later modified to add two sediment samples and no water sample; and LFP to cover sampling costs.

Response – Request implemented. Note, LFP later modified the request for two sediment samples. City of Kenmore and Ecology relocated the water column background sample to off-shore northeast Lake Washington near Lake Forest Park and Log Boom Park.

## Comment #11 from Elizabeth Mooney

**From:** elizabeth.mooney
**Sent:** Monday, October 29, 2012 7:55 PM
**To:** O'Brien, Maura (ECY)
**Cc:** Elizabeth Mooney; Janet and Bob Hays; Ann Hurst
**Subject:** Sediment and Water Sampling Plan Kenmore: ERTS Information 632786 (UNCLASSIFIED)

October 28, 2012

Maura O'Brien
Dept of Ecology
Comment regarding Sediment and Water Analysis Kenmore:

Dear Maura,
I am sending this email chain as evidence in support of my argument that the truth was not upheld, nor our laws abided by, nor our agencies able to support my ERTS call by enforcing the water quality laws that are supposed to protect our public right to Clean Water. The record was never corrected. I have called Coast Guard, WSDOT, DOE regarding this email.

The point is that the barging operation for SR 520 continues, the companies do the work, the waters and sediment have not been tested and the barge grounding and contaminated water (turbidity) was never admitted to have occurred.

I believe this in evidence that the project has not been abiding by the laws intended to protect our environment. Calportland is part of the team and is not allowing DOE to test the sediment in front of their property at the bottom of the lake. Why wouldn't they? We do not know the source of the dioxins that were found in high levels at Harbour Village Marina in October 2011. Since this behavior of denying a grounding occurred when in fact it did is an indicator that the companies and WSDOT and the contractors were not admitting to a grounding when in fact it occured, how can we trust without DOE testing that this is not the source of the high level of dioxins? There is a wharf that burned and that is in the lake. Burning wharfs might be a source of dioxins. This is good reason to have Calportland, to let their area be tested before it has more barges push in and out of the head of the channel.

I have seen the turbidity caused by the incident Greg Wingard observed flow (brown water) into Harbour Village Marina. I stood at Harbour Village Marina and talked to its harbormaster Mike, while watching the brown water in the marina as it contrasted with the blue water further out in the lake.

I can only assume that the barging that has been ongoing may have contributed to translocation of sediments. If you or WDFW need proof, the agencies would have had to test first, measured, and had a baseline from which to compare.

I hope the Calportland site will offer to let DOE test, but, regardless, I would hope one day to receive a letter that states that this email was in error. I have heard that WSDOT admitted they grounded during the ERTS 632786 incident, but I haven't seen a letter to correct this email message.

Elizabeth Mooney

**From:** "David R NWS Kendall" <David.R.Kendall@usace.army.mil>
**To:** "Elizabeth Mooney" <elizabeth.mooney@comcast.net>
**Cc:** "Clay Keown (ECY)" <ckeo461@ECY.WA.GOV>
**Sent:** Thursday, March 29, 2012 3:13:20 PM
**Subject:** RE: ERTS Information 632786 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Elizabeth: FYI, I got this email communication from John Hicks (Chief/Navigation), regarding tug movements/turbidity in Kenmore Channel. The Tugboat operator's email (see email string below) to USCG discusses their activity and indicates that there were no groundings.

I have no interest in getting in the middle of this, but wanted to let you know that the USCG investigated the complaints about the turbidity.

David
David R. Kendall, Ph.D.
Chief, Dredged Material Management Office
Seattle District Corps of Engineers
Phone: 206/764-3768
Fax: 206/764-6602
email: david.r.kendall@usace.army.mil

- FYI-see below

---

John A. Hicks
Chief, Navigation Section
Army Corps of Engineers, Seattle District
4735 E. Marginal Way S
Seattle, WA 98124-2255
(206) 764-6908- Telephone
(206) 595-2750- Cell
(206) 764-3308- Fax
john.a.hicks@usace.army.mil

-----Original Message-----
From: Heather.J.St.Pierre@uscg.mil [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Monday, March 26, 2012 11:23 AM
To: Hicks, John A NWS
Subject: FW: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Hi John,
I've attached the e-mail string to keep you posted. Let me know if you hear anything else about the Kenmore area.

Take care,
Heather

LCDR Heather St. Pierre
Chief, Waterways Management Division
U.S. Coast Guard Sector Puget Sound
1519 Alaskan Way South
Seattle, WA 98134-1192
206-217-6042
heather.j.st.pierre@uscg.mil

-----Original Message-----
From: EEdwards@mansonconstruction.com
[mailto:EEdwards@mansonconstruction.com]
Sent: Sunday, March 25, 2012 8:43 AM
To: St.Pierre, Heather LCDR; Overton, Randall; LaBoy, Anthony ENS
Cc: Monica Blanchard; Jessi Massingale; andy.hoff@kiewit.com;
Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com;
Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good morning LCDR Heather St. Pierre- Island Tug and Barge (ITB) uses the slip and North dock to berth a gravel barge for Cal Portland Concrete Company. ITB typically shifts in and out of the slip on a twice per week schedule. KGM coordinates this with both Cal Portland and ITB to verify we do not interfere with their schedule.

KGM looks forward to working with USCG, USACE and Lake Washington stakeholders to assure a safe and successful completion to the SR520 project.

Regards,
Eric

Description: KGM_logo.gifEric Edwards
Marine Assembly Manager | Kiewit/General/Manson, A Joint Venture
SR 520 Evergreen Point Floating Bridge
3015 112th Ave N.E., Suite 100 Bellevue, WA 98004
(p) 425-576-7081 | (c) 510-773-6934

From: Heather.J.St.Pierre@uscg.mil [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Saturday, March 24, 2012 8:07 AM
To: Eric Edwards; Overton, Randall; LaBoy, Anthony ENS
Cc: Monica Blanchard; Jessi Massingale; andy.hoff@kiewit.com;
Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com;
Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Morning Mr. Edwards,

Thank you for your quick response and additional details. Are there other tugs or companies that are using the facility as moorage? We may follow up with you if we have any questions as the bridge pontoon project becomes more active in the immediate area, and will be so for quite some time, so we appreciate your response and assistance. Best of luck on the project.

Regards,

LCDR Heather St. Pierre
Chief, Waterways Management Div.
USCG Sector Puget Sound
Sent with Good (www.good.com)

-----Original Message-----
From: Eric Edwards [EEdwards@MANSONCONSTRUCTION.COM]
Sent: Friday, March 23, 2012 09:51 PM Eastern Standard Time
To: Overton, Randall; St.Pierre, Heather LCDR; LaBoy, Anthony ENS
Cc: Monica Blanchard (MBlanchard@MansonConstruction.com); Jessi Massingale; andy.hoff@kiewit.com; Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com; Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Evening-

Kiewit- General- Manson (KGM) was conducting operations at our Kenmore dock facility with the Derrick Barge 24 and Tug Nancy M on both Tuesday (3-20-12) and Wednesday (3-21-12). The entrance channel and slip at Kenmore have approximately 14-18ft of water depth. DB24 drafts 7ft and Tug Nancy M drafts 11ft. No grounding or bottom disturbance occurred during the operations.

KGM has been and will continue to coordinating with all the stakeholders in the industrial park who are: Kenmore Air, Cal Portland and Lakeshore Construction to assure we do not block access to the waterway.

I would be happy to discuss this issue in further detail at your convenience. Please don't hesitate to call or write if further information is required.

Kind regards,
Eric Edwards
Marine Assembly Manager | Kiewit/General/Manson, A Joint Venture SR 520 Evergreen Point Floating Bridge
3015 112th Ave N.E., Suite 100 Bellevue, WA 98004
(p) 425-576-7081 | (c) 510-773-6934

-----Original Message-----
From: Monica Blanchard
Sent: Friday, March 23, 2012 5:17 PM
To: Eric Edwards
Subject: Fw: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore
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Sent using BlackBerry

Note: This message was sent from my mobile phone.

----- Original Message -----
From: St.Pierre, Heather LCDR [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Friday, March 23, 2012 05:08 PM
To: Monica Blanchard
Cc: jessi.massingale@floydsnider.com <jessi.massingale@floydsnider.com>; Overton, Randall <Randall.D.Overton@uscg.mil>; LaBoy, Anthony ENS <Anthony.P.Laboy@uscg.mil>
Subject: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Afternoon,

The USCG (Sector Puget Sound) and USACE received a report today that some citizens were concerned about tugs and crane barges involved in the SR 520 bridge project at the Kenmore Industrial Park. It was reported that tugs and crane barges involved in this project were grounding and disturbing bottom sediments to subsequently refloat the barges. This was believed to have caused shoaling in other nearby areas and impacting other waterway users and the navigability of the surrounding area.

If one of the towing vessels or if a certificated barge has grounded, this information must be reported to the Coast Guard as well.

We ask for your cooperation in working with us as well as the other waterway users in the area. If you have any questions, please let us know.

Regards,
LCDR Heather St. Pierre
Chief, Waterways Management Division
U.S. Coast Guard Sector Puget Sound
1519 Alaskan Way South
Seattle, WA 98134-1192
206-217-6042
heather.j.st.pierre@uscg.mil

-----Original Message-----
From: Elizabeth Mooney [mailto:elizabeth.mooney@comcast.net]
Sent: Thursday, March 29, 2012 11:08 AM

To: Ann Hurst
Cc: <gste461@ecy.wa.gov>; <happyhaze@msn.com>; <patrickeobrien@comcast.net>; <mobr461@ecy.wa.gov>; <cwan461@ecy.wa.gov>; larry.fisher@dfw.wa.gov; Kendall, David R NWS; David Radabaugh; Jeannie Summerhays; Clay Keown
Subject: Re: ERTS Information 632786

Hi all,

Could somebody please help solve this problem- where did the dioxins and PCB's at Harbour Village Marina come from and is the barge's churning up of lake sediment allowed or did it need an HPA from WDFW?

First of all, I observed pre- and post- barge activity on March 21 2012. I have an eye witness to the pre-barge moving event (Patrick Obrien on phone with Greg Stegman) when the people in the small boat were working in the water off the NW point of Kenmore Industrial Site (aka Lakepointe).

I contacted Greg by telephone this morning.

I have an appointment with Gary Sergeant Friday at 2pm.

I would like to call Mr. White. What is his number?

Who is the owner of the barge operation? Who is responsible if there is alleged translocation of lake sediment or contaminants of concern? Who is responsible for cost (of clean up if necessary) IF there has been translocation of contaminants of concern? How does anyone know if there is translocation of lake or stream sediments unless there is a prerequisite for measuring and monitoring? Who is regulating the water quality of these public locations?

Who should meet to talk to work out questions and answers? WSDOT; Pioneer Towing; Kiewit General Manson; ACE; NOAA, WDFW, DNR, City, Citizens? DOH, Harbour Village Marina and HV Condos, Adopt a stream foundation...

Sent from my iPhone
On Mar 29, 2012, at 7:30 AM, Ann Hurst <annmhurst@msn.com> wrote:

The below should read, "one Ecology expert in email mentioned the Navigation Channel as a potential source of PCB and Dioxin contamination at Harbor Village Marina," because of PCB contamination in Navigation Channel in 1996, as I recall.

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From: <mailto:annmhurst@msn.com> annmhurst@msn.com
To: <mailto:gste461@ecy.wa.gov> gste461@ecy.wa.gov
CC: elizabeth.mooney@comcast.net; happyhaze@msn.com; patrickeobrien@comcast.net; mobr461@ecy.wa.gov; <mailto:cwan461@ecy.wa.gov>

cwan461@ecy.wa.gov
Subject: RE: ERTS Information 632786
Date: Thu, 29 Mar 2012 06:25:27 -0700

Greg,
I did include the summary of your report at BasinNews.org and will post your document including the letter I wrote on the Documents page soon with WSDOT's response. I did not call Ecology. I wonder who did in addition to Elizabeth. That should be determined. Also, do you have the study of 1996 or 1998 that showed PCB contamination in the Navigation Channel?; one Ecology expert in email mentioned the Navigation Channel as a potential source of PCB and Dioxin contamination at Lakepointe. Janet and I will be looking at Ecology documents this morning and would appreciate not having to dig too deeply for that. Three experts point to three likely sources. I am thinking they all could be correct, that there is more than once source regarding contamination at Harbor Village Marina.
Best, Ann Hurst

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From: "Greg Stegman (ECY)" <GSTE461@ECY.WA.GOV>
To: "elizabeth mooney" <elizabeth.mooney@comcast.net>
Cc: "Maura O'Brien (ECY)" <MOBR461@ECY.WA.GOV>
Sent: Wednesday, March 28, 2012 4:06:28 PM
Subject: ERTS Information 632786

Elizabeth,
Attached is my report regarding my visit to the site on 3/21/12 concerning the barge issue and other issues we discussed. I also have photographs if you are interested.

Greg Stegman
Department of Ecology
Water Quality Program
Northwest Regional Office
425-649-7019

The information about incident number 632786 is attached in PDF format.

Note: You need to have an Adobe Acrobat Reader to read the information.

Classification: UNCLASSIFIED
Caveats: NONE

## Agencies Response to Comment #11

11A. Enforcing Washington Clean Water Act

Response – See Ecology's multiple responses to citizen comments and questions about turbidity and Washington Clean Water Act. See Response 1E above.

11B. Access to CalPortland and KIP sites for sediment sampling.

Response – A new sediment sample has been added at the northeast end of KNC, and see Response 1A above.

11C. Source(s) of dioxin found at Harbour Village Marina.

Response - This SSAP is the next step in evaluating the lateral extent of dioxin/furans at the northeast area of Lake Washington and Sammamish River. The SSAP will investigate the source or sources for dioxin/furans in this area. Currently, the source(s) are unknown.

# Comment #12 from Elizabeth Mooney

**From:** elizabeth.mooney
**Sent:** Monday, October 29, 2012 9:18 PM
**To:** O'Brien, Maura (ECY)
**Cc:** Ann Hurst; Janet and Bob Hays; Elizabeth Mooney
**Subject:** Kenmore Sediment and Water Characterization SAP 10-12-12 Comment

October 28, 2012

Maura O'Brien
Department of Ecology

Dear Maura,

I believe that, in addition to your plans for the Kenmore Sediment and Water Characterization SAP 10-12-12:

**DOE should force Calportland, Pioneer Towing, etc. to allow sediments on their property to be tested because there is reasonable cause to suspect they are contaminated and, furthermore, may be the source of contamination. The potential risk to public health necessitates prompt action.**

You have enough evidence and I hope you could find more money from your agency or other state agencies, such as WADOT, to fund further testing. I am attaching evidence that contaminants probably are causing there to be a "take" during chinook fall migration up the Sammamish River (Cottage Lake wild population), that PCB's (found at Pioneer Towing and present in fish in Lake Washington) can cause harm to those fish, that Ecology is aware that cement is associated with dioxins (Dioxin WA State Assessment), that barges caused illegal turbidity in the head of the channel in the area of the Kenmore Navigation Channel AFTER I had warned Mr. John White that his project (SR 520 anchor/deck) should have an HPA BEFORE they translocated sediments. Mr. White said to me, "But, they (Calportland) have been barging."

My point, Maura, is that they (Calportland) has been barging and WSDOT knew it and they shouldn't have been barging and churning up sediment at the bottom of the lake for years without proper permits, but they were and now I would deeply appreciate it if DOE could persuade them of the need to test. I do understand that the process is going to take some time to solve, but it would help to have cooperation from all parties for testing.

I have a Master's Degree in Fisheries from UW, a BA in Philosophy from Pomona College and I'm President of PERK, People for an Environmentally Responsible Kenmore, and I served on the Citizens Advisory Committee for the Kenmore Shoreline Master Plan Update. Please respect my opinion as not only an academic, a mother, but also as a scientist who discovered, by myself, without your agency's full disclosure, the presence of high levels of dioxins at Harbour Village Marina. There was an ERTS call from DNR to DOE in Oct 2011, but your agency didn't disclose it, and yet your agency allowed this SR 520 project to proceed. I know our former city manager contributed to the project happening in Kenmore. Enough is enough. We see the project will proceed, but please test the area where there is strong reason to believe there may be a source of the PCB or dioxin contaminants, by Calporltand and the KIP site, in the sediments or when the barges/tugs are churning up the sediment. The DOE document I've attached has a section about how a cement facility may be associated with dioxins.

If the companies will not allow testing, then why should their barging be allowed if there is evidence of translocation of sediment in Lake Washington?

I am including two recent (last few months) photos taken by our new city manager showing evidence of the burned wharf at Calportland. My understanding is that burning may produce dioxins. Isn't it critical to test in this area? Would lack of testing here constitute a data gap in the study, and potentially call into question the entire integrity of the Kenmore Sediment and Water Characterization SAP analysis/testing plan-project?

Please amend the Sampling plan, if possible, to test in front of Calportland. There are other reasons I think this is important.

Calportland received special Shoreline Master Plan perks to change wording to their benefit, not the public's, in my opinion. My colleagues and I do not approve of the changes Calportland proposed, city approved and Dept of Ecology approved. I informed the city of dioxins that DOE already had learned about from DNR. The barging may impact our public health and ecology. The only way I can believe our public can be protected from possible dioxin contamination by turbidity from ongoing increased barge/tug alleged illegal turbidity and translocation of contaminants is by Dept of Ecology succeeding in convincing the companies that testing the sediments under water (shorelands) and/or water (during tug/barge activity) beside Calportland is a good idea. From these photos, you can see Calportland's "head of the channel"s sediments" might harbor a possible source of dioxins. If so, these contaminants may cause harm to federally protected species and human health. It would be stronger study if you could find a way to include Calportland's inner head of the channel in the testing.

Since the wharf was burned, since there are high dioxins at Harbour Village Marina, since the city is spending $100,000 dollars to test for a very coarse evaluation, and since the translocation of sediments under water continues with barge activity, please do your best for the citizens of Kenmore to persuade the big companies to allow your testing? You are the best person who can find a way to test. If the companies won't let your agency test, can you suggest the city recommend the companies stop barging until they do so?

Since water quality is DOE's responsibility and since WSDOT's project must follow the laws, and since it appears that the barges/tugs cause violation of water quality laws, if barging continues, then it would be great if testing where translocation occurs/occurred, should take place.

We don't want to risk waste of public money nor public health. This waterway appears to have been affected by translocation of sediment. So, here is evidence of fire on the wharf that DOE and the City of Kenmore told Calportland they would be able to expand (Dave Radabaugh and Jeff Talent?). I hope DOE could coordinate and achieve testing of sediment under water at Calportland/Pioneer Towing in the "head of the channel" where the burned wharf (possible source of dioxin) exists.

May you expand the testing to include the testing by Calportland since I believe there has been translocation of sediment in Lake Washington (my ERTS # 632786 March 2012)? The KGM and WSDOT operators should have acquired an HPA because it appears that there has been movement of bottom sediments. I asked WADOT to factor in that their barge activities would likely translocated sediments on the lake bottom and that it would require an HPA. They decided not to factor that into their SR 520 project, something I believe was not the right thing to do.

I have spoken to my friend Ann Hurst and she adds:
*Often the tugs cannot turn the barges South without the tugs leaving the Kenmore Navigation Channel and gunning it next to Harbour Village Marina. The barges are too large and cumbersome for the design of the channel. The City told WSDOT that the barges would fit in the channel, WSDOT was told by Kiewitt/General/Manson that there would only be one barge per day and neither of those assertions were correct . Ecology, the State, has plenty of leverage to stop the barge traffic, and Ecology, then, to test the shore lands of Cal Portland and the Pioneer Towing Land. The Governor might even join in with Ecology to assert testing on those shore lands as she is plenty upset about the cracks in the pontoons K/G/M transported from Aberdeen. Even so, apparently, it is far easier to follow Water Quality Act barging from Aberdeen. There is precedent for Ecology to require the private companies pay for the testing.*

Elizabeth Mooney
Sent from my iPhone

Begin forwarded message:

**From:** Rob Karlinsey <rKarlinsey@kenmorewa.gov>
**Date:** October 29, 2012 10:34:08 AM PDT
**To:** Elizabeth Mooney <elizabeth.mooney@comcast.net>
**Subject: RE: photo**

Sorry I left before I saw your email. Here you go. From a distance these pilings look like they're just covered in dark creosote, but when you get up close, you can tell that a lot of it is charred from a fire.

**From:** elizabeth.mooney@comcast.net [mailto:elizabeth.mooney@comcast.net]
**Sent:** Saturday, October 27, 2012 11:38 AM
**To:** Rob Karlinsey
**Subject:** photo

Rob
If you have that photo, that'd be grand to have for tomorrow.
Thanks
Elizabeth

## Agencies Response to Comment #12

12A. Sediment sampling – see Response 11B above.

12B. Question about the WSDOT 520 Bridge project to proceed.

Response – The WSDOT 520 Bridge project was within City, County and State permits and requirements to begin.

12C. Photographs of burned wharf at CalPortland and request to sample at location.

Response – see Response 1A above.

12D. WSDOT 520 Bridge work at KIP requiring a HPA

Response – No HPA was required and see Response 12B above.

# Comment #13 from Mamie Bolender

Comment # 13

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | Mamie Bolender [mamiejb@hotmail.com] |
| **Sent:** | Monday, October 29, 2012 10:55 PM |
| **To:** | O'Brien, Maura (ECY) |
| **Subject:** | Need for testing for dioxins at Kenmore/Lake Forest Park |

Maura O'Brien
Washington State Department of Ecology

Dear Ms. O'Brien,

There is sufficient evidence that Dioxins are present to some significant degree in the waters off Kenmore which are being plied by barges which are disturbing the sediment of the region and causing these sediments and any toxins therein to be churned up and suspended in the water. These released sediments are being set free to float along and onto all the shores of North Lake Washington and beyond, contaminating the swimming beaches of Kenmore and Lake Forest Park and beyond. Dioxins are, inarguably, extremely toxic and detrimental to the health of our children and all who use these beaches for swimming and playing, but mostly the children. Unaware of this unseen danger, parents are allowing hundreds of children to be exposed to this hazard.

Extended testing must be done, and done soon, of the sediments along the north end of Lake Washington to determine the extent of migration of these sediments and the dangerous dioxins they contain.

1 Please cause this important testing to happen. The health of many children is at stake. This is a personal plea.

Respectfully submitted,

Mamie Bolender, mother, grandmother and co-president of the Lake Forest Park Stewardship Foundation

1

## Agencies Response to Comment #13

13. Request for dioxin testing at Kenmore and Lake Forest Park beaches for children safety.

Response – Yes the SSAP includes sediment testing for dioxin and other chemicals for public health and safety especially children.

## Comment #14 from Janet Hays

**From:** happyhaze@msn.com [mailto:happyhaze@msn.com]
**Sent:** Monday, October 29, 2012 11:28 PM
**To:** O'Brien, Maura (ECY)
**Subject:** scan0033.pdf

Comment #14

Sept 29, 2012
10:54

Dear Maura,

As you know I have worked diligently on keeping the waters of the state (Lake Washington and the Sammamish River for 5 years. I am not paid to do this and I do not have the credentials or the responsibility of your job. But some how I have chosen to invest my time and energy on ~~writing~~ documenting ~~the wrong~~ what I see occuring daily on the property called Kenmore Industrial Park since 2007. In that time I have made it my business to take pictures at least ~~one~~ a few pictures everyday that I have witnessed, tug and barge after tug and barge come in and out. I have witnessed Gary Sergeant's lessees paint, weld, pump bilges into the lake, burn palates on the shoreline and Glacier cement front load all their waste water from ~~[illegible]~~ cement trucks and surface water right into the lake ~~[illegible]~~ directly into the head of the channel. I have document 3 years of Waterfront Construction fueling over the water from fuel trucks the equipment on the barges.

2

LakeShore Marine Construction parent
large fishing boats out over the water,

I have sent you many pictures of
these violations. When we brought the
Clean water suit against Waterfront
Construction. It was because you and
the understaffed DOE did not enforce
or question the owners of the property
you just accepted their lies as facts.
Waterfront Construction did not even
have an NPDES permit when I began
reporting to you what I was seeing and
documenting. In fact as you said at
a Kenmore Master Plan Commission Sept 21 2009
meeting that the monitoring of the
ground water was never done for
8 years even though the consent decree
stated your agency DOE was to oversee
and enforce monitoring twice a year in
wet and dry season. This did not
occur until 2009 a gap of 8
years. Your explanation to the commission
was it fell through the cracks.

Now we have watched as
barges and tugs (still the same not BIG
[illegible] creating turbidity

3

~~the~~ from the wharf you cannot test infront of because it is private property.

This wharf & the Cal Portland pier are being used as it is the only point of egress and ingress for this activity. The amount of sand and gravel barges has increased from 2 a week to 2 or three a day. The barge-tugs from Kiewit are not one per week, they are daily upto 16 loads when hauling barges filled with cement trucks. They continue to traverse out of the head of the channel ~~to along the~~ out side of the buoys marking the channels width and boundary hugging the shoreline directly infront of the north shore (chip Davidson Marina) and then make a sharp turn and gun their cargo either south or further west to docking stations. I have stood at the Kenmore air pier and Harbor Village pier taking pictures of the water which is so filled with sediment you cannot see 6 inches into it.

~~Please~~ I do not understand how Cal Portland / Glacier / Fuyo - and Gary Sergeant and Kenmore Air,

4

can be allowed to ~~move~~ OPT OUT OF this sediment ~~with out~~ testing ~~to~~ ~~the~~ Given the amount of dioxin found at Harbor Village, and the readings clearly showed it get worse the closer it is) to the head of this channel.

Please consider this a revision to test as close as you can get to this private head of the channel.

My concern is for my community and the environmental health not commerce as our Shoreline Master Plan's wording was changed from commercial to manufacturing. We are now finding out why. the community is no longer able to recover from the sediments being shifted from the east end of the channel to the ~~the~~ docking stations even to ~~zig zagged to~~ zig zagging and manuevers they have been doing to widen the channel and dredge it them selves with these big barges and tugs. No one is hearing us, not because it isn't happening but because these property owners don't want to know.

Thank You

[signature]

P.S. Sorry this is written hand written Failing

(5)

P.S. I am not a scientist. this is from my heart and what I have witnessed, photographed and documented daily.

Thank you
Janet

## Agencies Response to Comment #14

Comment 14A. I have worked to protect waters of Washington State especially Lake Washington and Sammamish River and have photographed many, many environmental events over 5 years.

Response – The City, Ecology and the community appreciate your documentation of events at Lake Washington and Sammamish River and waters of Washington. The SSAP will be one more step in evaluating the environmental conditions at these Kenmore area locations and Lake Forest Park.

Note, page 2 you mentioned that the KIP Consent Decree requires twice year groundwater monitoring and Ecology did not enforce this. This statement is incorrect and the Consent Decree does not require twice year monitoring. The Consent Decree requires periodic groundwater compliance monitoring and this was conducted in 2009-2010. The 2012 monitoring in April and October will also count as periodic monitoring, so the next periodic monitoring will be 2017.

14B. Tug and barge traffic and turbidity – see above Response 1E above.

# Comment #15 from Jim Halliday

Comment #15

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | Jim Halliday [jimh@clearwire.net] |
| **Sent:** | Tuesday, October 30, 2012 9:23 AM |
| **To:** | O'Brien, Maura (ECY) |
| **Subject:** | Sediment testing |

Dear Ms. O'brien - I feel future liability risks should require DOE to force Calportland, Pioneer Towing, etc. to allow sediments on their property to be tested because there is reasonable cause to suspect they are contaminated and, furthermore, may be the source of contamination. The potential risk to public health necessitates prompt action.

Jim

Jim Halliday
206-365-1813
jimh@clearwire.net

*Co-chair* - Lake Forest Park StreamKeepers
*Board member* - Lake Forest Park Stewardship Foundation
*LFP Liaison* - People for an Environmentally Responsible Kenmore (PERK)
*Board member* - Sno-King Watershed Council

1

## Agencies Response to Comment #15

15. Request sediment sampling at CalPortland and KIP sites.

Response – see Responses 3A and 3B and 7N-2 above.

# Appendix A

Appendix A includes copies of the citizen comments as received plus attachments.

Comment #1

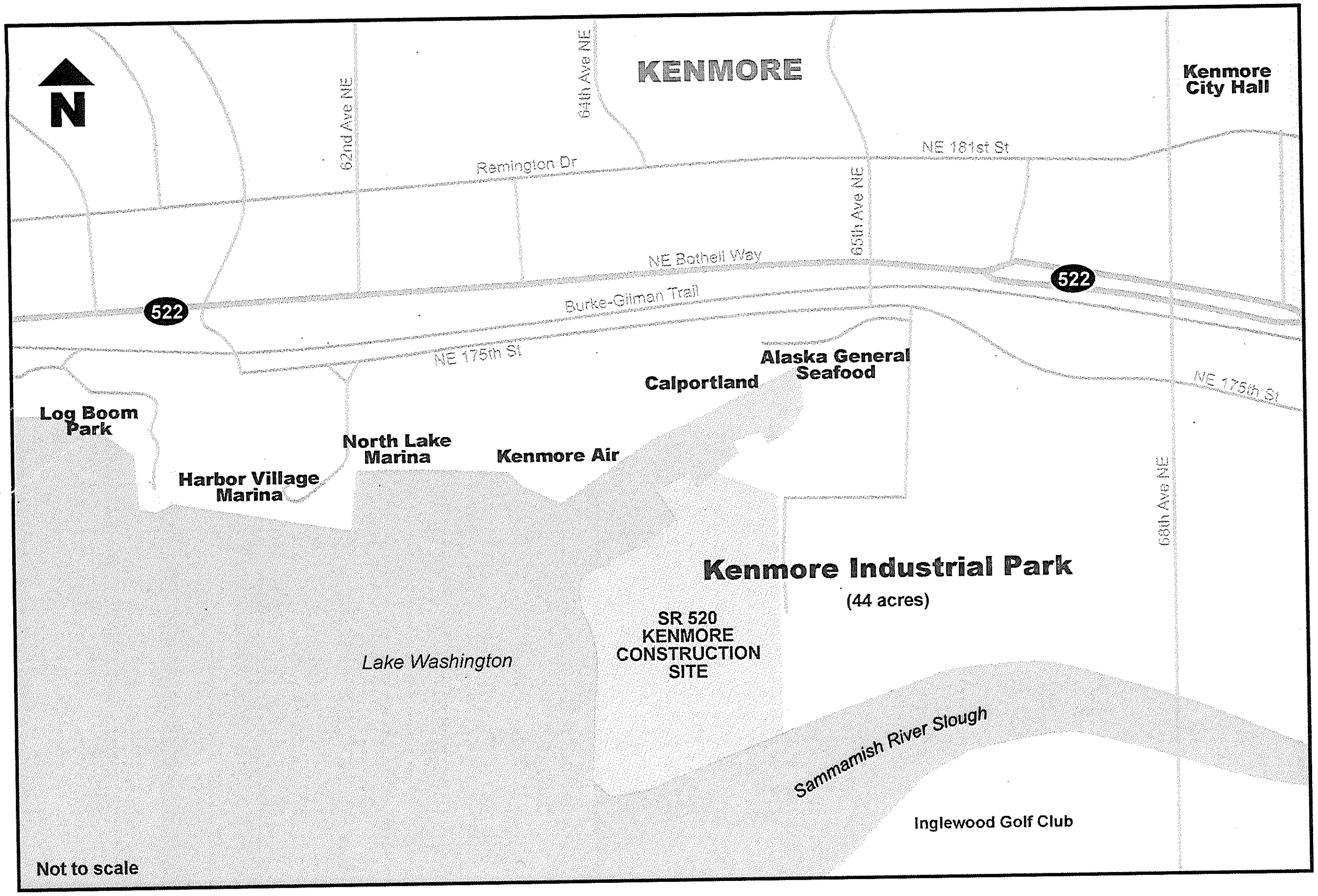
## O'Brien, Maura (ECY)

**From:** Ann Hurst [annmhurst@msn.com]
**Sent:** Tuesday, October 16, 2012 12:03 PM
**To:** O'Brien, Maura (ECY); chingpi.wang@ecy.wa.gov; Warren, Bob (ECY); rkarlinsey@kenmorewa.gov; bhampson@ci.kenmore.wa.us; bhampson@kenmorewa.gov; david.r.kendall@usace.army.mil; Hardy, Joan (DOH); harbourvillage@frontier.com
**Cc:** c4sep; stedward; nlccannouncements@yahoogroups.com
**Subject:** Anchor Testing, why not Cal Portland?
**Attachments:** Extraction of Dioxins from Environmental Samples by Pressurized Solvent Extraction (PSE).pdf

Maura O'Brien, Kenmore Yard Site Manager, and Rob Karlinsey, Kenmore City Manager,
My apologies if I added to the confusion. I was mistaken; in 1996 sample S1 was in nearly same location as proposed SG4 by Anchor (I mis-read the 1996 map).
Why the Cal Portland area was not tested for contaminants in 1996 and will not be by Anchor in forthcoming tests, however, yet remains a mystery to the public. In the past and perhaps today because it is not being proposed for dredging? What about disturbing the sediments for a new dock? It was my understanding that Cal Portland will get a new dock, has a new dock? **Do I find the permits/E.I.S. or DNS on Cal Portland dock with City or Ecology?**
I have researched that a batch plant that uses fly ash may contribute significantly to Dioxins when filling the fly ash flue through faulty equipment (warning bells not activated, bags in disrepair, operator error) a repeated occurrence at this site over decades, how much is documented depends on complaints and self-reporting. I yet advocate testing the Cal Portland shore lands as it looks to me like the flue is close to the water and Cal Portland's tax info indeed says Cal Portland is on the water, though Cal Portland did self-report the latest, known incident.
**Is the attached on Dioxin extraction new, useful in cutting costs, accurate?**
All parties are moving in a good direction; I yet advocate that the turbidity at Harbour Village Marina, created by the WSDOT contractors tugs and barges as the contractors try to turn the barges 90 degrees, stop. Pretty easy to observe, pretty easy to fine, pretty awful for the residents who have repeatedly, daily been exposed to the turbid water and horrific if this exposure affects their even not yet conceived children.
**Do you really think the barge contractors will self report their turbidity violations in the future if for the past months, since March, they have not done so -- even once -- and cannot make the turn without creating turbidity?**
Best, Ann Hurst

# Kenmore Industrial Park and surrounding area

June, 2012




November 2011

April 2012

Photo credit: Aequalis Photography

one PSE APPLICATIONS #211

# Extraction of Dioxins from Environmental Samples by Pressurized Solvent Extraction (PSE)

## Introduction

Pressurized solvent extraction is a new technique that reduces solvent consumption and sample preparation time. Solvent is pumped into an extraction vessel containing the sample and is heated and pressurized. The pressurized solvent at high temperature accelerates the extraction process by increasing the solubility of the analyte in the solvent and also increasing the kinetic rate of desorption of the analyte from the sample matrix.

Pressurized solvent extraction can be used to replace soxhlet and sonication techniques and is approved for use as EPA Method 3545. This method is a procedure for extracting water insoluble or slightly water soluble, semi-volatile organic compounds from soils, clays, sediments, sludges, and waste solids. The method is applicable to the extraction of semi-volatile organic compounds, organophosphorous pesticides, organochlorine pesticides, chlorinated herbicides, and PCBs.

This application note describes the pressurized solvent extraction of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) from fly ash.

Applied Separations
930 Hamilton Street
Allentown, PA 18101
610-770-0900
610-740-5520 (FAX)
www.appliedseparations.com

# *one* PSE APPLICATIONS #211

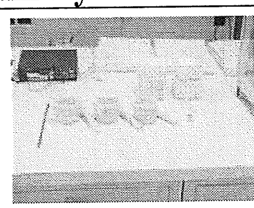
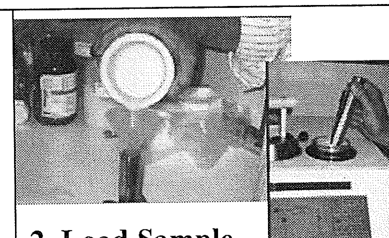
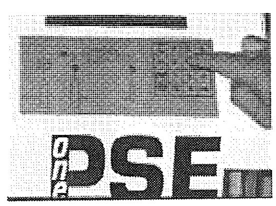
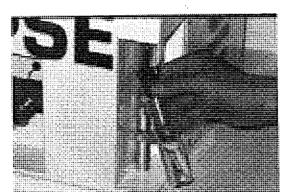
## Equipment

- ✓ Applied Separations' *one* PSE Pressurized Solvent Extractor
- ✓ 11 mL Extraction Vessel-Cat.#10625
- ✓ GC or GC/MS

## Solvents and Materials

- ✓ Toluene (pesticide grade)
- ✓ Acetic Acid (reagent grade)
- ✓ S/S Frits (10 micron)- Cat. #10710
- ✓ Collection Vials (60mL for extract collection)-Cat.#10650
- ✓ *Spe-ed*™ Matrix-Cat.#7950
- ✓ Ottawa Sand – Cat. #10548
- ✓ Cellulose Filter Disk-Cat. #10711

## Summary of Method

| | |
|---|---|
|  **1. Prepare Sample** |  **2. Load Sample** |
|   **3. Run Sample** |  **4. Collect Extract** |

Applied Separations
930 Hamilton Street
Allentown, PA 18101
610-770-0900
610-740-5520 (FAX)
www.appliedseparations.com

## Procedure

***Prepare Sediment/Soil Samples***

Decant and discard any water layer on a sediment sample. Mix the sample thoroughly, especially composited samples. Discard any foreign objects such as sticks, leaves, and rocks. Air-dry the sample at room temperature for 48 hours in a glass tray or on hexane-rinsed aluminum foil. Alternately, mix the sample with an equal volume of anhydrous sodium sulfate or *Spe-ed* Matrix until a free-flowing powder is obtained.

NOTE: *Dry, finely-ground soil/sediment allows the best extraction efficiency for nonvolatile, nonpolar organics, e.g., 4,4'-DDT, PCBs, etc. Air drying may not be appropriate for the analysis of the more volatile organochlorine pesticides (e.g., the BHCs) or the more volatile of the semi-volatile organics because of losses during the drying process.*

Dry sediment/soil and dry waste samples amenable to grinding. Grind or otherwise reduce the particle size of the waste so that it either passes through a 1mm sieve, or can be extruded through a 1mm hole. Disassemble grinder between samples, according to the manufacturer's instructions, and decontaminate with soap and water, followed by acetone and hexane rinses.

Gummy, fibrous, or oily materials not amenable to grinding should be cut, shredded, or otherwise reduced in size to allow mixing and maximum exposure of the sample surfaces for the extraction. The addition of anhydrous sodium sulfate to the sample (1:1) may make the mixture amenable to grinding.

***Determination of Dry Weight***

When sample results are to be calculated on a dry weight basis, a second portion of sample should be weighed at the same time as the portion used for analytical determination.

Immediately after weighing the sample for extraction, weigh 5 – 10 g of the sample into a tared crucible. Dry this aliquot overnight at 105 °C. Allow to cool in a desiccator before weighing. Calculate the % dry weight as follows:

$$\% \text{ dry weight} = \frac{\text{g of dry sample}}{\text{g of sample}} \times 100\%$$

Grind a sufficient weight of the dried sample to yield the sample weight needed for the determinative method (usually 10 – 30 g). Grind the sample until it passes through a 10-mesh sieve.

***Load Sample***

Prepare the extraction vessel(s) for analysis by placing a cellulose filter disk in the bottom opening followed by a 10µm s/s frit, and secure them in place with the retaining nut. Transfer the ground sample to an extraction vessel of the appropriate size for the analysis. Generally, an 11 mL vessel will hold 10 g of sample, a 22 mL vessel will hold 20 g of sample, and a 33 mL vessel will hold 30 g of sample.

Add the surrogates listed in the determinative method to each sample. Add the matrix spike/matrix spike duplicate compounds listed in the determinative method to the two additional aliquots of the sample selected for spiking.

Add clean Ottawa sand to within 1 cm of the top of the vessel's interior flange (see illustration on page 4-3 of User's Manual).

Next, place the extraction vessel into the *one* PSE oven. Load the *one* PSE collection rack with the appropriate number (one per sample) of 60 mL, precleaned, capped vials with septa. Set method conditions on the *one* PSE and start the extraction.

# onePSE APPLICATIONS #211

***Extraction Conditions***

*Program the following extraction parameters on the one PSE*

Program A Mode – 11 mL vessel

| | |
|---|---|
| Solvent: | Toluene or Toluene/Acetic Acid (5% v/v) if sample is pretreated with HCl |
| Temperature: | 150 ° C |
| Pressure: | 150 Bar |
| Cycles: | 3 |
| Static: | 5 minutes |
| Pause: | N=0 |
| Flush: | Solvent/gas/repeat flush:20 sec/2min/0 |

## Cleanup

Collect each extract in a clean 60 mL vial. Allow the extracts to cool after the extractions are complete. Collected extracts will be approximately 1.2 to 1.4 times the vessel volume.

The extract is now ready for cleanup or analysis, depending on the extent of interferants. Refer to Method 3600 for guidance on selecting appropriate cleanup methods. Certain cleanup and/or determinative methods may require a solvent exchange prior to cleanup and/or sample analysis.

## Analysis

GC/MS

## Results

***Recovery (ug/Kg) from Fly Ash***

| **Dioxins** | **PSE** | **Soxhlet** |
|---|---|---|
| 4CDD | 10.5 | 12.0 |
| 5CDD | 16.2 | 16.6 |
| 6CDD | 36.7 | 38.2 |
| 7CDD | 16.0 | 15.0 |
| 8CDD | 10.6 | 11.4 |

Applied Separations
930 Hamilton Street
Allentown, PA 18101
610-770-0900
610-740-5520 (FAX)
www.appliedseparations.com

# one PSE APPLICATIONS #211

## References

US EPA Method 3545 – Pressurized Fluid Extraction
US EPA Method 3600 – Cleanup
US EPA Method 8280A – Dioxin by HRGC/LRMS
US EPA Method 8290 – Dioxin by HRGC/HRMS

## Safety

The use of organic solvents, elevated temperatures, and high pressures present potential safety concerns in the laboratory. Common sense laboratory practices can be employed to minimize these concerns. However, the following sections describe additional steps that should be taken.

Extraction vessels in the *one* PSE oven are hot enough to burn unprotected skin. Allow the vessels to cool before removing them from the oven, or use appropriate protective equipment (e.g. insulated gloves or tongs) as recommended by the manufacturer.

During the gas purge step, some solvent vapors may exit through a vent port in the instrument. Connect this port to a fume hood or other means to prevent release of solvent vapors to the laboratory atmosphere. This precaution also applies to the removal of post extraction solvent from the collected extract.

Applied Separations
930 Hamilton Street
Allentown, PA 18101
610-770-0900
610-740-5520 (FAX)
www.appliedseparations.com

Comment # 2

**O'Brien, Maura (ECY)**

**From:** Kendall, David R NWS [David.R.Kendall@usace.army.mil]
**Sent:** Thursday, October 18, 2012 11:28 AM
**To:** elizabeth.mooney@comcast.net
**Cc:** dbent@kenmorewa.gov; landerson@kenmorewa.gov; Barney, Phyllis (ATG); happyhaze@msn.com; aaronmsmithlaw@gmail.com; Cleve Steward; Radabaugh, David (ECY); dreitan@insleebest.com; O'Brien, Maura (ECY); Wang, Ching-Pi (ECY); Hardy, Joan (DOH); Ann Hurst; Aaron Smith
**Subject:** RE: UPDATE draft sampling plan (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Elizabeth: I have been out of office the last several days. Thank you for your observations and response. I want to stress that I do not know the PCB source for the Harbor Village Marina PCB/dioxin contamination, and would look to Ecology TCP to ultimately evaluate that question and concern.

I also have no doubt that you are observing suspension and redistribution of sediments in the area due to barge traffic in the navigation channel, and that some of these sediments may settle within the Harbor Village Marina.

My reasoning that there is another primary source of the PCBs is based on the ten-fold differences in PCB concentrations in the Harbor Village Marina and in the navigation channel. The PCB concentrations observed in the navigation channel material (detected Aroclor 1254, ranged from 15 - 27 ppb, averaging 21 ppb-dry weight, and TOC normalized concentrations ranged from 0.38 - 0.66 ppm-TOC, averaging 0.5 ppm-TOC) were well below (State Sediment Quality Standards(SQS), where they were quantitated at only 4.2% of the SQS (PCB SQS = 12 ppm-TOC. By comparison, the PCB concentrations in the Harbor Village Marina, ranged from a low of 196 ppb to a high of 277 ppb for Aroclor 1254, averaging 237 ppb, which are greater than ten times the PCB levels observed in the navigation channel based on the average concentrations. At least with the data in hand, it simply does not appear that there are enough PCBs in the navigation channel to have provided the level of contamination seen over time in the marina.

I think we will have to wait until the sediment investigation due to take place in early November provides the data to evaluate the PCB and dioxin concentrations throughout Kenmore. Hopefully that data will provide some answers. I know my interagency colleagues and I in the Dredged Material Management Program are anxious to gather the necessary data to evaluate the extent of the PCB/dioxin contamination at Kenmore, and are confident that the proposed testing strategy will be helpful to that end.

David

David R. Kendall, Ph.D.
Chief, Dredged Material Managment Office

Seattle District Corps of Engineers
Phone: 206/764-3768
email: david.r.kendall@usace.army.mil

-----Original Message-----
From: elizabeth.mooney@comcast.net [mailto:elizabeth.mooney@comcast.net]
Sent: Monday, October 15, 2012 1:08 PM
To: Kendall, David R NWS
Cc: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; Cleve Steward; drad461@ecy.wa.gov; dreitan@insleebest.com; mobr461@ecy.wa.gov; cwan461@ecy.wa.gov; joan hardy; Ann Hurst; Aaron Smith
Subject: Re: UPDATE draft sampling plan (UNCLASSIFIED)

David,

I have read and reread your Oct 5 2012 email to Ann Hurst; unfortunately, I disagree with your conclusion. I'd like to explain why by sharing my personal observation of tug/barge activity and subsequent brown sediment-laden water drifting into Harbour Village Marina, and ask if you believe you might reconsider your conclusion based on new information.

Before I do that, I want to thank you for correcting the record so we now know the type of PCB in both Harbour Village Marina and in the Federal Navigation Channel are the same, Aroclor 1254. I hope that Dept of Ecology reflects that in their website information. It is important that people understand these details and that they know that the PCB type in Harbour Village Marina is the SAME type as the PCB type in the Federal Navigation Channel. That is what is important, in my opinion. I appreciate your going to the trouble to correct the record in the email attached. It makes sense.

In your Oct 5 email to Ann Hurst, you state (and I added an underline and bold for emphasis for what I believe is most important):

My email clarifying error in letter (6/6/12):

Hi all: I would like to point out that in the fifth paragraph of Attachment 1 to response letter, it states that the Corps of Engineers "determined that the PCB fingerprints were significantly different at the two sites" (Federal navigation channel and Harbor Village Marina). I would like to correct the record that that statement is in error. The Fingerprinting indicates the Aroclor quantified at both sites was the same, Aroclor 1254, as noted in attached Figure. I wanted to correct the record, as there is a lot of misinformation out there regarding the testing at these two locations. Thanks.

David

David R. Kendall, Ph.D.

Chief, Dredged Material Management Office

The reason I disagree with your conclusion:

I have watched the barges numerous times in the navigation channel. I see them stop in front of Harbour VIllage Marina to turn their vessels. Most importantly, I've seen brown water in Harbour Village Marina AFTER the barges have departed Kenmore Navigation Channel, passed Harbour Village Marina and headed out into Lake Washington.

On the same day when Greg Wingard watched from the Hays' condo and noted a Clean Water Act violation in August 2012, I went, afterwards, to the HV Marina and talked to the Harbormaster Mike. Since that was the same day that Greg Wingard had noted the turbidity due to the tug/barge activity in the Kenmore Navigation Channel, I feel confident that what I was seeing at HVM was due to the barge activity. Additionally, the Harbormaster told me it was true. The Harbormaster told me to look out into the marina. I could easily see that brown water was in the Harbour Village Marina. Mike said that brown water enters HVM after the tug/barges pass the marina in the Navigation Channel. According to Mike, it happens all the time. Therefore, your conclusion in the email makes no logical sense to me. You stated that: "The concentrations of PCBs found in Harbor Village Marina were 10 times the concentrations found in the federal navigation channel in the 1996 characterization, and therefore, the navigation channel is not the likely source for the contamination in Harbor Village Marina." On the contrary, David, doesn't it make sense that if the barges have been churning up the bottom of the sediment in the Federal Navigation Channel, and if the wind or current drive the suspended sediment toward Harbour Village Marina, that the increase in concentrations of PCB's would build up in the Harbour Village Marina? From what I saw, I hypothesize that barge activity translocates the sediment, and that, subsequently, the sediment drifts into the marina where it can't go any further and settles onto the bottom. It builds up in the marina due to the barges churning up sediment in a Federal Navigation channel that has inadequate depth for the barges/tugs using it.

Based on my personal observation, when the barges churn up the sediment at the bottom of the too shallow Federal Navigation Channel with their too deep tugs' activities, the sediment appears to be churned up and the brown water (filled with the sediment) travels right into the Harbour Village Marina, due to wind or current or whatever. That is what I believe I saw happening.

Can you please help me understand? As you know, my goal is to protect our right to having Clean Water. First we need to know where to test to get the answers we need. I am concerned about the method of testing. Perhaps, based on this information, there may be a reason to have Anchor QEA take a different type of sample to determine the extent/source of the dioxin and PCB at HVM. Since the Sediment Sampling draft went out today, I'd like to make sure you know about this brown water in HVM after tug/barge activity in the Navigation Channel.

Thanks very much,

Sincerely,

Elizabeth Mooney
206-979-3999

---

From: "David R NWS Kendall" <David.R.Kendall@usace.army.mil>
To: "Ann Hurst" <annmhurst@msn.com>, "Elizabeth.Mooney" <elizabeth.mooney@comcast.net>
Cc: dbent@kenmorewa.gov, landerson@kenmorewa.gov, phyllisb@atg.wa.gov, happyhaze@msn.com, aaronmsmithlaw@gmail.com, "Cleve Steward" <cleve.steward@amec.com>, drad461@ecy.wa.gov, dreitan@insleebest.com, mobr461@ecy.wa.gov, cwan461@ecy.wa.gov, "joan hardy" <joan.hardy@doh.wa.gov>
Sent: Friday, October 5, 2012 10:40:51 AM
Subject: RE: UPDATE draft sampling plan (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Ann: I have to correct the statement below attributed to me in an earlier Ecology response letter to Representative Pollett. Ecology incorrectly quoted me relative to PCB fingerprinting of the Aroclors at Harbor Village Marina and the Federal Navigation Channel. I have attached my email notifying Ecology (Maura Obrien) of that error. The factual error was later corrected, but apparently the earlier uncorrected transmittal letter is still being circulated.

The concentrations of PCBs found in Harbor Village Marina were 10 times the concentrations found in the federal navigation channel in the 1996 characterization, and therefore, the navigation channel is not the likely source for the contamination in Harbor Village Marina.

David

David R. Kendall, Ph.D.
Chief, Dredged Material Managment Office

Seattle District Corps of Engineers
Phone: 206/764-3768
email: david.r.kendall@usace.army.mil

My email clarifying error in letter (6/6/12):

Hi all: I would like to point out that in the fifth paragraph of Attachment 1 to response letter, it states that the Corps of Engineers "determined that the PCB fingerprints were significantly different at the two sites" (Federal navigation channel and Harbor Village Marina). I would like to correct the record that that statement is in error. The Fingerprinting indicates the Aroclor quantified at both sites was the same, Aroclor 1254, as noted in attached Figure. I wanted to correct the record, as there is a lot of misinformation out there regarding the testing at these two locations. Thanks.

David

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

Seattle District Corps of Engineers
Phone: 206/764-3768
Fax: 206/764-6602
email: david.r.kendall@usace.army.mil

-----Original Message-----
From: Ann Hurst [mailto:annmhurst@msn.com]
Sent: Thursday, October 04, 2012 4:41 PM
To: Elizabeth.Mooney
Cc: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; Steward, Cleve; drad461@ecy.wa.gov; dreitan@insleebest.com; mobr461@ecy.wa.gov; cwan461@ecy.wa.gov; Kendall, David R NWS; joan.hardy@doh.wa.gov

Subject: RE: UPDATE draft sampling plan

Elizabeth and All,
The 1996 sampling is attached, and yes, the channel where the docks reside was tested in 1996, with exceedances, but of the type that dissipate except for the relatively low PCB's. In an Ecology summary on line, Ecology states that Officer Kendall states, the type of PCB's found at Harbour Village Marina last year are not the same as found in 1996. What is off shore of Cal Portland in 2012 will be unknown without testing that area, and now we know with equipment failures and use of fly ash over time at the cement companies, the cement batch plants under various ownership and various controls of fly ash could be a cumulative source of the Dioxins.
As I read the RCW, and with informal info from County, since the docking area is within City Boundary, it is clearly City Responsibility; County responsibility in past.
There was no Dioxin testing in 1996, and we now know that materials containing PCB's degrade over time, so what was in 1996 would not be a footprint of what is today as I, a lay person, understand various explanations made by various scientists to me. And if there are the 1996 PCB types at Harbour Village Marina, they may be well buried, watching recently all the churning of barges at that corner of the Kenmore Navigation Channel closest to Harbour Village Marina, which may have been going on for years with cement barge traffic, it is not a surprise that the Harbour Village Marina needs dredging.
An Ecology summary also said Officer Kendall made a comment on the types of toxins in the past at Harbour Village Marina, not certain where that material resides; but as I would prefer actual source material, I am again bothering Officer Kendall by cc'ing him and hoping he can clarify. Thank you Officer Kendall.
All in all, if we don't get a good testing pattern and firm execution date, etc., I am not going to be a good sport, Phyllis and Dawn, especially today with the high barge traffic, turbidity, and other likely infractions, waiting for official report/s. Our health and it appears the workers' health is not being protected.
Best, Ann

---

Date: Thu, 4 Oct 2012 05:58:40 +0000
From: elizabeth.mooney@comcast.net
To: annmhurst@msn.com
CC: dbent@kenmorewa.gov; landerson@kenmorewa.gov; phyllisb@atg.wa.gov; happyhaze@msn.com; aaronmsmithlaw@gmail.com; cleve.steward@amec.com; drad461@ecy.wa.gov; dreitan@insleebest.com
Subject: Re: UPDATE draft sampling plan

Ann,

Isn't it the case that the water area (navigation channel) by Calportland/Lakepointe was tested in 1996? Why would anybody spend city money and Ecology's money to test if they aren't going to test there?

I left a message for our manager, Rob Karlinsey. It certainly was my understanding that city/Ecology money was to be spent looking for the source of the dioxins/PCB's. Would it make any sense to spend all that money on the Anchor QEA sampling if there is no sampling where they found PCB's in 1996? Am I forgetting something here?

Thanks.

Elizabeth

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Comment #3

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | Ann Hurst [annmhurst@msn.com] |
| **Sent:** | Wednesday, October 24, 2012 9:37 AM |
| **To:** | O'Brien, Maura (ECY); Wang, Ching-Pi (ECY) |
| **Cc:** | Barney, Phyllis (ATG); rkarlinsey@kenmorewa.gov |
| **Subject:** | FW: [stedwards] Dioxin Levels Love Canal, Vietnam, No Kiewitt skin in game? |
| **Attachments:** | message-footer.txt |

Maura,
I am in receipt of Anchor testing plan of Kenmore's shore lands; thank you. I am troubled that Kenmore's industries do not want their shore lands tested for Dioxin contamination. My comment is that you obtain a Court Order or whatever is necessary to test these shore lands using the most comprehensive testing methods available and require the industries pay for the testing. Ample justification is in email below, an answer that the public sought from me which I think is fair. By now you must realize that the K/G/M barges did not stick to one barge per day! One barge per day was K/G/M's deal with WSDOT, in the FEIS, and I assume was K/G/M's deal with Ecology.
Thank you. Best, Ann Hurst, 6302 NE 151st Street, Kenmore, WA 98028

---

From: annmhurst@msn.com
To: c4sep@yahoogroups.com; stedward@lists.riseup.net; nlccannouncements@yahoogroups.com
Date: Wed, 24 Oct 2012 09:09:41 -0700
Subject: [stedwards] Dioxin Levels Love Canal, Vietnam, No Kiewitt skin in game?

To give you an idea of how 90 pptr in Kenmore sediments compares to the most egregious Vietnam contamination and Love Canal:

The U.S. will spend $68 million to clean up Vietnam dioxin hot spots due to leaching of Agent Orange from dioxin storage sites:

"The general standard in most countries is that **dioxin levels must not exceed 1,000 ppt (parts per trillion) TEQ (toxic equivalent) in soil and 100 ppt in sediments**. Levels beyond that require immediate remediation. Average dioxin contamination in the soil of industrialized nations is less than 12 ppt." At Harbour Village Marina, the Dioxin level of **90 pptr** in sediments should have triggered further investigation as the number is approaching the 100 ppt that requires immediate remediation. See source: http://www.aspeninstitute.org/policy-work/agent-orange/cleaning-dioxin-contaminated-soils

The 13.2 pptr in the sediments of the Kenmore Navigation Channel is not approaching 100 ppt but it is above the threshold of 10 ppt which requires during clean-up that it be treated as a hazardous substance and not allowed to disperse into Lake Washington. Clearly it has been allowed to disperse with barge traffic. The City of Kenmore, perhaps WSDOT, could seek damages from K/G/M.

By comparison, Love Canal had 380 pptr just in the fly ash. Fly ash is a product that in March wafted from the fly ash flue of Cal Portland in Kenmore; while it is unlikely that the recent source of fly ash used by Cal Portland is a by product of burning toxic wastes, prior fly ash sources could well have been a result of burning materials that would create a by-product with heavy dioxin contamination. Fly ash has been used at the batch plant for decades to create cement products.

Love Canal surface water sediments measured 37 ppb – perhaps someone can translate into pptr, the storm sewer sediment of Love Canal was 672 ppm, and six private sump pumps next to the industrial garbage dump measured as high as 16,500 ppm. A clear picture of the source, a dump.

Kenmore is not Love Canal, yet we are nearing the immediate remediation point at Harbour Village Marina and the source needs to be found and contained.

We are only one of four states that does not consider absorption of Dioxin through the skin to be hazardous in particular situations: "For dioxin, incidental ingestion is the dominant exposure route for unrestricted/ residential use, and four states (Delaware, Mississippi, Pennsylvania, and Washington) base their cleanup levels on this pathway alone. Most others incorporate inhalation and/or dermal exposures, but those contributions tend to be relatively small. However, under certain scenarios (such as for excavation workers), these additional exposure routes can contribute substantially to the derived cleanup level." P.19
REVIEW OF STATE SOIL CLEANUP LEVELS FOR DIOXIN, 2009

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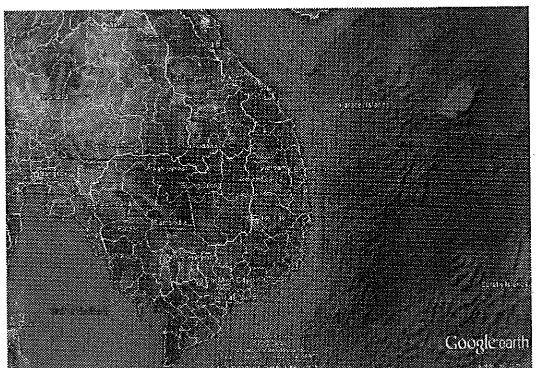
AGENT ORANGE IN VIETNAM PROGRAM

# Hot Spots: Cleaning Up Dioxin-Contaminated Soils

- Download the Hot Spots fact sheet (/sites/default/files/content/docs/agent-orange/4AOVIIFactSheet-HotSpots-CleaningUpDioxin-ContaminatedSoils-Aug2011.pdf)




(http://www.aspeninstitute.org/sites/default/files/content/docs/agent-orange/VNDioxinhotspots.kmz)

*Click on the image to launch a Google Earth interactive display (http://www.aspeninstitute.org/sites/default/files/content/docs/agent-orange/VNDioxinhotspots.kmz) of known and potential dioxin "hot spots" in Vietnam from the use of toxic herbicides. Created by the War Legacies Project (http://warlegacies.org/AgentOrange.htm), the map is based on research conducted by Hatfield Consultants (http://www.hatfieldgroup.com/default.aspx?p=/services/contaminantagentorange/agentorangereports) and their Vietnamese counterparts at the 10-80 Committee. Their research was funded by the Ford Foundation through a grant to the Ministry of Health in 2002. (Also available for Google Maps (https://maps.google.com/maps/ms?msid=216825182915981157584.000482fa653aa3fa51b4e&msa=0&ll=12.259854,115.433849&spn=22.281692,43.286133))*

Agent Orange/dioxin residues in Vietnam can be and are being cleaned up, using well-known and cost-effective methods. Additional resources would allow scale-up and expansion of these best practices to all existing "hot spots." Dioxin-contaminated herbicides were sprayed over about 5 million acres of upland and mangrove forests and about 500,000 acres of crops -- a total area the size of Massachusetts, about 24 percent of southern Vietnam. Some areas of Laos and Cambodia along the Vietnam border were also sprayed. Dioxin is not water-soluble. It breaks down in sunlight or clings to soil particles and is washed away in rainwater, so little remains in areas that were sprayed by air.[i] However, Hatfield Consultants (Canada) has found "hot spots" of high dioxin concentrations in areas where the dioxin-contaminated herbicides were stored, leaked or spilled. These are mostly on and around former U.S. military installations. Dioxin leached into the soil or was transported by runoff into the sediments of nearby rivers, lakes and ponds.

***About Hot Spots:*** Research continues, but as of August 2011, Hatfield and Vietnamese officials had located 28 dioxin hot spots, primarily where the Ranch Hand program was based. The most significant are at the Da Nang, Phu Cat and Bien Hoa airports that were used by the U.S. military.[ii] Safety standards for dioxin vary from country to country and by substance tested: food, air, water or soil. As most exposure to dioxin is through the food chain, the greatest concern for human exposure is the dioxin level in soil and sediment.

- The general standard in most countries is that dioxin levels must not exceed 1,000 ppt (parts per trillion) TEQ (toxic equivalent) in soil and 100 ppt in sediments. Levels beyond that require immediate remediation. Average dioxin contamination in the soil of industrialized nations is less than 12 ppt.
- In Vietnam, researchers found dioxin levels of up to 365,000 ppt at Da Nang, 262,000 ppt on the Bien Hoa base and 236,000 ppt in former storage areas on the Phu Cat base.[iii]

***Hot Spots Cleanup:*** The U.S. Agency for Toxic Substance and Disease Registry has determined that dioxin levels higher than 1,000 ppt in soil require intervention, including surveillance, research, health studies, community and physician education, and exposure investigation.[iv] The first step is to prevent access to contaminated areas by constructing fences and other barriers to protect the local population from further exposure. Second, containment measures such as concrete caps, filtration systems and sediment traps can prevent dioxin from being transported to secondary sites such as ponds and streams, and from there up the food chain to people. Then the isolated soils can be cleaned of dioxin through appropriate technical means.

***Dioxin cleanup:*** The cost of cleanup depends on the severity of the contamination, the type of soil affected and later uses planned for the area. Hatfield Consultants and its Vietnamese counterpart,

Office of National Steering Committee 33, estimate that a total of 234,780 cubic meters of soil and sediment need remediation at Bien Hoa, Da Nang and Phu Cat, the worst known sites – enough material to cover a football field nine feet deep. In mid-2010, the UNDP/Global Environmental Fund estimated the remediation cost for all three sites at

$58.7 million.[v] In mid-2011 the cost to clean up the dioxin at the Da Nang airport increased from an earlier estimate of $34 million to $43 million, bringing the total estimated costs for the three dioxin hotspots to $67.7 million.

***Actions by Vietnam and the United States:*** In 2003, the U.S. Environmental Protection Agency began a $2.4 million project in cooperation with the Vietnamese to investigate the situation at Da Nang, funding U.S. government agencies and their contractors. In 2007, the Joint Advisory Committee of U.S. and Vietnamese agencies began holding yearly meetings. In the same year, Congress allocated $3 million to address remediation of dioxin hotspots in Vietnam and to support public health programs in the surrounding communities.[vi] A second allocation of $3 million was included in the FY2009 Foreign Operations spending bill, and a third allocation of $15 million, substantially increasing U.S. government support, was approved for FY2010. In April 2011, Congress approved $18.5 million for FY2011, of which $3 million was specifically reserved for health activities. The U.S. Agency for International Development (USAID) has disbursed $3 million from Congressional appropriations in 2007, 2009 and 2010 to three non-governmental organizations for programs to support those with disabilities in the Da Nang area over the period 2008-2011. USAID is expected to increase that level to $3 million/year from 2012. In October 2009, USAID allocated $1.69 million to a U.S. engineering firm to assess dioxin contamination there and design a remediation plan. In October 2010, Secretary of State Hillary Clinton announced U.S. government support for a project to clean up the Da Nang hot spot which is now costed at $43 million.[vii]

***NGO Activities:*** The lead NGO has been the Ford Foundation, which through April 2011 provided $17.1 million in grants in Vietnam to test for and contain dioxin-contaminated soils, develop treatments and support centers for Vietnamese who have been exposed, restore landscapes, and educate the U.S. public and policymakers. Ford has also worked to increase awareness about Agent Orange/dioxin among donors and to encourage new donors such as UNICEF, UNDP, The Atlantic Philanthropies and the Bill & Melinda Gates Foundation. In May 2011 the Ford initiative on Agent Orange transited to the Aspen Institute. Many U.S. and Vietnamese NGOs have projects that provide services to the disabled in Vietnam.

**For More Information Contact:** James Hoppes at the Aspen Institute Agent Orange in Vietnam Program, 477 Madison Avenue Suite 730 New York, NY 10022. james.hoppes@aspeninstitute.org (mailto:james.hoppes@aspeninstitute.org), 215 887-3815.

*August 2011*

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[i] Dwernychuk, Wayne et al. "The Agent Orange Dioxin Issue in Vietnam: A Manageable Problem." Paper Presented at Dioxin 2006, Oslo, Norway http://www.warlegacies.org/OsloPaper2006.pdf (http://www.warlegacies.org/OsloPaper2006.pdf).

[ii] Vo Quy, "Statement to the House Subcommittee on Asia, the Pacific and Global Environment," Washington DC, June 4, 2009, http://www.internationalrelations.house.gov/111/quy060409.pdf (http://www.internationalrelations.house.gov/111/quy060409.pdf).

[iii] Committee 33 PowerPoint Presentation: "Overcoming consequences of toxic chemicals/dioxin: A difficult and long-term task." April 2009 http://www.warlegacies.org/Committee33_0209.pdf (http://www.warlegacies.org/Committee33_0209.pdf) and Office of the National Steering Committee 33, Ministry of Natural Resources & the Environment, and Hatfield Consultants, "Environmental and Human Health Assessment of Dioxin Contamination at Bien Hoa Airbase, Vietnam," July 2011.

[iv] Hatfield Consultants "Summary of Dioxin Contamination at Bien Hoa, Phu Cat and Da Nang Airbases, Viet Nam." PowerPoint presentation for the meeting of the U.S.-Vietnam Dialogue Group On Agent Orange/Dioxin, Washington, DC June 2009. http://www.warlegacies.org/Hatfield-Dioxin-Presentation-DC-052809.pdf (http://www.warlegacies.org/Hatfield-Dioxin-Presentation-DC-052809.pdf).

[v] Committee 33 PowerPoint Presentation: "Overcoming...

[vi] Michael Martin, "Vietnamese Victims of Agent Orange and U.S.-Vietnam Relations" Congressional Research Service Report. (May 2009) p. 9 http://www.warlegacies.org/CRSAO.pdf (http://www.warlegacies.org/CRSAO.pdf)

[vii] $500,000 is being used to finance a staff person for dioxin issues at the U.S. embassy in Hanoi and for more expert exchanges.

Comment #4

**O'Brien, Maura (ECY)**

**From:** Dennis mendrey [dennism@riserealtyllc.com]
**Sent:** Wednesday, October 24, 2012 11:02 AM
**To:** O'Brien, Maura (ECY)
**Subject:** RE: Webpage and media information for Kenmore Industrial Park site and Harbour Village Marina

Sound great!

*Working together for a better Kenmore,*

*Dennis*


**RISE REALTY LLC**
6410 NE 182 St
Kenmore, WA 98028
O = 206-686-8727
C = 425-681-8727
Fax = 206-686-8727
dennism@riserealtyllc.com
www.riserealtyllc.com


---

**From:** O'Brien, Maura (ECY) [mailto:MOBR461@ECY.WA.GOV]
**Sent:** Monday, October 15, 2012 11:13 AM
**To:** Dennis mendrey; Clyde Merriwether; elizabeth.mooney@comcast.net; happyhaze@msn.com; Ann Hurst; Cindy Beckett; patrickeobrien@comcast.net
**Cc:** nousley@ci.kenmore.wa.us; Greg Wingard
**Subject:** Webpage and media information for Kenmore Industrial Park site and Harbour Village Marina

## SEDIMENT SAMPLING & ANALYSIS PLAN COMMENT PERIOD Kenmore Area Sediment & Water Characterization – Oct 15-29, 2012

Ecology is holding a two week informal public comment period for the citizens of the Kenmore Area for the proposed Sediment Sampling and Analysis Plan at the Kenmore waterfront area. The Washington Department of Ecology with the full cooperation of the City of Kenmore are working in close consultation with the Washington State Department of Health (DOH) and Dredged Materials Management Program (DMMP) on the details for the Sediment Sampling and Analysis Plan (SSAP). The SSAP will include near shoreline sediment sampling at Log Boom Park, Lake Washington northeast waterfront, Harbour Village Marina, North Lake Marina, offshore of the Kenmore Industrial Park site, Kenmore Navigation Channel and Sammamish River, and water column samples at Log Boom Park. Final access arrangements have been completed.

The draft SSAP will be available for informal public review from October 15 – 29, 2012. This is not a formal state cleanup requirement (Model Toxics Control Act) for public involvement. Your review and comments are requested and please send written or email comments to Maura O'Brien at mobr461@ecy.wa.gov or Department of Ecology, 3190 – 160th Ave SE, Bellevue, WA 98008. Ecology, the City, DOH, and DMMP will review all comments received and finalize the SSAP.

SAMPLING SCHEDULE
Sampling is scheduled for early November, preliminary sediment and water column sampling results are estimated to be received in December, and a draft report with these results are estimated to be available in January 2013. This schedule is subject to change due to unforeseen circumstances, such as equipment availability and weather conditions.

Comment # 5

WASHINGTON STATE DEPARTMENT OF
**Natural Resources**
Peter Goldmark - Commissioner of Public Lands

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OCT 25 2012
DEPT OF ECOLOGY
TCP - NWRO

Caring for
your natural resources
... now and forever

October 22, 2012

Maura O'Brien, Toxics Cleanup Program NWRO
Washington State Department of Ecology
3190- 160th Ave SE
Bellevue, WA 98008

Re: Draft Sampling and Analysis Plan, Kenmore Sediment and Water Characterization

Dear Ms. O'Brien:

The Washington State Department of Natural Resources (DNR) would like to thank you for the opportunity to comment on the Draft Sampling and Analysis Plan for the Kenmore Sediment and Water Characterization.

DNR's comments are based on principles of stewardship and proprietary management derived from our legislative defined goals to protect State-Owned Aquatic Lands (SOAL) and preserve them for the public's benefit. We appreciate Ecology's consideration of these and any future comments related to the characterization of these sediments.

First, in Table 1, please note that DNR does not own state owned aquatic land-it is the manager of those lands.

Secondly, since the freshwater sediment standards are draft and are still being revised, they should not be the sole standards the nearshore samples should be screened against. (p. 27)

Sincerely,

Erika A Shaffer, MS
Aquatics Division, Sediment Specialist

Comment #6

# North Lake Marina

6201 NE 175TH St, Kenmore, WA. 98028
P#425.482.9465 F# 425.482.9386
www.northlakemarina.com

RECEIVED

OCT 26 2012

DEPT OF ECOLOGY
TCP - NWRO

October 25, 2012

City of Kenmore
Rob Karlinsey
Nancy Ousley
18120 68th Ave. NE
Kenmore, WA. 98028

Department of Ecology
Maura O'Brien
3190 160th Ave. SE
Bellevue, WA. 98008

Re: *Sampling and Analysis Plan Kenmore Area Sediment and Water Characterization*

Mr. Karlinsey, Ms. Ousley, and Ms. O'Brien,

We have reviewed the Sampling and Analysis Plan (the "Plan"). Please correct the Plan at page 3, second paragraph. The owner of North Lake Marina (Johnson & McLaughlin, LLC) is not participating in the Plan; rather, the property owners are the participating parties. It is our understanding Clifford Davidson has been working with the City, as a representative of Davidson Investment Properties, LLC, and Bernie Talmas, as Edwin Davidson's representative, spoke before the City Council at an open City Council meeting as to Mr. Davidson's intent to participate. North Lake Marina has agreed to facilitate any needed access and to provide moorage at no cost for the testing vessel. Please contact the undersigned if you have any questions concerning this letter.

Thank you,

Lori Johnson
North Lake Marina
Johnson & McLaughlin, LLC

Loren McLaughlin
North Lake Marina
Johnson & McLaughlin, LLC

Comment #7

# Comments on the Sediment Sampling and Analysis Plan – Kenmore Area Sediment and Water Characterization

October 26, 2012

RECEIVED
OCT 29 2012
DEPT OF ECOLOGY
TCP - NWRO

Prepared by:

Greg Wingard
PO Box 4051
Seattle, WA 98194-0051

Section 1.1

The Kenmore Navigation Channel (KNC) appears to terminate, adjacent to Kenmore Air. What is the status of the remaining portion of the head of the channel to the NE? Who owns it, and can it be sampled as well?

From our recent meeting, it is my understanding that the sediments at the head of the channel, northeast of and adjacent to the Kenmore Navigation Channel are in private ownership. Further, Ecology and/or the City of Kenmore have approached these property owners, including Kenmore Air, CalPortland, and Kenmore Industrial Park, who have declined to allow sampling of these in channel sediments as part of this SSAP project.

There is a high level of community concern about the potential contamination of the sediments in this area, and the head of the channel. This is based on available information such as present and former industrial uses, a fairly substantial fire involving creosoted timber, the sinking of a tug, which released at least some amount of product/waste (according to the United States Coast Guard), to list a few.

Sampling of these sediments is a high priority in the community, with a strong preference to see this sampling done sooner, rather than later. This concern is particularly critical due to the increased tug and barge traffic in this vicinity, which as been seen causing an increase in water turbidity, from the disturbance of channel sediment from prop wash.

While I understand there are some legal limits to what Ecology can do, or require a private property owner to do, I also want to be very clear that based on a reasonable assessment of the available information there is a strong community concern that sediments in the channel head, outside the KNC, may be contaminated, are being disturbed, and may be distributed as a result. Resolution of this data gap is a critical community issue that needs to be a high priority with Ecology, and Kenmore.

According to the plan this "screening level" study will be followed by a full DMMP characterization when the proposed funding for the project is two years or less out. There is some uncertainty in the proposed time lines here. Any information Ecology/Kenmore can provide on timing of further sampling after the initial screening is completed would be useful. My current understanding is that this is dependent to a large extent on federal funding/permission being available for the KNC dredge project. The assumed target date is currently thought to be between two and four years out, with substantial additional sediment data collection being done in that time frame.

The community requests that Ecology deal with this issue, of the time frame and potential scope of additional sampling concurrent with the release of data and reports resulting from this SSAP. By addressing this matter up front and as soon as possible Ecology/Kenmore can reassure the community of your commitment to collect the necessary data to see that community health and the environment of the north Lake Washington, and related near shore area is protected.

The document states the owners of Northlake Marina are interested in coordinating their dredging project, in conjunction with the KNC dredge to optimize potential cost savings. How does this fit in with the potential dredging at the Harbor Village Marina?

It would appear that given the somewhat closely coordinated approach and timing of the dredging at each of these three sites, that particular attention should be paid to the potential for any nexus between the sites. The current sampling design does not appear to meet this objective, as there appear to be remaining data gaps in the area east of the Harbor Village Marina, north and west of the KNC, and at the head of the channel north and east of the KNC.

My understanding is that Ecology/Kenmore are investigating the possibility of moving some sampling locations to address this issue to some extent, but that there is a lack of additional funds to allow for more sampling locations to be added.

The community requests that Ecology meet with the community as soon as possible after the data from this SSAP is released to discuss a data gaps analysis, including an assessment of what the additional priorities for sampling will be, and timing of further sampling efforts.

A substantial amount of both public and private funds will be expended in dredging, or corrective actions for the identified dredge project, or known contaminated site areas. The understanding of the potential contamination nexus between these proposed project areas, as well as additional nearby areas needs to be understood, and the potential for recontamination known and addressed prior to dredging or removal actions.

Section 1.2

The exact purpose of the water sampling is not clear. The primary chemicals of concern from the community perspective are the dioxin/furan/PCB's, and metals, in particular at Log Boom Park, as the park is closely adjacent to the known dioxin/furan/PCB contamination at the Harbor Village Marina. It is highly unlikely that these particular chemicals of concern would be found dissolved in the water column. The more likely scenario is that the water column would be contaminated by sediment stirred up by human, or mechanical activity. To the extent there is a risk to public health from the water column absent disturbed, suspended sediments, based on available data to date, it is much more likely that health risk would relate to biological constituents (pathogens), rather than chemicals of concern, such as dioxin/furans/PCB's and metals.

It does not appear that the water quality samples add much value to this sampling effort. If the expense related to the proposed water quality sampling is equal to, or greater than the cost of an additional sediment sample (my understanding is that the loaded cost of adding another sediment sampling location is ~$2,200), then Ecology/Kenmore should strongly consider scrapping the water quality sampling and instead adding an additional sediment sample(s), in one of the available areas where more data would be useful. A potential priority would be the area to the east of the current Harbor Village Marina samples.

Section 1.2 (sic)

There are clearly multiple purposes related to this sampling effort. In terms of sampling collection methods and analysis, these should be as homogenous as possible between all sampling locations, so as to maximize the potential statistical and comparative use of the data across the entire area sampled. It is not clear from this section how Ecology/Kenmore are going to optimize the statistical , and comparative usefulness of the sampling data. It is understood that there are some cost concerns/limitations that may impact aspects of this issue.

There is a reference to the revision of the Ecology sediment evaluation framework for freshwater, and that revision being available when published. The relevance to this SSAP is not clear. It is my understanding that the revised framework may be available in final form by the time the data from the SSAP project is available. If that is the case the consultant will use this updated document to screen the results against. The SSAP text of this will be clarified.

Section 1.3.1

Given the information about existing industries on, or in close proximity to the channel, the upper head of the channel, northeast of the KNC should be sampled as well. As this is discussed above, I will not repeat that information here.

Section 1.3.3

In the discussion of sediment loading the SSAP, provides specific citations related to sediment loading from stream 0056. In the discussion of the Sammamish River sediment loading and wind and wave transport, there are no citations provided, just a general assumption that the river is one of two primary contributory sources. Is there an available data on potential sediment loading from the River, or its sediment distribution?

It is understood that the current priority is to get the sampling underway. As a result, additional information of Sammamish River sediment loading to Lake Washington may wait until the data evaluation phase, rather than being included in the SSAP now. There is general agreement that additional information on Sammamish River sediment loading to Lake Washington will be useful.

In Ecology's recent update, "Harbour Village Marina", the site status and previous data are reported. This information is not referenced in section 1.3.3., of the SSAP.

In short the marina was already on Ecology's MTCA site list due to petroleum contamination, including soil and groundwater. The facility previously decided to deal with this site contamination through "natural attenuation." It has since been determined this petroleum contamination originated at an adjacent site, and Ecology's files are being updated to reflect this.

At the time the petroleum contamination was evaluated, data related to nearby dioxin/furan/PCB contamination was not known. There is potential concern that since petroleum at excessive levels has been located in the shallow groundwater at this facility, there may be a potential for the petroleum to impact nearby sediments. This is of concern as petroleum, in particular the lighter fractions of petroleum has the potential of mobilizing dioxin in soil, sediment, and water. Further consideration of this potential media/contamination nexus should be a high priority.

As mentioned above, given the historic information supplied in this report, and otherwise known about the CalPortland area, and the area outside of the KNC, referred to as the head of the channel, lack of samples from this area is a clear data gap. While it is understood that this area is private property, and neither Ecology or Kenmore have the immediate ability to collect samples on private property without property owner cooperation, plugging this data gap remains a top community priority.

Table 1

The table provides detail and rationale for selected sample locations. Near shore sediment samples are described as having a collection depth of 10 cm, and are collected with a trowel. Grab/box core samples are described as having a collection depth of 25 cm. The difference in sample depth adds a variable that interferes with the ability to compare results from these two groups of samples. Sediment sample depths should be as consistent as possible across this sampling effort. From our recent meeting the issue of cost was raised as part of the rationale for differing sample depths, though how much impact having uniform sampling depth would have on the budget was not discussed in any detail.

As per previous comment, it is not clear what value the water sampling has in the context of this limited sampling plan, or how single point in time water samples would be that useful in terms of a health assessment given time loaded variability of water samples as compared to sediment samples.

Water analysis should include turbidity, as there is a specific water quality criteria for that parameter. From the meeting, it was clarified that turbidity sampling will be done as part of the conventional parameters taken at all the sample sites. The text will be modified so this information is consistent with the field sample forms at the end of the SSAP.

Figure 2

As mentioned previously given the proximity, and/or planned coordination between the three planned dredging, or cleanup projects (it is not clear whether Harbor Village Marina will proceed as a MTCA cleanup, or as a dredging project), the potential for a nexus between these three areas, the Harbor Village Marina, North Lake Marina, and KNC should be a priority of this and future sampling efforts. The sediment sampling as proposed does not address better defining the eastward lateral extent of sediment contamination from the presently known dioxin/furan/PCB contamination at the Harbor Village Marina. It does not address the potential for a nexus between that contamination and the eastward elbow of the KNC where current tug, and barge operations are at least in part making a turn and have been observed causing excessive turbidity in the water column. It also does not address the undesignated section of the channel between the northeastern extent of the DNC and the channel head, where according to the historic information supplied, some of the most likely potential sediment contaminant sources are, or were located. Ecology/Kenmore will investigate moving some of the sampling locations to address this issue, as long as that doesn't interfere too much with other data quality objectives.

Ecology mentioned in our recent meeting that the City of Lake Forest Park is siting a sediment sample in their area in addition to what was initially planned by Ecology and Kenmore. It is not clear if this sample is depicted in Figure 2.

Section 3.4

The section refers to the three planned water samples and says a single "background" sample will be collected upstream of the 68th Avenue bridge on the Sammamish River. How does this location constitute "background", as compared to Log Boom Park. Wouldn't it be preferable to take a water sample from the central part of north Lake Washington, and use that as background?

It seems the differences in the total volume of water, potential for inputs and other factors would make an upstream Sammamish River sample less than satisfactory for this purpose, and a sample from the middle of north Lake Washington would be more representative.

Ecology agreed to examine moving the "background" water quality sample, and will respond to this concern.

Section 3.4.1

The difference between grabbing a core sample and the trowel method of sampling has the potential to introduce an unnecessary variable in the sediment sampling methods. This includes a variable in the portion of sample based on depth for the trowel method, as compared to coring which would better isolate the sampled sediment and collect a more representative sample on the vertical axis to the depth sampled. Ecology agreed it is important to strictly control the sample collection to assure a representative sample is collected, and a sample collection call-out will be added to address this issue.

The rationale for the difference in sample depths is not clear. There should be some clear, consistent rationale for the sampling depth, such as the depth of contamination as seen at the Harbor Village Marina, or the depth of the biologically active zone, or the depth of planned dredging, or the depth likely to be disturbed by human contact or mechanical means. There should be at least some brief explanation of why there is a difference in sediment sampling depths.

Section 5

What is the rational for the difference in TBT sampling methodology between the near shore, and surface sediment samples?

In the KNC samples, and the Harbor Village Marina samples the TBT sample will be collected in the lab from the sample pore volume water, with bulk TBT sample analysis if enough pore water volume is not present in the sample. The rest of the collected samples will have bulk TBT sampling, apparently irrespective of whether there is enough pore water volume, or not. There should be at least a brief explanation for this variance in the sampling methodology.

Table 7

The schedule is of concern. As laid out in the schedule there will be a fairly long period of time between sample collection, and the issuance of the looked for reports from Ecology and Department of Health. It is understood that it is Ecology and Kenmore's intent to issue the data to the public as soon as the Quality Assurance/Quality Control step is completed. It is understood that this will be relatively "raw" data, without detailed explanations or conclusions, which will come later when the final reports are issued.

References

Under the Ecology citations, there is no reference to the Ecology sediment evaluation framework for freshwater. Does this mean Anchor is not using this as a reference in this SSAP?

The SSAP text will be modified to clarify under what circumstances the new framework will, or will not be used.

There is a reference of a personal communication between J. LaFlam and Bill Joyce in 2012. What is the substance of this communication and the significance of citing to it in the SSAP?

It is understood from the recent meeting that the J. LaFlam citation was a reference to a discussion between Kenmore staff, and the Kenmore Fire Department to collect additional information on the previous wharf fire of creosote treated timber, in the vicinity of the current CalPortland facility. Given the available information on this creosote timber fire, and the verification that at least a portion of the burnt and partially burnt treated timbers are still in the water and sediment in the channel adjacent to CalPortland, Ecology should likely add this site to the known and suspected contaminated sites list under MTCA authority. KAN will be discussing this in the near future, and may provide some additional input on this point.

Comment #8

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | Kate Snider [Kate.Snider@floydsnider.com] |
| **Sent:** | Monday, October 29, 2012 1:50 PM |
| **To:** | O'Brien, Maura (ECY) |
| **Cc:** | Wang, Ching-Pi (ECY); Gary Sergeant |
| **Subject:** | Public comment on Sediment Sampling & Analysis Plan for Kenmore Area Sediment |

Maura,

The following comments on the Sediment Sampling & Analysis Plan for Kenmore Area Sediment are provided on behalf of Gary Sergeant and Pioneer Towing, Inc.

1. Section 1.3.3, paragraph 5, page 9: Ecology's recent Public Participation Plan (PPP) update includes a description of the KIP site history that is more accurate than this description presented in the SAP. We would appreciate substitution of your text from the PPP. Most importantly, the 6th sentence regarding reported disposal of medical wastes and transformers should be deleted, as it is an old conjecture which has since been disproven.

2. Table 1: Our understanding is that sediment samples SG-14, SG-15, SG-16 and SG-17 will be on DNR aquatic lands property, offshore of KIP. Please confirm.

3. Figure 2 and Table 1: Throughout the year, significant sediment loads are conveyed out of the Sammamish River, and are deposited throughout the north end of Lake Washington. We are surprised that the proposed sampling plan does not include samples within the depositional area of the mouth of the Sammamish River, that would analyze this material as a potential source of contamination to the area. We recommend that approximately 2 sediment grab sample locations be added at (or relocated to) the centerline of the Sammamish River Small Boat Navigation Channel, south of SG-15 and in-between SG-16 and SG-17. In addition to the proposed SG-01, these sample locations could be used to characterize Sammamish River bed load as a potential source.

Please let Gary or I know if you have any questions.

Thanks,

Kate

**Kate Snider, PE Principal**
**FLOYD | SNIDER**
Strategy * Science * Engineering
Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867
cell: 206-375-0762
www.floydsnider.com

---

**From:** O'Brien, Maura (ECY) [mailto:MOBR461@ECY.WA.GOV]
**Sent:** Monday, October 15, 2012 12:51 PM
**To:** Gary Sergeant; Kate Snider; Lakey, Kevin
**Cc:** Wang, Ching-Pi (ECY)
**Subject:** FW: Webpage and media information for the Sediment Sampling and Analysis Plan for the Kenmore waterfront area.

Hello,
Here is the Kenmore Area announcement and plan. The SSAP is posted both on the Ecology's Harbour Village Marina webpage and on the Kenmore Industrial Park site webpage.

Maura

## SEDIMENT SAMPLING & ANALYSIS PLAN COMMENT PERIOD Kenmore Area Sediment & Water Characterization – Oct 15-29, 2012

Ecology is holding a two week informal public comment period for the citizens of the Kenmore Area for the proposed Sediment Sampling and Analysis Plan at the Kenmore waterfront area. The Washington Department of Ecology with the full cooperation of the City of Kenmore are working in close consultation with the Washington State Department of Health (DOH) and Dredged Materials Management Program (DMMP) on the details for the Sediment Sampling and Analysis Plan (SSAP). The SSAP will include near shoreline sediment sampling at Log Boom Park, Lake Washington northeast waterfront, Harbour Village Marina, North Lake Marina, offshore of the Kenmore

Industrial Park site, Kenmore Navigation Channel and Sammamish River, and water column samples at Log Boom Park. Final access arrangements have been completed.

The draft SSAP will be available for informal public review from October 15 – 29, 2012. This is not a formal state cleanup requirement (Model Toxics Control Act) for public involvement. Your review and comments are requested and please send written or email comments to Maura O'Brien at mobr461@ecy.wa.gov or Department of Ecology, 3190 – 160th Ave SE, Bellevue, WA 98008. Ecology, the City, DOH, and DMMP will review all comments received and finalize the SSAP.

SAMPLING SCHEDULE
Sampling is scheduled for early November, preliminary sediment and water column sampling results are estimated to be received in December, and a draft report with these results are estimated to be available in January 2013. This schedule is subject to change due to unforeseen circumstances, such as equipment availability and weather conditions.

Maura S. O'Brien, PG/HG #869
Professional Geologist/Hydrogeologist
Toxics Cleanup Program - NWRO
Department of Ecology
3190 - 160th Avenue SE
Bellevue, WA 98008-5452
Tele 425-649-7249
Fax 425-649-7098
Email mobr461@ecy.wa.gov

Comment # 9

**O'Brien, Maura (ECY)**

**From:** Greg Wingard [gwingard@earthlink.net]
**Sent:** Monday, October 29, 2012 2:58 PM
**To:** O'Brien, Maura (ECY)
**Subject:** Re: SSAP meeting with Ecology

Maura:

My initial hope for the sampling approach was that at least the additional sampling in the Harbor Village Marina area would be consistent with the data group from the previous sampling there. I understand what that would do to the sampling budget.

Failing that, that the sample data collected as part of this SSAP project would be consistent enough across the sediment data set to allow for easy data comparison and statistical assessment of the data.

Even the deeper cores from the sediment data are fairly shallow in depth, under a foot (around four inches). The trowel samples at 10 cm, only close to four inches. Since these samples are essentially single composite samples per sample location, the difference in depth, and the very shallow nature of the near shore sediment sampling is troubling. Under four inches may not even accurately describe the depth which is likely to be disturbed in the near shore areas by human and mechanical activity, as my understanding is that much of this sediment is very soft muck.

As we discussed, it is my belief that it is important that we get additional data as soon as possible. There will also be some future data collection to address some of the shortfalls of this data set, including deeper samples at least in some locations (primarily associated with the dredging).

I tried to balance these concerns, benefits and short comings in my comments, but as you can tell remain concerned about the shallow nature of the samples, and the lack of identical sampling parameters between all sediment samples collected.

How much additional cost is involved in making all the samples 25cm? As the entire vertical profile, irrespective of depth is in essence a single composite per sample location, at the additional 15cm of vertical sampled sediment is not that much additional volume, it doesn't seem to me like there should be that much additional cost to simply collect 25cm of sample, across all sediment sampling locations.

Regards,

Greg

On 10/29/12 2:08 PM, O'Brien, Maura (ECY) wrote:

> Thanks Greg and I appreciate your efforts to get the SSAP comments to me early.
>
> I am working on them.
>
> Maura
>
> Maura S. O'Brien, PG/HG #869
> Professional Geologist/Hydrogeologist
> Toxics Cleanup Program - NWRO
> Department of Ecology
> 3190 - 160th Avenue SE
> Bellevue, WA 98008-5452
> Tele 425-649-7249
> Fax 425-649-7098
> Email mobr461@ecy.wa.gov
>
> ---
>
> **From:** Greg Wingard [mailto:gwingard@earthlink.net]
> **Sent:** Saturday, October 27, 2012 9:50 PM
> **To:** O'Brien, Maura (ECY)
> **Subject:** Re: SSAP meeting with Ecology
>
> Maura:
>
> My last message bounced back for some reason, a problem I have occasionally with Ecology email addresses.
>
> You mentioned you wanted my comments prior to the Monday deadline if possible.

I would have spent a bit more time on edits and such, but given I am going to be gone all day tomorrow, if I don't get them out now, it will be Monday before I have a chance to send them.

Here they are.

Regards,

Greg

On 10/25/12 5:20 PM, O'Brien, Maura (ECY) wrote:

> Thank you Greg for the opportunity to meet with you and discuss comments about the proposed Sediment SSAP.
>
> I appreciate your insights and working together and then we will have a clearer sampling plan and together get the job accomplished as best we are able, and will limited funds.
>
> Yes the City of Lake Forest Park now, has requested to add one sediment and water column samples off their park shoreline.
>
> I look forward to receiving your written comments by Monday, Oct 29 and earlier if feasible as I will be working on the SSAP this Sunday.
>
> Maura
>
> Maura S. O'Brien, PG/HG #869
> Professional Geologist/Hydrogeologist
> Toxics Cleanup Program - NWRO
> Department of Ecology
> 3190 - 160th Avenue SE
> Bellevue, WA 98008-5452
> Tele 425-649-7249
> Fax 425-649-7098
> Email mobr461@ecy.wa.gov

Comment #10

*Mayor*
Mary Jane Goss

17425 Ballinger Way NE
Lake Forest Park, WA 98155-5556
Telephone: 206-368-5440
Fax: 206-364-6521
E-mail: cityhall@ci.lake-forest-park.wa.us
www.cityoflfp.com

CITY OF LAKE FOREST PARK
INCORPORATED 1961



10/25/2012

Ms. Maura O'Brien
Department of Ecology
3190 160th Ave NE
Bellevue, WA 98008

Dear Ms. O'Brien,

Thank you for meeting with City staff to discuss the Kenmore waterfront area sediment sampling and analysis plan (SSAP). As you know, the presence of chemicals and potential presence of contamination in Lake Washington sediments is an issue of serious concern for the City of Lake Forest Park.

The proposed SSAP does not provide for sampling in Lake Forest Park despite the close proximity (~2400') of the Lake Forest Park Waterfront Park and the Civic Club to the proposed sampling area. Each of these facilities provides access to Lake Washington while the Civic Club has a popular swimming area. There are also 29 residences on the lake between Log Boom Park and Waterfront Park.

We understand that the rationale for not sampling in Lake Forest Park is based on the Kenmore Lake Line Lakebed Sedimentation Analysis study that indicates the migration of sediment is predominately to the northeast. If this were true, sediment on the Lake Forest Park waterfront would travel toward Kenmore. Unfortunately, this has not been our experience. In fact, seasonal changes in sediment migration have been observed with sediment migrating, at times, in the southwest direction taking sediment from the Kenmore waterfront area into Lake Forest Park.

As a result, the City respectfully requests that a sediment grab sample and a water sample be taken between the Lake Forest Park Waterfront Park and the Civic Club as part of the Kenmore Waterfront area SSAP. See the attached map to better understand the area. Please contact Aaron Halverson, Environmental Programs Manager at (206) 957-2836 or ahalverson@ci.lake-forest-park.wa.us if you have comments or questions.

Sincerely,

Mary Jane Goss

Mary Jane Goss
Mayor


Lake Forest Park Sampling Map
R-8-SO
LP-SO
King County
The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.
Date: 10/25/2012 Source: King County iMAP - Property Information (http://www.metrokc.gov/GIS/iMAP)

Comment # 11

**O'Brien, Maura (ECY)**

**From:** elizabeth.mooney@comcast.net
**Sent:** Monday, October 29, 2012 7:55 PM
**To:** O'Brien, Maura (ECY)
**Cc:** Elizabeth Mooney; Janet and Bob Hays; Ann Hurst
**Subject:** Sediment and Water Sampling Plan Kenmore: ERTS Information 632786 (UNCLASSIFIED)

October 28, 2012

Maura O'Brien
Dept of Ecology

Comment regarding Sediment and Water Anaylysis Kenmore:

Dear Maura,

I am sending this email chain as evidence in support of my argument that the truth was not upheld, nor our laws abided by, nor our agencies able to support my ERTS call by enforcing the water quality laws that are supposed to protect our public right to Clean Water. The record was never corrected. I have called Coast Guard, WSDOT, DOE regarding this email.

The point is that the barging operation for SR 520 continues, the companies do the work, the waters and sediment have not been tested and the barge grounding and contaminated water (turbidity) was never admitted to have occurred.

I believe this in evidence that the project has not been abiding by the laws intended to protect our environment. Calportland is part of the team and is not allowing DOE to test the sediment in front of their property at the bottom of the lake. Why wouldn't they? We do not know the source of the dioxins that were found in high levels at Harbour Village Marina in October 2011. Since this behavior of denying a grounding occurred when in fact it did is an indicator that the companies and WSDOT and the contractors were not admitting to a grounding when in fact it occured, how can we trust without DOE testing that this is not the source of the high level of dioxins? There is a wharf that burned and that is in the lake. Burning wharfs might be a source of dioxins. This is good reason to have Calportland, to let their area be tested before it has more barges push in and out of the head of the channel.

I have seen the turbidity caused by the incident Greg Wingard observed flow (brown water) into Harbour Village Marina. I stood at Harbour Village Marina and talked to its harbormaster Mike, while watching the brown water in the marina as it contrasted with the blue water further out in the lake.

I can only assume that the barging that has been ongoing may have contributed to translocation of sediments. If you or WDFW need proof, the agencies would have had to test first, measured, and had a baseline from which to compare.

I hope the Calportland site will offer to let DOE test, but, regardless, I would hope one day to receive a letter that states that this email was in error. I have heard that WSDOT admitted they grounded during the ERTS 632786 incident, but I haven't seen a letter to correct this email message.

Elizabeth Mooney

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**From:** "David R NWS Kendall" <David.R.Kendall@usace.army.mil>
**To:** "Elizabeth Mooney" <elizabeth.mooney@comcast.net>
**Cc:** "Clay Keown (ECY)" <ckeo461@ECY.WA.GOV>
**Sent:** Thursday, March 29, 2012 3:13:20 PM
**Subject:** RE: ERTS Information 632786 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Elizabeth: FYI, I got this email communication from John Hicks (Chief/Navigation), regarding tug movements/turbidity in Kenmore Channel. The Tugboat operator's email (see email string below) to USCG discusses their activity and indicates that there were no groundings.

I have no interest in getting in the middle of this, but wanted to let you know that the USCG investigated the complaints about the turbidity.

David

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

Seattle District Corps of Engineers
Phone: 206/764-3768
Fax: 206/764-6602
email: david.r.kendall@usace.army.mil

- FYI-see below

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John A. Hicks
Chief, Navigation Section
Army Corps of Engineers, Seattle District
4735 E. Marginal Way S
Seattle, WA 98124-2255
(206) 764-6908- Telephone
(206) 595-2750- Cell
(206) 764-3308- Fax
john.a.hicks@usace.army.mil

-----Original Message-----
From: Heather.J.St.Pierre@uscg.mil [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Monday, March 26, 2012 11:23 AM
To: Hicks, John A NWS
Subject: FW: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Hi John,

I've attached the e-mail string to keep you posted. Let me know if you hear anything else about the Kenmore area.

Take care,

Heather

LCDR Heather St. Pierre
Chief, Waterways Management Division
U.S. Coast Guard Sector Puget Sound
1519 Alaskan Way South
Seattle, WA 98134-1192
206-217-6042
heather.j.st.pierre@uscg.mil

-----Original Message-----
From: EEdwards@mansonconstruction.com
[mailto:EEdwards@mansonconstruction.com]
Sent: Sunday, March 25, 2012 8:43 AM
To: St.Pierre, Heather LCDR; Overton, Randall; LaBoy, Anthony ENS
Cc: Monica Blanchard; Jessi Massingale; andy.hoff@kiewit.com; Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com; Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good morning LCDR Heather St. Pierre- Island Tug and Barge (ITB) uses the slip and North dock to berth a gravel barge for Cal Portland Concrete Company. ITB typically shifts in and out of the slip on a twice per week schedule. KGM coordinates this with both Cal Portland and ITB to verify we do not interfere with their schedule.

KGM looks forward to working with USCG, USACE and Lake Washington stakeholders to assure a safe and successful completion to the SR520 project.

Regards,
Eric

Description: KGM_logo.gifEric Edwards

Marine Assembly Manager | Kiewit/General/Manson, A Joint Venture

SR 520 Evergreen Point Floating Bridge

3015 112th Ave N.E., Suite 100 Bellevue, WA 98004

(p) 425-576-7081 | (c) 510-773-6934

From: Heather.J.St.Pierre@uscg.mil [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Saturday, March 24, 2012 8:07 AM
To: Eric Edwards; Overton, Randall; LaBoy, Anthony ENS
Cc: Monica Blanchard; Jessi Massingale; andy.hoff@kiewit.com; Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com; Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Morning Mr. Edwards,

Thank you for your quick response and additional details. Are there other tugs or companies that are using the facility as moorage? We may follow up with you if we have any questions as the bridge pontoon project becomes more active in the immediate area, and will be so for quite some time, so we appreciate your response and assistance. Best of luck on the project.

Regards,

LCDR Heather St. Pierre
Chief, Waterways Management Div.
USCG Sector Puget Sound
Sent with Good (www.good.com)

-----Original Message-----
From: Eric Edwards [EEdwards@MANSONCONSTRUCTION.COM]
Sent: Friday, March 23, 2012 09:51 PM Eastern Standard Time
To: Overton, Randall; St.Pierre, Heather LCDR; LaBoy, Anthony ENS
Cc: Monica Blanchard (MBlanchard@MansonConstruction.com); Jessi Massingale; andy.hoff@kiewit.com; Frank.Young@kiewit.com; Erik.Nelson@kiewit.com; Ron.Wika@kiewit.com; Robert.Brenner@kiewit.com
Subject: RE: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Evening-

Kiewit- General- Manson (KGM) was conducting operations at our Kenmore dock facility with the Derrick Barge 24 and Tug Nancy M on both Tuesday (3-20-12) and Wednesday (3-21-12). The entrance channel and slip at Kenmore have approximately 14-18ft of water depth. DB24 drafts 7ft and Tug Nancy M drafts 11ft. No grounding or bottom disturbance occurred during the operations.

KGM has been and will continue to coordinating with all the stakeholders in the industrial park who are: Kenmore Air, Cal Portland and Lakeshore Construction to assure we do not block access to the waterway.

I would be happy to discuss this issue in further detail at your convenience. Please don't hesitate to call or write if further information is required.

Kind regards,

Eric Edwards
Marine Assembly Manager | Kiewit/General/Manson, A Joint Venture SR 520
Evergreen Point Floating Bridge
3015 112th Ave N.E., Suite 100 Bellevue, WA 98004
(p) 425-576-7081 | (c) 510-773-6934

-----Original Message-----
From: Monica Blanchard
Sent: Friday, March 23, 2012 5:17 PM
To: Eric Edwards
Subject: Fw: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

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Sent using BlackBerry

Note: This message was sent from my mobile phone.

----- Original Message -----
From: St.Pierre, Heather LCDR [mailto:Heather.J.St.Pierre@uscg.mil]
Sent: Friday, March 23, 2012 05:08 PM
To: Monica Blanchard
Cc: jessi.massingale@floydsnider.com <jessi.massingale@floydsnider.com>; Overton, Randall <Randall.D.Overton@uscg.mil>; LaBoy, Anthony ENS <Anthony.P.Laboy@uscg.mil>
Subject: SR 520 Bridge Project - Tugs and Crane Barge in Kenmore

Good Afternoon,

The USCG (Sector Puget Sound) and USACE received a report today that some citizens were concerned about tugs and crane barges involved in the SR 520 bridge project at the Kenmore Industrial Park. It was reported that tugs and crane barges involved in this project were grounding and disturbing bottom sediments to subsequently refloat the barges. This was believed to have caused shoaling in other nearby areas and impacting other waterway users and the navigability of the surrounding area.

If one of the towing vessels or if a certificated barge has grounded, this information must be reported to the Coast Guard as well.

We ask for your cooperation in working with us as well as the other waterway users in the area. If you have any questions, please let us know.

Regards,

LCDR Heather St. Pierre
Chief, Waterways Management Division
U.S. Coast Guard Sector Puget Sound
1519 Alaskan Way South
Seattle, WA 98134-1192
206-217-6042
heather.j.st.pierre@uscg.mil

-----Original Message-----
From: Elizabeth Mooney [mailto:elizabeth.mooney@comcast.net]
Sent: Thursday, March 29, 2012 11:08 AM
To: Ann Hurst
Cc: <gste461@ecy.wa.gov>; <happyhaze@msn.com>; <patrickeobrien@comcast.net>; <mobr461@ecy.wa.gov>; <cwan461@ecy.wa.gov>; larry.fisher@dfw.wa.gov; Kendall, David R NWS; David Radabaugh; Jeannie Summerhays; Clay Keown
Subject: Re: ERTS Information 632786

Hi all,

Could somebody please help solve this problem- where did the dioxins and PCB's at Harbour Village Marina come from and is the barge's churning up of lake sediment allowed or did it need an HPA from WDFW?

First of all, I observed pre- and post- barge activity on March 21 2012. I have an eye witness to the pre-barge moving event (Patrick Obrien on phone with Greg Stegman) when the people in the small boat were working in the water off the NW point of Kenmore Industrial Site (aka Lakepointe).

I contacted Greg by telephone this morning.

I have an appointment with Gary Sergeant Friday at 2pm.

I would like to call Mr. White. What is his number?

Who is the owner of the barge operation? Who is responsible if there is alleged translocation of lake sediment or contaminants of concern? Who is responsible for cost (of clean up if necessary) IF there has been translocation of contaminants of concern? How does anyone know if there is translocation of lake or stream sediments unless there is a prerequisite for measuring and monitoring? Who is regulating the water quality of these public locations?

Who should meet to talk to work out questions and answers? WSDOT; Pioneer Towing; Kiewit General Manson; ACE; NOAA, WDFW, DNR, City, Citizens? DOH, Harbour Village Marina and HV Condos, Adopt a stream foundation...

Sent from my iPhone

On Mar 29, 2012, at 7:30 AM, Ann Hurst <annmhurst@msn.com> wrote:

The below should read, "one Ecology expert in email mentioned the Navigation Channel as a potential source of PCB and Dioxin contamination at Harbor Village Marina," because of PCB contamination in Navigation Channel in 1996, as I recall.

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From: <mailto:annmhurst@msn.com> annmhurst@msn.com
To: <mailto:gste461@ecy.wa.gov> gste461@ecy.wa.gov
CC: elizabeth.mooney@comcast.net; happyhaze@msn.com; patrickeobrien@comcast.net; mobr461@ecy.wa.gov; <mailto:cwan461@ecy.wa.gov> cwan461@ecy.wa.gov

Subject: RE: ERTS Information 632786
Date: Thu, 29 Mar 2012 06:25:27 -0700

Greg,

I did include the summary of your report at BasinNews.org and will post your document including the letter I wrote on the Documents page soon with WSDOT's response. I did not call Ecology. I wonder who did in addition to Elizabeth. That should be determined. Also, do you have the study of 1996 or 1998 that showed PCB contamination in the Navigation Channel?; one Ecology expert in email mentioned the Navigation Channel as a potential source of PCB and Dioxin contamination at Lakepointe. Janet and I will be looking at Ecology documents this morning and would appreciate not having to dig too deeply for that. Three experts point to three likely sources. I am thinking they all could be correct, that there is more than once source regarding contamination at Harbor Village Marina.

Best, Ann Hurst

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From: "Greg Stegman (ECY)" <GSTE461@ECY.WA.GOV>
To: "elizabeth mooney" <elizabeth.mooney@comcast.net>
Cc: "Maura O'Brien (ECY)" <MOBR461@ECY.WA.GOV>
Sent: Wednesday, March 28, 2012 4:06:28 PM
Subject: ERTS Information 632786

Elizabeth,

Attached is my report regarding my visit to the site on 3/21/12 concerning the barge issue and other issues we discussed. I also have photographs if you are interested.

Greg Stegman
Department of Ecology
Water Quality Program
Northwest Regional Office
425-649-7019

The information about incident number 632786 is attached in PDF format.

Note: You need to have an Adobe Acrobat Reader to read the information.

Classification: UNCLASSIFIED
Caveats: NONE

**O'Brien, Maura (ECY)**

**From:** elizabeth.mooney@comcast.net
**Sent:** Monday, October 29, 2012 8:34 PM
**To:** O'Brien, Maura (ECY)
**Cc:** Elizabeth Mooney
**Subject:** Sediment and Water Sampling Kenmore Comment
**Attachments:** Meador et al. PCBs Duwamish Ecotox 2010.pdf; Meador AqConser 02 PCBs.pdf; ERTS March 21, 2012 tires and water.jpg; barge ERTS 632786 March 21 2012.jpg

Oct 28, 2012

Maura O'Brien
Department of Ecology

Dear Maura,

I realize that we've been talking with the City, Dept of Ecology and the community for years about wishing for a baseline testing of water quality and sediment at the Kenmore Shoreline.

Given the recent high levels of dioxins found at Harbour Village Marina, the barge/tug activities allegedly stirring up sediment in the North Lake Washington area, the migration of federally protected chinook salmon and the outmigration of smolts that hug the shoreline, the attached evidence (Meador) that provides evidence about detrimental effects of contaminants on fish, the PCB's present in fish in Lake Washington (DOH, Hardy et al.), I'd like to ask that you consider, if you can not presently gain permission for lake bottom sediment testing in the area of Calportland and Pioneer Towing for something like the following:

water samples (test for contaminants in the collected water) in addition to turbidity sampling, with those samples to be collected to reflect when turbid water is being caused by tugs/barges, and a background sample or two of the water when it is free of sediment being caused by tugs/barges

I am interested in protecting not only the habitat for fish and other animals, but also the environment for public health. I think it would be helpful to test the sediment by Calportland and Pioneer Towing to rule out any contaminants of concern, but, if they won't allow that testing of the lake bottom, then perhaps it would be possible for DOE to test the water for any contaminants when the barges are stirring up sediment (like that in the ERTS 632786) vs when the barges/tugs are not stirring up sediment in the head of the channel.

I am attaching the photos I took the first time I saw the barges going out of the head of the channel in March 2012 when I observed the very brown water and had seen the contractors measuring the depth of the mouth of the channel at 8:30 am. I am also attaching the articles that address the negative impacts of toxins on fish.

Thank you.

Elizabeth Mooney

Ecotoxicology (2010) 19:141–152
DOI 10.1007/s10646-009-0399-x

# Bioaccumulation of polychlorinated biphenyls in juvenile chinook salmon (*Oncorhynchus tshawytscha*) outmigrating through a contaminated urban estuary: dynamics and application

**James P. Meador · Gina M. Ylitalo · Frank C. Sommers · Daryle T. Boyd**

Accepted: 29 July 2009 / Published online: 14 August 2009


**Abstract** A field study was conducted to examine bioaccumulation of polychlorinated biphenyls (PCBs) for hatchery-raised and naturally reared (wild) ocean-type juvenile chinook salmon outmigrating through the Lower Duwamish Waterway (LDW), a contaminated urban estuary in Seattle, WA, USA. These results show differences in bioaccumulation of PCBs over time and space in this estuary, which may also occur for any contaminant that is distributed heterogeneously in this system. Highly mobile, outmigrating salmon accumulated ~3–5 times more PCBs on the east side of the LDW than fish on the west side, which is supported by an almost identical difference in mean sediment concentrations. The tPCB concentration data suggest that for most of the spring and early summer, juvenile chinook were likely segregated between the east and west side of the LDW, but may have crossed the channel later in the year as larger fish. Additionally, we used biota-sediment accumulation factors to assess the relative degree of bioaccumulation and explore these factors as potential metrics for predicting adverse sediment concentrations. These results highlight the importance of time and space in sampling design for a highly mobile species in a heterogeneous estuary.

J. P. Meador (✉) · F. C. Sommers
Ecotoxicology and Environmental Fish Health Program, Environmental Conservation Division, Northwest Fisheries Science Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112, USA
e-mail: James.meador@noaa.gov

G. M. Ylitalo · D. T. Boyd
Environmental Assessment Program, Environmental Conservation Division, Northwest Fisheries Science Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112, USA

**Keywords** PCBs · Bioaccumulation · Salmon · Spatial segregation · Toxicity guideline value

## Introduction

Even though polychlorinated biphenyls (PCBs) were banned in the United States in 1979, they persist at high concentrations in sediments and aquatic foodwebs. The influx of cleaner sediments over time was expected to accumulate and bury these contaminants below the biologically active zone; however, these compounds still occur at very high concentrations in surface sediment and are biologically available to biota.

The Green River flows northwest from the western flanks of the Cascade Mountains near Mt. Rainier and travels ~150 km to Elliott Bay near downtown Seattle, WA, USA. For the last 19 km the Green River is called the Duwamish River and for the final 9 km it is known as the Lower Duwamish Waterway (LDW; Fig. 1). At river kilometer (rkm) 0 the river splits into the East and West Waterways around Harbor Island for 2 km before entering Elliott Bay. The LDW is a marine-influenced urban estuary that has been the focus of intense studies due to its highly contaminated sediment and water. The average width of the LDW is ~130 m and the water depth ranges from 3 to 20 m; however, most of LDW is maintained at 10 m depth (mean lower low water) by dredging. Even though most of the natural habitat has been severely altered, off-channel areas (e.g., Slip 4 and Kellogg Island) and a narrow shallow-slope intertidal habitat can be found along the waterway where outmigrating salmon likely forage and can be collected.

Past work has documented that sediment and organisms in the LDW are contaminated with PCBs, PAHs,

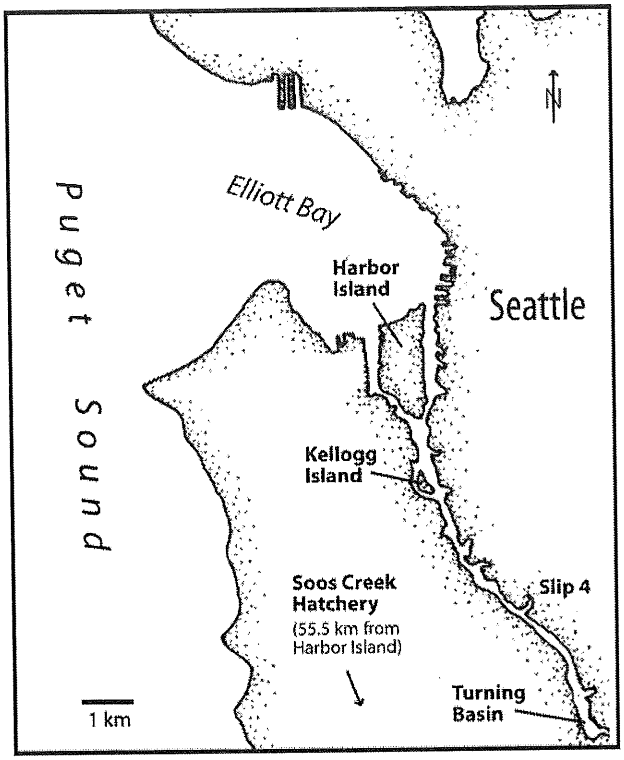


**Fig. 1** Map of the Lower Duwamish Waterway

tributyltin, and other contaminants of concern (Varanasi et al. 1993; LDWG 2007). The entire LDW was listed as a Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 2001 and is currently progressing through the standard superfund remedial process. PCBs have been an important concern in the LDW for several years after they were discovered at high concentrations in sediment at several sites. We focused on PCBs because of elevated concentrations in the LDW, high potential for toxicity to juvenile salmon, low elimination rates in fish, and relative ease of assessing sediment and tissue concentrations.

Several salmonids including chinook (*O. tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), and winter steelhead (*O. mykiss*), are raised in several hatcheries in this watershed and released every year. For most years, ~5–6 million fish have been released annually into the Green River and most of these (≈70%) are age 0+ (subyearling; age 0–1 year) ocean-type chinook (Sieler et al. 2002), which are protected in this watershed under the Endangered Species Act and were the target of our study. Juvenile chinook are released from three hatcheries on this system; however, 80% or more come from the Soos Creek hatchery. Additionally, ~1 million ocean-type chinook naturally rear (wild) in this system and also migrate through the LDW (Sieler et al. 2002). Since 2000, essentially all hatchery chinook released in this watershed have been marked by clipping their adipose fin. Because the error rate (bad clips) is generally low at ~4% (Ruggerone et al. 2006), this procedure has allowed us to distinguish hatchery from naturally reared fish with fairly high confidence. Juvenile salmonids migrate from relatively uncontaminated upstream waters into the Duwamish River and LDW during smoltification where they adjust to seawater, feed on relatively abundant invertebrates, and rear from a few days to several weeks before exiting to open water. The peak migration for age 0+ hatchery fish occurs from late May to mid June and wild fish are found in the Duwamish from mid January through late summer (Ruggerone et al. 2006).

The goal for this study was to examine PCB bioaccumulation in highly mobile, outmigrating juvenile salmon in this estuary, determine total amount accumulated, and examine the application of bioaccumulation factors to predict sediment concentrations that may result in adverse tissue concentrations. Our hypothesis was that juvenile chinook fish would migrate along the west or east bank of the river and reflect the contamination of each region. If fish freely crossed the waterway, the concentrations of PCBs and other contaminants in fish collected at Kellogg Island should be similar to the levels in fish collected at Slip 4. Small outmigrating salmonids tend to stay in shallow areas as they feed and migrate through an estuary (Healey 1991). On average, the west side of the LDW contains substantially lower concentrations of PCBs in sediment than those collected on the east side, which we hypothesized would be reflected in the amount bioaccumulated by the fish collected. Although not in our original design, we were also able to consider some temporal aspects of PCB bioaccumulation for juvenile salmonids because our sample dates spanned 11 weeks over late spring and mid summer.

## Methods

The area of focus for this study is the lower Duwamish River occurring from the turning basin (rkm 7.6) to the confluence of the east and west waterways at the southern tip of Harbor Island (rkm 0; Fig. 1) and constitutes most of the marine influenced section of the Duwamish River. The surface area of intertidal and subtidal sediment in this section of river is ~142 ha (350 acres).

### Fish sampling

Juvenile chinook were sampled from four locations in this river system. For the upstream sites in the Green River, fish were collected from the Soos Creek Hatchery on Big Soos Creek (a few km upstream of the confluence of the Green River and Big Soos Creek at rkm 54.4) for 3 years

(2000–2002) usually before they were released in late May, except in 2002 when fish were sampled from the hatchery on 8 August. Naturally reared fish (wild) were also collected one year (2000) from a screw trap at rkm 55.6, which is upstream from the Soos Creek hatchery and confluence of the Green River and Big Soos Creek. These fish were acquired live from personnel of the Washington Department of Fisheries and Wildlife (WDFW).

On the west side of the LDW, we collected fish at Kellogg Island, which is a semi-natural area off the main channel at rkm 1.3. On the east side we sampled fish at Slip 4 (rkm 4.3), which is a 1.5 ha (3.6 acre) blind inlet off the main channel. Historically, we have observed large numbers of migrating salmon and other fish species at these two locations. We sampled at both LDW sites over 4 years (2000–2002 and 2004). For the year 2000, we sampled fish in late May; ∼5 days after the last group of hatchery fish had been released from the Soos Creek hatchery. For subsequent years, we collected fish at these sites from late June to early August. We also analyzed two composite samples of juvenile coho collected at Slip 4 in 2002 to determine if the values for whole body and stomach concentrations were similar to those found for chinook.

A 100-m beach seine was used in the LDW for sample collections and all fish were kept alive in coolers until processing at our laboratory. Samples were frozen at −80°C until analyzed. Stomach contents were removed from all fish; therefore the whole-body concentrations represent only the PCBs that were assimilated. Whole fish were analyzed as individuals or composite samples, each containing from 3 to 10 individuals. Samples for stomach contents were almost always composites of material from several individuals.

## Analytical determinations for OCs and lipid in tissue

Whole-body fish and stomach content samples were analyzed for organochlorines (OCs), including dioxin-like PCBs, other selected PCB congeners, by a high-performance liquid chromatography/ultraviolet photodiode array (HPLC/PDA) method (Krahn et al. 1994). Sample extractions were split for PCB and lipid analyses. Prior to sample cleanup, a 1 ml portion of each whole-body extract was removed for percent lipid analyses by thin-layer chromatography/flame ionization detection (TLC/FID) (Ylitalo et al. 2005b). Lipid classes were measured by FID, but are not reported here. Percent lipid values were calculated by summing the concentrations of all lipid classes determined for each sample.

A separate study compared the tissue concentrations from sample splits for our HPLC/PDA method (NOAA lab) and those obtained with high resolution gas chromatography/mass spectrometry (GC/MS; Axys Analytical Services LTD, Sidney, British Columbia, Canada). The results for 30 samples (four species, whole body and muscle, range of 5–300 ng/g) indicated close agreement between methods, although 80% of the GC/MS values were higher than those for the HPLC/PDA method (Sandie O'Neill and James West, WDFW, personal communication). The overall mean (SD) percentage difference among all samples was 24 (0.22)%, which is very low. These results are supported by other studies that have shown close agreement for summed PCB concentrations obtained by the HPLC/PDA and GC/MS methods for a wide range of marine biota (Krahn et al. 1994; Ylitalo et al. 2005a).

### *Quality assurance for HPLC/PDA method*

A method blank and a National Institute of Standards and Technology (NIST) blue mussel Standard Reference Material (SRM 1974a or 1974b) sample were analyzed with each sample set containing 8–12 field samples as part of a performance-based quality assurance program (Sloan et al. 2006). Results obtained for SRMs were in excellent agreement with the certified and reference values published for these materials by the National Institute of Standards and Technology. In addition, the other quality control samples met established laboratory criteria. Duplicate analyses were conducted for 10% of the tissue samples, with relative standard deviations ≤30% for more than 80% of analytes detected in the samples. Method blanks contained no more than four analytes that exceeded four times the limit of quantitation (LOQ), unless the analyte was not detected in the associated tissue samples in the set. The percent recovery of the surrogate standard ranged from 70 to 105%.

## Sediment concentrations

A separate study of 326 sediment samples for PCBs in the Duwamish estuary (Industrial Economics 1998) was used to analyze bioaccumulation in fish (Table 1). This study conducted a comprehensive analysis of PCBs in sediment over the entire Lower Duwamish Waterway (142 ha sampled) from the turning basin to rkm 0 that included our fish collection sites. Total organic carbon and PCBs were determined for each sample, which allowed determination of the organic-carbon normalized sediment concentrations ($sed_{oc}$). The same method (HPLC/PDA) for PCB analysis described above for tissue was also used to quantify PCBs for these sediment samples. Of the sediment sites that were examined in detail, tPCBs from the LDW were mostly consistent with the Aroclor 1254 pattern or a mix of Aroclors 1254 and 1260 (>90% of samples).

The waterway was divided into five cross-river sections (intertidal and subtidal for the east and west sides and the navigational channel). The demarcation between the

**Table 1** Concentrations of total polychlorinated biphenyls (tPCBs) in sediment

| Regions and locations | Mean sediment (ng/g sed) | Mean $sed_{oc}$ (μg/g OC) | | Hectares | Sediment (ng/g sed) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean (SD) | Median | | 10th | 25th | 50th | 90th | 95th |
| West side | 150 (20) 113 | 10.6 (1.5) | 5.1 | 54.2 | 7 | 28 | 63 | 337 | 545 |
| East side (to Slip 4) | 500 (150) 95 | 33.5 (9.8) | 7.8 | 22.9 | 6 | 11 | 107 | 1,038 | 1,987 |
| Kellogg Island | 190 (60) 35 | 8.9 (1.8) | 5.3 | 28.9 | 11 | 28 | 69 | 444 | 756 |
| Slip 4 | 1,200 (320) 42 | 88.8 (24.5) | 35.1 | 16.5 | 74 | 190 | 450 | 2,700 | 4,511 |
| East side—Slip 4 to opposite Kellogg Island | 180 (40) 59 | 10.7 (1.6) | 6.5 | 18.6 | 18 | 41 | 87 | 428 | 672 |

Values are mean and standard deviation (SD) for total PCBs in sediment and $sed_{oc}$ (organic carbon (OC) normalized values; μg total PCBs/g OC in sediment). Several percentile values are also shown for each region and location. All values determined with minimum unbiased estimator for a lognormal distribution. Following SD denotes the number of samples per mean value. Data from Industrial Economics (1998)

subtidal areas and the channel was determined from navigation charts (Industrial Economics 1997). Within these major sections, numerous substrata were defined. A total of 90 substrata (nonoverlapping polygons of the sediment surface) were determined for the LDW. Some of the substrata represent discrete areas (e.g., slips, backwaters, noncontinuous intertidal areas, outfalls, and seeps). The overall intent for this sampling scheme was the primary efficiency criterion of stratification designs that concentrations within strata are more homogeneous than concentrations over the entire study area (Industrial Economics 1997).

Sediment sample sites within substrata were determined randomly and spaced less than 100 meters apart. Of the 54 substrata selected for our analysis, the mean (SD) size was 1.42 (1.45) ha. The mean (SD) number of samples for all substrata from that study was 2.2 (1.7) per hectare and no one area was overly represented. Substrata in the navigation channel were not included because we assumed that juvenile chinook would not occur in that area of the LDW or interact with this benthic environment that is frequently disturbed by river flow, tidal flux, and vessels.

To determine the mean $sed_{oc}$ for the west side, all intertidal and subtidal samples from just north of the Turning Basin (rkm 7.6) to the southern tip of Harbor Island (rkm 0) were included. This value was used for the BSAF calculation for salmonids collected at Kellogg Island. Similarly, we choose all intertidal and subtidal sediment samples from just north of the Turning Basin to ~1,000 m north of Slip 4 on the east side for the BSAF equation for chinook collected at Slip 4. One sediment sample in Slip 4 was excluded because it was considered an outlier (Grubbs test, $P < 0.0001$). The tPCBs for this one sample was 25 μg/g, which was 50 times the mean value for all east side samples ($n = 96$) and was therefore not representative of values from this region. This hot spot represented a very small area and its inclusion would likely have skewed the BSAF values and conclusions. We also determined the sediment concentrations at the collection sites. For Kellogg Island, we included all inter- and subtidal sediment data from sampling sites around Kellogg Island and all sites ~1,000 m north and south of the island to calculate the mean $sed_{oc}$. The sediment concentrations for Slip 4 were determined in a similar fashion including all sites in Slip 4 and those inter- and subtidal sites 1,000 m to the north and south of this area.

Most of the PCB sediment contamination occurs on the east side of the LDW in inter- and subtidal areas from the Turning Basin to Slip 4 and is substantially more contaminated than the west side (Industrial Economics 1998). We determined that 56% of the sample sites on the east side contained PCB sediment concentrations >100 ng/g dry wt, which was higher than that for the west side (25%). Because we did not sample fish downstream of Slip 4 on the east side of the river those sediment concentrations were not included. The mean concentration for all sub- and intertidal sediment samples between Slip 4 and Harbor Island (rkm 0) on the east side was determined to be much lower than the upriver portion of the east side and very similar to the mean determined for the entire west side of the LDW (Table 1). This area contained one sample that was 23 times higher than the mean value and 10 times higher than any other concentration. It was determined to be an outlier based on Grubbs test ($P < 0.0001$) and was excluded for the same reasons stated above for the one Slip 4 value. If included, the mean tPCB sediment concentration would be 220 ng/g dry wt. a 25% increase, which was considered an undue influence for one of 60 samples.

Determination of PCB accumulation in the lower Duwamish

We used a mass balance approach to determine the total ng of PCBs accumulated per fish (body burden, bb) collected in the lower Duwamish.

$$PCB_{bb} = tPCB_{ld} \times WT_{ld} - tPCB_{u} \times WT_{u} \quad (1)$$

where $PCB_{bb}$ represents the total ng of PCBs accumulated, $tPCB_x$ denotes the concentration of total PCBs (wet weight), and $WT_x$ is the wet weight for each fish or composite mean sampled. Subscripts for $x$ are as follows: ld denotes fish collected in the Lower Duwamish and u denotes upriver fish (hatchery or wild). For all hatchery fish collected in the LDW we used the hatchery-collected fish for the upriver concentration in Eq. 1 ($tPCB_u$) and for all wild fish collected in the LDW we used the mean concentration of tPCBs measured in wild fish collected from the screw trap in 2000 ($tPCB_u$).

Biota-sediment bioaccumulation factors (BSAFs) were calculated to highlight differences and similarities among species and sites. The following equation was used:

$$BSAF = \frac{[\text{tissue}]/f_{lip}}{[\text{sediment}]/f_{oc}} \quad (2)$$

where $f_{oc}$ is the fraction of organic carbon (g/g dry wt.) and $f_{lip}$ is the fraction of lipid (g/g wet wt). For the collection year 2000, specific site and type (wild or hatchery) lipid concentrations were used. For all other years a mean lipid value of 1.0% was determined from all remaining data and used for the BSAF calculations for chinook.

We assumed that fish had an equal chance of visiting (temporally and spatially) each of the sediment sites that were used for these calculations. We also assumed that each tPCB sediment concentration was proportional to the tPCB concentration for water and prey in the immediate area around the sample and that accumulation was proportional to the OC normalized sediment concentration ($sed_{oc}$). We calculated BSAFs using mean tissue and sediment concentrations, which we believe provided a better estimate of bioaccumulation than median values.

These BSAF values were used to determine a sediment concentration that would be expected to protect outmigrating juvenile salmon from adverse biological effects. This sediment quality guideline was calculated with Eq. 1 by solving for $sed_{oc}$. For these calculations we used a mean whole-body lipid content of 1% wet weight (Table 2) and the 50th percentile for organic carbon (OC), which was 1.6% dry wt for each side of the waterway. We selected the PCB tissue toxicity guideline of 2.4 μg/g lipid for salmonids from Meador et al. (2002) for conversion to sediment values.

### Toxicity equivalents

We calculated the sum of toxic equivalents (ΣTEQs) for dioxin-like (dl) PCBs for each sample. Each TEQ was determined by multiplying a dl PCB concentration with its toxicity equivalent factor (TEF) for fish, which was obtained from van den Berg et al. (1998). Our analytical method quantified the dl-PCB congeners 77, 105, 118, 126, 156, 157, 169, and 189. The other four dl congeners (81, 114, 123, and 167) were not quantified due to problems with coelution by interfering compounds. The TEQ levels calculated in the current study are conservative values because of the higher limits of detection of the HPLC/PDA system compared to the GC/MS method and they do not include the contributions from polychlorinated dibenzodioxins (PCDDs) or dibenzofurans (PCDFs). In addition, when the concentration of a dioxin-like PCB was below the LOQ, a value of zero for the specific congener was used in the calculation, which was more conservative than the commonly used value of one-half the LOQ. These below-detection values were not used because our LOQ was relatively high (0.03–0.4 ng/g wet weight for most samples), which was due to low sample weights (<4 g).

### Statistical analysis

Most of the concentration data reported here were log-normally distributed, which is very common for such data (Gilbert 1987). Because lognormally distributed data are skewed, a minimum variance unbiased (MVU) estimator is more appropriate for computing statistics, such as the mean, variance, and quantiles. We used the MVU estimator algorithms in Gilbert (1987) for estimating the mean, variance, and quantiles (Eqs. 13.1, 13.2, and 13.24) for all log-normally distributed data (TEQs, BSAFs, and whole-body, stomach, and sediment concentrations). This MVU algorithm was not used when sample sizes were <3. We used SYSTAT 11 to construct cumulative distribution functions (CDFs), perform regression analysis, and to examine distributions. Statview 5.0 was used to perform Analysis of Variance (ANOVA) and post-hoc testing. After performing the ANOVA, a post-hoc examination of treatment means was conducted with Fisher's Protected Least Significant Difference (PLSD) test. Log values for concentrations were used for ANOVAs and regressions. We also used Grubbs Test to examine datasets for statistical outliers. Standard deviation is shown to provide a measure of the range in data and standard error of the mean (SEM) was used to indicate variation about the mean.

## Results

### PCBs in salmon

Juvenile chinook from upstream areas (hatchery and screw trap) contained very low levels of tPCBs, except for hatchery fish in 2001 (Table 3). Mean tPCBs concentrations in fish collected from Slip 4 were always higher than those collected at Kellogg Island. Although variability was observed among individuals, it was likely due to a range in time spent in the LDW (Fig. 2). The differences between wild and hatchery fish collected in the LDW were mixed.

**Table 2** Data for salmon collected in the Duwamish River and upstream

| Year | | Type | Wt (g) | Len (mm) | Lipid (%) | BSAF | BSAF median | N {N tot} |
|---|---|---|---|---|---|---|---|---|
| Kellogg Island | | | | | | | | |
| 2000 | May | Chinook W | 4.4 (1.1) | 76.5 (6.8) | 1.6 (0.3) 4c | 0.18 (0.01) | 0.18 | 17 {31} |
| | May | Chinook H | 4.8 (0.2) | 79.7 (0.3) | 1.8 (0.1) 3c | 0.21 (0.02) | 0.21 | 3 {30} |
| 2001 | June | Chinook W | 5.4 (3.0) | 84.5 (18.9) | – | 0.82 (0.53) | 0.47 | 4 {4} |
| 2001 | August | Chinook W | 12.1 (4.3) | 106 (8.9) | – | 0.35 (0.07) | 0.20 | 35 {39} |
| 2001 | June | Chinook H | 6.1 | 85 | – | 0.21 | – | 1 {1} |
| 2001 | August | Chinook H | 12.3 (2.1) | 111 (4.2) | – | 0.89 (0.44) | 0.48 | 6 {6} |
| 2002 | August | Chinook W | 10.7 (5.2) | 100 (12.3) | 1.1 (0.3) 7i | 2.9 (1.3) | 1.4 | 7 {7} |
| | August | Chinook H | 19.7 | 124 | 1.2 1i | 3.9 | – | 1 {1} |
| 2004 | July | Chinook H | 9.8 (1.0) | 102 (2) | 0.9 (0.7) 3c | 1.2 (0) | 1.2 | 3 {9} |
| | July | Chinook W | 11.3 | 107 | 1.9 | 0.8 | – | 1 {3} |
| Slip 4 | | | | | | | | |
| 2000 | May | Chinook H | 4.6 (1.0) | 80.1 (5.6) | 2.0 (0.1) 2c | 0.30 (0.12) | 0.20 | 7 {15} |
| | May | Chinook W | 3.4 (0.1) | 69.5 (0.7) | – | 0.25 (0.3) | – | 2 {2} |
| 2001 | June | Chinook W | 3.5 (0.9) | 72.3 (5.6) | – | 1.1 (0.18) | 1.0 | 12 {12} |
| 2001 | August | Chinook W | 12.7 (4.3) | 107 (11.0) | – | 0.90 (0.6) | 0.36 | 5 {5} |
| 2001 | June | Chinook H | 5.0 (0.08) | 82.7 (1.5) | – | 0.55 (0.16) | 0.50 | 3 {3} |
| 2001 | August | Chinook H | 12.7 (3.3) | 109 (7.3) | – | 0.53 (0.1) | 0.46 | 4 {4} |
| 2002 | August | Chinook W | 7.3 | 8.8 | 0.9 (0.3) 2i | 1.2 | – | 1 |
| | August | Chinook H | 20.5 | 120 | 1.1 1i | 3.8 | – | 1 |
| | August | Coho W | 5.4 (0.7) | 78.8 (4.5) | 1.8 (0.1) 2c | 0.8 (0.1) | – | 2 {7} |
| Soos Creek | | | | | | | | |
| 2000 | – | Wild | 3.9 (0.8) | 73.3 (5.5) | 1.9 (0.4) 2c | – | – | 14 {26} |
| | – | Hatchery | 6.0 | – | 2.2 (0.6) 3i | – | – | – |
| 2001 | – | Hatchery | 2.5 (0.07) | – | – | – | – | 7 {7} |
| 2002 | – | Hatchery | 9.4 (0) | – | 1.6 (1.2) 2i | – | – | 2 {2} |

Values shown as mean and standard deviation and determined with algorithms for lognormal distributions (Gilbert 1987) for all $n \geq 3$. Type (*W* wild; *H* hatchery; *M* mix of both types). *N* is the number of samples for each mean and *n* total is the total number of fish measured for length, weight, PCBs and BSAFs. Sample sizes for lipids shown next to value. "i" indicates individuals and "c" indicates composite values (ci indicates a combination of composite and individual values). Composite samples contained 3–10 individuals

There were no significant differences between hatchery and wild fish collected at Slip 4 for all years combined. Concentrations of tPCBs in the hatchery origin fish collected from Kellogg Island were significantly higher than wild fish ($P = 0.04$) when all years were considered, which was mostly due to a pulse of upriver wild fish with low tPCBs in August 2001.

The tPCB values for the composite samples containing coho salmon were not different than those containing chinook from Slip 4 in 2002. The coho whole-body concentrations were 550 and 440 ng/g, which were lower than the mean value for the two individual chinook (725 ng/g). The stomach contents concentrations for the coho and chinook composite samples (one each) for 2002 from Slip 4 were essentially identical (750 and 770 ng/g), which is reflected in the mean value and low SD.

The temporal aspect of PCB bioaccumulation is also noteworthy. The fish collected in 2000 were sampled in late May, which was ~5 days after the last release of fish from the Soos Creek hatchery. Total PCB concentrations in both wild and hatchery fish for the year 2000 were relatively low compared to the other sampling periods, which occurred later in the summer (Fig. 2). The Kellogg Island fish contained substantially lower concentrations of tPCB than Slip 4 fish for the years 2000 ($P < 0.005$) and 2001 ($P < 0.0001$; Table 3; Fig. 2). For 2002, the differences were far less substantial ($P = 0.12$), which may have been due to larger fish that were able to cross the waterway. The highest tPCB concentrations for Kellogg Island fish occurred in the largest fish collected, which may be the result of an increased ability to cross the waterway from the east side. Excluding all fish with tPCB concentrations <15 ng/g (these were considered background levels), the correlation between fish weight and tPCBs for Kellogg Island fish (all years) was highly significant ($P < 0.001$) with an $r^2 = 0.50$ ($n = 59$). There was no such correlation

**Table 3** Total PCB concentrations in juvenile salmon collected in the Duwamish River and upstream

| | Soos Creek hatchery | Soos Creek wild | Kellogg Island hatch | Kellogg Island wild | Slip 4 hatch | Slip 4 wild |
|---|---|---|---|---|---|---|
| Whole body | | | | | | |
| 24–31 May 2000 | 15 (1.1) 5i | 7.8 (0.8) 14ci | 40 (4) 3c | 30 (1.3) 17 ci | 203 (80) 7ci | 131 (159) 2i |
| 25 June 2001 | 50 (2.4) 7i | – | 24 1i | 94 (56) 4i | 185 (59) 3i | 376 (60) 12i |
| 1 August 2001 | – | – | 94 (47) 6i | 37 (7) 35 ci | 177 (34) 4i | 302 (195) 5i |
| 7–8 August 2002 | 10 (0.1) 2i | – | 445 1i | 302 (151) 7i | 725 (375) 2i M | 495 (78) 2c ¥ |
| 29 July 2004 | – | – | 130 (0) 3c | 180 1c | – | – |

| Stomach contents | Soos hatchery | Soos Creek wild | Kellogg Island mix | Slip 4 mix | Difference |
|---|---|---|---|---|---|
| 2000 | – | 23 1c | 57 (21) 3c | 247 (30) 3c | 4.3 |
| 2001 | – | – | 182 (138) 2c | 445 (360) 2c | 2.4 |
| 2002 | 12 Ø | – | 260 (-) 1c | 760 (14) 2c ¥ | 2.9 |

Values are mean and standard deviation (SD) ng/g. Following SD denotes $n$ observations per mean value; "i" means individuals and "c" means composite values (ci indicates a combination of composite and individual values). Whole-body composite samples contained 3–10 individuals. M is mix for origin and mostly hatchery fish. Stomach contents were removed from these fish and used for separate analysis as composite samples containing 5–30 individuals. Date shows when in-river fish collected. Soos Creek fish (wild and hatchery) collected 18 May to 1 June, except for 2002 (8 August). Chinook in all samples except for ¥, which was two composite samples ($n = 3$ and 4 individuals) of juvenile coho and one comp for stomach contents (770 ng/g). Ø hatchery food. All values as wet weight, except fish food as dry wt (wet wt. equivalent for fish food ≈ 2.7 ng/g)

when all fish from Slip 4 were considered ($P = 0.42$, $r^2 = 0.02$, $n = 36$). Additionally, any whole-body tPCB value over 400 ng/g in fish from Kellogg Island was determined to be a statistical outlier ($P < 0.05$) in Grubbs test, which supports the contention that larger fish (>15 g) collected at Kellogg Island did not accumulate most of their PCBs from the west side of the LDW.

Concentrations of tPCBs in stomach contents of juvenile chinook collected at Kellogg Island and Slip 4 were substantially elevated compared to stomach contents in upriver wild fish and hatchery food (Table 3). These values also show site and year differences that are consistent with those for whole-body tPCBs. An analysis of the ratio for tPCBs in whole-body juvenile chinook and stomach contents (wet weights) for site/year combinations were relatively consistent with a mean (SD) of 0.77 (0.40) $n = 12$.

For the 2001 hatchery fish, we had sufficient data to estimate a likely growth rate. Five fish were sampled from the hatchery (mean (SD) 2.5 (0.1) g) on 7 June 2001 and compared to hatchery fish collected 54 days later at Kellogg Island and Slip 4 in the LDW. The mean weight (SD) for those fish was 13.7 (4.6) g $n = 10$. Based on a simple growth equation the mean growth rate was determined to be 3.2% bw/day (range = 2.6–4.4% bw/day). Fish were released from the hatchery between 18 May and 11 June 2001, therefore these values represent the maximum growth rate. If we assumed that all of the fish collected were from the earliest date (18 May) the mean growth rate would be 2.4%; however, these fish would have been smaller at the time of release.

For each individual fish and composite sample we determined the amount of tPCB that was accumulated in the LDW, which is presented as a percentage increase in total body burden (Fig. 3). This plot shows the general trend of higher bioaccumulation for Slip 4 fish and compared to Kellogg Island fish. All fish exhibited a positive increase in the total amount of PCBs and most increases were substantial. For example, the median increase in total ng of PCBs for all juvenile chinook collected in this study was 11-fold, which is equivalent to a 1,000% increase.

The ΣTEQ values (PCBs only) for all salmonid samples were low exhibiting a mean (SD) of 0.012 (0.024) ng/g lipid. The relationship between tPCBs and ΣTEQs in juvenile salmonids was very strong ($r^2 = 0.90$, $n = 110$) indicating that the concentration of tPCBs is a good predictor for the toxic potential from the dioxin-like congeners (Fig. 4).

## Lipids

Percent lipid content for whole-body juvenile chinook based on wet weight was similar for the years 2001–2004 but higher for the year 2000 (Table 2), which is consistent with the usual pattern of smoltification whereby fish lose lipid content as they transition to seawater (Brett 1995). The mean and SEM was 1.0% (0.1) for 16 individual and composite chinook samples collected over 2001–2004.

## BSAFs

The $P$-values ($n = 6$) for all possible pair combinations for the year 2000 BSAFs from the PLSD multiple comparison test were high ($P > 0.57$) indicating no difference between regions or fish origin for this year (Table 2). The majority

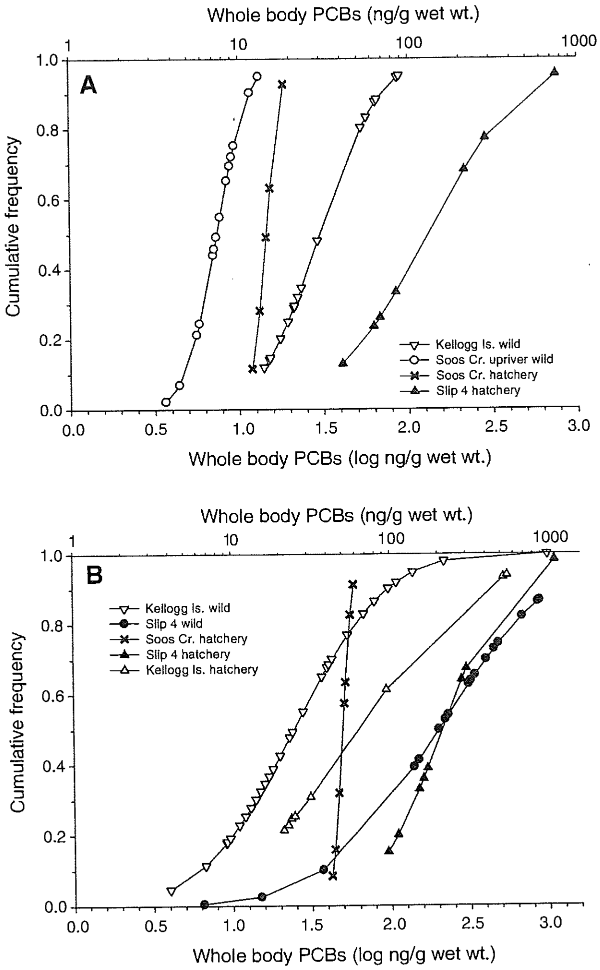


**Fig. 2** Cumulative frequency distribution for total PCBs in juvenile chinook. $Log_{10}$ concentrations are plotted. Upper $x$-axis show arithmetic equivalents. Location and origin (hatchery or wild) shown. **a** Data for the year 2000. **b** Data for the year 2001

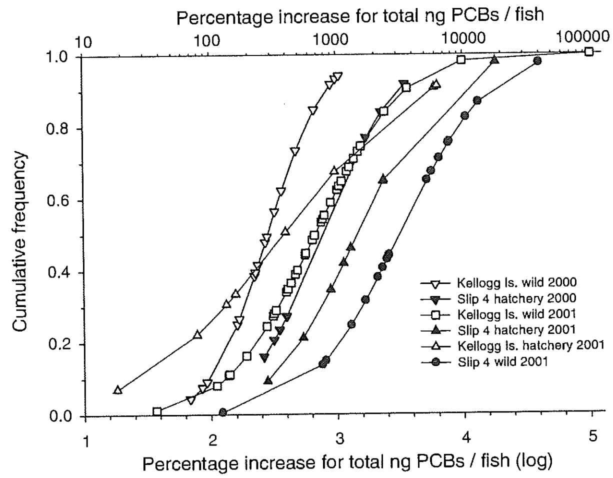


**Fig. 3** Increase in total polychlorinated biphenyls (PCBs) in juvenile chinook. Cumulative frequency plot shows the percent increase in total nanograms of PCB per fish for the years 2000 and 2001. Data are based on individual fish or mean values for composite samples and plotted as $\log_{10}$ values. Arithmetic values shown on top $x$-axis. Location, fish origin (wild or hatchery), and year of collection indicated in legend

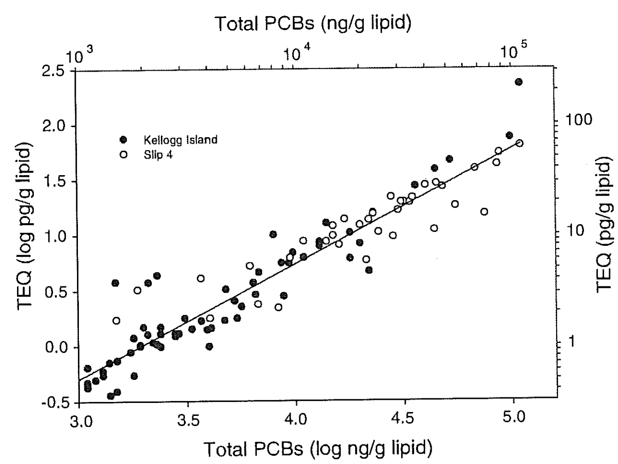


**Fig. 4** Regression of total PCBs and PCB TEQs. Values are $\log_{10}$ total PCB concentrations in whole body juvenile chinook salmon and the sum of toxic equivalent quotients (TEQs) for the dioxin like PCBs. Arithmetic equivalents shown on the upper $x$-axis and right $y$-axis. The equation is $\Sigma TEQ = 3.39 + 1.03{*}tPCBs$, all concentrations as $\log_{10}$ ng/g or pg/g lipid

(74%) of all pairwise comparisons between year 2000 BSAFs and all other years were significantly different ($n = 26$). Fish collected for the years 2001–2004 were collected later in the summer, which provided potentially more time for bioaccumulation and higher BSAFs. Almost all comparisons among 2001–2004 BSAFs returned high $P$-values ($P > 0.1$), except for one low value for Kellogg Island wild fish for 2001.

## Sediment guideline

We calculated the 50th, 90th, and 95th percentile sediment concentration associated with its respective BSAF for a given region for the years 2001–2004 (Table 4). These were calculated for all outmigrating juvenile salmon, except those from the year 2000 because of the short time spent in the lower Duwamish. If the year 2000 samples were included, the percentile values for the BSAFs would change slightly (e.g., 90th percentile, Kellogg Island = 1.4 and Slip 4 = 2.2) from the values presented in Table 4.

# Discussion

## PCBs in tissue

The variability in tPCB concentration in outmigrating juvenile chinook was high over time and space; however, a

**Table 4** Proposed sediment values to protect against adverse effects in the Lower Duwamish Waterway

| Qtile | Fish (tPCBs) | | BSAF | Sediment guideline (tPCBs) | |
|---|---|---|---|---|---|
| | ng/g | μg/g lipid | | μg/g OC | Sed ng/g |
| Kellogg Island/west side ($n = 58$) | | | | | |
| 50th | 39 | 3.9 | 0.36 | 7.1 | 106 |
| 90th | 205 | 20.6 | 1.9 | 1.3 | 20 |
| 95th | 331 | 33.1 | 3.0 | 0.83 | 13 |
| Mean (sd) | 88 (19) | – | 0.81 (0.18) | – | – |
| Slip 4/east side ($n = 26$) | | | | | |
| 50th | 237 | 20.8 | 0.72 | 3.4 | 55 |
| 90th | 789 | 90.7 | 2.4 | 1.0 | 16 |
| 95th | 1111 | 138 | 3.4 | 0.70 | 12 |
| Mean (sd) | 360 (75) | – | 1.1 (0.2) | – | – |

Mean, SD, and various quantile values (Qtiles) determined with equation for lognormal distribution in Gilbert (1987). All fish for a given region over years (except 2000) were combined (years 2001–2004). Equation 2 used to determine $sed_{oc}$ guideline values using BSAF and tissue guideline (2.4 μg/g lipid) for salmonids from Meador et al. (2002). Mean whole-body juvenile chinook lipid was 1% wet weight and 50th percentile for organic carbon (OC) for each side was 1.6% dry wt

few distinct patterns were detected. These data show that fish on the more contaminated east side of the LDW accumulated far higher amounts of tPCBs than those collected on the west side. Even though some benthic areas on the west side of the LDW contain high concentrations of tPCBs, it appears that the overall average concentration for the different sides is the more important metric for determining bioaccumulation in this mobile species. Based on these observations we conclude that the outmigrating fish probably follow the shallow areas of one side of the waterway or the other and are not likely to cross the channel until later in the summer when they achieve a larger size. One study (Ruggerone et al. 2006) sampled the mid channel area of the LDW from December through February 2005 with a purse seine and found no young-of-the-year chinook (~1.5 g individuals) in this habitat.

The concentrations of tPCBs in fish collected in the year 2000 were on average lower (two to tenfold) than for fish sampled in other years. This lower tPCB trend was not apparent for the year 2000 Slip 4 hatchery fish, which was due to due one individual fish out of 15 that comprise the mean. Without that one value, the mean drops 38% (from 203 to 125 ng/g). These lower values for the year 2000 fish may have been due to the relatively short time for exposure due to recent releases from the main hatchery, increased competition for prey items, or a change in the composition of their prey. The low tPCB concentrations in hatchery fish for the year 2000 may have been caused by the limited time these fish were in the LDW; however, this does not explain the lower values for wild fish, which may have been in the system longer. A plausible explanation for these differences is the expected high degree of competition for prey items among all fish during peak migration of the hatchery fish, which is supported by the lower concentrations for stomach contents for the year 2000 fish. The large release of hatchery fish and subsequent potential competitive interactions among these fish in the Duwamish for scarce resources has been proposed by Nelson et al. (2004) and Ruggerone and Jeanes (2004). This peak in abundance is relatively short-lived because most of the hatchery fish spend little time in this estuary (Nelson et al. 2004).

The low values for 2001 (August) Kellogg Island wild fish were considered atypical due to a number of large fish with near background concentrations. Based on this observation it appears that some juvenile salmon may reside upriver for extended periods before migrating into the contaminated lower estuary. This was observed by Nelson et al. (2004) for both wild and hatchery fish collected at rkm 21 in late June. Interestingly, the percentage of wild fish with low tPCBs (<25 ng/g) for both sampling dates (June and August) at Kellogg Island was far higher (58%) than what we observed at Slip 4 (13%), indicating that these newly arrived fish likely migrated down the west side of the waterway or spent very little time in the LDW before collection at Kellogg Island.

Wild fish are present in the Duwamish as early as January (Ruggerone et al. 2006; Nelson et al. 2004) and show two peaks in abundance, late February/early March for the fry migrants and late May for the fingerlings (Nelson et al. 2004). Based on these data, it is possible that wild chinook may spend several weeks in contaminated areas of the Duwamish accumulating PCBs. As discussed by Thorpe (1994), residence time in an estuary for juvenile chinook is variable and generally a function of season, fish size, and type of estuary; however, 30–90 days is not unusual.

All juvenile chinook increased their total PCB load as they outmigrated through the Lower Duwamish Waterway. As tPCB concentrations increased, fish also increased in mass, which resulted in very high percentage increases in total PCB burden. Juvenile chinook in an estuary are capable of growing at rates of 3–5% body weight/day (Brett 1995; Healey 1991), which is consistent with our observed growth rates of ~3.2% bw/day for the 2001 fish and one study conducted in the LDW (Cordell et al. 2006). This very high rate of growth is due to a feeding rate of 12–20% body weight per day (Brett 1995), which is an important factor because these fish are likely accumulating contaminants at a high rate as a consequence of their high ingestion rate. The rate of prey consumption is an important kinetic parameter for any food web or bioaccumulation model.

One interesting observation is the percentage occurrence of wild versus hatchery fish in our collections. For the year 2000 the percentage of wild fish was 38%, which was most likely related to the recent releases of hatchery fish into the system. For the succeeding years, the percent occurrence of wild fish was far higher averaging 62%, including 1 year (2001) that averaged 83% wild fish. Studies have shown that hatchery reared fish will spend less time in the estuary than naturally reared fish (Levings et al. 1986), which is apparent from these data. This observation is important because we are more concerned with impacts to wild fish, including chinook salmon, under the Endangered Species Act than fish of hatchery origin. Due to the higher percentage of wild fish during the summer months and the higher levels of bioaccumulation observed for these fish compared to those earlier in the spring, the main focus should be on this group of fish that have spent several weeks in the estuary accumulating high levels of toxic compounds.

It is difficult to predict habitat usage by highly mobile, outmigrating juvenile chinook; however, we expected that a large percentage of fish would stay close to shore because of the generally higher abundance of prey and protection from predators. We believe that the higher tissue concentrations and relatively similar BSAFs for fish from the east versus west side of the waterway support this assumption of segregation within this system and indicate the need to consider appropriate geographic scales for bioaccumulation assessment for this (or any) fish species.

We found a very high correlation ($r^2 = 0.90$) between total PCBs and PCB TEQ values that could be used for predictions of toxicity. A few fish were elevated (PCB TEQ > 0.05 ng/g lipid); however, most were below the mean 95th percentile species protection benchmark for lethal effects (0.39 ng/g lipid) proposed by Steevens et al. (2005). When other dioxin-like compounds are considered, chinook at this life stage, and other species in the LDW, may exhibit TEQ values that are high enough to elicit toxic responses. It is known that dioxin-like compounds can impair the immune system, inhibit growth, cause thymic atrophy, and act as endocrine disruptors (Giesy and Kannan 1998), each an important function for estuarine fish.

BSAFs

As expected, the BSAFs for the year 2000 were generally lower because fish were collected in the spring, which is likely due to a short time period for accumulation, type of prey items available, or competition leading to reduced dietary uptake. For the other years, some of the juvenile chinook samples exhibited BSAF values that were surprisingly high. Based on their growth rate, juvenile chinook likely have a high rate of dietary accumulation and therefore would accumulate high tissue concentrations relatively rapidly. It is possible for these fish to exhibit high levels of accumulation and relatively high BSAFs after several days to a few weeks in the LDW. Additionally, salmonids have a high rate of ventilation, therefore uptake from the water column via the gills could be an important pathway for contaminant accumulation (Meador et al. 2008). The relative similarity for chinook BSAFs between the two regions for a given year (Tables 2, 4) and the high $P$-values between matched Kellogg Island and Slip 4 samples indicates that our selection of sediment concentrations for the BSAF calculations was appropriate for this species. This is also supported by the data in Table 4. If we had selected the sediment concentration at the collection sites, the tPCB tissue concentrations should have be tenfold higher in fish from the east side of the LDW compared to those from the west side. Additionally, using those $Sed_{oc}$ values (8.9 and 88 μg/g OC) would have produced highly skewed BSAF values. Given the expected similar rates of ingestion and ventilation for these fish, plus a similar time frame for exposure, the BSAF values between the two sides of the LDW were expected to be similar.

Our intent was not to use BSAFs as an indicator of steady-state bioaccumulation or the theoretical bioaccumulation potential, but to allow for interconversion between tissue and sediment concentrations with the lowest achievable variance. The mean and various quantiles for the chinook BSAFs for both regions were relatively similar and varied by less than a factor of two, which was considerably less than the variability observed for whole-body tPCBs. We believe that many of these fish are far from steady state and that the rates of uptake (dietary and ventilatory) are the main factors controlling the levels of whole-body PCBs. For bioaccumulation, organismal lipid content is an important factor only for individuals at steady state and for chemicals that are not metabolized. While the numerator of the BSAF equation (lipid-normalized tissue concentrations) may not be an accurate indicator of bioaccumulation for fish in this study, we do consider the denominator ($sed_{oc}$) to be a reasonable indicator of the bioavailable fraction from all sources available for uptake, which is primarily water and prey.

Determining a sediment guideline based on bioaccumulation

The determination of sediment concentrations that may result in adverse tissue concentrations can be accomplished with BSAF values (Meador 2006). For example, Meador et al. (2002) proposed that a tissue concentration of 2.4 μg tPCBs/g lipid was a protective tissue quality guideline (TQG) for salmonids. This TQG describes the 10th percentile of a variety of adverse biological responses for non-embryonic salmonids (fry to adult) that was compiled from several research studies. Using the BSAF (Eq. 2) and the TQG, we can solve for a sediment concentrations that should be protective against adverse effects. By examining the distribution of BSAF values observed in this study, we were able to determine sediment concentrations that could be used to protect a given percentage of the individuals. The values we provide in Table 4 would allow regulators to select appropriate percentile values that would be used to protect a given percentage of the population of outmigrant chinook salmon. For example, if the 90th percentile BSAF value was selected for chinook in the LDW, the sediment value to protect fish from bioaccumulating an adverse tissue concentration ($\geq$2.4 μg/g lipid) would be 1.0 μg/g OC. The vast majority of juvenile chinook are from hatcheries and these fish move quickly through this estuary; however, it is the naturally reared juvenile chinook salmon that can spend considerable time in this system and likely accumulate high concentrations of PCBs and other contaminants that justifies this high percentage value.

The data we present here are just one example describing this application. Of course, several factors affect bioaccumulation and the BSAF, such as variable uptake and elimination rates, reduced bioavailability, reduced exposure, and insufficient time for sediment-water partitioning or tissue steady state. Because of these differences in bioaccumulation, a BSAF that is specific for a given estuary and species is recommended for a more accurate representation of bioaccumulation as a function of the above factors. Lipid content is also an important factor. Even though organismal lipid likely had little effect on the magnitude of bioaccumulation of PCBs for these fish (e.g., Stow et al. 1996), we believe that tissue lipids will be a factor in determining the toxic response. As proposed elsewhere (Lassiter and Hallam 1990), the lipid content of tissue controls the proportional availability of accumulated hydrophobic toxicants and therefore the magnitude of the toxic response, which is a factor we considered when developing the tPCB TQG for salmonids (Meador et al. 2002).

It is clear from these data that bioaccumulation of PCBs for a given area and time is highly variable. This is strong support for the importance of extensively sampling a given area at various locations and times to adequately characterize bioaccumulation, especially when considering population responses. These recommendations for other small estuaries include sampling in several locations, taking multiple samples over a species' potential residence time, and using a probabilistic approach for characterizing tissue concentrations that may lead to adverse effects. Obviously, a few composite samples from one or two randomly selected locations at one time period would severely underestimate the bioaccumulation potential for juvenile salmon as they rear in an estuary to accumulate mass and lipid stores before their first winter in open water. Additionally, these data indicate the importance of reducing sediment concentrations to effect reduced tissue concentrations to levels that are expected to be safe for fish and their prey. Assessing bioaccumulation in an iterative fashion after multiple rounds of sediment cleanup will provide needed information that remediation efforts are effective.

**Acknowledgments** We thank Sean Sol, Maryjean Willis, Mark Myers, O. Paul Olson, Gladys Yanagida, Dan Lomax, and Bernadita Anulacion for assistance with field collections, sample preparation, and analytical analyses. Jay Field and Lyndal Johnson provided several insightful comments on this manuscript.

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Comment # 12

**O'Brien, Maura (ECY)**

| | |
|---|---|
| **From:** | elizabeth.mooney@comcast.net |
| **Sent:** | Monday, October 29, 2012 9:18 PM |
| **To:** | O'Brien, Maura (ECY) |
| **Cc:** | Ann Hurst; Janet and Bob Hays; Elizabeth Mooney |
| **Subject:** | Kenmore Sediment and Water Characterization SAP 10-12-12 Comment |
| **Attachments:** | rob k wharf calportland 1.jpg; Dioxin WA State source Assess-1-1.pdf; Meador et al. PCBs Duwamish Ecotox 2010.pdf; Meador AqConser 02 PCBs.pdf; rob k calportland wharf 2.jpg; rob k wharf calportland 1.jpg |

October 28, 2012

Maura O'Brien
Department of Ecology

Dear Maura,

I believe that, in addition to your plans for the Kenmore Sediment and Water Characterization SAP 10-12-12:

**DOE should force Calportland, Pioneer Towing, etc. to allow sediments on their property to be tested because there is reasonable cause to suspect they are contaminated and, furthermore, may be the source of contamination. The potential risk to public health necessitates prompt action.**

You have enough evidence and I hope you could find more money from your agency or other state agencies, such as WADOT, to fund further testing. I am attaching evidence that contaminants probably are causing there to be a "take" during chinook fall migration up the Sammamish River (Cottage Lake wild population), that PCB's (found at Pioneer Towing and present in fish in Lake Washington) can cause harm to those fish, that Ecology is aware that cement is associated with dioxins (Dioxin WA State Assessment), that barges caused illegal turbidity in the head of the channel in the area of the Kenmore Navigation Channel AFTER I had warned Mr. John White that his project (SR 520 anchor/deck) should have an HPA BEFORE they translocated sediments. Mr. White said to me, "But, they (Calportland) have been barging."

My point, Maura, is that they (Calportland) has been barging and WSDOT knew it and they shouldn't have been barging and churning up sediment at the bottom of the lake for years without proper permits, but they were and now I would deeply appreciate it if DOE could persuade them of the need to test. I do understand that the process is going to take some time to solve, but it would help to have cooperation from all parties for testing.

I have a Master's Degree in Fisheries from UW, a BA in Philosophy from Pomona College and I'm President of PERK, People for an Environmentally Responsible Kenmore, and I served on the Citizens Advisory Committee for the Kenmore Shoreline Master Plan Update. Please respect my opinion as not only an academic, a mother, but also as a scientist who discovered, by myself, without your agency's full disclosure, the presence of high levels of dioxins at Harbour Village Marina. There was an ERTS call from DNR to DOE in Oct 2011, but your agency didn't disclose it, and yet your agency allowed this SR 520 project to proceed. I know our former city manager contributed to the project happening in Kenmore. Enough is enough. We see the project will proceed, but please test the area where there is strong reason to believe there may be a source of the PCB or dioxin contaminants, by Calporltand and the KIP site, in the sediments or when the barges/tugs are churning up the sediment. The DOE document I've attached has a section about how a cement facility may be associated with dioxins.

If the companies will not allow testing, then why should their barging be allowed if there is evidence of translocation of sediment in Lake Washington?

I am including two recent (last few months) photos taken by our new city manager showing evidence of the burned wharf at Calportland. My understanding is that burning may produce dioxins. Isn't it critical to test in this area? Would lack of testing here constitute a data gap in the study, and potentially call into question the entire integrity of the Kenmore Sediment and Water Characterization SAP analysis/testing plan-project?

Please amend the Sampling plan, if possible, to test in front of Calportland. There are other reasons I think this is important.

Calportland received special Shoreline Master Plan perks to change wording to their benefit, not the public's, in my opinion. My colleagues and I do not approve of the changes Calportland proposed, city approved and Dept of Ecology approved. I informed the city of dioxins that DOE already had learned about from DNR. The barging may impact our public health and ecology. The only way I can believe our public can be protected from possible dioxin contamination by turbidity from ongoing increased barge/tug alleged illegal turbidity and translocation of contaminants is by Dept of Ecology succeeding in convincing the companies that testing the sediments under water (shorelands) and/or water (during tug/barge activity) beside Calportland is a good idea. From these photos, you can see Calportland's "head of the channel"s sediments" might harbor a possible source of dioxins. If so, these contaminants may cause harm to federally protected species and human health. It would be stronger study if you could find a way to include Calportland's inner head of the channel in the testing.

Since the wharf was burned, since there are high dioxins at Harbour Village Marina, since the city is spending $100,000 dollars to test for a very coarse evaluation, and since the translocation of sediments under water continues with barge activity, please do your best for the citizens of Kenmore to persuade the big companies to allow your testing? You are the best person who can find a way to test. If the companies won't let your agency test, can you suggest the city recommend the companies stop barging until they do so?

Since water quality is DOE's responsibility and since WSDOT's project must follow the laws, and since it appears that the barges/tugs cause violation of water quality laws, if barging continues, then it would be great if testing where translocation occurs/occurred, should take place.

We don't want to risk waste of public money nor public health. This waterway appears to have been affected by translocation of sediment. So, here is evidence of fire on the wharf that DOE and the City of Kenmore told Calportland they would be able to expand (Dave Radabaugh and Jeff Talent?). I hope DOE could coordinate and achieve testing of sediment under water at Calportland/Pioneer Towing in the "head of the channel" where the burned wharf (possible source of dioxin) exists.

May you expand the testing to include the testing by Calportland since I believe there has been translocation of sediment in Lake Washington (my ERTS # 632786 March 2012)? The KGM and WSDOT operators should have acquired an HPA because it appears that there has been movement of bottom sediments. I asked WADOT to factor in that their barge activities would likely translocated sediments on the lake bottom and that it would require an HPA. They decided not to factor that into their SR 520 project, something I believe was not the right thing to do.

I have spoken to my friend Ann Hurst and she adds:
*Often the tugs cannot turn the barges South without the tugs leaving the Kenmore Navigation Channel and gunning it next to Harbour Village Marina. The barges are too large and cumbersome for the design of the channel. The City told WSDOT that the barges would fit in the channel, WSDOT was told by Kiewitt/General/Manson that there would only be one barge per day and neither of those assertions were correct . Ecology, the State, has plenty of leverage to stop the barge traffic, and Ecology, then, to test the shore lands of Cal Portland and the Pioneer Towing Land. The Governor might even join in with Ecology to assert testing on those shore lands as she is plenty upset about the cracks in the pontoons K/G/M transported from Aberdeen. Even so, apparently, it is far easier to follow Water Quality Act barging from Aberdeen. There is precedent for Ecology to require the private companies pay for the testing.*

Elizabeth Mooney
Sent from my iPhone

Begin forwarded message:

> **From:** Rob Karlinsey <rKarlinsey@kenmorewa.gov>
> **Date:** October 29, 2012 10:34:08 AM PDT
> **To:** Elizabeth Mooney <elizabeth.mooney@comcast.net>
> **Subject: RE: photo**
>
> Sorry I left before I saw your email. Here you go. From a distance these pilings look like they're just covered in dark creosote, but when you get up close, you can tell that a lot of it is charred from a fire.

**From:** elizabeth.mooney@comcast.net [mailto:elizabeth.mooney@comcast.net]
**Sent:** Saturday, October 27, 2012 11:38 AM
**To:** Rob Karlinsey
**Subject:** photo

Rob
If you have that photo, that'd be grand to have for tomorrow.
Thanks
Elizabeth

Comment # 13

## O'Brien, Maura (ECY)

**From:** Mamie Bolender [mamiejb@hotmail.com]
**Sent:** Monday, October 29, 2012 10:55 PM
**To:** O'Brien, Maura (ECY)
**Subject:** Need for testing for dioxins at Kenmore/Lake Forest Park

Maura O'Brien
Washington State Department of Ecology

Dear Ms. O'Brien,

There is sufficient evidence that Dioxins are present to some eignificant degree in the waters off Kenmore which are being plied by barges which are disturbing the sediment of the region and causing these sediments and any toxins therein to be churned up and suspended in the water. These released sediments are being set free to float along and onto all the shores of North Lake Washington and beyond, contaminating the swimming beaches of Kenmore and Lake Forest Park and beyond. Dioxins are, inarguably, extremely toxic and detrimental to the health of our children and all who use these beaches for swimming and playing, but mostly the children. Unaware of this unseen danger, parents are allowing hundreds of children to be exposed to this hazard.

Extended testing must be done, and done soon, of the sediments along the north end of Lake Washington to determine the extent of migration of these sediments and the dangerous dioxins they contain.

Please cause this important testing to happen. The health of many children is at stake. This is a personal plea.

Respectfully submitted,

Mamie Bolender, mother, grandmother and co-president of the Lake Forest Park Stewardship Foundation

Comment #14

Sept 29, 2012
10:54

Dear Maura,

As you know I have worked diligently on keeping the waters of the State (Lake Washington and the Sammamish River) for 5 years. I am not paid to do this and I do not have the credentials or the responsibility of your job. But some how I have chosen to invest my time and energy on ~~righting~~ documenting ~~the wrong~~ what I see occurring daily on the property called Kenmore Industrial Park since 2007. In that time I have made it my business to take pictures at least ~~one~~ a few pictures everyday that I have witnessed tug and barge after tug and barge come in and out. I have witnessed Gary Sergeant's lessees paint, weld, pump bilges into the lake, burn palates on the shoreline and Glacier cement front load all their waste water from ~~those~~ cement trucks and surface water right into the lake directly into the head of the chanel. I have document 3 years of Waterfront Construction fueling over the water from fuel trucks the equipment on

2

LakeShore Marine Construction park large fishing boats out over the water.

I have sent you many pictures of these violations, when we brought the Clean water suit against Waterfront Construction. It was because you and the understaffed DOE did not enforce or question the owners of the property you just accepted their lies as facts. Waterfront Construction did not even have an NPDES permit when I began reporting to you what I was seeing and documenting. In fact as you said at a Kenmore Master Plan Commission (Sept 21 2009) meeting that the monitoring of the ground water was never done for 8 years even though the consent decree stated your agency (DOE) was to oversee and enforce monitoring twice a year in wet and dry season. This did not occur until 2009 a gap of 8 years. Your explanation to the commission was it fell through the cracks.

Now we have watched as barges and tugs (still the same not BIG

[illegible]

~~the~~ from the wharf you cannot test in front of because it is private property.

This wharf & the Cal Portland pier are being used as it is the only point of egress and ingress for this activity. The amount of sand and gravel barges has increased from 2 a week to 2 or three a day. The barge-tugs from Kiewit are not one per week, they are daily up to 16 loads when hauling barges filled with cement trucks. They continue to traverse out of the head of the channel ~~to hug the~~ out side of the buoys marking the channels width and boundarys hugging the shoreline directly in front of the North shore (chip Davidsons Marina) and then make a sharp turn and gun their cargo either south or further west to docking stations. I have stood at the Kenmore air pier and Harbor Village pier taking pictures of the water which is so filled with sediment you cannot see 6 inches into it.

~~Please~~ I do not understand how Cal Portland / Glacier / Fuyo - and

can be allowed to ~~move~~ opt out of this sediment
~~with out~~ testing. Given the
amount of dioxins found at Harbor
Village. And the readings clearly
showed it get worse the closer it is
to the head of this channel.

Please consider this in a revision
to test as close as you can get to this
private head of the channel.

My concern is for my community
and the environmental health not commerce
as our Shoreline Master Plan's
wording was changed from commercial to
manufacturing. We the community are now finding
out why. ~~It~~ is no longer able to
recover from the sediments being shifted
from the east end of the channel to the the
docking stations even to ~~zig zagged to~~
zig zagging and manuevers they have
been doing to widen the channel and
dredge it them selves with these big
barges and tugs). No one is hearing us
not because it isn't happening but
because these property owners don't want
to know.

Thank You

P.S. Sorry this is hand written [illegible] failing

5

P.S. I am not a scientist. this is from my heart and what I have witnessed, photographed and documented daily.

Thank you
Janet

Comment #15

**O'Brien, Maura (ECY)**

**From:** Jim Halliday [jimh@clearwire.net]
**Sent:** Tuesday, October 30, 2012 9:23 AM
**To:** O'Brien, Maura (ECY)
**Subject:** Sediment testing

Dear Ms. O'brien - I feel future liability risks should require DOE to force Calportland, Pioneer Towing, etc. to allow sediments on their property to be tested because there is reasonable cause to suspect they are contaminated and, furthermore, may be the source of contamination. The potential risk to public health necessitates prompt action.

Jim

Jim Halliday
206-365-1813
jimh@clearwire.net

*Co-chair* - Lake Forest Park StreamKeepers
*Board member* - Lake Forest Park Stewardship Foundation
*LFP Liaison* - People for an Environmentally Responsible Kenmore (PERK)
*Board member* - Sno-King Watershed Council

# Ecology Evaluation Report

# Appendix C

# Anchor QEA, Sampling and Analysis Results Memorandum for Kenmore Sediment and Water Characterization

March 2013

# SAMPLING AND ANALYSIS RESULTS MEMORANDUM KENMORE SEDIMENT AND WATER CHARACTERIZATION

**Prepared for**

Washington State Department of Ecology
Dredged Material Management Program
Washington State Department of Health

**On Behalf of**

City of Kenmore
18120 68th Avenue NE
Kenmore, Washington 98028

**Prepared by**

Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

**March 2013**

# SAMPLING AND ANALYSIS RESULTS MEMORANDUM
# KENMORE SEDIMENT AND WATER CHARACTERIZATION

**Prepared for**

Washington State Department of Ecology

Dredged Material Management Program

Washington State Department of Health

**On Behalf of**

City of Kenmore

18120 68th Avenue NE

Kenmore, Washington 98028

**Prepared by**

Anchor QEA, LLC

720 Olive Way, Suite 1900

Seattle, Washington 98101

**March 2013**

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## LIST OF ACRONYMS AND ABBREVIATIONS

| Abbreviation | Definition |
|---|---|
| °C | degrees Celsius |
| µg/kg | micrograms per kilogram |
| ARI | Analytical Resources, Inc. |
| BEACH | Beach Environmental Assessment, Communication and Health |
| City | City of Kenmore |
| cm | centimeter |
| DGPS | differential global positioning system |
| dioxin/furan TEQ | total dioxin and furan toxic equivalency |
| DMMO | Dredged Material Management Office |
| DMMP | Dredged Material Management Program |
| DO | dissolved oxygen |
| DOH | Washington State Department of Health |
| DVR | Data Validation Report |
| Ecology | Washington State Department of Ecology |
| J | sample results qualified as "estimated" |
| KIP | Kenmore Industrial Park |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| LDC | Laboratory Data Consultants |
| ML | DMMP Maximum Level |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MTCA | Model Toxics Control Act |
| ng/kg | nanograms per kilogram or parts per trillion |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PCP | pentachlorophenol |
| PSEP | Puget Sound Estuary Program |
| QA | quality assurance |
| Results Memorandum | Sampling and Analysis Results Memorandum |
| SAP | *Sampling and Analysis Plan; Kenmore Area Sediment and Water Characterization* |

| Abbreviation | Definition |
|---|---|
| SAPA | *Sediment Sampling Analysis Plan Appendix* |
| SL | DMMP Screening Level |
| SL1 | interim freshwater Screening Level 1 |
| SL2 | interim freshwater Screening Level 2 |
| SQV | Sediment Quality Value |
| SVOC | Semi-volatile organic compound |
| TBT | tributyltin |
| TEQ | toxic equivalency |
| TOC | total organic carbon |
| TSS | total suspended solids |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |
| WDFW | Washington Department of Fish and Wildlife |

# 1 INTRODUCTION

This Sampling and Analysis Results Memorandum (Results Memorandum) summarizes the results of the sediment and water characterization conducted in the northeastern portion of Lake Washington in and near the City of Kenmore (City). Anchor QEA, LLC (Anchor QEA), prepared this memorandum on behalf of the City, in partnership with the Washington State Department of Ecology (Ecology), and in accordance with the procedures described in the Ecology-approved *Sampling and Analysis Plan; Kenmore Area Sediment and Water Characterization* (SAP) (Anchor QEA 2012).

The characterization effort supports a number of objectives for the City and Ecology. First, the characterization is intended to support the City's ongoing work with the U.S. Army Corps of Engineers (USACE) to support a request for funding in the USACE budget for maintenance dredging of the federal Kenmore Navigation Channel (Figure 1). Second, with financial assistance from Ecology's Clean Sites Initiative fund, the City and Ecology are conducting additional characterization activities to evaluate the potential presence of chemicals of concern along the shoreline. The characterization has been designed to support Ecology's Model Toxics Control Act (MTCA) cleanup action requirements, as well as the Health Consultations to be developed by Washington State Department of Health (DOH). Health Consultations are anticipated to be prepared by DOH for public health, safety, and environmental concerns in human-use areas along Log Boom Park, at the Washington Department of Fish and Wildlife (WDFW) public motor boat launch along the Sammamish River, and Kenmore Industrial Park (KIP; also known as Lakepointe). Additionally, at the request of the City of Lake Forest Park, two sediment samples were collected along the northwestern shoreline of Lake Washington adjacent to Lyon Creek Park.


ANCHOR QEA

**NOTE:**
WDFW = Washington State Department of Fish and Wildlife

**Figure 1**
Sample Locations
Sampling and Analysis Results Memorandum
Kenmore Sediment Characterization

## 1.1 Kenmore Navigation Channel Screening Level Characterization

The Kenmore Navigation Channel (Figure 1) was constructed in 1981, as a USACE project authorized in Section 107 of the 1960 River and Harbors Act, to a depth of 15 feet below lake level. The Kenmore Navigation Channel is approximately 100 to 120 feet wide and 2,900 feet long, and primarily serves barge and other marine traffic for industrial and commercial uses. The Kenmore Navigation Channel was last sampled in 1996 for dredge characterization, dredged in 1997, and last surveyed in 2010, which showed areas shallower than 15 feet below lake level. The most recent maintenance dredging of the Kenmore Navigation Channel was prior to the City's 1998 incorporation. Currently, King County is the Local Sponsor Authority for the Kenmore Navigation Channel and the Sammamish River Small Boat Navigation Channel. The City, King County, and the USACE are presently exploring the possible transfer of the Local Sponsor Authority for the Kenmore Navigation Channel to the City. The USACE estimates that maintenance dredging would require removal of 31,700 cubic yards of sediment within the channel.

The Dredged Material Management Office (DMMO) at the USACE has indicated that a screening level characterization will provide information about potential options for disposal of dredged sediment. According to Dredged Material Management Program (DMMP) protocols, a full sediment characterization would provide information to determine if sediment is suitable for unconfined open-water disposal. However, these characterization results are only valid for 2 years in areas ranked "High" by DMMP, which includes the Kenmore Navigation Channel. Acquisition of funding and completion of maintenance dredging is not likely to occur within 2 years of the commencement date of this project. Given the timing of the maintenance dredging, the DMMO agreed that it made sense for the City to conduct a screening level assessment to provide information to support pursuing federal funding for maintenance dredging. The DMMO also agreed that the timing for a full DMMP characterization effort should be within 2 years of the anticipated maintenance dredging event.

The owners of the North Lake Marina are also participating parties in the sediment characterization efforts to assess the options for sediment disposal in the event that maintenance dredging is conducted within the marina. The marina owners are interested in privately funding the dredging of the marina, in conjunction with the dredging of the

Kenmore Navigation Channel, to save money and share costs (e.g., dredge equipment mobilization fees) with the USACE.

Any future proposed dredging plans for Kenmore Navigation Channel, Harbour Village Marina, or North Lake Marina will be determined by each party based on navigational needs, cost, and other considerations. A summary of previous sediment characterization and dredging is provided in the SAP (Anchor QEA 2012).

## 1.2 Additional Nearshore Sediment and Surface Water Characterization

The City and Ecology requested additional characterization activities to evaluate the current condition of nearshore sediment and surface water in the Kenmore area waterfront. The purpose of the additional characterization activities is to determine sediment and water quality and possible health and environmental risks. This information will provide a better understand whether potential contamination is present in sediment and surface water. The surface water and sediment results are intended to be used by Ecology for characterization activities to evaluate the presence and concentration of chemicals and possible contamination in the lake and river waterfront areas, as well as to continue the MTCA evaluation of nearshore sediments. The results will also be used to support the Health Consultations in the vicinity of Log Boom Park and adjacent to KIP that will be developed by DOH. Ecology will determine if additional testing will be required to further characterize potential sources of contamination.

## 1.3 Sediment Investigation Overview

This section provides a brief overview of the sediment investigation conducted in November 2012. Specific sampling and analysis protocols for the sediment sampling activities, sample location and frequency, equipment, procedures to be used during the sampling, and sample handling and analysis are described in the SAP (Anchor QEA 2012).

Sample collection and analyses were performed and prepared consistent with the multi-agency reviewed and approved SAP (Anchor QEA 2012). The SAP was developed in accordance with the 2008 DMMP User's Manual (DMMO 2009) and Ecology's *Sediment Sampling and Analysis Plan Appendix* (Ecology 2008). All sample handling and analyses followed the most recent Puget Sound Estuary Program (PSEP) protocols for collecting and handling sediment and water samples (PSEP 1986, 1997a, 1997b, 1997c) and the 2008 DMMP User's Manual (including the 2009 update) and Clarification Papers and updates (DMMO 2009; Hoffman 1998; Kendall 2001; USACE 2010; Inouye and Fox 2011).

Between November 6 and November 8, 2012, Anchor QEA collected 30 sediment samples (including two field duplicates) from 28 locations. Ecology staff supported sample collection on November 6 and 7, 2012. Three water samples (including one duplicate) were collected at Log Boom Park, and one background water sample was collected offshore in Lake Washington on November 7, 2012. Sediment collection information and sample descriptions are provided in Table 1. Surface water collection information is provided in Table 2. Sediment and water sampling locations are shown in Figure 1.

Sediment samples for the DMMP screening level characterization were collected on November 8, 2012, and included samples SG-02 and SG-03 from North Lake Marina and SG-04 through SG-09 from the Kenmore Navigation Channel. These sediment samples were analyzed for the full DMMP analyte list (DMMO 2010, 2011) for the screening level characterization, including metals, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), dioxins and furans, and tributyltin (TBT) in porewater, as well as total organic carbon (TOC), grain size, and moisture content. The chemistry data were compared to the DMMP interpretive criteria for marine open-water disposal (at the marine DMMP disposal sites) in Section 3.2.1 (DMMO 2010, 2011). Results are presented in Table 3.

Sediment samples HT-01 through HT-11 were collected with a hand trowel in nearshore areas at Log Boom Park, Tributary 0056, the WDFW boat launch, and Lyon Creek Park on November 7, 2012. Sediment samples SG-01, and SG-10 through SG-17 were collected using a grab sampler deployed from a sampling vessel on November 9, 2012, from the Harbour Village Marina, north and offshore of KIP, and the lower reaches of the Sammamish River. These samples were tested in accordance with the *Sediment Management Standards* (Ecology 1995) for metals, SVOCs, pesticides, PCBs, and dioxin and furans, as well as physical parameters, including TOC, grain size, and moisture content. TBT analysis was also conducted on bulk sediment at these locations. Data from these samples were compared to the interim freshwater Sediment Quality Values (SQVs) in Section 3.22. These interim freshwater SQVs were developed by Ecology in 2003 (Ecology 2003) and adopted by the Regional Sediment Evaluation Team[1] in 2006 (USACE et al. 2006). The data and screening results are presented in Table 4.

Surface water samples, HT-01 and HT-04, and the background sample, WS-10, were collected on November 7, 2012. Water quality field parameters were measured on site (Table 2). Water samples were analyzed for total metals, dissolved metals, SVOCs, polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), total suspended solids (TSS), total dissolved solids, and hardness. The surface water results are summarized in Section 3.3. Surface water data are presented in Table 5.

[1] Consists of the USACE Northwestern Division (Portland, Seattle and Walla Walla Districts), National Marine Fisheries Service, U. S. Fish and Wildlife Service, U.S. Environmental Protection Agency Region 10, Oregon Department of Environmental Quality, Ecology, Washington Department of Natural Resources, and the Idaho Department of Environmental Quality.

# 2 SAMPLE COLLECTION AND HANDLING

This section provides an overview of the sample collection and handling procedures. The methods and procedures described herein were followed by Anchor QEA and their subcontractors during the November 2012 data collection activities. Detailed descriptions are found in the SAP (Anchor QEA 2012).

## 2.1 Sediment Collection Procedures

Sediment samples SG-02 through SG-17 were collected from the Kenmore Navigation Channel and other submerged areas (Harbour Village Marina, North Lake Marina, etc.) using a power grab sampler from a vessel equipped with differential global positioning system (DGPS) and a depth sounder. Samples from the navigation channel and in North Lake Marina were collected to the maximum penetration possible (target 25 centimeter [cm] below mudline) to better represent deeper sediment that could be removed during dredging. Samples from other submerged areas were collected from the top 10 cm to represent the biologically active zone, consistent with guidance in Ecology's *Sediment Sampling and Analysis Plan Appendix* (SAPA; Ecology 2008). Prior to deployment at each station, the power grab sampler was decontaminated, and upon retrieval, samples were evaluated for compliance with the acceptance criteria described in the SAP (Anchor QEA 2012). If an acceptable sample was collected, sediment from the appropriate interval was collected and homogenized in a stainless steel bowl prior to being placed into sample containers.

Sediment samples HT-01 through HT-11 were collected from Log Boom Park, Tributary 0056, the WDFW boat launch, and Lyon Creek Park using a hand trowel from shallow submerged sediment areas. Sediments were collected as close as possible to the target coordinates in order to collect fine-grained material (to the extent available) that represent areas where people are likely to come in contact with the sediment. Sample HT-10 at Lake Forest Park was collected from an exposed area due to the low lake level. During collection with the hand trowel, care was taken to prevent resuspension of sediment prior to and during sampling. Hand collected samples were homogenized in a stainless steel bowl prior to being placed into sample containers.

Sediment collection information recorded in the field, including water depth, recovery depth, coordinates, and sample interval, are shown in Table 1. Sediment samples were placed in a cooler with ice and delivered to ARI within 24 hours of collection. Chain-of-custody forms and daily logs are provided in Appendix A.

## 2.2 Surface Water Collection Procedures

Water quality parameters were measured in the field using a multi-probe water quality meter (e.g., YSI) prior to collecting a water sample. The water quality meter was lowered approximately 1 foot below the surface and was allowed to equilibrate before taking measurements of turbidity, conductivity, temperature, dissolved oxygen, and pH. Water quality field parameters, including temperature, pH, conductivity, turbidity, and dissolved oxygen (DO), that were recorded in the field are provided in Table 2. Chain-of-custody forms are provided in Appendix A.

Water samples were collected according to Ecology's Standard Operating Procedure guidance (Ecology 2006), which is consistent with the protocols of the Beach Environmental Assessment, Communication, and Health (BEACH) program (Schneider 2004). Field personnel waded into knee-deep water (approximately 2.5 feet) and collected a water sample by hand with a dipper attached to an extension rod. Samples were collected to a depth of at least 6 inches below the surface (Ecology 2006). The background location sample was collected from the boat on the same day as the shoreline water samples, using the same methods. Water samples were placed in a cooler with ice and were shipped or delivered to the laboratory within 24 hours of collection.

## 2.3 Deviation from the Sampling and Analysis Plan

Deviations from the SAP (Anchor QEA 2012) were limited to the movement of several target sample stations. These changes are summarized below:

- Station HT-07 was moved upstream, above the weir within tributary 0056, as directed by Maura O'Brien (Ecology).
- Station SG-01 was moved 85 feet to the northwest of the target location to locate the sample within the middle of the navigation channel.

- Station SG-04 was moved 50 feet to the northeast of the target location due to refusal encountered at the target location.
- Station SG-16 was moved 50 feet to the southwest of the target location at the request of Maura O'Brien (Ecology) to be closer to the former KIP outfall.

# 3 CHEMICAL TESTING RESULTS

Chemical analysis requirements for sediment and surface water samples are summarized in the Ecology-approved SAP (Anchor QEA 2012). As described in the SAP, all chemical analyses were performed by Analytical Resources, Inc. (ARI), in Tukwila, Washington. All samples were preserved in accordance with the analytical method and stored at a temperature of 4 degrees Celsius (°C).

## 3.1 Summary of Data Quality/Validation Results

The following section describes the assessment and validation of analytical data reported by ARI. Complete data packages are presented in Appendix B. Data validation was performed by Anchor QEA and Laboratory Data Consultants (LDC). Validation reports are presented in Appendix C.

Chemical data were validated in accordance with the analytical methods and the following U.S. Environmental Protection Agency (USEPA) guidance:

- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004)
- *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 1999)
- *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA 2008)

As described in the SAP, Anchor QEA performed a Stage 2A level (USEPA 2009) data quality review (equivalent to a QA1 review), in accordance with USEPA National Functional Guidelines (Anchor QEA 2012; USEPA 2004, 2008) on all data except for dioxin and furans. Dioxin and furan data were validated at a Stage 4 level (USEPA 2009) by LDC, a third party validator, using the DQOs outlined by the DMMO (2010) and the SAPA (Ecology 2008). The data were validated in accordance with the project-specific DQOs, analytical method criteria, and the laboratory's internal performance standards based on their Standard Operating Procedures.

Anchor QEA determined that accuracy was acceptable as demonstrated by the surrogate, laboratory control sample (LCS)/laboratory control sample duplicate (LCSD), and matrix spike (MS)/matrix spike duplicate (MSD) percent recovery values, with the exceptions noted in the Data Validation Report (DVR; Appendix C). Precision was also acceptable as demonstrated by the laboratory duplicates, MS/MSD, and LCS/LCSD relative percent difference values, with the exceptions noted in the DVR (Appendix C). Most data were deemed acceptable as reported; all other data are acceptable as qualified.

LDC determined that dioxin and furan analysis was conducted within all specifications of the methods, and no results were rejected. Sample results were qualified as appropriate, based on the results of the LDC validation report (Appendix C). Sample results qualified as "estimated" (J) are usable as qualified. Based on the Stage 4 data validation, results are considered valid and useable for all purposes.

## 3.2 Sediment Chemistry Results

The remainder of this section summarizes the results of the chemical testing of sediment samples and the comparison of the data to DMMP interpretive criteria (DMMO 2010, 2011) or the interim freshwater SQVs (Ecology 2003; USACE et al. 2006). Ecology is currently in the process of amending the freshwater SQVs. Once they are approved and published, the SQVs will be applied to these results by Ecology. Sediment data results are presented in Tables 3 and 4.

### *3.2.1 DMMP Screening Level Characterization*

This section summarizes the comparison of chemical results from the North Lake Marina and Kenmore Navigation Channel samples with the DMMP interpretive criteria for marine open-water disposal sites (DMMO 2010, 2011). The results for the full DMMP analyte list for sediment samples from stations SG-02 to SG-09 are presented in Table 3 and are summarized below.

In North Lake Marina, four chemicals exceeded one or two DMMP screening levels. The concentrations of benzoic acid, benzyl alcohol, and total dioxin and furan toxic equivalency (dioxin/furan TEQ) exceeded the DMMP Screening Level (SL) in both samples. Benzoic acid was also above the DMMP Maximum Level (ML) in both samples. One sample exceeded the SL for TBT. Dioxin/furan was 20.3 and 37.0 nanograms per kilogram or parts per trillion (ng/kg) toxic equivalency (TEQ) for samples SG-02 and SG-03, respectively, which is above the ML.

In Kenmore Navigation Channel three chemicals exceeded DMMP screening levels. Specifically, benzyl alcohol exceeded the SL at five of the six locations. Two of those locations exceeded the ML for benzoic acid. Dioxin/furan ranged from 1.5 to 8.4 ng/kg TEQ and was above the SL in four of the six locations.

In general, chlorinated hydrocarbons and pesticides were not detected in any of the samples, and the frequency of detection of phthalates, phenols, and PCB Aroclors was relatively low. Concentrations of PAHs and metals were below the DMMP criteria.

These preliminary screening results will inform future dredge planning. A full dredge material characterization will be required to evaluate for suitability of open-water disposal. This testing will be based on collection and testing of sediment cores and may include bioassay testing, if required.

### *3.2.2 Sediment Comparison to the Interim Freshwater Screening Levels*

This section summarizes the results of the comparison of sediment data with the interim freshwater SQVs (Ecology 2003; USACE et al. 2006). Table 4 presents the results for shoreline sediment samples from stations HT-01 through HT-11, grab samples from stations SG-01 and SG-10 through SG-17, as well as the DMMP screening level characterization samples from stations SG-02 through SG-09, compared to the SQVs[2].

#### *3.2.2.1 Shoreline Sediment Samples*

Shoreline sediment samples were collected by hand trowel from 11 stations at Log Boom Park (five locations), Tributary 0056 (two locations), the WDFW boat launch (two locations), and at Lyon Creek Park (two locations). Concentrations were measured above SQVs for copper, bis(2ethylhexyl)phthalate, and dimethyl phthalate in individual samples. PAHs were detected

[2] SQVs are established for most parameters tested as part of this investigation, but not all.

at all of the shoreline stations, but were below the freshwater SQVs. The frequency of detection was low for chlorinated hydrocarbons, phenols, the miscellaneous extractables, and PCB Aroclors. Pesticides were not detected, where analyzed. Specific results for each location are described below.

##### 3.2.2.1.1 Log Boom Park

In the five samples collected at Log Boom Park, concentrations exceeded the interim freshwater Screening Level 2 (SL2) for bis(2ethylhexyl)phthalate in HT-04 and for the interim freshwater Screening Level 1 (SL1) for copper in HT-05. No other concentrations exceeded SQVs in any other Log Boom Park samples. PCBs were non-detect in samples HT-01, HT-02, HG-03, and HT-05, and were below SQVs in HT-04. The dioxin/furan concentration was highest in sample HT-04, at 7.9 ng/kg TEQ, with samples HT-01, HT-02, HT-03, and HT-05 below 2.17 ng/kg TEQ.

##### 3.2.2.1.2 Tributary 0056

Of the two samples collected at Tributary 0056, located north of Log Boom Park, no concentrations exceeded SQVs. PCBs were non-detect in each sample. The dioxin/furan concentration was less than 1.33 ng/kg TEQ in each sample.

##### 3.2.2.1.3 WDFW Boat Launch

Of the two samples collected at the WDFW boat launch, dimethyl phthalate exceeded SQVs in both samples (above SL1 for HT-08 and SL2 for HT-09). PCBs were non-detect, and the dioxin/furan concentration was less than 1.35 ng/kg TEQ in each sample.

##### 3.2.2.1.4 Lyon Creek Park

Of the two samples collected at Lyon Creek Park, no concentrations exceeded SQVs. PCBs were non-detect, and the dioxin/furan concentration was less than 0.52 ng/kg TEQ in each sample.

#### *3.2.2.2 Surface Sediment Grab Samples*

Surface sediment samples (0 to 10 cm) were collected at nine stations from the Sammamish River, Harbour Village Marina, north of KIP, and KIP shoreline. Concentrations were measured above SQVs for lead, zinc, bis(2ethylhexyl)phthalate, di-n-octyl phthalate, and benzo(b,j,k)fluoranthenes in individual samples. The frequency of detection was low for miscellaneous extractables, pesticides, and PCB Aroclors. Chlorinated hydrocarbons were not detected. Specific results for each location are described below.

##### 3.2.2.2.1 Sammamish River

Three samples were collected from the lower reaches of the Sammamish River, two of which are located adjacent to KIP. No concentrations exceeded SQVs in sample locations SG-01, SG-16, and SG-17. PCBs were non-detect, and the dioxin/furan concentration ranged from 0.35 to 2.30 ng/kg TEQ.

##### 3.2.2.2.2 Harbour Village Marina

Of the four samples and a duplicate sample collected at the Harbour Village Marina, five chemicals exceeded one or more screening levels: copper, zinc, two phthalates, and dioxin/furans. The SL1 was exceeded for lead and zinc in sample SG-11, and for zinc in SG-12 and SG-13. Bis(2ethylhexyl) phthalate exceeded SL2 in each sample, and di-n-octyl phthalate exceeded SL2 in SG-11 and SG-13. PCBs and pesticides were low or non-detect in each sample. The dioxin/furan concentration was lowest in sample SG-10 (6.6 ng/kg TEQ), but higher in sample SG-12 (26.6 ng/kg TEQ), SG-13 (50 ng/kg TEQ and 19 ng/kg TEQ in duplicate samples), and SG-11 (71 ng/kg TEQ).

##### 3.2.2.2.3 North of Kenmore Industrial Park

One sample was collected north of KIP, beyond the end of the navigation channel. Copper, zinc, benzo(b,j,k)fluoranthenes, and bis(2ethylhexyl)phthalate exceeded the SL1 in sample SG-14. PCBs were detected slightly above the detection limit (20 micrograms per kilogram [μg/kg]). The dioxin/furan concentration was 10.1 ng/kg TEQ.

#### 3.2.2.2.4 Kenmore Industrial Park Shoreline

Three samples were collected along KIP: one along the west shoreline and two along the south side. No concentrations exceeded SQVs in samples SG-15, SG-16, or SG-17 collected along the KIP shoreline. PCBs were non-detect, and the dioxin/furan concentration was below 2.3 ng/kg TEQ.

### *3.2.2.3 DMMP Screening Level Characterization Samples*

Results of DMMP screening level sediment samples are presented in Section 3.2.1 and the DMMP interpretive criteria in Table 3. These results are compared to SQVs in Table 4.

Two samples were collected in North Lake Marina, and concentrations of cadmium, chromium, and zinc exceeded SL1 in both samples (SG-02 and SG-03). Concentrations exceeded SL2 for bis(2ethylhexyl)phthalate in both samples, for di-n-octyl phthalate in SG-03, and for total PCBs in SG-02. Dioxin/furan concentrations were 20.3 and 37 ng/kg TEQ.

In the Kenmore Navigation Channel, six samples were collected for DMMP characterization from 20 to 25 cm depth. Five chemicals were detected above one or more screening levels. Zinc exceeded SL1 in samples SG-05 and SG-06. Bis(2ethylhexyl)phthalate exceeded SL1 in samples SG-05, SG-08, and SG-09 and SL2 in samples SG-06 and SG-07. Di-n-octyl phthalate also exceeded SL1 in sample SG-06. Dioxin/furan concentrations ranged from 1.5 to 8.4 ng/kg TEQ. Concentrations of all other chemicals were below SQV criteria.

## 3.3 Surface Water Results

Chemical concentrations in surface water samples were low in the two Log Boom Park samples and in the reference sample. Results for PAHs, chlorinated hydrocarbons, phthalates, and miscellaneous extractables were all non-detect. Chemical concentrations in the Log Boom Park samples were similar to the reference sample concentrations.

# 4 CONCLUSIONS

The conclusions of the comparison of the sediment data to the DMMP interpretive criteria (DMMO 2010, 2011) or the interim freshwater SQVs (Ecology 2003; USACE et al. 2006) are summarized below.

## 4.1 DMMP Screening Level Characterization Samples

### *4.1.1 Kenmore Navigation Channel*

Concentrations of benzoic acid and benzyl alcohol were above DMMP criteria for marine open water disposal. However, as allowed according to DMMP guidance, bioassay testing could be conducted on site sediment as part of a full DMMP characterization to determine if dredged sediment is suitable for open-water disposal.

The dioxin/furan TEQ exceeded the DMMP criteria in some samples. However, suitability for open-water disposal would be determined based on the volume-weighted average of dredged sediment using data collected as part of a full DMMP characterization.

A full DMMP characterization would be necessary to determine suitability for marine open-water disposal closer to when dredging would occur.

### *4.1.2 North Lake Marina*

Concentrations of benzoic acid and benzyl alcohol were above DMMP criteria. However, as allowed according to DMMP guidance, bioassay testing could be conducted on site sediment as part of a full DMMP characterization to determine if dredged sediment is suitable for open-water disposal.

The dioxin/furan TEQ exceeded the ML DMMP criteria in both samples, which could influence suitability of open-water disposal, pending completion of a full DMMP characterization.

A full DMMP characterization would be necessary to determine suitability for open-water disposal closer to when dredging would occur.

## 4.2 Shoreline Areas

### 4.2.1 Log Boom Park

Sediment concentrations were below all SQVs in most samples, with bis(2ethylhexyl)phthalate above SL2 in HT-04 and copper above SL1 in HT-05. Water concentrations were similar to background concentrations. These results will be evaluated as part of future work to be conducted by DOH to develop a health consultation.

### 4.2.2 Kenmore Industrial Park

No concentrations exceeded SQVs along both the Lake Washington and the Sammamish River KIP shorelines. PCBs were non-detect, and the dioxin/furan concentration was below 2.3 ng/kg TEQ. These results will be evaluated as part of future work to be conducted by DOH to develop a health consultation.

## 4.3 Other Areas

Concentrations exceeded SQVs for total PCBs, benzo(b,j,k)fluoranthenes, bis(2ethylhexyl)phthalate, di-n-octyl phthalate, cadmium, copper, zinc, at one or more locations at Harbour Village Marina, the WDFW boat launch, and north of KIP. Dioxin/furan concentrations were higher at Harbour Village Marina and North Lake Marina than testing results from other areas, which will be evaluated by Ecology along with other results to determine next steps for further evaluation, if needed.

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# TABLES

**Table 1**
**Sediment Grab Observation Summary**

| Station ID | Date Collected | Water Depth (feet) | Recovery Depth (cm) | Coordinates | | Sample Interval (cm) | Sediment Observations | | | | | Grab Quality Notes, Number of Attempts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Northing | Easting | | Sediment Type | Biota | Organic Matter/Debris | Odor | Sheen | |
| HT-01 | 11/6/2012 | 0.5 | 10 | 279602 | 1288090 | 0-10 | Gravely SAND | Trace shells | Trace surface organic matter | None | None | Hand collected |
| HT-02 | 11/6/2012 | 0.8 | 10 | 279590 | 1288199 | 0-10 | Fine-SAND, trace silt | Trace shells | Trace organic matter, with woody debris streaking | None | None | Hand collected |
| HT-03 | 11/6/2012 | 0.8 | 10 | 279505 | 1288473 | 0-10 | Silty fine-SAND | None | Woody streak at 2 inches | Slight $H_2S$ | None | Hand collected |
| HT-04 | 11/6/2012 | 0.5 | 10 | 279422 | 1288684 | 0-10 | Clayey SILT | None | Substantial loose woody debris | None | None | Hand collected |
| HT-05 | 11/6/2012 | 1 -1.5 | 10 | 279265 | 1288694 | 0-10 | Gravely SAND | Trace clams and worms | Trace woody debris | None | None | Hand collected |
| HT-06 | 11/6/2012 | 0.2 | 10 | 279241 | 1288812 | 0-10 | Silty fine-SAND with trace clay | None | Trace aquatic plant roots and leaves and woody debris | None | None | Hand collected |
| HT-07 | 11/6/2012 | 0.2 | 10 | 279734 | 1289089 | 0-10 | Pebbly, medium-coarse silty SAND | None | Trace woody debris and organic matter | None | None | Hand collected near edges of stream |
| HT-08 | 11/6/2012 | 0.5 | 10 | 278405 | 1291778 | 0-10 | Gray silty fine-SAND | Trace shells | Trace organic woody debris | None | None | Hand collected |
| HT-09 | 11/6/2012 | 0.5 | 10 | 278377 | 1291935 | 0-10 | Fine-sandy SILT, few pebbles and trace clay | None | None | None | None | Hand collected |
| HT-10 | 11/6/2012 | Dry | 10 | 277892 | 1285959 | 0-10 | Gray medium-SAND, trace fines and gravel | Trace shells | None | None | None | Hand collected |
| HT-11 | 11/6/2012 | 1-1.5 | 10 | 277815 | 1286028 | 0-10 | Gray medium-coarse-SAND, with gravel and trace fines | Trace shells | None | None | None | Hand collected |
| SG-01 | 11/7/2012 | 3.0 | 20.5 | 277963 | 1289407 | 0-10 | Gray fine-SAND with trace medium-sand and silt | Trace clams | None | None | None | Good grab, station moved to navigation channel |
| SG-02 | 11/8/2012 | 4.5 | 22 | 279179 | 1289549 | 0-22 | Very soft SILT | 40% plant cover | Trace organic matter | None | Trace | First grab accepted |
| SG-03 | 11/8/2012 | 4.6 | 25 | 279174 | 1289661 | 0-25 | Soft SILT, trace fine sand at bottom 5 cm | Trace shells | Trace leaves and sticks | None | Trace | First grab accepted |
| SG-04 | 11/8/2012 | 20.4 | 20 | 279139 | 1290268 | 0-15 | Gravely SAND to 15 cm with large gravel below | None | Trace organic matter, sticks, roots | None | None | First grab with rocks in jaw, second grab accepted |
| SG-05 | 11/8/2012 | 17.4 | 23.5 | 278907 | 1289917 | 0-23 | Soft SILT, trace fine sand | None | Moderate organic matter | None | None | First grab overpenetrated, second grab accepted |
| SG-06 | 11/8/2012 | 17.7 | 25 | 278711 | 1289558 | 0-25 | Moderately stiff SILT with trace clay | Trace worms | Moderate organic matter, with 20% woody debris in bottom 3 cm | None | None | First grab insufficient recovery, second grab accepted |
| SG-07 | 11/8/2012 | 16.9 | 27 | 278254 | 1289072 | 0-25 | Soft SILT with lenses of sand | None | 15% surface wood, High pulp-like organic matter at 20 to 25 cm | None | None | First grab accepted |
| SG-08 | 11/8/2012 | 16.1 | 26 | 277764 | 1288689 | 0-25 | Silty fine-SAND | None | Substantial organics | None | None | First grab accepted |
| SG-09 | 11/8/2012 | 18.4 | 26.5 | 277396 | 1288456 | 0-25 | SILT and trace silty fine-sand | None | Trace organic debris | None | None | First grab accepted |
| SG-10 | 11/7/2012 | 4.6 | 26 | 279175 | 1288815 | 0-10 | Fine sandy SILT with coarse-sand below 10 cm | None | Aquatic plants at surface, moderate arganic matter with streaks of woody debris | None | None | First grab accepted |
| SG-11 | 11/7/2012 | 4.8 | 28.5 | 279159 | 1289048 | 0-10 | Soft SILT | None | Trace macrophytes on surface, trace organic matter | None | Slight | First grab overpenetrated, second grab accepted |

**Table 1**
**Sediment Grab Observation Summary**

| Station ID | Date Collected | Water Depth (feet) | Recovery Depth (cm) | Coordinates | | Sample Interval (cm) | Sediment Observations | | | | | Grab Quality Notes, Number of Attempts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Northing | Easting | | Sediment Type | Biota | Organic Matter/Debris | Odor | Sheen | |
| SG-12 | 11/7/2012 | 8.1 | 19 | 278974 | 1288780 | 0-10 | Soft SILT | Worms | Moderate organic matter, with lens of woody material | None | None | First grab accepted |
| SG-13 | 11/7/2012 | 8.1 | 24 | 278858 | 1289306 | 0-10 | SILT | None | Trace organics and woody debris | None | None | First grab accepted |
| SG-14 | 11/7/2012 | 17.2 | 19 | 279416 | 1290608 | 0-10 | Slightly sandy SILT | None | Moderate organic matter | None | Slight | First grab accepted |
| SG-15 | 11/7/2012 | 1.9 | 23 | 278643 | 1290067 | 0-10 | Slighty silty fine-SAND | Trace shells and worms | Trace woody debris | None | None | First grab accepted |
| SG-16 | 11/7/2012 | 10.4 | 21 | 278308 | 1290504 | 0-10 | Fine-SAND | None | Trace wood fragments | None | None | First grab accepted |
| SG-17 | 11/7/2012 | 4.4 | 23.5 | 278642 | 1291535 | 0-10 | SILT to 6 cm with soft clay below | Trace clams | Surface with abundant leaves, organic matter | None | None | First grab accepted |

Notes:
Predominant sediment type displayed in ALL CAPS.
cm = centimeter
$H_2S$ = hydrogen sulfide
ID = identification

**Table 2**
**Water Quality Sample Collection Summary**

| Station ID | Location | Date Collected | Time | Water Depth (feet) | Coordinates | | Sample Depth (feet) | Field Parameters | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Northing | Easting | | Temperature (°C) | pH | Conductivity (mS/cm) | Turbidity (NTU) | DO (mg/L) | |
| HT-01 | Log Boom Park Shoreline | 11/7/2012 | 15:46 | 1.8 | 279602 | 1288090 | 1 | 12.5 | 7.69 | 0.148 | 5.78 | 9.06 | Tannin color, moderately turbid |
| HT-04 | Log Boom Park Shoreline | 11/7/2012 | 16:15 | 2.0 | 279590 | 1288199 | 0.5-1 | 12.39 | 7.51 | 0.142 | 5.46 | 8.28 | Tannin color, water sample collected from shoreward end of dock |
| WS-10 | Reference | 11/7/2012 | 14:50 | 9.6 | 278267 | 1287851 | 3 | 12.68 | 7.91 | 0.145 | 0.78 | 11.63 | Moderately turbid, few floating macrophytes |

Notes:

°C = degrees Celsius

DO = dissolved oxygen

ID = identification

mg/L = milligrams per liter

mS/cm = millisiemens per centimeter

NTU = Nephelometric Turbidity Unit

## Table 3
## Sediment Results Compared to DMMP Criteria from Kenmore Navigation Channel and North Lake Marina

| | | | Location ID | SG-02 | SG-03 | SG-04 | SG-05 | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Location | North Lake Marina | | Kenmore Navigation Channel | | | | | | |
| | | | Sample ID | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 |
| | | | Sample Date | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| | | | Sample Interval | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm |
| | DMMP SL | DMMP BT | DMMP ML | | | | | | | | | |
| **Conventional Parameters (%)** | | | | | | | | | | | | |
| Total organic carbon | -- | -- | -- | 7.12 | 6.60 | 2.73 | 5.43 | 4.89 | 4.95 | 7.07 | 3.30 | 5.22 |
| Total solids | -- | -- | -- | 25.7 | 25.6 | 80.8 | 35.0 | 29.9 | 33.7 | 34.3 | 42.0 | 35.7 |
| Total volatile solids | -- | -- | -- | 13.51 | 15.15 | 1.72 | 11.13 | 13.89 | 13.40 | 14.11 | 9.10 | 10.58 |
| Gravel | -- | -- | -- | 0.4 | 11.8 | 71.4 | 3.1 | 0.1 U | 0.5 | 2.6 | 0.3 | 0.1 |
| Sand, Very Coarse | -- | -- | -- | 6.5 | 9.2 | 7.6 | 2.9 | 7.4 | 2.7 | 2.7 | 1.5 | 2.1 |
| Sand, Coarse | -- | -- | -- | 5.5 | 7.2 | 6.9 | 5.3 | 6.6 | 3.1 | 2.8 | 1.5 | 1.7 |
| Sand, Medium | -- | -- | -- | 5.5 | 7.2 | 7.6 | 11.1 | 6.2 | 6.3 | 6.0 | 3.9 | 6.9 |
| Sand, Fine | -- | -- | -- | 7.2 | 7.8 | 2.9 | 14.3 | 8.6 | 24.4 | 21.9 | 22.2 | 15.9 |
| Sand, Very Fine | -- | -- | -- | 9.1 | 10.1 | 1.0 | 15.2 | 15.9 | 18.9 | 18.6 | 21.2 | 13.4 |
| Fines (silt + clay) | -- | -- | -- | 65.8 | 46.7 | 2.5 | 48.1 | 55.2 | 44.1 | 45.4 | 49.3 | 59.7 |
| Silt, Coarse | -- | -- | -- | 10.0 | 13.1 | -- | 7.7 | 8.6 | 11.0 | 13.7 | 13.0 | 19.7 |
| Silt, Medium | -- | -- | -- | 19.3 | 8.4 | -- | 16.0 | 15.5 | 12.1 | 11.0 | 13.7 | 12.9 |
| Silt, Fine | -- | -- | -- | 15.2 | 10.9 | -- | 9.9 | 12.1 | 7.9 | 7.6 | 8.4 | 10.9 |
| Silt, Very Fine | -- | -- | -- | 11.1 | 7.0 | -- | 7.1 | 7.8 | 5.9 | 6.1 | 6.3 | 7.6 |
| Clay, Coarse | -- | -- | -- | 5.6 | 4.5 | -- | 4.3 | 6.3 | 3.8 | 3.9 | 3.9 | 4.7 |
| Clay, Medium | -- | -- | -- | 3.2 | 1.8 | -- | 1.9 | 3.2 | 2.5 | 2.1 | 2.6 | 2.6 |
| Clay, Fine | -- | -- | -- | 1.4 | 1.1 | -- | 1.3 | 1.6 | 0.9 | 0.9 | 1.4 | 1.3 |
| **Metals (mg/kg)** | | | | | | | | | | | | |
| Antimony | 150 | -- | 200 | 20 U | 20 U | 6 U | 10 U | 20 U | 10 U | 10 U | 10 U | 10 U |
| Arsenic | 57 | 507.1 | 700 | 20 U | 20 U | 6 U | 10 U | 20 U | 10 U | 10 U | 10 U | 10 U |
| Cadmium | 5.1 | 11.3 | 14 | 1.3 | 1.2 | 0.3 | 0.7 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 |
| Chromium | 260 | 260 | -- | 56 | 55 | 35 | 43 | 57 | 41 | 44 | 44 | 48 |
| Copper | 390 | 1027 | 1300 | 92.4 | 88.1 | 14.6 | 35.6 | 43.6 | 30 | 28.7 | 28 | 31.1 |
| Lead | 450 | 975 | 1200 | 62 | 42 | 5 | 28 | 31 | 21 | 21 | 21 | 24 |
| Mercury | 0.41 | 1.5 | 2.3 | 0.18 | 0.1 | 0.02 U | 0.08 | 0.1 | 0.11 | 0.08 | 0.07 | 0.08 |
| Nickel | -- | -- | -- | 48 | 45 | 30 | 39 | 46 | 41 | 42 | 40 | 43 |
| Selenium | -- | 3 | -- | 2 U | 2 U | 0.6 U | 1 U | 2 U | 1 U | 1 U | 1 U | 1 U |
| Silver | 6.1 | 6.1 | 8.4 | 1 U | 1 U | 0.4 U | 0.9 U | 1 U | 0.9 U | 0.8 U | 0.7 U | 0.9 U |
| Zinc | 410 | 2783 | 3800 | 231 | 267 | 49 | 143 | 164 | 126 | 123 | 113 | 130 |
| **Organometallic Compounds (µg/L)** | | | | | | | | | | | | |
| Tributyltin (porewater) | 0.15 | 0.15 | -- | 0.67 | 0.058 | 0.049 | 0.008 | 0.023 | 0.0050 U | 0.0050 U | 0.0050 U | 0.0050 U |
| **Polycyclic Aromatic Hydrocarbons (µg/kg)** | | | | | | | | | | | | |
| 1-Methylnaphthalene | -- | -- | -- | 21 | 9.8 J | 20 U | 13 J | 20 U | 20 U | 19 U | 9.6 J | 20 U |
| 2-Methylnaphthalene | 670 | -- | 1900 | 31 | 25 | 20 U | 26 | 14 J | 20 U | 19 U | 19 U | 20 U |
| Acenaphthene | 500 | -- | 2000 | 320 | 33 | 14 J | 26 | 17 J | 20 U | 19 U | 19 U | 20 U |
| Acenaphthylene | 560 | -- | 1300 | 22 | 16 J | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| Anthracene | 960 | -- | 13000 | 66 | 68 | 26 | 39 | 28 | 18 J | 19 U | 19 U | 20 U |
| Benzo(a)anthracene | 1300 | -- | 5100 | 210 | 190 | 81 | 110 | 110 | 110 | 52 | 42 | 40 |
| Benzo(a)pyrene | 1600 | -- | 3600 | 190 | 160 | 62 | 76 | 120 | 63 | 55 | 50 | 45 |
| Benzo(g,h,i)perylene | 670 | -- | 3200 | 170 | 130 | 43 | 63 | 93 | 36 | 41 | 41 | 36 |
| Chrysene | 1400 | -- | 21000 | 440 | 340 | 110 | 190 | 190 | 140 | 82 | 73 | 72 |
| Dibenzo(a,h)anthracene | 230 | -- | 1900 | 67 | 55 | 15 J | 21 | 37 | 17 J | 12 J | 11 J | 13 J |
| Fluoranthene | 1700 | 4600 | 30000 | 480 | 410 | 220 | 310 | 290 | 150 | 140 | 130 | 120 |
| Fluorene | 540 | -- | 3600 | 98 | 46 | 14 J | 37 | 28 | 12 J | 9.7 J | 19 U | 20 U |
| Indeno(1,2,3-c,d)pyrene | 600 | -- | 4400 | 140 | 110 | 39 | 51 | 81 | 33 | 38 | 36 | 33 |
| Naphthalene | 2100 | -- | 2400 | 83 | 58 | 20 U | 50 | 38 | 18 J | 25 | 14 J | 24 |
| Phenanthrene | 1500 | -- | 21000 | 170 | 190 | 140 | 180 | 140 | 72 | 68 | 64 | 59 |
| Pyrene | 2600 | 11980 | 16000 | 590 | 440 | 190 | 300 | 290 | 140 | 130 | 120 | 120 |
| Total Benzofluoranthenes (b,j,k) (U = 0) | 3200 | -- | 9900 | 530 | 420 | 140 | 220 | 300 | 170 | 140 | 120 | 120 |
| Total LPAH (DMMP) (U = 0) | 5200 | -- | 29000 | 760 | 410 J | 190 J | 330 | 250 J | 120 J | 103 J | 78 J | 83 |

**Table 3**
**Sediment Results Compared to DMMP Criteria from Kenmore Navigation Channel and North Lake Marina**

| | | | Location ID | SG-02 | SG-03 | SG-04 | SG-05 | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Location** | **North Lake Marina** | | **Kenmore Navigation Channel** | | | | | | |
| | | | **Sample ID** | **SG-02-S-C-121108** | **SG-03-S-C-121108** | **SG-04-S-C-121108** | **SG-05-S-C-121108** | **SG-06-S-C-121108** | **SG-07-S-C-121108** | **SG-07-S-C-DUP-121108** | **SG-08-S-C-121108** | **SG-09-S-C-121108** |
| | | | **Sample Date** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** | **11/8/2012** |
| | | | **Sample Interval** | **0-22 cm** | **0-25 cm** | **0-15 cm** | **0-23 cm** | **0-25 cm** | **0-25 cm** | **0-25 cm** | **0-25 cm** | **0-25 cm** |
| | **DMMP SL** | **DMMP BT** | **DMMP ML** | | | | | | | | | |
| Total HPAH (DMMP) (U = 0) | 12000 | -- | 69000 | **2820** | **2260** | **900 J** | **1340** | **1510** | **860 J** | **690 J** | **620 J** | **600 J** |
| **Chlorinated Hydrocarbons (µg/kg)** | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 31 | -- | 64 | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| 1,2-Dichlorobenzene | 35 | -- | 110 | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| 1,3-Dichlorobenzene | -- | -- | -- | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| 1,4-Dichlorobenzene | 110 | -- | 120 | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| Hexachlorobenzene | 22 | 168 | 230 | 4.9 U | 4.9 U | 4.9 U | 5.0 U | 4.8 U | 4.9 U | 4.8 U | 4.8 U | 4.8 U |
| Hexachloroethane | -- | -- | -- | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| **Phthalates (µg/kg)** | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 1300 | -- | 8300 | **680** | **510** | 62 U | **260** | **540** | **330** | **300** | **240** | **240** |
| Butylbenzyl phthalate | 63 | -- | 970 | **32** | **32** | 20 U | 20 U | **57** | **28** | 19 U | **36** | **29** |
| Diethyl phthalate | 200 | -- | 1200 | 49 U | **38 J** | 49 U | 49 U | **58** | 49 U | 48 U | 48 U | 49 U |
| Dimethyl phthalate | 71 | -- | 1400 | **28** | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| Di-n-butyl phthalate | 1400 | -- | 5100 | 19 U | **9.8 J** | 20 U | 20 U | 20 U | 20 U | **12 J** | 19 U | 20 U |
| Di-n-octyl phthalate | 6200 | -- | 6200 | 19 U | **58 J** | 20 U | **22 J** | **41 J** | **22 J** | 19 U | 19 U | 20 U |
| **Phenols (µg/kg)** | | | | | | | | | | | | |
| 2,4-Dimethylphenol | 29 | -- | 210 | 19 UJ | 20 UJ | 20 UJ | 20 UJ | 20 UJ | 20 UJ | 19 UJ | 19 UJ | 20 UJ |
| 2-Methylphenol (o-Cresol) | 63 | -- | 77 | 19 U | 20 U | 20 UJ | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| 4-Methylphenol (p-Cresol) | 670 | -- | 3600 | **74** | **76** | 39 U | **74** | **91** | **54** | **31 J** | **22 J** | **36 J** |
| Pentachlorophenol | 400 | 504 | 690 | 190 U | 200 U | 200 U | 200 U | 200 U | 200 U | 190 U | 190 U | 200 U |
| Phenol | 420 | -- | 1200 | 19 U | **110** | 20 U | **180** | **80** | **42** | **42** | **19** | **39** |
| **Miscellaneous Extractables (µg/kg)** | | | | | | | | | | | | |
| Benzoic acid | 650 | -- | 760 | **960** | **1300** | 390 U | **1300** | **1100** | **430** | **480** | **300 J** | **510** |
| Benzyl alcohol | 57 | -- | 870 | **82** | **130** | 20 U | **160** | **190** | **120** | **100** | **61** | **110** |
| Dibenzofuran | 540 | -- | 1700 | **30** | **35** | 20 U | **28** | 20 U | 20 U | 19 U | 19 U | 20 U |
| N-Nitrosodiphenylamine | 28 | -- | 130 | 19 U | 20 U | 20 U | 20 U | 20 U | 20 U | 19 U | 19 U | 20 U |
| **Pesticides (µg/kg)** | | | | | | | | | | | | |
| 4,4'-DDD (p,p'-DDD) | 16 | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U |
| 4,4'-DDE (p,p'-DDE) | 9 | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U | 1.7 U | 1.6 U | 1.6 U | 1.6 U |
| 4,4'-DDT (p,p'-DDT) | 12 | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U |
| Aldrin | 9.5 | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.65 U | 0.63 U | 0.64 U | 0.63 U | 0.63 U | 0.63 U |
| Chlordane, alpha- (cis-Chlordane) | -- | -- | -- | 0.83 U | 0.83 U | 0.83 U | 0.84 U | 0.82 U | 0.83 U | 0.81 U | 0.81 U | 0.81 U |
| Chlordane, beta- (trans-Chlordane) | -- | -- | -- | 0.78 U | 0.78 U | 0.77 U | 0.79 U | 0.77 U | 0.78 U | 0.76 U | 0.76 U | 0.76 U |
| Dieldrin | 1.9 | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U | 1.7 U | 1.6 U | 1.6 U | 1.6 U |
| Heptachlor | 1.5 | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.65 U | 0.63 U | 0.64 U | 0.63 U | 0.63 UJ | 0.63 U |
| Hexachlorobutadiene | 11 | -- | 270 | 4.9 U | 4.9 U | 4.9 U | 5.0 U | 4.8 U | 4.9 U | 4.8 U | 4.8 U | 4.8 U |
| Nonachlor, cis- | -- | -- | -- | 1.6 U | 1.6 U | 1.6 U | 1.7 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U |
| Nonachlor, trans- | -- | -- | -- | 4.7 U | 4.7 U | 4.7 U | 4.8 U | 4.7 U | 4.7 U | 4.6 U | 4.6 U | 4.6 U |
| Oxychlordane | -- | -- | -- | 2.3 U | 2.3 U | 2.3 U | 2.3 U | 2.3 U | 2.3 U | 2.2 U | 2.2 U | 2.2 U |
| Sum 4,4' DDT, DDE, DDD (U = 0) | -- | 50 | 69 | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U |
| Total Chlordane (U = 0) | 2.8 | 37 | -- | 4.7 U | 4.7 U | 4.7 U | 4.8 U | 4.7 U | 4.7 U | 4.6 U | 4.6 U | 4.6 U |
| **PCB Aroclors (µg/kg)** | | | | | | | | | | | | |
| Aroclor 1016 | -- | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Aroclor 1221 | -- | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Aroclor 1232 | -- | -- | -- | 19 U | 19 U | 20 U | 29 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Aroclor 1242 | -- | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Aroclor 1248 | -- | -- | -- | 58 U | 38 U | 20 U | 19 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Aroclor 1254 | -- | -- | -- | **88** | 48 U | 20 U | 29 U | 28 U | 19 U | **22** | 18 U | 20 U |
| Aroclor 1260 | -- | -- | -- | **33** | **22** | 20 U | 19 U | 19 U | 19 U | 19 U | 18 U | 20 U |
| Total PCB Aroclors (U = 0) | 130 | -- | 3100 | **121** | **22** | 20 U | 29 U | 28 U | 19 U | **22** | 18 U | 20 U |

**Table 3**
**Sediment Results Compared to DMMP Criteria from Kenmore Navigation Channel and North Lake Marina**

| Location ID | | | | SG-02 | SG-03 | SG-04 | SG-05 | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | | | | North Lake Marina | | Kenmore Navigation Channel | | | | | | |
| Sample ID | | | | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 |
| Sample Date | | | | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| Sample Interval | | | | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm | 0-25 cm |
| | DMMP SL | DMMP BT | DMMP ML | | | | | | | | | |
| **PCB Aroclors (mg/kg-OC)** | | | | | | | | | | | | |
| Total PCB Aroclors (U = 0) | -- | 38 | -- | **1.7** | **0.33** | 0.73 U | 0.53 U | 0.57 U | 0.38 U | **0.31** | 0.55 U | 0.38 U |
| **Dioxin Furans (ng/kg)** | | | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | -- | **0.975 J** | **0.599 J** | **0.15 J** | **0.322 J** | **0.478 J** | **0.306 J** | **0.341 J** | **0.293 J** | **0.372 J** |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | -- | **7.83** | **3.75** | **0.381 J** | **1.33** | **1.58** | **1.18** | **1.03** | **0.870 J** | **1.24** |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | -- | **14.5** | **6.97** | **0.491 J** | **2.18** | **2.65** | **1.42 J** | **1.38 J** | **1.36 J** | **1.71 J** |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | -- | **53.1** | **28.0** | **1.62 J** | **8.58** | **9.51** | **4.38** | **4.21** | **3.85** | **5.03** |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | -- | **29.5** | **14.5** | **0.897 J** | **4.84** | **5.68** | **2.85** | **2.95** | **2.99** | **3.54** |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | -- | **1020** | **610** | **40.5** | **184** | **237** | **85.5** | **82.7** | **88.5** | **103** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | -- | -- | -- | **7420** | **4760** | **307** | **1540** | **2520** | **652** | **613** | **684** | **798** |
| Total Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | -- | **14.9 J** | **9.77 J** | **1.13 J** | **4.22 J** | **4.89 J** | **4.25 J** | **3.82 J** | **3.33 J** | **4.12 J** |
| Total Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | -- | **43.9** | **26.5** | **2.51 J** | **9.38 J** | **9.24 J** | **8.33 J** | **7.29 J** | **6.12 J** | **7.92 J** |
| Total Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | -- | **334** | **206** | **16.1** | **60.4** | **70.1** | **31.4 J** | **30.2 J** | **27.2 J** | **35.0 J** |
| Total Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | -- | **2260** | **1620** | **134** | **473** | **803** | **167** | **155** | **160** | **191** |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | -- | -- | -- | **3.37** | **2.13** | **0.173 J** | **0.841 J** | **0.967 J** | **0.643 J** | **0.579 J** | **0.553 J** | **0.784 J** |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | -- | **3.04** | **1.71 J** | **0.164 J** | **0.684 J** | **0.746 J** | **0.442 J** | **0.466 J** | **0.409 J** | **0.577 J** |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | -- | **3.27** | **1.86** | **0.128 J** | **0.785 J** | **0.826 J** | **0.452 J** | **0.556 J** | **0.540 J** | **0.573 J** |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | -- | **8.04** | **4.83** | **0.289 J** | **1.74 J** | **1.90 J** | **1.20 J** | **1.05 J** | **1.30 J** | **1.43 J** |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | -- | **8.28** | **4.02** | **0.261 J** | **1.45 J** | **1.64 J** | **0.989 J** | **0.958 J** | **0.964 J** | **1.23 J** |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | -- | -- | -- | **3.12** | **1.8 J** | **0.185 J** | **0.751 J** | **0.846 J** | **0.386 J** | **0.411 J** | **0.366 J** | **0.497 J** |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | -- | **11.7** | **6.21** | **0.361 J** | **2.14** | **2.55** | **1.40 J** | **1.34 J** | **1.37 J** | **1.74 J** |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | -- | -- | -- | **137** | **84.1** | **4.39** | **25.4** | **31.3** | **14.6** | **14.6** | **18.7** | **17.7** |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | -- | -- | -- | **7.34** | **4.63** | **0.315 J** | **1.63 J** | **1.98 J** | **1.06 J** | **1.14 J** | **1.83 J** | **1.33 J** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | -- | -- | -- | **366** | **272** | **10.8** | **71.9** | **108** | **40.9** | **39.5** | **66.0** | **46.6** |
| Total Tetrachlorodibenzofuran (TCDF) | -- | -- | -- | **55.5 J** | **32.2 J** | **2.12 J** | **13.8 J** | **15.5 J** | **11.1 J** | **10.3 J** | **9.21 J** | **12.2 J** |
| Total Pentachlorodibenzofuran (PeCDF) | -- | -- | -- | **119** | **59.4 J** | **3.51 J** | **22.5 J** | **24.5 J** | **14.8 J** | **14.2 J** | **12.8 J** | **17.1 J** |
| Total Hexachlorodibenzofuran (HxCDF) | -- | -- | -- | **240** | **136 J** | **7.38 J** | **45.2** | **51.1 J** | **25.8 J** | **25.6** | **25.7 J** | **30.6 J** |
| Total Heptachlorodibenzofuran (HpCDF) | -- | -- | -- | **404** | **273** | **13.1 J** | **79.2** | **104** | **43.8** | **43.3** | **57.2 J** | **52.8 J** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0) | 4 - 10[a] | -- | 10 | **37.0 J** | **20.3 J** | **1.6 J** | **6.8 J** | **8.4 J** | **4.2 J** | **4.0 J** | **3.9 J** | **4.9 J** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2) | 4 - 10[a] | -- | 10 | **37.0 J** | **20.3 J** | **1.6 J** | **6.8 J** | **8.4 J** | **4.2 J** | **4.0 J** | **3.9 J** | **4.9 J** |

Notes:

a Non-dispersive Screening Levels. DMMUs with dioxin concentrations below 10 ng/kg TEQ will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 ng/kg TEQ

Detected concentration is greater than DMMP Marine SL (screening level)

Detected concentration is greater than DMMP Marine BT (bioaccumulation trigger)

Detected concentration is greater than DMMP Marine ML (maximum level)

All non-detect pesticides and dioxin/furan data were reported at the **method detection limit**; all other non-detect data were reported at the **reporting limit**. Non-detect exceedances are not highlighted.

Totals are calculated as the sum of all detected results (U=0). If all results are not detected, the highest reporting limit value is reported as the sum.

Totals are calculated as the sum of all detected results and 1/2 the undetected reporting limit (U=1/2). If all results are not detected, the highest reporting limit value is reported as the sum.

Total LPAH (Low PAH) are the total of Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. 2-Methylnapthalene is not included in the sum of LPAHs.

Total HPAH (High PAH) are the total of Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene.

Sum 4,4' DDT, DDE, DDD consists of the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

Total Chlordane includes alpha-chlordane (cis-chlordane), beta-chlordane (trans-chlordane), cis-nonaclor, trans-nonaclor, and oxychlordane.

Total DMMP PCB Aroclors is the total of all PCB Aroclors listed in this table.

Dioxin/Furan Toxicity Equivalency (TEQ) values as of 2005, World Health Organization.

USEPA Stage 2A validation was performed by Anchor QEA on all compounds, except dioxin/furans.

USEPA Stage 4 validation was performed by LDC on dioxin/furans.

**Bold = Detected result**

-- = results not reported or not applicable

% = percent
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
BT = bioaccumulation trigger
cm = centimeter
DMMP = Dredged Material Management Program
HPAH = high polycyclic aromatic hydrocarbons
ID = identification
J = estimated value
LPAH = low polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilogram
mg/kg-OC = milligrams per kilogram, organic carbon normalized
ML = maximum level
ng/kg = nanograms per kilogram
PCB = polychlorinated biphenyl
SL = screening level
TEQ = toxic equivalency
U = compound analyzed, but not detected above detection limit
UJ = compound analyzed, but not detected above estimated detection limit
USEPA = U.S. Environmental Protection Agency

## Table 4
## Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values

| | | Location ID | HT-01 | HT-02 | HT-03 | HT-04 | HT-05 | HT-06 | HT-07 | HT-08 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Log Boom Park Shoreline | | | | | Tributary 0056 | | WDFW Boat Launch |
| | | Sample ID | HT-01-S-C-121106 | HT-02-S-C-121106 | HT-03-S-C-121106 | HT-04-S-C-121106 | HT-05-S-C-121106 | HT-06-S-E-121106 | HT-07-S-E-121106 | HT-08-S-C-121106 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| **Conventional Parameters (%)** | | | | | | | | | | |
| Total organic carbon | -- | -- | **0.240** | **0.484** | **0.770** | **6.20** | **0.531** | **1.25** | **1.72** | **3.08** |
| Total solids | -- | -- | **77.3** | **78.8** | **65.7** | **50.9** | **80.4** | **74.8** | **80.5** | **77.2** |
| Total volatile solids | -- | -- | **0.67** | **1.46** | **7.06** | **19.69** | **2.05** | **1.54** | **1.72** | **1.49** |
| Gravel | -- | -- | **12.1** | **29.8** | **5.6** | **0.4** | **62.9** | **8.3** | **41.1** | **38.0** |
| Sand, Very Coarse | -- | -- | **3.5** | **1.6** | **1.6** | **0.5** | **8.6** | **2.5** | **10.4** | **2.2** |
| Sand, Coarse | -- | -- | **6.3** | **2.4** | **2.0** | **0.8** | **8.1** | **6.9** | **12.7** | **1.8** |
| Sand, Medium | -- | -- | **23.8** | **11.3** | **13.0** | **4.3** | **12.7** | **35.8** | **18.4** | **20.5** |
| Sand, Fine | -- | -- | **45.2** | **35.2** | **22.6** | **26.2** | **4.8** | **32.2** | **11.1** | **28.5** |
| Sand, Very Fine | -- | -- | **6.1** | **17.7** | **48.7** | **54.2** | **0.9** | **8.3** | **3.6** | **5.8** |
| Fines (silt + clay) | -- | -- | **3.0** | **2.0** | **6.3** | **13.6** | **2.0** | **6.1** | **2.7** | **3.2** |
| Silt, Coarse | -- | -- | 3.0 U | 2.0 U | **6.3** | **13.6** | 2.0 U | **3.7** | 2.7 U | 3.2 U |
| Silt, Medium | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.7** | 2.7 U | 3.2 U |
| Silt, Fine | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.6** | 2.7 U | 3.2 U |
| Silt, Very Fine | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.4** | 2.7 U | 3.2 U |
| Clay, Coarse | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.4** | 2.7 U | 3.2 U |
| Clay, Medium | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.2** | 2.7 U | 3.2 U |
| Clay, Fine | -- | -- | 3.0 U | 2.0 U | 0.1 U | 0.1 U | 2.0 U | **0.1** | 2.7 U | 3.2 U |
| **Metals (mg/kg)** | | | | | | | | | | |
| Antimony | -- | -- | 6 UJ | 6 UJ | 7 UJ | 10 UJ | 6 UJ | 7 UJ | 6 UJ | 6 UJ |
| Arsenic | 20 | 51 | 6 U | 6 U | 7 U | 10 U | 6 U | 7 U | 6 U | 6 U |
| Cadmium | 1.1 | 1.5 | 0.2 U | 0.3 U | **0.3** | **0.5** | **0.4** | **0.3** | **0.3** | **0.3** |
| Chromium | 95 | 100 | **17.8 J** | **23.3 J** | **23.0 J** | **27 J** | **20.3 J** | **25.5 J** | **30.1 J** | **29.6 J** |
| Copper | 80 | 830 | **4.3** | **5.6** | **7.6** | **15.2** | **220** | **9.9** | **11.4** | **38.2** |
| Lead | 340 | 430 | **4** | **4** | **10** | **16** | **3** | **6** | **10** | **7** |
| Mercury | 0.28 | 0.75 | 0.03 U | 0.02 U | 0.03 U | **0.23** | 0.02 U | 0.02 U | 0.03 U | 0.02 U |
| Nickel | 60 | 70 | **20** | **24** | **25** | **27** | **36** | **30** | **34** | **28** |
| Selenium | -- | -- | 0.6 U | 0.6 U | 0.7 U | 1 U | 0.6 U | 0.6 U | 0.6 U | 0.6 U |
| Silver | 2 | 2.5 | 0.4 U | 0.4 U | 0.4 U | 0.6 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Zinc | 130 | 400 | **34** | **41** | **58** | **117** | **69** | **53** | **90** | **54** |
| **Organometallic Compounds** | | | | | | | | | | |
| Tributyltin (porewater) μg/L | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Tributyltin (bulk) μg/kg | -- | -- | -- | -- | -- | -- | -- | 3.4 U | 3.7 U | -- |
| **Polycyclic Aromatic Hydrocarbons (μg/kg)** | | | | | | | | | | |
| 1-Methylnaphthalene | -- | -- | 4.6 U | **2.5 J** | **27** | **83** | 4.6 U | 4.7 U | **4.4 J** | 4.6 U |
| 2-Methylnaphthalene | 470 | 560 | 4.6 U | **4.0 J** | **51** | **190** | 4.6 U | **6.1** | **6.7** | **3.5 J** |
| Acenaphthene | 1100 | 1300 | 4.6 U | **3.1 J** | **55** | **120** | 4.6 U | **3.4 J** | 4.9 U | 4.6 U |
| Acenaphthylene | 470 | 640 | 4.6 U | 4.9 U | **3.4 J** | **20** | 4.6 U | 4.7 U | 4.9 U | 4.6 U |
| Anthracene | 1200 | 1600 | 4.6 U | **4.6 J** | **54** | **190** | **3.8 J** | **7.8** | 4.9 U | 4.6 U |

## Table 4
## Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values

| Location ID | | | HT-01 | HT-02 | HT-03 | HT-04 | HT-05 | HT-06 | HT-07 | HT-08 |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | | | Log Boom Park Shoreline | | | | | Tributary 0056 | | WDFW Boat Launch |
| Sample ID | | | HT-01-S-C-121106 | HT-02-S-C-121106 | HT-03-S-C-121106 | HT-04-S-C-121106 | HT-05-S-C-121106 | HT-06-S-E-121106 | HT-07-S-E-121106 | HT-08-S-C-121106 |
| Sample Date | | | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 |
| Sample Interval | | | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Benzo(a)anthracene | 4300 | 5800 | 4.6 U | **6.0** | **75** | **330** | **10** | **38** | **18 J** | **9.6** |
| Benzo(a)pyrene | 3300 | 4800 | 4.6 U | **3.3 J** | **57** | **210** | **5.7** | **42** | **24** | **10** |
| Benzo(b,j,k)fluoranthenes | 600 | 4000 | 4.6 U | **9.0** | **120** | **550** | **16** | **88** | **50** | **25** |
| Benzo(g,h,i)perylene | 4000 | 5200 | 4.6 U | 4.9 U | **34** | **74** | **3.2 J** | **21** | **26** | **6.9** |
| Chrysene | 5900 | 6400 | 4.6 U | **8.0** | **110** | **480** | **18** | **50** | **29** | **15** |
| Dibenzo(a,h)anthracene | 800 | 840 | 4.6 U | 4.9 U | **7.0** | **23** | 4.6 U | **5.8** | 4.9 U | 4.6 U |
| Fluoranthene | 11000 | 15000 | **4.3 J** | **24** | **260** | **1100** | **22** | **100** | **50** | **28** |
| Fluorene | 1000 | 3000 | 4.6 U | **5.8** | **72** | **230** | **2.4 J** | **6.1** | 4.9 U | **3.2 J** |
| Indeno(1,2,3-c,d)pyrene | 4100 | 5300 | 4.6 U | 4.9 U | **25** | **69** | 4.6 U | **19** | **20** | **5.7** |
| Naphthalene | 500 | 1300 | 4.6 U | **6.8** | **97** | **380** | **2.6 J** | **5.8** | **2.8 J** | **3.3 J** |
| Phenanthrene | 6100 | 7600 | **3.1 J** | **20** | **260** | **860** | **8.0** | **51** | **20** | **11** |
| Pyrene | 8800 | 16000 | **3.0 J** | **19** | **170** | **740** | **18** | **85** | **39** | **26** |
| Total LPAH (SEF) (U = 0) | 6600 | 9200 | **3.1 J** | **44 J** | **590 J** | **2000** | **17 J** | **80 J** | **30 J** | **21 J** |
| Total LPAH (SEF) (U = 1/2) | 6600 | 9200 | **17 J** | **47 J** | **590 J** | **2000** | **24 J** | **83 J** | **39 J** | **28 J** |
| Total HPAH (SEF) (U = 0) | 31000 | 55000 | **7.3 J** | **69 J** | **860** | **3600** | **93 J** | **450** | **260 J** | **130** |
| Total HPAH (SEF) (U = 1/2) | 31000 | 55000 | **23 J** | **77 J** | **860** | **3600** | **98 J** | **450** | **260 J** | **130** |
| **Chlorinated Hydrocarbons (µg/kg)** | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| 1,2-Dichlorobenzene | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| 1,3-Dichlorobenzene | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| 1,4-Dichlorobenzene | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| Hexachlorobenzene | -- | -- | 19 U | 20 U | 19 U | **23** | 18 U | 4.9 U | 4.9 U | 18 U |
| Hexachloroethane | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| **Phthalates (µg/kg)** | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 220 | 320 | **16 J** | **18 J** | **66** | **460** | **23** | **110** | **79** | **72** |
| Butylbenzyl phthalate | 260 | 370 | 19 U | 20 U | **16 J** | **65** | 18 U | 19 U | 20 U | **19** |
| Diethyl phthalate | -- | -- | **67** | 49 U | 48 U | 49 U | 46 U | 48 U | 50 U | 46 U |
| Dimethyl phthalate | 46 | 440 | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | **97** |
| Di-n-butyl phthalate | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | **28** |
| Di-n-octyl phthalate | 26 | 45 | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| **Phenols (µg/kg)** | | | | | | | | | | |
| 2,4-Dimethylphenol | -- | -- | 19 UJ | 20 UJ | 19 UJ | 20 UJ | 18 UJ | 19 UJ | 20 UJ | 18 UJ |
| 2-Methylphenol (o-Cresol) | -- | -- | 19 U | 20 U | 19 U | **16 J** | 18 U | 19 U | 20 U | 18 U |
| 4-Methylphenol (p-Cresol) | -- | -- | 38 U | 39 U | **36 J** | **150** | **24 J** | 38 U | 40 U | 37 U |
| Pentachlorophenol | -- | -- | 190 U | 200 U | 190 U | 200 U | 180 U | 190 U | 200 U | 180 U |
| Phenol | -- | -- | 19 U | 20 U | **18 J** | **180** | **10 J** | 19 U | 20 U | 18 U |
| **Miscellaneous Extractables (µg/kg)** | | | | | | | | | | |
| Benzoic acid | -- | -- | 380 U | 390 U | 390 U | **390 J** | 370 U | 380 U | 400 U | 370 U |
| Benzyl alcohol | -- | -- | 19 U | 20 U | **20** | **210** | 18 U | **37** | **19 J** | 18 U |
| Dibenzofuran | 400 | 440 | 4.6 U | **5.5** | **78** | **280** | 4.6 U | **5.6** | 4.9 U | 4.6 U |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | HT-01 | HT-02 | HT-03 | HT-04 | HT-05 | HT-06 | HT-07 | HT-08 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Log Boom Park Shoreline | | | | | Tributary 0056 | | WDFW Boat Launch |
| | | Sample ID | HT-01-S-C-121106 | HT-02-S-C-121106 | HT-03-S-C-121106 | HT-04-S-C-121106 | HT-05-S-C-121106 | HT-06-S-E-121106 | HT-07-S-E-121106 | HT-08-S-C-121106 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Hexachlorobutadiene | -- | -- | 10 UJ | 10 UJ | 10 UJ | 10 UJ | 10 UJ | 4.9 U | 4.9 U | 10 UJ |
| N-Nitrosodiphenylamine | -- | -- | 19 U | 20 U | 19 U | 20 U | 18 U | 19 U | 20 U | 18 U |
| **Pesticides (µg/kg)** | | | | | | | | | | |
| 4,4'-DDD (p,p'-DDD) | -- | -- | -- | -- | -- | -- | -- | 0.66 U | 0.66 U | -- |
| 4,4'-DDE (p,p'-DDE) | -- | -- | -- | -- | -- | -- | -- | 0.60 U | 0.61 U | -- |
| 4,4'-DDT (p,p'-DDT) | -- | -- | -- | -- | -- | -- | -- | 0.93 U | 0.94 U | -- |
| Aldrin | -- | -- | -- | -- | -- | -- | -- | 0.27 U | 0.27 U | -- |
| Chlordane, alpha- (cis-Chlordane) | -- | -- | -- | -- | -- | -- | -- | 0.25 U | 0.25 U | -- |
| Chlordane, beta- (trans-Chlordane) | -- | -- | -- | -- | -- | -- | -- | 0.37 U | 0.38 U | -- |
| Dieldrin | -- | -- | -- | -- | -- | -- | -- | 0.49 U | 0.49 U | -- |
| Heptachlor | -- | -- | -- | -- | -- | -- | -- | 0.64 U | 0.65 U | -- |
| Nonachlor, cis- | -- | -- | -- | -- | -- | -- | -- | 2.6 U | 2.6 U | -- |
| Nonachlor, trans- | -- | -- | -- | -- | -- | -- | -- | 2.6 U | 2.6 U | -- |
| Oxychlordane | -- | -- | -- | -- | -- | -- | -- | 4.0 U | 4.0 U | -- |
| **PCB Aroclors (µg/kg)** | | | | | | | | | | |
| Aroclor 1016 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1221 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1232 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1242 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1248 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1254 | -- | -- | 18 U | 19 U | 19 U | **28 J** | 17 U | 17 U | 20 U | 17 U |
| Aroclor 1260 | -- | -- | 18 U | 19 U | 19 U | 18 U | 17 U | 17 U | 20 U | 17 U |
| Total PCB Aroclors (U = 0) | 60 | 120 | 18 U | 19 U | 19 U | **28 J** | 17 U | 17 U | 20 U | 17 U |
| **Dioxin Furans (ng/kg)** | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **0.134 J** | **0.168 J** | **0.239 J** | **0.546 J** | **0.151 J** | **0.176 J** | **0.156 J** | **0.148 J** |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | 0.0671 U | **0.158 J** | **0.640 J** | **2.14** | **0.420 J** | **0.274 J** | **0.243 J** | **0.144 J** |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | 0.209 U | **0.137 J** | **0.654 J** | **2.18** | **0.340 J** | **0.374 J** | **0.347 J** | **0.120 J** |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **0.193 J** | **0.434 J** | **2.25** | **8.69** | **0.884 J** | **1.50 J** | **0.911 J** | **0.387 J** |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **0.103 J** | **0.275 J** | **1.29 J** | **4.33** | **0.790 J** | **0.785 J** | **0.660 J** | **0.289 J** |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **3.79** | **9.30** | **38.7** | **178** | **18.4** | **25.4** | **17.1** | **8.06** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | -- | -- | **31.4** | **101** | **272** | **1460** | **136** | **188** | **136** | **59.8** |
| Total Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **0.132 J** | **0.362 J** | **2.56 J** | **7.22 J** | **0.667 J** | **1.26 J** | **1.27 J** | **0.601 J** |
| Total Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **0.170 J** | **0.780 J** | **4.21 J** | **14.3 J** | **2.79 J** | **1.77 J** | **1.68 J** | **0.735 J** |
| Total Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **1.20 J** | **3.17 J** | **16.3 J** | **65.1 J** | **8.55 J** | **9.16 J** | **6.05** | **2.53 J** |
| Total Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **7.37** | **21.4** | **83.9** | **423** | **40.0** | **47.3** | **30.4** | **14.5** |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | -- | -- | 0.0355 U | **0.135 J** | **0.397 J** | **1.41** | 0.0860 U | **0.252 J** | 0.116 U | 0.0818 U |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | 0.0611 U | 0.0990 U | **0.303 J** | **0.871 J** | 0.115 U | **0.204 J** | 0.142 U | 0.0818 UJ |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.0454 J** | **0.0812 J** | **0.317 J** | **1.05** | **0.117 J** | **0.252 J** | **0.156 J** | **0.0758 J** |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.0375 J** | **0.105 J** | **0.459 J** | **1.79 J** | **0.205 J** | **0.559 J** | **0.261 J** | **0.124 J** |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.0493 J** | **0.115 J** | **0.518 J** | **1.78 J** | **0.219 J** | **0.320 J** | **0.221 J** | **0.130 J** |

## Table 4
## Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values

| | | Location ID | HT-01 | HT-02 | HT-03 | HT-04 | HT-05 | HT-06 | HT-07 | HT-08 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Log Boom Park Shoreline | | | | | Tributary 0056 | | WDFW Boat Launch |
| | | Sample ID | HT-01-S-C-121106 | HT-02-S-C-121106 | HT-03-S-C-121106 | HT-04-S-C-121106 | HT-05-S-C-121106 | HT-06-S-E-121106 | HT-07-S-E-121106 | HT-08-S-C-121106 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/6/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.0335 J** | 0.145 U | **0.185 J** | **0.618 J** | **0.127 J** | **0.180 J** | **0.0917 J** | **0.0539 J** |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.0572 J** | **0.129 J** | **0.754 J** | **2.65** | **0.270 J** | **0.503 J** | **0.355 J** | **0.0858 J** |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | -- | -- | **0.643 J** | **1.21 J** | **5.68** | **26.8** | **2.44** | **3.93** | **3.43** | **1.59 J** |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | -- | -- | 0.414 U | **0.0495 J** | **0.349 J** | **1.77 J** | **0.233 J** | **0.302 J** | **0.215 J** | **0.134 J** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | -- | -- | **1.91 J** | **3.44 J** | **11.8** | **71.5** | **7.39** | **8.80** | **9.54** | **3.89 J** |
| Total Tetrachlorodibenzofuran (TCDF) | -- | -- | **0.444 J** | **1.46 J** | **6.63 J** | **25.6 J** | **1.25 J** | **4.09 J** | **4.03 J** | **1.15 J** |
| Total Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.876 J** | **1.84 J** | **9.79 J** | **31.3 J** | **3.87 J** | **6.10 J** | **5.70 J** | **1.56 J** |
| Total Hexachlorodibenzofuran (HxCDF) | -- | -- | **1.18 J** | **2.42 J** | **13.6 J** | **50.5 J** | **4.60 J** | **8.75 J** | **6.85 J** | **2.41 J** |
| Total Heptachlorodibenzofuran (HpCDF) | -- | -- | **1.88** | **3.61 J** | **18.4 J** | **79.5 J** | **6.91 J** | **11.6** | **10.2** | **4.22** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0) | | | **0.25 J** | **0.62 J** | **2.2 J** | **7.9 J** | **1.1 J** | **1.3 J** | **0.98 J** | **0.55 J** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2) | | | **0.30 J** | **0.63 J** | **2.2 J** | **7.9 J** | **1.2 J** | **1.3 J** | **0.99 J** | **0.56 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| Location ID | | | HT-09 | HT-10 | HT-11 | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | | | WDFW Boat Launch | Lyon Creek Park | | Sammamish River | North Lake Marina | | Kenmore Navigation Channel | |
| Sample ID | | | HT-09-S-C-121106 | HT-10-S-LFP-121106 | HT-11-S-LFP-121106 | SG-01-S-C-121107 | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 |
| Sample Date | | | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/7/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| Sample Interval | | | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| **Conventional Parameters (%)** | | | | | | | | | | |
| Total organic carbon | -- | -- | 2.13 | 1.91 | 0.456 | 1.33 | 7.12 | 6.60 | 2.73 | 5.43 |
| Total solids | -- | -- | 67.5 | 80.2 | 83.9 | 72.9 | 25.7 | 25.6 | 80.8 | 35.0 |
| Total volatile solids | -- | -- | 2.57 | 1.18 | 0.91 | 1.19 | 13.51 | 15.15 | 1.72 | 11.13 |
| Gravel | -- | -- | 19.1 | 33.3 | 51.4 | 0.1 U | 0.4 | 11.8 | 71.4 | 3.1 |
| Sand, Very Coarse | -- | -- | 2.0 | 11.0 | 8.1 | 0.2 | 6.5 | 9.2 | 7.6 | 2.9 |
| Sand, Coarse | -- | -- | 1.9 | 22.2 | 15.6 | 2.1 | 5.5 | 7.2 | 6.9 | 5.3 |
| Sand, Medium | -- | -- | 15.2 | 25.8 | 19.3 | 47.4 | 5.5 | 7.2 | 7.6 | 11.1 |
| Sand, Fine | -- | -- | 37.3 | 5.9 | 4.7 | 44.2 | 7.2 | 7.8 | 2.9 | 14.3 |
| Sand, Very Fine | -- | -- | 13.6 | 1.2 | 0.4 | 4.0 | 9.1 | 10.1 | 1.0 | 15.2 |
| Fines (silt + clay) | -- | -- | 10.8 | 0.5 | 0.4 | 2.2 | 65.8 | 46.7 | 2.5 | 48.1 |
| Silt, Coarse | -- | -- | 6.0 | 0.5 U | 0.4 U | -- | 10.0 | 13.1 | -- | 7.7 |
| Silt, Medium | -- | -- | 1.3 | 0.5 U | 0.4 U | -- | 19.3 | 8.4 | -- | 16.0 |
| Silt, Fine | -- | -- | 1.1 | 0.5 U | 0.4 U | -- | 15.2 | 10.9 | -- | 9.9 |
| Silt, Very Fine | -- | -- | 1.1 | 0.5 U | 0.4 U | -- | 11.1 | 7.0 | -- | 7.1 |
| Clay, Coarse | -- | -- | 0.6 | 0.5 U | 0.4 U | -- | 5.6 | 4.5 | -- | 4.3 |
| Clay, Medium | -- | -- | 0.5 | 0.5 U | 0.4 U | -- | 3.2 | 1.8 | -- | 1.9 |
| Clay, Fine | -- | -- | 0.3 | 0.5 U | 0.4 U | -- | 1.4 | 1.1 | -- | 1.3 |
| **Metals (mg/kg)** | | | | | | | | | | |
| Antimony | -- | -- | 7 UJ | 6 UJ | 6 UJ | 6 UJ | 20 U | 20 U | 6 U | 10 U |
| Arsenic | 20 | 51 | 7 U | 6 U | 6 U | 6 UJ | 20 U | 20 U | 6 U | 10 U |
| Cadmium | 1.1 | 1.5 | 0.4 | 0.3 | 0.3 | 0.2 U | 1.3 | 1.2 | 0.3 | 0.7 |
| Chromium | 95 | 100 | 28.8 J | 24.3 J | 22.6 J | 29.3 | 56 | 55 | 35.0 | 43 |
| Copper | 80 | 830 | 21.9 | 8.9 | 8.9 | 5.9 J | 92.4 | 88.1 | 14.6 | 35.6 |
| Lead | 340 | 430 | 11 | 9 | 7 | 4 J | 62 | 42 | 5 | 28 |
| Mercury | 0.28 | 0.75 | 0.03 U | 0.02 U | 0.02 U | 0.03 U | 0.18 | 0.1 | 0.02 U | 0.08 |
| Nickel | 60 | 70 | 26 | 27 | 30 | 23 | 48 | 45 | 30 | 39 |
| Selenium | -- | -- | 0.7 U | 0.6 U | 0.6 U | 0.6 U | 2 U | 2 U | 0.6 U | 1 U |
| Silver | 2 | 2.5 | 0.4 U | 0.3 U | 0.4 U | 0.4 U | 1 U | 1 U | 0.4 U | 0.9 U |
| Zinc | 130 | 400 | 64 | 59 | 55 | 43 J | 231 | 267 | 49 | 143 |
| **Organometallic Compounds** | | | | | | | | | | |
| Tributyltin (porewater) µg/L | -- | -- | -- | -- | -- | -- | 0.67 | 0.058 | 0.049 | 0.008 |
| Tributyltin (bulk) µg/kg | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Polycyclic Aromatic Hydrocarbons (µg/kg)** | | | | | | | | | | |
| 1-Methylnaphthalene | -- | -- | 3.0 J | 4.8 U | 4.8 U | 4.8 U | 21 | 9.8 J | 20 U | 13 J |
| 2-Methylnaphthalene | 470 | 560 | 5.8 | 4.8 U | 4.8 U | 4.8 U | 31 | 25 | 20 U | 26 |
| Acenaphthene | 1100 | 1300 | 4.8 U | 4.8 U | 4.8 U | 4.8 U | 320 | 33 | 14 J | 26 |
| Acenaphthylene | 470 | 640 | 4.8 U | 4.8 U | 4.8 U | 4.8 U | 22 | 16 J | 20 U | 20 U |
| Anthracene | 1200 | 1600 | 3.7 J | 4.8 U | 4.8 U | 4.8 U | 66 | 68 | 26 | 39 |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | HT-09 | HT-10 | HT-11 | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | WDFW Boat Launch | Lyon Creek Park | | Sammamish River | North Lake Marina | | Kenmore Navigation Channel | |
| | | Sample ID | HT-09-S-C-121106 | HT-10-S-LFP-121106 | HT-11-S-LFP-121106 | SG-01-S-C-121107 | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/7/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Benzo(a)anthracene | 4300 | 5800 | 24 | 18 J | 4.8 U | 15 J | 210 | 190 | 81 | 110 |
| Benzo(a)pyrene | 3300 | 4800 | 25 | 21 | 4.8 U | 15 J | 190 | 160 | 62 | 76 |
| Benzo(b,j,k)fluoranthenes | 600 | 4000 | 64 | 44 | 2.5 J | 35 J | 530 | 420 | 140 | 220 |
| Benzo(g,h,i)perylene | 4000 | 5200 | 24 | 19 | 4.8 U | 3.2 J | 170 | 130 | 43 | 63 |
| Chrysene | 5900 | 6400 | 35 | 26 | 2.4 J | 20 | 440 | 340 | 110 | 190 |
| Dibenzo(a,h)anthracene | 800 | 840 | 3.8 J | 4.8 U | 4.8 U | 4.8 U | 67 | 55 | 15 J | 21 |
| Fluoranthene | 11000 | 15000 | 63 | 56 | 3.0 J | 51 | 480 | 410 | 220 | 310 |
| Fluorene | 1000 | 3000 | 4.2 J | 4.8 U | 4.8 U | 4.8 U | 98 | 46 | 14 J | 37 |
| Indeno(1,2,3-c,d)pyrene | 4100 | 5300 | 19 | 16 J | 4.8 U | 3.6 J | 140 | 110 | 39 | 51 |
| Naphthalene | 500 | 1300 | 4.2 J | 4.8 U | 4.8 U | 4.8 U | 83 | 58 | 20 U | 50 |
| Phenanthrene | 6100 | 7600 | 48 | 29 | 4.8 U | 26 | 170 | 190 | 140 | 180 |
| Pyrene | 8800 | 16000 | 68 | 41 | 20 U | 39 | 590 | 440 | 190 | 300 |
| Total LPAH (SEF) (U = 0) | 6600 | 9200 | 66 J | 29 | 4.8 U | 26 | 790 | 440 J | 190 J | 360 |
| Total LPAH (SEF) (U = 1/2) | 6600 | 9200 | 71 J | 43 | 4.8 U | 40 | 790 | 440 J | 220 J | 370 |
| Total HPAH (SEF) (U = 0) | 31000 | 55000 | 330 J | 240 J | 7.9 J | 180 J | 2800 | 2300 | 900 J | 1300 |
| Total HPAH (SEF) (U = 1/2) | 31000 | 55000 | 330 J | 240 J | 30 J | 180 J | 2800 | 2300 | 900 J | 1300 |
| **Chlorinated Hydrocarbons (µg/kg)** | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| 1,2-Dichlorobenzene | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| 1,3-Dichlorobenzene | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| 1,4-Dichlorobenzene | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| Hexachlorobenzene | -- | -- | 19 U | 19 U | 20 U | 19 U | 4.9 U | 4.9 U | 4.9 U | 5.0 U |
| Hexachloroethane | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| **Phthalates (µg/kg)** | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 220 | 320 | 130 | 31 | 21 J | 28 | 680 | 510 | 62 U | 260 |
| Butylbenzyl phthalate | 260 | 370 | 19 U | 19 U | 20 U | 19 U | 32 | 32 | 20 U | 20 U |
| Diethyl phthalate | -- | -- | 48 U | 48 U | 49 U | 48 U | 49 U | 38 J | 49 U | 49 U |
| Dimethyl phthalate | 46 | 440 | 970 | 19 U | 20 U | 19 U | 28 | 20 U | 20 U | 20 U |
| Di-n-butyl phthalate | -- | -- | 17 J | 19 U | 20 U | 19 U | 19 U | 9.8 J | 20 U | 20 U |
| Di-n-octyl phthalate | 26 | 45 | 15 J | 19 U | 20 U | 19 U | 19 U | 58 J | 20 U | 22 J |
| **Phenols (µg/kg)** | | | | | | | | | | |
| 2,4-Dimethylphenol | -- | -- | 19 UJ | 19 UJ | 20 UJ | 19 UJ | 19 UJ | 20 UJ | 20 UJ | 20 UJ |
| 2-Methylphenol (o-Cresol) | -- | -- | 19 U | 19 U | 20 U | 19 UJ | 19 U | 20 U | 20 UJ | 20 U |
| 4-Methylphenol (p-Cresol) | -- | -- | 38 U | 39 U | 39 U | 38 U | 74 | 76 | 39 U | 74 |
| Pentachlorophenol | -- | -- | 190 U | 190 U | 200 U | 190 U | 190 U | 200 U | 200 U | 200 U |
| Phenol | -- | -- | 11 J | 19 U | 20 U | 19 U | 19 U | 110 | 20 U | 180 |
| **Miscellaneous Extractables (µg/kg)** | | | | | | | | | | |
| Benzoic acid | -- | -- | 140 J | 390 U | 390 U | 380 U | 960 | 1300 | 390 U | 1300 |
| Benzyl alcohol | -- | -- | 23 | 19 U | 20 U | 19 U | 82 | 130 | 20 U | 160 |
| Dibenzofuran | 400 | 440 | 4.8 U | 4.8 U | 4.8 U | 4.8 U | 30 | 35 | 20 U | 28 |

## Table 4
## Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values

| | | Location ID | HT-09 | HT-10 | HT-11 | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | WDFW Boat Launch | Lyon Creek Park | | Sammamish River | North Lake Marina | | Kenmore Navigation Channel | |
| | | Sample ID | HT-09-S-C-121106 | HT-10-S-LFP-121106 | HT-11-S-LFP-121106 | SG-01-S-C-121107 | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/7/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Hexachlorobutadiene | -- | -- | 10 UJ | 10 UJ | 10 UJ | 10 UJ | 4.9 U | 4.9 U | 4.9 U | 5.0 U |
| N-Nitrosodiphenylamine | -- | -- | 19 U | 19 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U |
| **Pesticides (µg/kg)** | | | | | | | | | | |
| 4,4'-DDD (p,p'-DDD) | -- | -- | -- | -- | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U |
| 4,4'-DDE (p,p'-DDE) | -- | -- | -- | -- | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U |
| 4,4'-DDT (p,p'-DDT) | -- | -- | -- | -- | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U |
| Aldrin | -- | -- | -- | -- | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.65 U |
| Chlordane, alpha- (cis-Chlordane) | -- | -- | -- | -- | -- | -- | 0.83 U | 0.83 U | 0.83 U | 0.84 U |
| Chlordane, beta- (trans-Chlordane) | -- | -- | -- | -- | -- | -- | 0.78 U | 0.78 U | 0.77 U | 0.79 U |
| Dieldrin | -- | -- | -- | -- | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U |
| Heptachlor | -- | -- | -- | -- | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.65 U |
| Nonachlor, cis- | -- | -- | -- | -- | -- | -- | 1.6 U | 1.6 U | 1.6 U | 1.7 U |
| Nonachlor, trans- | -- | -- | -- | -- | -- | -- | 4.7 U | 4.7 U | 4.7 U | 4.8 U |
| Oxychlordane | -- | -- | -- | -- | -- | -- | 2.3 U | 2.3 U | 2.3 U | 2.3 U |
| **PCB Aroclors (µg/kg)** | | | | | | | | | | |
| Aroclor 1016 | -- | -- | 19 U | 19 U | 19 U | 17 U | 19 U | 19 U | 20 U | 19 U |
| Aroclor 1221 | -- | -- | 19 U | 19 U | 19 U | 17 U | 19 U | 19 U | 20 U | 19 U |
| Aroclor 1232 | -- | -- | 19 U | 19 U | 19 U | 17 U | 19 U | 19 U | 20 U | 29 U |
| Aroclor 1242 | -- | -- | 19 U | 19 U | 19 U | 17 U | 19 U | 19 U | 20 U | 19 U |
| Aroclor 1248 | -- | -- | 19 U | 19 U | 19 U | 17 U | 58 U | 38 U | 20 U | 19 U |
| Aroclor 1254 | -- | -- | 19 U | 19 U | 19 U | 17 U | **88** | 48 U | 20 U | 29 U |
| Aroclor 1260 | -- | -- | 19 U | 19 U | 19 U | 17 U | **33** | **22** | 20 U | 19 U |
| Total PCB Aroclors (U = 0) | 60 | 120 | 19 U | 19 U | 19 U | 17 U | **121** | **22** | 20 U | 29 U |
| **Dioxin Furans (ng/kg)** | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **0.183 J** | **0.168 J** | **0.153 J** | **0.164 J** | **0.975 J** | **0.599 J** | **0.150 J** | **0.322 J** |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **0.305 J** | **0.117 J** | 0.0660 U | **0.107 J** | **7.83** | **3.75** | **0.381 J** | **1.33** |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **0.414 J** | 0.303 U | **0.0718 J** | **0.0809 J** | **14.5** | **6.97** | **0.491 J** | **2.18** |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **1.25 J** | **0.377 J** | **0.312 J** | **0.310 J** | **53.1** | **28.0** | **1.62 J** | **8.58** |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **0.825 J** | **0.245 J** | **0.103 J** | **0.219 J** | **29.5** | **14.5** | **0.897 J** | **4.84** |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **24.8** | **6.32** | **5.45** | **5.70** | **1020** | **610** | **40.5** | **184** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | -- | -- | **169** | **40.1** | **44.9** | **40.5** | **7420** | **4760** | **307** | **1540** |
| Total Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **1.70 J** | **0.338 J** | **0.341 J** | **0.395 J** | **14.9 J** | **9.77 J** | **1.13 J** | **4.22 J** |
| Total Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **2.15 J** | **0.617 J** | **0.293 J** | **0.391 J** | **43.9** | **26.5** | **2.51 J** | **9.38 J** |
| Total Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **8.76** | **2.30 J** | **1.76 J** | **2.07 J** | **334** | **206** | **16.1** | **60.4** |
| Total Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **47.3** | **11.0** | **14.0** | **10.9** | **2260** | **1620** | **134** | **473** |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | -- | -- | **0.175 J** | 0.0751 U | 0.153 U | 0.0691 U | **3.37** | **2.13** | **0.173 J** | **0.841 J** |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.159 J** | 0.0909 U | 0.0563 U | **0.0770 J** | **3.04** | **1.71 J** | **0.164 J** | **0.684 J** |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.165 J** | **0.146 J** | **0.0466 J** | **0.0592 J** | **3.27** | **1.86** | **0.128 J** | **0.785 J** |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.556 J** | **0.136 J** | **0.0834 J** | **0.154 J** | **8.04** | **4.83** | **0.289 J** | **1.74 J** |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.373 J** | **0.119 J** | **0.0660 J** | **0.0573 J** | **8.28** | **4.02** | **0.261 J** | **1.45 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | HT-09 | HT-10 | HT-11 | SG-01 | SG-02 | SG-03 | SG-04 | SG-05 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | WDFW Boat Launch | Lyon Creek Park | | Sammamish River | North Lake Marina | | Kenmore Navigation Channel | |
| | | Sample ID | HT-09-S-C-121106 | HT-10-S-LFP-121106 | HT-11-S-LFP-121106 | SG-01-S-C-121107 | SG-02-S-C-121108 | SG-03-S-C-121108 | SG-04-S-C-121108 | SG-05-S-C-121108 |
| | | Sample Date | 11/6/2012 | 11/6/2012 | 11/6/2012 | 11/7/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 |
| | | Sample Interval | 0-10 cm | 0-10 cm | 0-10 cm | 0-10 cm | 0-22 cm | 0-25 cm | 0-15 cm | 0-23 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.265 J** | 0.140 U | 0.162 U | 0.0573 U | **3.12** | **1.80 J** | **0.185 J** | **0.751 J** |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **0.534 J** | **0.128 J** | **0.134 J** | **0.0553 J** | **11.7** | **6.21** | **0.361 J** | **2.14** |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | -- | -- | **6.28** | **1.05 J** | **0.840 J** | **1.19 J** | **137** | **84.1** | **4.39** | **25.4** |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | -- | -- | **0.574 J** | **0.0652 J** | **0.0272 J** | **0.0454 J** | **7.34** | **4.63** | **0.315 J** | **1.63 J** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | -- | -- | **14.0** | **2.38 J** | **1.61 J** | **2.67 J** | **366** | **272** | **10.8** | **71.9** |
| Total Tetrachlorodibenzofuran (TCDF) | -- | -- | **2.79 J** | **2.82 J** | **0.720 J** | **0.679 J** | **55.5 J** | **32.2 J** | **2.12 J** | **13.8 J** |
| Total Pentachlorodibenzofuran (PeCDF) | -- | -- | **4.39 J** | **2.74 J** | **2.97 J** | **1.28 J** | **119** | **59.4 J** | **3.51 J** | **22.5 J** |
| Total Hexachlorodibenzofuran (HxCDF) | -- | -- | **11.2 J** | **2.46 J** | **2.49 J** | **2.43 J** | **240** | **136 J** | **7.38 J** | **45.2** |
| Total Heptachlorodibenzofuran (HpCDF) | -- | -- | **19.5** | **2.73 J** | **2.23 J** | **3.28 J** | **404** | **273** | **13.1 J** | **79.2** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0) | | | **1.4 J** | **0.52 J** | **0.32 J** | **0.46 J** | **37.0 J** | **20.3 J** | **1.6 J** | **6.8 J** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2) | | | **1.4 J** | **0.54 J** | **0.37 J** | **0.47 J** | **37.0 J** | **20.3 J** | **1.6 J** | **6.8 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| Location ID | | | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | SG-12 |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | | | Kenmore Navigation Channel | | | | | Harbour Village Marina | | |
| Sample ID | | | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 | SG-10-S-E-121107 | SG-11-S-E-121107 | SG-12-S-E-121107 |
| Sample Date | | | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| Sample Interval | | | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| **Conventional Parameters (%)** | | | | | | | | | | |
| Total organic carbon | -- | -- | 4.89 | 4.95 | 7.07 | 3.30 | 5.22 | 3.14 | 10.8 | 4.65 |
| Total solids | -- | -- | 29.9 | 33.7 | 34.3 | 42.0 | 35.7 | 56.1 | 16.9 | 27.4 |
| Total volatile solids | -- | -- | 13.89 | 13.40 | 14.11 | 9.10 | 10.58 | 6.51 | 24.10 | 13.67 |
| Gravel | -- | -- | 0.1 U | 0.5 | 2.6 | 0.3 | 0.1 | 5.3 | 0.1 U | 0.6 |
| Sand, Very Coarse | -- | -- | 7.4 | 2.7 | 2.7 | 1.5 | 2.1 | 3.0 | 5.3 | 4.2 |
| Sand, Coarse | -- | -- | 6.6 | 3.1 | 2.8 | 1.5 | 1.7 | 3.9 | 4.6 | 3.8 |
| Sand, Medium | -- | -- | 6.2 | 6.3 | 6.0 | 3.9 | 6.9 | 13.2 | 4.4 | 3.5 |
| Sand, Fine | -- | -- | 8.6 | 24.4 | 21.9 | 22.2 | 15.9 | 26.5 | 5.6 | 5.2 |
| Sand, Very Fine | -- | -- | 15.9 | 18.9 | 18.6 | 21.2 | 13.4 | 21.9 | 7.4 | 11.6 |
| Fines (silt + clay) | -- | -- | 55.2 | 44.1 | 45.4 | 49.3 | 59.7 | 26.4 | 72.7 | 71.1 |
| Silt, Coarse | -- | -- | 8.6 | 11.0 | 13.7 | 13.0 | 19.7 | 17.2 | 18.6 | 22.9 |
| Silt, Medium | -- | -- | 15.5 | 12.1 | 11.0 | 13.7 | 12.9 | 3.9 | 20.2 | 22.9 |
| Silt, Fine | -- | -- | 12.1 | 7.9 | 7.6 | 8.4 | 10.9 | 1.9 | 14.3 | 12.5 |
| Silt, Very Fine | -- | -- | 7.8 | 5.9 | 6.1 | 6.3 | 7.6 | 1.4 | 10.9 | 6.2 |
| Clay, Coarse | -- | -- | 6.3 | 3.8 | 3.9 | 3.9 | 4.7 | 1.0 | 5.1 | 3.4 |
| Clay, Medium | -- | -- | 3.2 | 2.5 | 2.1 | 2.6 | 2.6 | 0.5 | 2.6 | 2.0 |
| Clay, Fine | -- | -- | 1.6 | 0.9 | 0.9 | 1.4 | 1.3 | 0.5 | 1.1 | 1.0 |
| **Metals (mg/kg)** | | | | | | | | | | |
| Antimony | -- | -- | 20 U | 10 U | 10 U | 10 U | 10 U | 9 UJ | 30 UJ | 20 UJ |
| Arsenic | 20 | 51 | 20 U | 10 U | 10 U | 10 U | 10 U | 9 UJ | 30 UJ[a] | 20 UJ |
| Cadmium | 1.1 | 1.5 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 | 0.4 | 1 U | 0.7 U |
| Chromium | 95 | 100 | 57 | 41 | 44 | 44 | 48 | 29.8 | 52 | 44 |
| Copper | 80 | 830 | 43.6 | 30.0 | 28.7 | 28.0 | 31.1 | 18.8 J | 97 J | 47.5 J |
| Lead | 340 | 430 | 31 | 21 | 21 | 21 | 24 | 19 J | 50 J | 27 J |
| Mercury | 0.28 | 0.75 | 0.10 | 0.11 | 0.08 | 0.07 | 0.08 | 0.04 | 0.1 | 0.1 |
| Nickel | 60 | 70 | 46 | 41 | 42 | 40 | 43 | 33 | 47 | 41 |
| Selenium | -- | -- | 2 U | 1 U | 1 U | 1 U | 1 U | 0.9 U | 3 U | 2 U |
| Silver | 2 | 2.5 | 1 U | 0.9 U | 0.8 U | 0.7 U | 0.9 U | 0.5 U | 2 U | 1 U |
| Zinc | 130 | 400 | 164 | 126 | 123 | 113 | 130 | 97 J | 377 J | 185 J |
| **Organometallic Compounds** | | | | | | | | | | |
| Tributyltin (porewater) µg/L | -- | -- | 0.023 | 0.005 U | 0.005 U | 0.005 U | 0.005 U | -- | -- | -- |
| Tributyltin (bulk) µg/kg | -- | -- | -- | -- | -- | -- | -- | 3.6 U | 9.8 | 6.8 |
| **Polycyclic Aromatic Hydrocarbons (µg/kg)** | | | | | | | | | | |
| 1-Methylnaphthalene | -- | -- | 20 U | 20 U | 19 U | 9.6 J | 20 U | 5.5 | 13 J | 5.2 |
| 2-Methylnaphthalene | 470 | 560 | 14 J | 20 U | 19 U | 19 U | 20 U | 12 | 47 | 13 |
| Acenaphthene | 1100 | 1300 | 17 J | 20 U | 19 U | 19 U | 20 U | 14 | 32 | 18 J |
| Acenaphthylene | 470 | 640 | 20 U | 20 U | 19 U | 19 U | 20 U | 3.5 J | 19 J | 5.7 |
| Anthracene | 1200 | 1600 | 28 | 18 J | 19 U | 19 U | 20 U | 57 | 66 | 41 |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | SG-12 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Kenmore Navigation Channel | | | | | Harbour Village Marina | | |
| | | Sample ID | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 | SG-10-S-E-121107 | SG-11-S-E-121107 | SG-12-S-E-121107 |
| | | Sample Date | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Benzo(a)anthracene | 4300 | 5800 | 110 | 110 | 52 | 42 | 40 | 200 | 200 | 120 |
| Benzo(a)pyrene | 3300 | 4800 | 120 | 63 | 55 | 50 | 45 | 190 | 210 | 110 |
| Benzo(b,j,k)fluoranthenes | 600 | 4000 | 300 | 170 | 140 | 120 | 120 | 400 | 570 | 290 |
| Benzo(g,h,i)perylene | 4000 | 5200 | 93 | 36 | 41 | 41 | 36 | 140 | 110 | 85 |
| Chrysene | 5900 | 6400 | 190 | 140 | 82 | 73 | 72 | 290 | 370 | 210 |
| Dibenzo(a,h)anthracene | 800 | 840 | 37 | 17 J | 12 J | 11 J | 13 J | 34 | 45 | 36 |
| Fluoranthene | 11000 | 15000 | 290 | 150 | 140 | 130 | 120 | 480 | 430 | 300 |
| Fluorene | 1000 | 3000 | 28 | 12 J | 9.7 J | 19 U | 20 U | 28 | 38 | 59 |
| Indeno(1,2,3-c,d)pyrene | 4100 | 5300 | 81 | 33 | 38 | 36 | 33 | 110 | 90 | 77 |
| Naphthalene | 500 | 1300 | 38 | 18 J | 25 | 14 J | 24 | 38 | 39 | 39 |
| Phenanthrene | 6100 | 7600 | 140 | 72 | 68 | 64 | 59 | 260 | 210 | 170 |
| Pyrene | 8800 | 16000 | 290 | 140 | 130 | 120 | 120 | 800 | 470 | 230 |
| Total LPAH (SEF) (U = 0) | 6600 | 9200 | 260 J | 120 J | 100 J | 78 J | 83 | 410 J | 450 J | 350 J |
| Total LPAH (SEF) (U = 1/2) | 6600 | 9200 | 270 J | 150 J | 140 J | 130 J | 130 | 410 J | 450 J | 350 J |
| Total HPAH (SEF) (U = 0) | 31000 | 55000 | 1500 | 860 J | 690 J | 620 J | 600 J | 2600 | 2500 | 1500 |
| Total HPAH (SEF) (U = 1/2) | 31000 | 55000 | 1500 | 860 J | 690 J | 620 J | 600 J | 2600 | 2500 | 1500 |
| **Chlorinated Hydrocarbons (µg/kg)** | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| 1,2-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| 1,3-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| 1,4-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| Hexachlorobenzene | -- | -- | 4.8 U | 4.9 U | 4.8 U | 4.8 U | 4.8 U | 4.8 U | 3.9 U | 4.9 U |
| Hexachloroethane | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| **Phthalates (µg/kg)** | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 220 | 320 | 540 | 330 | 300 | 240 | 240 | 480 | 740 | 360 |
| Butylbenzyl phthalate | 260 | 370 | 57 | 28 | 19 U | 36 | 29 | 20 U | 24 | 71 |
| Diethyl phthalate | -- | -- | 58 | 49 U | 48 U | 48 U | 49 U | 50 U | 44 J | 100 |
| Dimethyl phthalate | 46 | 440 | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| Di-n-butyl phthalate | -- | -- | 20 U | 20 U | 12 J | 19 U | 20 U | 20 U | 20 U | 26 |
| Di-n-octyl phthalate | 26 | 45 | 41 J | 22 J | 19 U | 19 U | 20 U | 20 U | 87 | 20 U |
| **Phenols (µg/kg)** | | | | | | | | | | |
| 2,4-Dimethylphenol | -- | -- | 20 UJ | 20 UJ | 19 UJ | 19 UJ | 20 UJ | 20 UJ | 20 UJ | 20 UJ |
| 2-Methylphenol (o-Cresol) | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 11 J | 12 J |
| 4-Methylphenol (p-Cresol) | -- | -- | 91 | 54 | 31 J | 22 J | 36 J | 160 | 150 | 74 |
| Pentachlorophenol | -- | -- | 200 U | 200 U | 190 U | 190 U | 200 U | 200 U | 55 J | 200 U |
| Phenol | -- | -- | 80 | 42 | 42 | 19 | 39 | 55 | 140 | 300 |
| **Miscellaneous Extractables (µg/kg)** | | | | | | | | | | |
| Benzoic acid | -- | -- | 1100 | 430 | 480 | 300 J | 510 | 520 | 1400 | 1500 |
| Benzyl alcohol | -- | -- | 190 | 120 | 100 | 61 | 110 | 200 | 530 | 300 |
| Dibenzofuran | 400 | 440 | 20 U | 20 U | 19 U | 19 U | 20 U | 19 | 24 | 13 |

## Table 4
## Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values

| | | Location ID | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | SG-12 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Kenmore Navigation Channel | | | | | Harbour Village Marina | | |
| | | Sample ID | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 | SG-10-S-E-121107 | SG-11-S-E-121107 | SG-12-S-E-121107 |
| | | Sample Date | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| Hexachlorobutadiene | -- | -- | 4.8 U | 4.9 U | 4.8 U | 4.8 U | 4.8 U | 4.8 U | 3.9 U | 10 UJ |
| N-Nitrosodiphenylamine | -- | -- | 20 U | 20 U | 19 U | 19 U | 20 U | 20 U | 20 U | 20 U |
| **Pesticides (µg/kg)** | | | | | | | | | | |
| 4,4'-DDD (p,p'-DDD) | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U | 1.6 U | 1.3 U | 1.7 U |
| 4,4'-DDE (p,p'-DDE) | -- | -- | 1.6 U | 1.7 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U | **7.2 J** | **4.0 J** |
| 4,4'-DDT (p,p'-DDT) | -- | -- | 1.7 U | 1.7 U | 1.7 U | 1.7 U | 1.6 U | 1.6 U | 1.3 U | 1.7 U |
| Aldrin | -- | -- | 0.63 U | 0.64 U | 0.63 U | 0.63 U | 0.63 U | 0.62 U | 0.51 U | 0.64 U |
| Chlordane, alpha- (cis-Chlordane) | -- | -- | 0.82 U | 0.83 U | 0.81 U | 0.81 U | 0.81 U | 0.80 U | 0.66 U | 0.83 U |
| Chlordane, beta- (trans-Chlordane) | -- | -- | 0.77 U | 0.78 U | 0.76 U | 0.76 U | 0.76 U | 0.75 U | 0.62 U | 0.78 U |
| Dieldrin | -- | -- | 1.6 U | 1.7 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U | 1.3 U | 1.7 U |
| Heptachlor | -- | -- | 0.63 U | 0.64 U | 0.63 U | 0.63 UJ | 0.63 U | 0.62 U | 0.51 U | 0.64 U |
| Nonachlor, cis- | -- | -- | 1.6 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U | 1.6 U | 1.3 U | 1.6 U |
| Nonachlor, trans- | -- | -- | 4.7 U | 4.7 U | 4.6 U | 4.6 U | 4.6 U | 4.6 U | 3.8 U | 4.7 U |
| Oxychlordane | -- | -- | 2.3 U | 2.3 U | 2.2 U | 2.2 U | 2.2 U | 2.2 U | 1.8 U | 2.3 U |
| **PCB Aroclors (µg/kg)** | | | | | | | | | | |
| Aroclor 1016 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | 19 U | 19 U |
| Aroclor 1221 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | 19 U | 19 U |
| Aroclor 1232 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | 19 U | 19 U |
| Aroclor 1242 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | 19 U | 19 U |
| Aroclor 1248 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | 39 U | 24 U |
| Aroclor 1254 | -- | -- | 28 U | 19 U | **22** | 18 U | 20 U | 32 U | 48 U | 49 U |
| Aroclor 1260 | -- | -- | 19 U | 19 U | 19 U | 18 U | 20 U | 18 U | **29 J** | 19 U |
| Total PCB Aroclors (U = 0) | 60 | 120 | 28 U | 19 U | **22** | 18 U | 20 U | 32 U | **29 J** | 49 U |
| **Dioxin Furans (ng/kg)** | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **0.478 J** | **0.306 J** | **0.341 J** | **0.293 J** | **0.372 J** | **0.388 J** | **1.32** | **0.804 J** |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **1.58** | **1.18** | **1.03** | **0.870 J** | **1.24** | **1.47** | **12.8** | **5.10** |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **2.65** | **1.42 J** | **1.38 J** | **1.36 J** | **1.71 J** | **2.26** | **25.8** | **8.29** |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **9.51** | **4.38** | **4.21** | **3.85** | **5.03** | **8.32** | **119** | **38.8** |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **5.68** | **2.85** | **2.95** | **2.99** | **3.54** | **4.73** | **52.3** | **18.0** |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **237** | **85.5** | **82.7** | **88.5** | **103** | **168** | **2120** | **769** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | -- | -- | **2520** | **652** | **613** | **684** | **798** | **1290** | **16500** | **6410** |
| Total Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **4.89 J** | **4.25 J** | **3.82 J** | **3.33 J** | **4.12 J** | **3.27 J** | **14.7 J** | **9.33 J** |
| Total Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **9.24 J** | **8.33 J** | **7.29 J** | **6.12 J** | **7.92 J** | **8.56 J** | **60.3** | **27.8** |
| Total Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **70.1** | **31.4 J** | **30.2 J** | **27.2 J** | **35.0 J** | **50.6 J** | **563** | **199** |
| Total Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **803** | **167** | **155** | **160** | **191** | **332** | **4150** | **1470** |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | -- | -- | **0.967 J** | **0.643 J** | **0.579 J** | **0.553 J** | **0.784 J** | **0.759 J** | **3.38** | **2.15** |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.746 J** | **0.442 J** | **0.466 J** | **0.409 J** | **0.577 J** | **0.675 J** | **5.37 J** | **2.87** |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **0.826 J** | **0.452 J** | **0.556 J** | **0.540 J** | **0.573 J** | **0.725 J** | **5.19** | **2.57 J** |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **1.90 J** | **1.20 J** | **1.05 J** | **1.30 J** | **1.43 J** | **1.49 J** | **15.3** | **6.40** |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **1.64 J** | **0.989 J** | **0.958 J** | **0.964 J** | **1.23 J** | **1.26 J** | **13.6** | **5.15** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-06 | SG-07 | SG-07 | SG-08 | SG-09 | SG-10 | SG-11 | SG-12 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Location | Kenmore Navigation Channel | | | | | Harbour Village Marina | | |
| | | Sample ID | SG-06-S-C-121108 | SG-07-S-C-121108 | SG-07-S-C-DUP-121108 | SG-08-S-C-121108 | SG-09-S-C-121108 | SG-10-S-E-121107 | SG-11-S-E-121107 | SG-12-S-E-121107 |
| | | Sample Date | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/8/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 25 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | | | |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | -- | -- | 0.846 J | 0.386 J | 0.411 J | 0.366 J | 0.497 J | 0.692 J | 7.11 | 2.96 |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | 2.55 | 1.40 J | 1.34 J | 1.37 J | 1.74 J | 1.96 | 21.1 | 8.02 |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | -- | -- | 31.3 | 14.6 | 14.6 | 18.7 | 17.7 | 22.3 | 282 | 104 |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | -- | -- | 1.98 J | 1.06 J | 1.14 J | 1.83 J | 1.33 J | 1.59 J | 15.3 | 6.00 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | -- | -- | 108 | 40.9 | 39.5 | 66.0 | 46.6 | 77.5 | 871 | 356 |
| Total Tetrachlorodibenzofuran (TCDF) | -- | -- | 15.5 J | 11.1 J | 10.3 J | 9.21 J | 12.2 J | 11.3 J | 51.2 J | 29.7 J |
| Total Pentachlorodibenzofuran (PeCDF) | -- | -- | 24.5 J | 14.8 J | 14.2 J | 12.8 J | 17.1 J | 19.7 J | 157 J | 75.2 J |
| Total Hexachlorodibenzofuran (HxCDF) | -- | -- | 51.1 J | 25.8 J | 25.6 | 25.7 J | 30.6 J | 39.1 | 472 | 193 J |
| Total Heptachlorodibenzofuran (HpCDF) | -- | -- | 104 | 43.8 | 43.3 | 57.2 J | 52.8 J | 73.3 | 879 | 347 |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0) | | | 8.4 J | 4.2 J | 4.0 J | 3.9 J | 4.9 J | 6.6 J | 71.0 J | 26.6 J |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2) | | | 8.5 J | 4.2 J | 4.0 J | 3.9 J | 4.9 J | 6.6 J | 71.0 J | 26.6 J |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-13 | SG-13 | SG-14 | SG-15 | SG-16 | SG-17 |
|---|---|---|---|---|---|---|---|---|
| | | Location | Harbour Village Marina | | North of KIP | Kenmore Industrial Park Shoreline | | |
| | | Sample ID | SG-13-S-E-121107 | SG-13-S-E-DUP-121107 | SG-14-S-E-121107 | SG-15-S-E-121107 | SG-16-S-E-121107 | SG-17-S-E-121107 |
| | | Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | |
| **Conventional Parameters (%)** | | | | | | | | |
| Total organic carbon | -- | -- | **5.45** | **3.82** | **4.33** | **1.87** | **0.724** | **2.98** |
| Total solids | -- | -- | **23.2** | **22.7** | **51.0** | **82.4** | **77.7** | **46.9** |
| Total volatile solids | -- | -- | **15.02** | **14.56** | **7.61** | **1.24** | **0.98** | **6.70** |
| Gravel | -- | -- | 0.1 U | 0.1 U | **22.6** | **0.4** | **0.1** | **0.3** |
| Sand, Very Coarse | -- | -- | **4.3** | **3.4** | **6.0** | **1.5** | **0.4** | **3.3** |
| Sand, Coarse | -- | -- | **3.2** | **3.0** | **7.6** | **3.9** | **5.5** | **3.9** |
| Sand, Medium | -- | -- | **2.8** | **2.9** | **14.6** | **22.3** | **77.5** | **5.5** |
| Sand, Fine | -- | -- | **5.1** | **4.6** | **11.4** | **62.7** | **14.6** | **6.0** |
| Sand, Very Fine | -- | -- | **10.1** | **9.3** | **7.3** | **6.8** | **1.2** | **11.7** |
| Fines (silt + clay) | -- | -- | **74.6** | **76.7** | **30.6** | **2.4** | **0.8** | **69.1** |
| Silt, Coarse | -- | -- | **11.5** | **11.6** | **7.5** | **--** | **--** | **12** |
| Silt, Medium | -- | -- | **21.2** | **22.4** | **7.9** | **--** | **--** | **17.3** |
| Silt, Fine | -- | -- | **16.9** | **17.4** | **5.3** | **--** | **--** | **13.0** |
| Silt, Very Fine | -- | -- | **13.3** | **13.7** | **4.9** | **--** | **--** | **9.2** |
| Clay, Coarse | -- | -- | **6.4** | **6.1** | **2.0** | **--** | **--** | **6.1** |
| Clay, Medium | -- | -- | **3.3** | **3.0** | **1.2** | **--** | **--** | **4.3** |
| Clay, Fine | -- | -- | **1.9** | **2.5** | **1.7** | **--** | **--** | **7.2** |
| **Metals (mg/kg)** | | | | | | | | |
| Antimony | -- | -- | 20 UJ | 20 UJ | 10 UJ | 6 UJ | 6 UJ | 10 UJ |
| Arsenic | 20 | 51 | 20 UJ | 20 UJ | 10 UJ | 6 UJ | 6 UJ | 10 UJ |
| Cadmium | 1.1 | 1.5 | 0.9 U | 0.9 U | **0.7** | 0.3 U | 0.2 U | 0.4 U |
| Chromium | 95 | 100 | **54** | **55** | **36** | **20.9** | **29.9** | **54** |
| Copper | 80 | 830 | **62.1 J** | **62.8 J** | **111 J** | **5.5 J** | **5.4 J** | **13.5 J** |
| Lead | 340 | 430 | **32 J** | **32 J** | **26 J** | **7 J** | **4 J** | **7 J** |
| Mercury | 0.28 | 0.75 | **0.1** | **0.1** | **0.24** | 0.03 U | 0.03 U | **0.04** |
| Nickel | 60 | 70 | **46** | **45** | **35** | **20** | **26** | **34** |
| Selenium | -- | -- | 2 U | 2 U | 1 U | 0.7 U | 0.6 U | 1 U |
| Silver | 2 | 2.5 | 1 U | 1 U | 0.7 U | 0.4 U | 0.4 U | 0.6 U |
| Zinc | 130 | 400 | **205 J** | **205 J** | **182 J** | **57 J** | **43 J** | **64 J** |
| **Organometallic Compounds** | | | | | | | | |
| Tributyltin (porewater) µg/L | -- | -- | **--** | **--** | **0.010** | **--** | **--** | **--** |
| Tributyltin (bulk) µg/kg | -- | -- | **12** | **12** | **--** | 3.6 U | **--** | **--** |
| **Polycyclic Aromatic Hydrocarbons (µg/kg)** | | | | | | | | |
| 1-Methylnaphthalene | -- | -- | **18 J** | **7.2** | **34** | 4.7 U | 4.8 U | 4.9 U |
| 2-Methylnaphthalene | 470 | 560 | **24** | **19** | **59** | 4.7 U | 4.8 U | **7.4** |
| Acenaphthene | 1100 | 1300 | **17 J** | **16 J** | **130** | **3.8 J** | 4.8 U | 4.9 U |
| Acenaphthylene | 470 | 640 | **26** | **7.5** | **26** | 4.7 U | 4.8 U | 4.9 U |
| Anthracene | 1200 | 1600 | **48** | **44** | **150** | 4.7 U | 4.8 U | **11 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-13 | SG-13 | SG-14 | SG-15 | SG-16 | SG-17 |
|---|---|---|---|---|---|---|---|---|
| | | Location | Harbour Village Marina | | North of KIP | Kenmore Industrial Park Shoreline | | |
| | | Sample ID | SG-13-S-E-121107 | SG-13-S-E-DUP-121107 | SG-14-S-E-121107 | SG-15-S-E-121107 | SG-16-S-E-121107 | SG-17-S-E-121107 |
| | | Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | |
| Benzo(a)anthracene | 4300 | 5800 | **150** | **160** | **360** | **4.6 J** | 4.8 U | **42** |
| Benzo(a)pyrene | 3300 | 4800 | **140** | **120** | **250** | **4.1 J** | **2.9 J** | **41** |
| Benzo(b,j,k)fluoranthenes | 600 | 4000 | **380** | **320** | **720** | **12** | **8.2** | **91** |
| Benzo(g,h,i)perylene | 4000 | 5200 | **120** | **85** | **95** | 4.7 U | 4.8 UJ | **27** |
| Chrysene | 5900 | 6400 | **300** | **240** | **550** | **4.9** | **3.0 J** | **64** |
| Dibenzo(a,h)anthracene | 800 | 840 | **40** | **26** | **42** | 4.7 U | 4.8 UJ | 4.9 U |
| Fluoranthene | 11000 | 15000 | **260** | **220** | **1200** | **12 J** | **11 J** | **130** |
| Fluorene | 1000 | 3000 | **46** | **32** | **150** | **5.5** | 4.8 U | **2.5 J** |
| Indeno(1,2,3-c,d)pyrene | 4100 | 5300 | **100** | **79** | **97** | 4.7 U | 4.8 UJ | **24** |
| Naphthalene | 500 | 1300 | **39** | **40** | **170** | 4.7 U | 4.8 UJ | **4.0 J** |
| Phenanthrene | 6100 | 7600 | **190** | **160** | **830** | **16 J** | **2.6 J** | **93** |
| Pyrene | 8800 | 16000 | **290** | **230** | **920** | **11 J** | **9.7 J** | **120** |
| Total LPAH (SEF) (U = 0) | 6600 | 9200 | **390 J** | **320 J** | **1500** | **25 J** | **2.6 J** | **120 J** |
| Total LPAH (SEF) (U = 1/2) | 6600 | 9200 | **390 J** | **320 J** | **1500** | **35 J** | **17 J** | **120 J** |
| Total HPAH (SEF) (U = 0) | 31000 | 55000 | **1800** | **1500** | **4200** | **49 J** | **35 J** | **540** |
| Total HPAH (SEF) (U = 1/2) | 31000 | 55000 | **1800** | **1500** | **4200** | **56 J** | **44 J** | **540** |
| **Chlorinated Hydrocarbons (µg/kg)** | | | | | | | | |
| 1,2,4-Trichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| 1,2-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| 1,3-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| 1,4-Dichlorobenzene | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| Hexachlorobenzene | -- | -- | 4.9 U | 4.9 U | 4.9 U | 0.97 U | 19 U | 19 U |
| Hexachloroethane | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| **Phthalates (µg/kg)** | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 220 | 320 | **560** | **430** | **280** | **21 J** | **19 J** | **150** |
| Butylbenzyl phthalate | 260 | 370 | **82** | **56** | **43** | 19 U | 19 U | 19 U |
| Diethyl phthalate | -- | -- | **55** | 50 U | **68** | 47 U | 48 U | 48 U |
| Dimethyl phthalate | 46 | 440 | 20 U | 20 U | 19 U | 19 U | 19 U | **38** |
| Di-n-butyl phthalate | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| Di-n-octyl phthalate | 26 | 45 | **73 J** | **42** | **24** | 19 U | 19 U | **11 J** |
| **Phenols (µg/kg)** | | | | | | | | |
| 2,4-Dimethylphenol | -- | -- | 20 UJ | 20 UJ | 19 UJ | 19 UJ | 19 UJ | 19 UJ |
| 2-Methylphenol (o-Cresol) | -- | -- | **12 J** | **14 J** | 19 U | 19 U | 19 U | 19 U |
| 4-Methylphenol (p-Cresol) | -- | -- | **110** | **110** | **59** | **10 J** | 39 U | **270** |
| Pentachlorophenol | -- | -- | **52 J** | 200 U | 190 U | 190 U | 190 U | 190 U |
| Phenol | -- | -- | **200** | **350** | **80** | 19 U | 19 U | **82** |
| **Miscellaneous Extractables (µg/kg)** | | | | | | | | |
| Benzoic acid | -- | -- | **1600** | **1700** | **610** | 370 U | 390 U | **430** |
| Benzyl alcohol | -- | -- | **360** | **380** | **100** | 19 U | 19 U | **62** |
| Dibenzofuran | 400 | 440 | **12** | **17** | **90** | **4.7** | 4.8 U | 4.9 U |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-13 | SG-13 | SG-14 | SG-15 | SG-16 | SG-17 |
|---|---|---|---|---|---|---|---|---|
| | | Location | Harbour Village Marina | | North of KIP | Kenmore Industrial Park Shoreline | | |
| | | Sample ID | SG-13-S-E-121107 | SG-13-S-E-DUP-121107 | SG-14-S-E-121107 | SG-15-S-E-121107 | SG-16-S-E-121107 | SG-17-S-E-121107 |
| | | Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | |
| Hexachlorobutadiene | -- | -- | 4.9 U | 4.9 U | 4.9 U | 0.97 U | 10 UJ | 10 UJ |
| N-Nitrosodiphenylamine | -- | -- | 20 U | 20 U | 19 U | 19 U | 19 U | 19 U |
| **Pesticides (µg/kg)** | | | | | | | | |
| 4,4'-DDD (p,p'-DDD) | -- | -- | 1.7 U | 1.7 U | 1.7 U | 0.33 U | -- | -- |
| 4,4'-DDE (p,p'-DDE) | -- | -- | 1.7 U | **4.4 J** | 1.7 U | 0.33 U | -- | -- |
| 4,4'-DDT (p,p'-DDT) | -- | -- | 1.7 U | 1.7 U | 1.7 U | 0.33 UJ | -- | -- |
| Aldrin | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.13 U | -- | -- |
| Chlordane, alpha- (cis-Chlordane) | -- | -- | 0.83 U | 0.83 U | 0.82 U | 0.16 U | -- | -- |
| Chlordane, beta- (trans-Chlordane) | -- | -- | 0.78 U | 0.78 U | 0.77 U | 0.15 U | -- | -- |
| Dieldrin | -- | -- | 1.7 U | 1.7 U | 1.6 U | 0.33 U | -- | -- |
| Heptachlor | -- | -- | 0.64 U | 0.64 U | 0.64 U | 0.13 U | -- | -- |
| Nonachlor, cis- | -- | -- | 1.6 U | 1.6 U | 1.6 U | 0.32 U | -- | -- |
| Nonachlor, trans- | -- | -- | **4.1 J** | 4.7 U | 4.7 U | 0.94 U | -- | -- |
| Oxychlordane | -- | -- | 2.3 U | 2.3 U | 2.3 U | 0.45 U | -- | -- |
| **PCB Aroclors (µg/kg)** | | | | | | | | |
| Aroclor 1016 | -- | -- | 20 U | 20 U | 19 U | 18 U | 18 U | 19 U |
| Aroclor 1221 | -- | -- | 20 U | 20 U | 19 U | 18 U | 18 U | 19 U |
| Aroclor 1232 | -- | -- | 25 U | 35 U | 28 U | 18 U | 18 U | 19 U |
| Aroclor 1242 | -- | -- | 20 U | 20 U | 19 U | 18 U | 18 U | 19 U |
| Aroclor 1248 | -- | -- | 20 U | 20 U | 19 U | 18 U | 18 U | 19 U |
| Aroclor 1254 | -- | -- | 50 U | 25 U | **20** | 18 U | 18 U | 19 U |
| Aroclor 1260 | -- | -- | 20 U | 20 U | 19 U | 18 U | 18 U | 19 U |
| Total PCB Aroclors (U = 0) | 60 | 120 | 50 U | 35 U | **20** | 18 U | 18 U | 19 U |
| **Dioxin Furans (ng/kg)** | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **0.719 J** | **0.521 J** | **0.404 J** | **0.154 J** | **0.144 J** | **0.226 J** |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **5.66** | **2.51** | **1.99** | **0.0891 J** | **0.0758 J** | **0.491 J** |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **11.8** | **5.28** | **3.06** | **0.143 J** | **0.0679 J** | **1.03 J** |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **97.4** | **32.5** | **12.5** | **0.818 J** | **0.202 J** | **2.12** |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **25.6** | **10.8** | **6.86** | **0.350 J** | **0.168 J** | **2.33** |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **1730** | **600** | **304** | **13.9** | **4.24** | **50.3** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | -- | -- | **14400** | **4830** | **2490** | **105** | **32.0** | **252** |
| Total Tetrachlorodibenzo-p-dioxin (TCDD) | -- | -- | **10.5 J** | **4.89 J** | **5.27 J** | **0.446 J** | **0.481 J** | **1.11 J** |
| Total Pentachlorodibenzo-p-dioxin (PeCDD) | -- | -- | **31.5** | **13.1 J** | **13.5 J** | **0.632 J** | **0.441 J** | **2.03 J** |
| Total Hexachlorodibenzo-p-dioxin (HxCDD) | -- | -- | **353** | **136** | **102** | **4.11 J** | **1.86 J** | **14.9 J** |
| Total Heptachlorodibenzo-p-dioxin (HpCDD) | -- | -- | **3200** | **1120** | **877** | **27.3** | **8.18** | **82.0** |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | -- | -- | **2.84 J** | **1.22** | **1.09** | 0.103 U | 0.0220 U | 0.136 U |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **5.30 J** | **2.06 J** | **0.796 J** | **0.0911 J** | **0.0758 J** | **0.126 J** |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | -- | -- | **4.71** | **1.82** | **0.957 J** | **0.0752 J** | 0.0439 U | **0.136 J** |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **13.2** | **4.94** | **2.26** | **0.176 J** | **0.0918 J** | **0.625 J** |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **8.24** | **3.39** | **2.08** | **0.103 J** | **0.0739 J** | **0.725 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

| | | Location ID | SG-13 | SG-13 | SG-14 | SG-15 | SG-16 | SG-17 |
|---|---|---|---|---|---|---|---|---|
| | | Location | Harbour Village Marina | | North of KIP | Kenmore Industrial Park Shoreline | | |
| | | Sample ID | SG-13-S-E-121107 | SG-13-S-E-DUP-121107 | SG-14-S-E-121107 | SG-15-S-E-121107 | SG-16-S-E-121107 | SG-17-S-E-121107 |
| | | Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| | | Sample Interval | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm | 0 - 10 cm |
| | Freshwater SL1 | Freshwater SL2 | | | | | | |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | -- | -- | **7.63** | **2.82** | **0.816 J** | 0.0653 U | 0.0259 U | 0.110 U |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | -- | -- | **15.4** | **5.77** | **2.90** | **0.190 J** | **0.0559 J** | **1.06 J** |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | -- | -- | **230** | **93.1** | **36.2** | **2.05** | **0.888 J** | **14.4** |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | -- | -- | **10.6** | **4.97** | **2.54 J** | **0.0713 J** | **0.0639 J** | **0.950 J** |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | -- | -- | **837** | **379** | **106** | **5.88** | **1.75 J** | **24.5** |
| Total Tetrachlorodibenzofuran (TCDF) | -- | -- | **32.4 J** | **15.9 J** | **15.4 J** | **1.06 J** | **0.681 J** | **2.50 J** |
| Total Pentachlorodibenzofuran (PeCDF) | -- | -- | **129 J** | **51.6 J** | **28.9 J** | **3.73 J** | **0.950 J** | **5.21 J** |
| Total Hexachlorodibenzofuran (HxCDF) | -- | -- | **438 J** | **161** | **64.1 J** | **3.85 J** | **1.56 J** | **17.8 J** |
| Total Heptachlorodibenzofuran (HpCDF) | -- | -- | **809** | **314 J** | **115 J** | **6.17 J** | **2.41 J** | **31.5** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0) | | | **50.0 J** | **19.0 J** | **10.1 J** | **0.64 J** | **0.35 J** | **2.3 J** |
| Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2) | | | **50.0 J** | **19.0 J** | **10.1 J** | **0.65 J** | **0.36 J** | **2.3 J** |

**Table 4**
**Kenmore Area Sediment Results Compared to Interim Freshwater Sediment Quality Values**

Notes:

| | |
|---|---|
| (yellow) | Detected concentration is greater than Freshwater SL1 screening level |
| (cyan) | Detected concentration is greater than Freshwater SL2 screening level |

a Arsenic result of 30UJ was verified to be between the MDL and the RL and below the screening level.

All non-detect pesticides and dioxin/furan data were reported at the **MDL**; all other non-detect data were reported at the **RL**.
Totals are calculated as the sum of all detected results (U=0). If all results are not detected, the highest reporting limit value is reported as the sum.
Totals are calculated as the sum of all detected results and 1/2 the undetected reporting limit (U=1/2). If all results are not detected, the highest reporting limit value is reported as the sum.
Total LPAH (Low PAH) SEF is the total of 2-Methylnapthalene, Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene and Anthracene.
Total HPAH (High PAH) SEF is the total of Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b,j,k)fluoranthenes, Benzo(a)pyrene, Indeno(1,2,3-c,d)pyrene, Dibenzo(a,h)anthracene and Benzo(g,h,i)perylene.
Total PCB Aroclors is the total of all PCB Aroclors listed in this table.
Dioxin/Furan TEQ values as of 2005, World Health Organization.

USEPA Stage 2A validation was performed by Anchor QEA on all compounds, except dioxin/furans.
USEPA Stage 4 validation was performed by LDC on dioxin/furans.

**Bold = Detected result**
-- = results not reported or not applicable
% = percent
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
HPAH = high polycyclic aromatic hydrocarbons
J = estimated value
KIP = Kenmore Industrial Park
LPAH = low polycyclic aromatic hydrocarbons
MDL = method detection limit
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
PCB = polychlorinated biphenyl
TEQ = toxic equivalency
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit
USEPA = U.S. Environmental Protection Agency
WDFW = Washington State Department of Fish and Wildlife

**Table 5**

**Surface Water Results from Log Boom Park Shoreline and Lake Washington Reference Area**

| Location ID | HT-01 | HT-04 | HT-04 | WS-10 |
|---|---|---|---|---|
| Location Description | Log Boom Park Shoreline | | | Reference |
| Sample ID | HT-01-W-C-121107 | HT-04-W-C-121107 | HT-04-W-C-DUP-121107 | WS-10-W-C-121107 |
| Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| Sample Depth | 1 ft | 0.5-1 ft | 0.5-1 ft | 3 ft |
| **Conventional Parameters (mg/L)** | | | | |
| Hardness as CaCO3 | **48** | **50** | **49** | **43** |
| Total suspended solids | **13.8** | **3.7** | **3.4** | **2.0** |
| Total dissolved solids | **76.0** | **78.0** | **74.0** | **59.0** |
| **Metals (µg/L)** | | | | |
| Antimony | 1 U | 1 U | 0.2 U | 0.2 U |
| Arsenic | **2** | **2** | **1.2** | **0.9** |
| Barium | **11** | **9** | **8.7** | **6.2** |
| Beryllium | 0.5 U | 0.5 U | 0.2 U | 0.2 U |
| Cadmium | 0.5 U | 0.5 U | 0.1 U | 0.1 U |
| Calcium | **11100** | **11500** | **11400** | **10200** |
| Chromium | 2 U | 2 U | 0.5 U | 1 U |
| Copper | **2.8** | **2.6** | **3.2** | **1.6** |
| Iron | **480** | **330** | **330** | **160** |
| Lead | **0.5** | 0.5 U | **0.3** | 0.1 U |
| Magnesium | **4830** | **5060** | **4970** | **4210** |
| Manganese | **111** | **32** | **12.4** | **21** |
| Mercury | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Nickel | **2** | **1** | **1.2** | **0.7** |
| Selenium | 2 U | 2 U | 0.5 U | 0.5 U |
| Silver | 1 U | 1 U | 0.2 U | 0.2 U |
| Thallium | 1 U | 1 U | 0.2 U | 0.2 U |
| Zinc | 20 U | 20 U | 4 U | 4 U |
| **Metals, Dissolved (µg/L)** | | | | |
| Antimony | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Arsenic | **0.8** | **1.0** | **1.0** | **0.8** |
| Barium | **7.4** | **7.8** | **7.7** | **6.0** |
| Beryllium | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Cadmium | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Chromium | 1 U | 1 U | 1 U | 1 U |
| Copper | **1.9** | **2.1** | **2.0** | **1.2** |
| Iron | **110** | **150** | **150** | **90** |
| Lead | **0.1** | **0.1** | 0.1 U | 0.1 U |
| Manganese | **2.8** | **4.6** | **5.1** | **13.8** |
| Mercury | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Nickel | **1.1** | **1.1** | **1.0** | **0.8** |
| Selenium | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| Silver | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Thallium | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Zinc | **6** | 4 U | 4 U | 4 U |

**Table 5**

**Surface Water Results from Log Boom Park Shoreline and Lake Washington Reference Area**

| Location ID | HT-01 | HT-04 | HT-04 | WS-10 |
|---|---|---|---|---|
| Location Description | Log Boom Park Shoreline | | | Reference |
| Sample ID | HT-01-W-C-121107 | HT-04-W-C-121107 | HT-04-W-C-DUP-121107 | WS-10-W-C-121107 |
| Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| Sample Depth | 1 ft | 0.5-1 ft | 0.5-1 ft | 3 ft |
| **Polycyclic Aromatic Hydrocarbons (µg/L)** | | | | |
| 1-Methylnaphthalene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| 2-Methylnaphthalene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Acenaphthene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Acenaphthylene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Anthracene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Benzo(a)anthracene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Benzo(a)pyrene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Benzo(b,j,k)fluoranthenes | 0.20 U | 0.20 U | 0.20 U | 0.20 U |
| Benzo(g,h,i)perylene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Chrysene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Dibenzo(a,h)anthracene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Fluoranthene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Fluorene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Indeno(1,2,3-c,d)pyrene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Naphthalene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Phenanthrene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Pyrene | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| **Chlorinated Hydrocarbons (µg/L)** | | | | |
| 1,2,4-Trichlorobenzene | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| 1,2-Dichlorobenzene | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| 1,3-Dichlorobenzene | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| 1,4-Dichlorobenzene | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Hexachlorobenzene | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Hexachloroethane | 2.0 U | 2.0 U | 2.0 U | 2.0 U |
| **Phthalates (µg/L)** | | | | |
| Bis(2-ethylhexyl)phthalate | 3.0 U | 3.0 U | 3.0 U | 3.0 U |
| Butylbenzyl phthalate | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Diethyl phthalate | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Dimethyl phthalate | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Di-n-butyl phthalate | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| Di-n-octyl phthalate | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| **Phenols (µg/L)** | | | | |
| 2,4-Dimethylphenol | 3.0 U | 3.0 U | 3.0 U | 3.0 U |
| 2-Methylphenol (o-Cresol) | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| 4-Methylphenol (p-Cresol) | 2.0 U | 2.0 U | 2.0 U | 2.0 U |
| Pentachlorophenol | **0.024 J** | **0.022 J** | **0.020 J** | 0.025 U |
| Phenol | 1.0 U | 1.0 U | 1.0 U | 1.0 U |
| **Miscellaneous Extractables (µg/L)** | | | | |
| Benzoic acid | 20 U | 20 U | 20 U | 20 U |
| Benzyl alcohol | 2.0 U | 2.0 U | 2.0 U | 2.0 U |
| Dibenzofuran | 0.10 U | 0.10 U | 0.10 U | 0.10 U |

**Table 5**
**Surface Water Results from Log Boom Park Shoreline and Lake Washington Reference Area**

| Location ID | HT-01 | HT-04 | HT-04 | WS-10 |
|---|---|---|---|---|
| Location Description | Log Boom Park Shoreline | | | Reference |
| Sample ID | HT-01-W-C-121107 | HT-04-W-C-121107 | HT-04-W-C-DUP-121107 | WS-10-W-C-121107 |
| Sample Date | 11/7/2012 | 11/7/2012 | 11/7/2012 | 11/7/2012 |
| Sample Depth | 1 ft | 0.5-1 ft | 0.5-1 ft | 3 ft |
| Hexachlorobutadiene | 0.050 U | 0.050 U | 0.050 U | 0.050 U |
| N-Nitrosodiphenylamine | 1.0 U | 1.0 U | 1.0 U | 1.0 U |

Notes:
All non-detect data were reported at the **reporting limit**.

USEPA Stage 2A validation was performed by Anchor QEA on all compounds

**Bold = Detected result**
-- = results not reported or not applicable

ft = feet
ID = identification
J = estimated value
mg/L = milligrams per liter
µg/L = micrograms per liter
U = Compound analyzed, but not detected above detection limit

# APPENDIX A
# CHAIN-OF-CUSTODY FORMS AND DAILY LOGS (ON CD)

# APPENDIX B
# LAB DATA (ON CD)

# APPENDIX C
# DATA VALIDATION REPORT (ON CD)

# Ecology Evaluation Report

# Appendix D

# Washington Soil Dioxin Study Results
# Ecology Publication No. 11-09-219

# September 2011

DEPARTMENT OF ECOLOGY
State of Washington

*Frequently Asked Questions*

**Toxics Cleanup Program** **September 2011**

# Washington Soil Dioxin Study Results

## Background

The Department of Ecology (Ecology) recently completed a statewide study where concentrations of certain chemicals were measured in soil collected from urban and rural areas. The overall goal of the study was to define the range of concentrations of dioxins and furans (dioxins) and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) found in the soil of urban and rural areas of Washington.

For the rural part of the study, Ecology collected soil samples from state parks throughout the state (Figure 1). Samples were collected to help Ecology understand what levels of these chemicals were present in areas not influenced by human activity. Samples were analyzed for dioxins, cPAHs and arsenic. Soil concentrations were similar to levels reported in previous studies conducted in Washington and other parts of the United States.

For the urban part of the study, Ecology partnered with the City of Seattle to collect soil samples in six Seattle neighborhoods. These neighborhoods were South Park, Georgetown, Ravenna, Capitol Hill, West Seattle and Ballard (Figure 2). In each neighborhood, Ecology and the City collected 20 samples from randomly selected planting strips. Samples were analyzed for dioxins and cPAHs.

The range of dioxin and cPAH concentrations in the Seattle soil samples were similar to the range of concentrations measured in other cities. In general, the average cPAH levels were somewhat lower than levels reported in other cities and average dioxin levels were somewhat higher than those found in other cities. This document contains information about the study methods, results and next steps.

## Q: How were the samples collected?

**A:** Rural area sample collection:

- Ecology collected samples from state parks in areas with a population density of less than 500 people per square mile.
- Sample areas were located at least 2.5 miles away from a major highway.
- Each sample was made up of the top three inches of soil from five locations within a 0.5 acre sampling area.


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Bellevue, WA
By appointment only, call (425) 649-7190

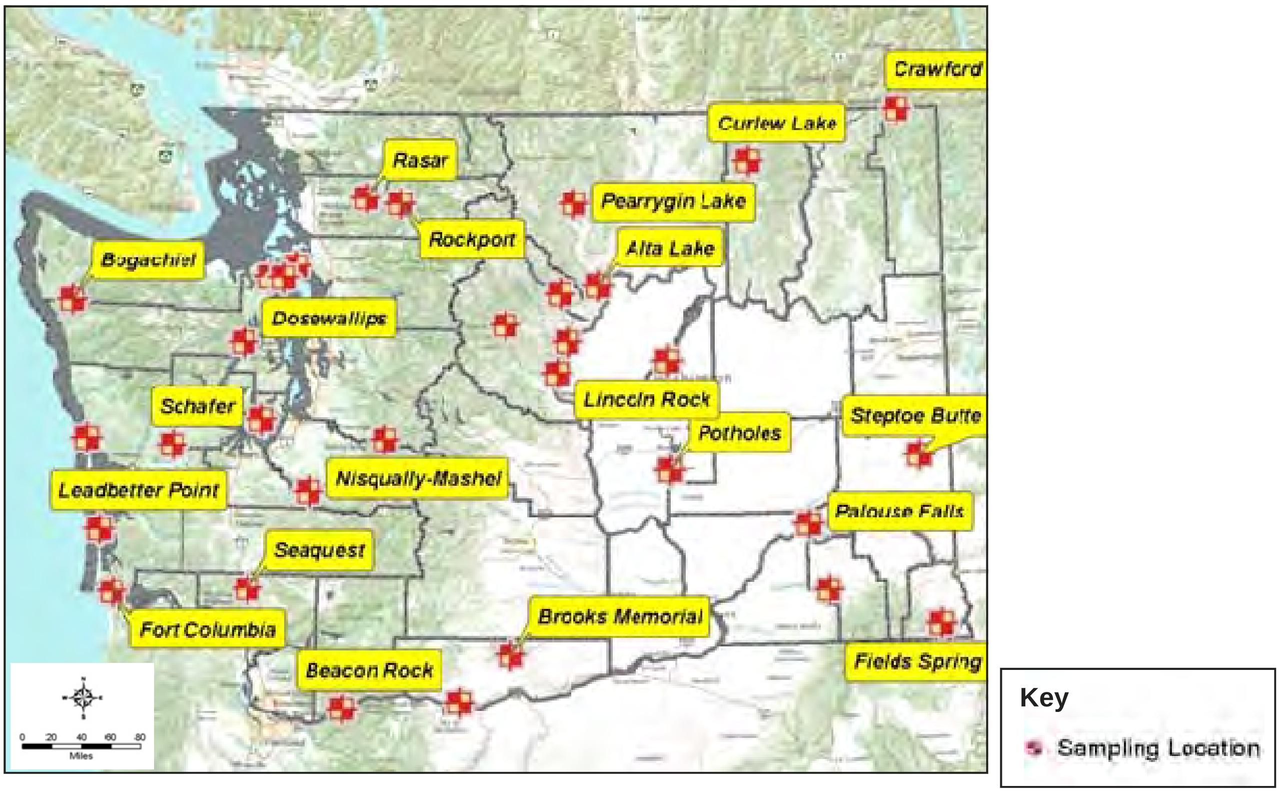
**Visit Ecology's Web site to read the study report:**

http://www.ecy.wa.gov/programs/tcp/sites_brochure/lower_duwamish/SoilDioxinStudy/SoilDioxinStudy-hp.html

Urban area sample collection:.

- Ecology collected soil samples from six Seattle neighborhoods.
- A total of 20 soil samples were collected from city-owned roadway planting strips in each neighborhood area. The sample locations were randomly chosen using standard statistical methods.
- Each sample included soil gathered from five locations at one site. The top three inches of soil was used for sampling. The soil from the five locations was mixed together to form one sam-

**Figure 1. Rural soil dioxin study area.**




## Q: What did the study find in urban areas?

**A:** Soil dioxin concentrations ranged from 1.7 parts per trillion (ppt) to 114.7 ppt. (Table 1). The average level of dioxin found in Seattle neighborhoods was 19 ppt. Dioxin levels varied within and across different neighborhoods. As shown in Table 1 (page 4), average levels range from 7.5 ppt (West Seattle) to 36 ppt (Georgetown).

Soil cPAH concentrations ranged from 1.9 parts per billion (ppb) to 8,851 ppb. The average level of cPAHs was 260 ppb. cPAH concentrations varied within and across neighborhoods. As shown in Table 2 (page 4), average levels range from 54 ppb (West Seattle) to 680 ppb (Capitol Hill).

## Q: How do these levels compare with other urban areas?

**A:** Agencies and academic researchers have performed studies measuring dioxin and cPAH soil concentrations in urban areas. The data from this study cannot be directly compared to these studies because of differences in population size and density, traffic patterns, study design and other factors, However, information from these other studies can provide some context for evaluating the current study results.

**Figure 2. Seattle urban soil dioxin study area.**


- **Dioxin levels in other cities:** The range of dioxin concentrations in the Seattle study are similar to the range of concentrations reported for urban soils in other parts of the US. However, the average levels in this study are slightly higher than levels reported in other cities.

- **CPAH levels in other cities:** The range of cPAH concentrations in the Seattle study are similar to the range of concentrations reported for urban soils in other parts of the US. However, the average levels in this study generally fall at the lower end of the average concentrations reported in other cities.

## Q: How do these numbers compare to state and federal cleanup levels?

**A:** This study was designed to get an overall idea of the range of dioxins and cPAHs levels in rural and urban soils. It was not designed to support decisions about whether individual properties or areas have contamination above state and federal cleanup levels. However, state and federal regulatory guidelines do provide some context for evaluating the study results. Tables 1 and 2 summarize the results of those comparisons for dioxins and cPAHs, respectively.

**Cleanup levels and screening levels.**

- Ecology, the Agency of Toxics and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA) have all developed cleanup levels or screening levels for dioxins and/or cPAHs. These values are typically used to define areas that require no further action.
- The average dioxin concentrations in five of the six neighborhoods are above the state Model Toxics Control Act (MTCA) cleanup levels. However, the average concentrations do not exceed the ATSDR and EPA soil screening levels for dioxins (Table 1).
- The average cPAH concentration in four neighborhoods are above the MTCA cleanup level. The average concentration of all six neighborhoods are higher than the EPA screening level.

### Table 1. Dioxin Levels in Seattle Neighborhoods and Comparisons to State and Federal Regulatory Limits

| Neighborhood | [1]Range (ppt) | Average | [2]Number of Samples above State MTCA Method B cleanup level (11 ppt) | [3]Number of Samples above Federal ATSDR screening Level (50 ppt) | [4]Number of Samples above EPA Draft cleanup Level (72 ppt) |
|---|---|---|---|---|---|
| Ballard | 1.9 - 62.4 | 26 | 17 | 2 | 0 |
| Capitol Hill | 3.2 - 96.2 | 18 | 8 | 3 | 1 |
| Georgetown | 5.3 - 114.7 | 36 | 17 | 4 | 2 |
| Ravenna | 5.2 - 49.6 | 15 | 7 | 0 | 0 |
| South Park | 3.6 - 22.7 | 12 | 12 | 0 | 0 |
| West Seattle | 1.7 - 32.8 | 7.5 | 2 | 0 | 0 |
| All areas | 1.7 - 114.7 | 19 | 63 | 9 | 3 |

### Table 2. Carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) Levels in Seattle Neighborhoods and Comparisons to State and Federal Regulatory Limits

| Neighborhood | Range (ppb) | Average | [2]Number of Samples above State MTCA B Cleanup Level (137 ppb) | [5]Number of Samples above EPA Screening Level (15 ppb) |
|---|---|---|---|---|
| Ballard | 35.2 - 1247 | 340 | 13 | 20 |
| Capitol Hill | 34.4 - 8,851 | 680 | 12 | 20 |
| Georgetown | 46.5 - 973.4 | 240 | 11 | 20 |
| Ravenna | 25.9 - 1945 | 260 | 7 | 20 |
| South Park | 7.4 - 388.7 | 100 | 6 | 19 |
| West Seattle | 1.9 - 404.1 | 54 | 2 | 8 |
| All areas | 1.9 - 8851 | 260 | 51 | 107 |

[1] Soil data for dioxins is reported as toxic equivalents (TEQs). This means that the measured concentrations have been adjusted to reflect the different levels of potency of individual dioxin and furan components. The concentrations, adjusted for potency level, are combined into a single concentration that reflects the potential toxicity of the mixture of dioxin and furan components.

[2] State MTCA is a rule that outlines procedures for setting cleanup levels for hazardous substances.

[3] Federal Agency for Toxic Substances Disease Registry Screening Levels. This level is used to identify areas where more study is needed and is not a cleanup level.

[4] Environmental Protection Agency proposed soil screening levels. EPA's Superfund cleanup program published draft soil cleanup guidelines in 2009. These guidelines are used for setting cleanup levels for hazardous substances.

[5] The EPA cPAH screening level is a guideline used for setting cleanup levels for hazardous substances.

## Q: What did the study find in rural areas?

**A:** Dioxin levels in the soils from Washington state parks ranged from 0.15 - 9.4 ppt. The average concentration was 1.7 ppt. CPAH levels in the soils from Washington state parks ranged from 0.16 to 24 ppb. The average concentration was 2.3 ppb.

## Q: Where do cPAHs and dioxins and furans come from?

**A:** Most dioxins are produced when people burn wood or waste. Waste incinerators, home burn barrels, fireplaces, and wood stoves release dioxins into the air. Exhaust from diesel engines also contains dioxins, as do emissions from natural sources such as forest fires and volcanoes. Some industrial processes, such as chlorine bleaching at pulp mills and certain types of chemical manufacturing, can also produce dioxins.

Currently, most of the cPAHs released to the atmosphere in the Puget Sound region come from vehicles and wood stoves. Creosote-treated wood, used motor oil, and some driveway sealers contain cPAHs that can enter the environment.

Dioxins and cPAHs released into the atmosphere can fall to the ground and contaminate soil and water. Due to changes in environmental regulations and industrial processes, emissions of dioxins and cPAHs in the U.S. have decreased significantly since the 1970s.

## Q: How could I be exposed to dioxins or cPAHs?

**A:** Everyone is exposed to dioxins and cPAHs because they are in many foods (for dioxins, especially meat and dairy products) and present throughout our environment. For nonsmokers, about 90 to 95% of exposure usually comes from food. While cigarette smokers may have a little extra exposure to dioxins, their exposure to cPAHs may be significantly higher, equaling or exceeding that from food. Soil, air, and water usually contribute only a small part of our exposure to dioxins and cPAHs. Exposure to contamination could occur if you have direct contact with the soil (when gardening or playing in the dirt) or accidentally inhaling or ingesting soil.

## Q: How could these chemicals affect the health of my family?

**A:** People's exposure to dioxins and cPAHs in Seattle soils is expected to be small compared to exposure from other sources such as food, and compared to exposures that have been found to have harmful effects in people and animals. Any potential effects are likely to be small enough that they would be difficult to even measure.

Several studies have found increased rates of cancer in people who have had many years of exposure to dioxins in their workplace. Dioxins have also been linked to cancer in many experiments in laboratory animals. However, the amount of exposure in these studies was significantly higher than would occur from Seattle soils. Based on data from animal studies, there is some concern that exposure to lower levels of dioxins over long periods (or higher levels at sensitive times) might affect reproduction or development. Dioxins may also have harmful effects on the liver, peripheral nerves, and the immune system.

Several cPAH-containing mixtures, including tobacco smoke, coal tar, and creosote are known to cause cancer in people, while studies in animals found that exhaust from gasoline and diesel engines can cause cancer. Also, individual cPAHs have been shown to cause cancer in animals. Other health effects have been observed for a few cPAHs, but the evidence is not as strong as for cancer. The levels of cPAH exposure in these studies were significantly higher than would be expected from soils in Seattle neighborhoods.

## Q: How can I reduce my exposure to dioxins and cPAHs?

**A:** There are several ways that you can reduce your exposure to dioxins and cPAHs. These include:

- Washing your hands before eating after playing or working outside
- Removing your shoes before going inside
- Preventing children from eating dirt
- Washing children's toys, bedding and pacifiers often
- Damp dusting, mopping and vacuuming often
- Keeping your pets clean – brush and bathe them often
- Eating a healthy and balanced diet and reducing your intake of fatty foods (whole milk, meat)
- Washing fruits and vegetables before eating them, especially if they are grown at home
- Gardening in raised beds with clean soil
- Wearing gloves when gardening or landscaping

## Q: Can I eat the vegetables in my garden?

**A:** Fruits and vegetables are okay to eat because they take up only a small fraction of dioxins and cPAHs that are in soil. However, since garden soils may cling to the outside of the edible portions, it is important to peel or thoroughly wash the produce to remove any contamination that may be present.

## Q: Will Ecology clean up the soil found to have contamination above state cleanup levels?

**A:** The goal of the study was not to determine areas for cleanup but instead to determine the range of contamination in urban and rural areas of Washington. While some soil concentrations exceed the MTCA cleanup levels, Ecology does not believe those concentrations are high enough to require immediate cleanup actions. Exposure to these chemicals can be reduced by taking the steps outlined on page 6.

## Q: Will more sampling be done?

**A:** Ecology has no current plans to do more soil sampling.

## Q: How will Ecology use the results from the Seattle neighborhood study?

**A:** There are many MTCA cleanup sites in Washington with dioxin and cPAH contamination. The Seattle neighborhood soil sampling data will help Ecology in several ways. Ecology will use the results to:

- Determine if more sampling is needed in one or more of the six Seattle neighborhoods and where.
- Design future studies in other Washington cities. No two cities are completely alike. However, study results will help Ecology to design studies to provide context for decisions on soil cleanup actions in other areas.
- Help identify ways to prevent sediment contamination in Seattle rivers and lakes. For example, Ecology is currently exploring the relationships between contamination levels in soil, storm water and sediment. These data will help Ecology better understand geographic patterns of contamination.

## Q: How will Ecology use the rural background sampling results?

**A:** The rural sampling data will help Ecology define natural background levels for dioxins and cPAHs. Ecology evaluates natural background levels when making cleanup decisions under the MTCA rule. The rule specifies that soil cleanup levels shall not be established at levels below natural background levels. Natural background levels are typically considered to be levels found in rural areas that are not near local sources of contamination.

## Q: How does this study relate to the T117 and other cleanup sites near the areas that were sampled?

**A:** Our study goal was to gather information about dioxins and cPAHs in soil around the Seattle area. The study results will provide context for investigations of individual cleanup sites. However, the study results are not meant to be part of an Ecology remedial investigation and will not lead to property cleanups by Ecology.

DEPARTMENT OF
ECOLOGY
State of Washington
3190 160th Avenue SE
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## Seattle Soil Dioxin Study
## Seattle, WA

### Results of Soil Dioxin Study in South Park, Georgetown, Ravenna, Capitol Hill, Ballard and West Seattle


*Photo credit John Monnat*

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**Want to get more involved with efforts to clean up the Duwamish River?**
Contact the Duwamish River Cleanup Coalition at contact@duwamishcleanup.org, (206) 954-0218 or visit http://www.duwamishcleanup.org/index.html

DEPARTMENT OF ECOLOGY State of Washington

# Results of a Department of Ecology Washington Soil Dioxin Study

The Department of Ecology (Ecology) recently completed a state-wide study where concentrations of certain chemicals were measured in soil collected from urban and rural areas. The overall goal of the study was to define the range of concentrations of dioxins and furans (dioxins) and polycyclic aromatic hydrocarbons (PAHs) found in the soil of urban and rural areas of Washington. Samples were collected to help Ecology understand what levels of these chemicals were present in areas not influenced by human activity.

For the rural part of the study, Ecology collected soil samples from state parks throughout the state. Samples were analyzed for dioxins, PAHs and arsenic. Soil concentrations were similar to levels reported in previous studies conducted in Washington and other parts of the United States.

For the urban part of the study, Ecology partnered with the City of Seattle to collect soil samples in six Seattle neighborhoods. These neighborhoods were South Park, Georgetown, Ravenna, Capitol Hill, West Seattle and Ballard neighborhoods. In each neighborhood, Ecology and the Seattle City Light collected 20 samples from randomly selected planting strips. Samples were analyzed for dioxins and PAHs,

The range of dioxin and PAH concentrations in the Seattle soil samples were similar to the range of concentrations measured in other cities. In general, the average PAH levels were somewhat lower than levels reported in other cities and average dioxin levels were somewhat higher than those found in other cities. This document contains information about the study methods, results and next steps. If you would like a copy of this fact sheet in another language, please contact Meg Bommarito at (425) 649-7256 or Meg.Bommarito@ecy.wa.gov.

## Kết quả của Bộ Sinh Thái Học Của Washington Về Đất Dioxin

Khoa Sinh thái học (Sinh thái học) gần đây đã hoàn thành một nghiên cứu trên toàn tiểu bang nơi nồng độ của một số hóa chất được đo trong đất được thu thập từ các khu vực đô thị và nông thôn. Mục tiêu tổng thể của nghiên cứu là để xác định phạm vi của nồng độ dioxin và furan (dioxin) và hydrocarbon aromatic (PAHs) được tìm thấy trong đất của các khu vực đô thị và nông thôn của Washington. Các mẫu được thu thập để giúp Sinh thái học hiểu mức độ các hóa chất này đã có mặt tại các khu vực không bị ảnh hưởng bởi hoạt động của con người.

Đối với một phần nông thôn của nghiên cứu, sinh thái học thu thập đất mẫu từ các công viên của tiểu bang. Mẫu được phân tích cho dioxin, PAHs và asen. Nồng độ đất tương tự như mức độ báo cáo trong các nghiên cứu trước đây tiến hành ở Washington và các bộ phận khác của Hoa Kỳ.

Đối với phần đô thị của nghiên cứu, Sinh Thái Học hợp tác với Seattle City Light để thu thập đất mẫu trong sáu khu phố Seattle. Các khu dân cư là South Park, Georgetown, Raven0na, Capitol Hill, West Seattle và Ballard. Tại mỗi khu phố, Sinh Thái và City of Seattle thu thập 20 mẫu từ lựa chọn ngẫu nhiên trồng dải. Các mẫu được phân tích dioxin và PAH,

Phạm vi của các nồng độ dioxin và PAH trong các mẫu đất Seattle tương tự như phạm vi của nồng độ đo ở các thành phố khác. Nhìn chung, các mức trung bình PAH thấp hơn mức được báo cáo ở các thành phố khác và mức độ trung bình của dioxin cao hơn so với những người được tìm thấy ở các thành phố khác. Tài liệu này chứa thông tin về các phương pháp nghiên cứu, kết quả và các bước tiếp theo. Nếu bạn muốn một bản sao của tờ thông tin này trong một ngôn ngữ khác, xin vui lòng liên hệ với Meg Bommarito at (425) 649-7256 hoặc Meg.Bommarito@ecy.wa.gov.

## Resultados del Estudio de la Dioxina de la Tierra del Departamento de Ecología de Washington

El Departamento de Ecología (Ecología) completó recientemente un estudio a nivel del estado en el que se midieron las concentraciones de algunos químicos en la tierra que se recogió en áreas rurales y urbanas. El objetivo general del estudio era definir el rango de concentración de dioxinas y furanos (dioxinas) e hidrocarburos aromáticos policíclicos (PAH) que se encuentran en la tierra de las áreas urbanas y rurales de Washington. Las muestras se recogieron para ayudar a Ecología a comprender qué niveles de estos químicos estaban presentes en áreas en las que la actividad humana no está presente.

En las partes rurales del estudio, Ecología recolectó muestras de tierra de los parques estatales en todo el estado. Se analizaron dichas muestras en busca de dioxinas, PAH y arsénico. Las concentraciones de tierra eran similares a los niveles informados en estudios anteriores llevados a cabo en Washington y otras ciudades de Estados Unidos.

En las partes urbanas del estudio, Ecología se asoció con City of Seattle para recolectar la tierra de seis urbanizaciones de Seattle. Dichas urbanizaciones fueron South Park, Georgetown, Ravenna, Capitol Hill, West Seattle y Ballard. En cada una de ellas, Ecología y Seattle City Light recogieron 20 muestras de franjas de plantas seleccionadas al azar. Estas muestras se analizaron en busca de dioxinas y PAH.

El rango de concentración de dioxinas y PAH en las muestras de tierra de Seattle fue similar al rango de concentración que se midió en otras ciudades. En general, los niveles promedio de PAH estuvieron un tanto por debajo de los niveles estudiados en otras ciudades, mientras que los niveles promedio de dioxinas estuvieron un poco por encima de los hallados en otras ciudades. Este documento contiene información sobre los métodos de estudio, los resultados y los próximos pasos. Si desea una copia de esta hoja informativa en otro idioma, por favor, entre en contacto con Meg Bommarito por el (425) 649-7256 o por su correo Meg.Bommarito@ecy.wa.gov.

## 生態部華盛頓州土壤「戴奧辛」含量調查

生態部最近完成了對全州城市及郊區土壤樣本中化學物質濃度的調查。調查的總體目標是確定華盛頓州城市及郊區土壤中戴奧辛和呋喃以及多環芳香烴的濃度範圍。採集樣本是為了幫助生態部了解這些化學物質在尚未受到人類活動影響的地區的存在水準 。

在本次調查的郊區部份，生態部從全州的州立公園中收集土壤樣本，分析其中所含的戴奧辛、多環芳香烴和砷。些化學物質在土壤中的濃度與華盛頓州及美國其他部分報告的水準相似。

在調查的城市部份，生態部與西雅圖City Light 合作採集了西雅圖六個社區的土壤樣本。這些社區是South Park、Georgetown、Ravenna、Capitol Hill、West Seattle和Ballard。生態部和西雅圖 City Light 在每個社區從隨機挑選的種植地帶收集 20 個樣本，分析樣本中的戴奧辛和多環芳香烴。

西雅圖土壤樣本中戴奧辛和多環芳香烴的濃度範圍與其他城市測得的濃度範圍相似。一般而言，多環芳香烴平均水準略低於其他城市報告的水準，而戴奧辛平均水準則略高於其他城市。此文件列出調查方法、結果及後續步驟的相關資訊。如果您希望得到翻譯成其他語言文字的副本，請聯絡Meg Bommarito ，電話 (425) 649-7256 或發送電子信件至 Meg.Bommarito@ecy.wa.gov。