APPENDIX F

UPDATED SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

Mashapaug Cove
333 Adelaide Avenue
Providence, RI

Prepared by AMEC

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1.0 INTRODUCTION

This is an Updated Screening Level Ecological Risk Assessment (SLERA) submitted as part of the Supplemental SIR in 2006 (MACTEC, 2006) which evaluated Mashapaug Cove as required by the April 5, 2006 Amended Notice of Responsibility issued by the Rhode Island Department of Environmental Management (RIDEM) to Textron, Inc. and the City of Providence (RIDEM, 2006). This SLERA builds on the conclusions from the previous evaluations and includes data collected after the completion of that evaluation.

This SLERA is being performed in accordance with the following regulations and guidelines:

- Rhode Island Department of Environmental Management Remediation Regulations, as amended, February 2004
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA 540-R-97-006. June 1997
- Framework for Ecological Risk Assessment. EPA-630-R-92-001. February, 1992
- Guidance for Ecological Risk Assessment. EPA-630-R-95-002F. April, 1998

This SLERA addresses surface water and sediment in the Outer Cove Study Area. The previous SLERA evaluated the entire Mashapaug Cove. It has been determined that the sediment in the Inner Cove is impacted and a remedial action is required for the Inner Cove sediments. This SLERA evaluates risks associated with likely post-remedial conditions (after removal and replacement of Inner Cove surficial sediment). In other words, this SLERA is documenting the effectiveness of the proposed sediment remediation in reducing risk to ecological receptors. In accordance with §8.05 of the Rhode Island Remediation Regulation (RIDEM, 2004 and revised in 2012) and following the definition of "environmentally sensitive areas" in §3.16, this SLERA does not evaluate soil in upland areas surrounding the Cove.

As described in the 1997 USEPA Guidance, the purpose of the SLERA is to identify all complete exposure pathways and to conduct a conservative assessment of all chemicals of potential concern (COPCs), and carry to a Baseline Ecological Risk Assessment (BERA) only those site related chemicals for which risk cannot be ruled out. The results of the SLERA are used to determine whether the available information is adequate to make risk management decisions. Based on the SLERA, it may be concluded either:

- There is a negligible ecological risk and therefore the Site or components of the site require no further study
- There is (or might be) a risk of adverse ecological effects, and the ecological risk assessment process will continue with a baseline ecological risk assessment
- The information is not adequate to make a decision, but the ecological assessment process will continue.

Thus, in accordance with the 1997 USEPA guidance, this SLERA:

- Summarizes site data
- Characterizes the site conditions
- Provides screening level problem formulation, screening level effects evaluation, exposure estimate, and risk calculation
- Identifies which contaminants found at the site can be eliminated from further consideration and which should be evaluated further, as part of a BERA.

2.0 PROBLEM FORMULATION

2.1 Site Background

The former Gorham Manufacturing Facility is situated on a 37 acre parcel at 333 Adelaide Avenue in Providence, Rhode Island (Figure 2.1). Between 1890 and 1986, sterling silver and plated silverware, as well as bronze castings, were manufactured on-site. Operations included casting, rolling, polishing, lacquering, forging, plating, annealing, soldering, degreasing, machining, and melting.

The former manufacturing facility has been improved with a retail complex on Parcel A and a high school on Parcel B. The former manufacturing site is bordered by a rail line and inductrial commercial properties to the east, Mashapaug Cove to the north, Mashapaug Pond to the west, and Adelaide Avenue and a residential neighborhood to the south. The 333 Adelaide Avenue property slopes downward toward Mashapaug Cove and Mashapaug Pond. Figure 2.2 shows the location of Mashapaug Cove.

The 2006 Amended Notice of Responsibility required an assessment of Mashapaug Cove. A SLERA was completed for Mashapaug Cove as part of the Supplemented SIR (MACEC, 2006). The SLERA completed in 2006 primarily used surface water and sediment data collected in 2006. Additional surface water and sediment data have been collected in 2011. This SLERA will use these new data to update the SLERA completed in 2006. The previous SLERA evaluated as two exposure areas, Mashapaug Cove and the Property Line. Based on multiple investigations it has been determined that the sediments in the Inner Cove are impacted by the former Site. Furthermore, it has been determined that there is a need for some type of remedial action due to the impact of these sediments. Since it has been determined there is a need for a remedial action in the Inner Cove, this area is not evaluated in this SLERA (the SLERA evaluates hypothetical post-remedy conditions). Mashapaug Cove has an area slightly larger than four acres and is within the property line of 333 Adelaide Avenue as shown on Figure 2-2. The southern half of Mashapaug Cove is herein referred to as the Inner Cove and the northern half slightly beyond the property line referred to as the Outer Cove Study Area. Mashapaug Cove is located in the northeast corner of Mashapaug Pond.

2.2 Environmental Setting

The environmental setting was characterized in 2006. Since 2006 there have not been any major changes to the environmental setting.

2.2.1 Methodology

On June 20, 2006, a MACTEC biologist visited Mashapaug Cove to conduct a reconnaissance level habitat assessment. The habitat assessment occurred following a prolonged period of rain thus recorded observations reflect high water conditions. Wetland and shore-line habitats were qualitatively characterized in terms of their dominant plant species, vegetative strata, presence of invasive species, and presence of human disturbance or alteration. During the field visit,

mammals, birds, herpetiles, and benthic organisms observed by direct observation (sight) or sign were recorded. Along the Cove shoreline, a dip net was used to collect aquatic macroinvertebrates from sediment and from habitat provided by submerged plants and logs. Specimens were sorted and identified in the field down to the lowest possible taxa.

2.2.2 Natural Communities and Wildlife

Terrestrial Shoreline. The shoreline along the Cove is characterized by a deciduous woodland community. The tree canopy is dominated by black birch (*Betula lenta*) and red maple (*Acer rubrum*), and also contains cottonwood (*Populus deltoides*), grey birch (*Betula populifolia*), oak (*Quercus* sp.), black locust (*Robinia pseudoacacia*), catalpa (*Catalpa* sp.), and mulberry (*Morus* sp.). The tree canopy reaches approximately 30 feet in height, and provides 100 percent cover. The largest trees have a diameter at breast height (dbh) of approximately 7 inches. The shrub slayer is dominated by poison ivy (*Toxicodendron radicans*), highbush blueberry (*Vaccinium corymbosum*), lowbush blueberry (*Vaccinium angustifolium*), greenbrier (*Smilax rotundifolia*), arrowwood (*Vibermun dentatum*), mountain laurel (*Kalmia latifolia*), honeysuckle (*Lonicera japonica*), and knotweed (*Polygonum cuspidatum*). The herbaceous layer is dominated by poison ivy, with frequent occurrences of Japanese barberry (*Berberis thunbergii*) and sweet-pepper bush (*Clethra alnifoliaea*). Although vegetation along the shoreline is relatively dense, there are occasional small breaks which give direct access to the water.

Tree cavities, logs, brush piles, and pond overhangs provide nesting and perching habitat for redwing blackbirds (*Agelaius phoeniceus*), black capped chickadee (*Poecile atricapillus*), goldfinch (*Carduelis tristis)*, and mourning doves (*Zenaida macroura*), which were observed on-site. A pair of swans (*Cygnus* sp.) were observed nesting on the western peninsula. Raccoon (*Procyon lotor*) tracks were also observed along the shoreline and eastern grey squirrels (*Sciurus carolinensis*) were observed in the woods.

Topography along the western peninsula slopes up gently from the water's edge, rising to approximately 5 feet above the high water line. Topography along the eastern side of the Cove is steeper, with a hill rising approximately thirty feet to overlook the Cove and Pond. Soil is covered by a thin organic leafy layer less than 1 cm in thickness. Soil is sandy, and is classified by the Natural Resource Conservation Service (NRCS) as Hinckley gravelly sandy loam (HkC). This soil series is excessively drained soil occurring on terraces, outwash plains, kames, and eskers. Typically the surface layer is dark brown gravelly sandy loam about 6 inches thick. The subsoil is 11 inches thick; the upper 4 inches of the subsoil is yellowish brown gravelly sandy loam, and the lower 7 inches is light yellowish brown gravelly loamy sand. The substratum is light brownish gray very gravelly sand to a depth of 60 inches or more (NRCS, 2006). The permeability of this soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low, and runoff is slow. The soil is extremely acid through medium acid (NRCS, 2006).

Portions of the shoreline habitat show signs of anthropogenic disturbance, but there are no visible signs of plant stress. Exotic invasive plants species, such as honeysuckle, barberry, and knotweed are common within the terrestrial shoreline community. The nesting swans are also

exotic and invasive species. The ground surface is heavily littered. Approximately five concrete structures (former groundwater wells) occur near the pond. The shoreline habitat is segmented by an overgrown or abandoned dirt road/pathway adjacent to the Cove perimeter along the western shoreline. Bordering the terrestrial shoreline community to the south is a shopping mall parking lot.

Aquatic community. The Cove consists largely of open water, approximately 4 acres in area, and is characterized as eutrophic. At the time of the habitat survey water temperature was 26 C and the water column was turbid with visibility to approximately 1-foot depth. There are no emergent plant communities except very close to shore during periods of floods or high water when the waterline rises to encompass terrestrial shoreline plants. Rooted vegetation, consisting of water lilies (*Nymphaea odorata*), were observed in several groupings within the Cove. Submerged logs and branches also create habitat stratification suitable for fish cover. In the summer, massive amounts of rooted and floating aquatic vegetation choke the water column.

Substrate along the shoreline is typically sand with trace gravel overlain by a thin (less than 1 inch) detrital layer. Water boatmen (*Cymatia* sp.), backswimmers (*Notonecta* sp.), and water striders (*Limnogonus fossarum*) were observed in the water column. Dragon fly and damselfly larvae (Odonata), amphipods, and oligocheates were identified in dip net samples collected from substrate in sandier areas. Amphipods, leaches, chironomids, and dragonfly larva were observed in the center of the shoreline among rooted vegetation and thicker detrital layer.

Juvenile fish were observed along the shoreline but could not be identified, and fish observed jumping in the center of the Cove were tentatively identified as carp. No amphibians were observed and none were heard calling. Mallard ducks, as well as one of the nesting pairs of swans were observed foraging within the Cove.

Water depth in the Cove appears to be shallower than in the rest of the pond. Bathymetric data collected in December 2011 show that within the Inner Cove, water depth averages between 3 feet and 3.5 feet. In the Outer Cove, water depth increases to approximately 10 feet to 11 feet in the vicinity of the property line.

Mashapaug Pond has been classified as Class B surface water (RIDEM, 2006). Class B waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They should be suitable for compatible industrial process and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters should have good aesthetic value.

2.2.3 Threatened and Endangered Species

The RIDEM Geographic Data Viewer was used to determine the presence of rare species habitat. Based on the available maps, no rare species habitat were identified in the vicinity of the project site.

2.3 Exposure Pathways

Investigations of the former Gorham Manufacturing Facility and the remainder of the property at 333 Adelaide Avenue have identified evidence of releases of hazardous materials to soils and groundwater. Many of the sources have been addressed though remedial actions, and no longer represent a source from which hazardous material could migrate.

The 1995 RI Report indicated that six categories of release, or potential release had been identified. These include: oil from removed and out-of-service underground storage tanks (USTs); volatile organic compounds (VOCs) in soil and groundwater from above-ground storage tanks (ASTs), production activities (particularly in the areas of Buildings W and T), or incidental disposal; fill material of the West Parking and North Bank Areas; surface soils containing PCBs near the transformer pad and Building N; releases of oil from machines to building basements; and possible contaminants conveyed from the site in stormwater runoff. Subsequent to the RI Report, an additional source was identified; a slag pile located immediately south of Mashapaug Cove appears to have been accumulated from smelter operations that were performed in Building V of the former facility. The slag pile consisted of very dense, metals-containing solid material that was present in chunks ranging in diameter between one inch and ten inches. The slag pile was excavated and removed from the property in July 2006. In addition to the excavation, capping of upland soil along the banks of the Cove has been completed in November 2012.

Bronze casting, silverware manufacturing, and plating activities have resulted releases of metals (especially lead and copper) to soils on Parcels A, B, and C. Chlorinated VOCs have been detected in groundwater in the areas of former Buildings W and T. The Building W area is a probable source area for tetrachloroethylene (PCE) in groundwater. However, the specific source or point of release of PCE in the vadose zone soil or in the shallow groundwater has not been identified. Free floating product (fuel oil) and petroleum contaminated soils were identified at the former location of the two former 19,000-gallon USTs.

The specific source of the dioxins and furans is not known. However, the distribution of dioxin and furan homolog groups in soil and sediment appears to be consistent with the signature associated with municipal waste incineration (MACTEC, 2006).

Investigations to date indicate that metals and polycyclic aromatic hydrocarbons (PAHs) and other persistent materials in surficial soils and fill material have the potential to migrate with soil material via overland flow during and immediately after precipitation events. It appears that historically, soils from the former facility area and along the filled area immediately to the south of Mashapaug Cove have been subjected to this mechanism and a number of drainage swales have been identified between the higher elevation former facility area and the shoreline of Mashapaug Cove. Leachate containing metals from the former slag pile might have discharged directly into the Cove, or it may have first infiltrated into groundwater and been subsequently transported into the Cove. These areas have been capped, completed in November 2012, which has eliminated overland flow of these contaminants into the Cove. There is a plume of chlorinated VOCs in groundwater which flows in a northerly direction from the higher elevation

former facility area in the direction of Mashapaug Cove. The groundwater appears to discharge into Mashapaug Cove, passing through the sediments of the cove in the process. Available data indicate that minimal transfer of chlorinated VOCs from groundwater to surface water is occurring. The available sediment quality data suggest that the highly organic sediments of the Cove may be acting as a sink for VOCs in groundwater that passes through the sediment.

2.4 Data Used in the SLERA

Data evaluated in this SLERA are associated with surface water and sediment samples collected in June 2006 and December 2011 from the Outer Cove Study Area. Sample locations used in the SLERA for the Outer Cove Study Area are shown in Figure 2.2.

One surface water sample was collected in June 2006 at SW11. Surface water at this location was analyzed for VOCs, SVOCs, pesticides, PCBs, dioxins/furans, and total and dissolved metals. Four sediment samples were collected in June 2006 at locations SED11, SED13, SED14, and SED15. All sediment samples were collected in the 0-1 ft depth interval. All sediment samples from these locations were analyzed for VOCs, SVOCs, pesticides, PCBs, dioxins/furans, metals, and total organic carbon. Sediments collected at location SED15 were analyzed for AVS/SEM metals. Data used in the SLERA for the Outer Cove Study Area are presented in Attachment A.

Eighteen surface water and sediment samples were collected in December 2011 from locations SED/SW33 to SED/SW48, SED/SW59, and SED/SW60. Surface water samples from these locations were analyzed for dioxins/furan and total and dissolved metals. All sediment samples were collected in the 0-1 ft depth interval. All sediment samples from these locations were analyzed for dioxins/furans, metals, total organic carbon, and AVS/SEM metals. Data used in the SLERA for the Outer Cove Study Area are presented in Attachment A.

2.5 Ecotoxicity

Toxicological profiles of the families of compounds subject to evaluation in the SLERA (VOCs, SVOCs, metals, and dioxins and furans) are summarized in Attachment B.

2.6 Initial Ecological Conceptual Model

The initial ecological conceptual model illustrates initial estimates of contaminant fate and transport mechanisms, complete exposure pathways, and primary and secondary receptors. Generic assessment and measurement endpoints were used, as discussed in Section 2.8. The initial ecological conceptual model is based on the current understanding of the site conditions, and serves as a framework for evaluating ecological exposure and risk.

The initial ecological conceptual model for the site is shown in Figure 2.3 and illustrates:

- The source area (i.e. the former facility area and potentially the slag pile)

- Transport mechanisms (processes that partition chemicals among various environmental media or move chemicals within a medium)
- Exposure to media (those environmental media from which organisms may be exposed to chemicals).

Based on site information, it appears complete exposure pathways exist for organisms inhabiting surface water and sediment habitats in the Outer Cove Study Area. Fauna feeding on aquatic plants, benthic macroinvertebrates, and fish may also be exposed.

2.7 Complete Exposure Pathways

Chemicals may move from environmental media to ecological receptors through several major biological exposure mechanisms:

- Uptake of chemicals from sediment through roots (vegetation)
- Dermal exposure to chemicals in sediment (mammals and amphibians)
- Ingestion of chemicals bound to sediment (benthic invertebrates, aquatic and semi-aquatic birds, mammals, amphibians)
- Ingestion of dissolved chemicals in surface water (benthic invertebrates, amphibians, aquatic and semi-aquatic birds and mammals)
- Ingestion of chemicals through consumption of contaminated plants (herbivores, omnivores)
- Ingestion of chemicals through consumption of contaminated prey (all predators)

Although inhalation and dermal absorption pathways are possibly complete for some receptors, these pathways are considered to be minor compared to dietary ingestion and are not be evaluated.

2.8 Assessment and Measurement Endpoints for the Benchmark Comparison

Endpoints are used in the ecological risk assessment to define the ecological attributes to be protected (assessment endpoints) and to define measurable characteristics of those attributes that can be used to gauge the degree of impact that may occur (measurement endpoints). Assessment endpoints most often relate to attributes of biological populations or communities. They contain an entity (e.g., invertebrate population) and an attribute of that entity (e.g., survival rate).

Assessment endpoints for the SLERA are based on generic assessment endpoints associated with screening ecotoxicity endpoints. The endpoints are considered generic because they are based on a variety of organisms and are therefore considered to be representative of entire communities.

Assessment and measurement endpoints for the benchmark comparison are:

SLERA Assessment and Measurement Endpoints

Assessment Endpoint	Measurement Endpoint
Sustainability (survival, growth, reproduction) of local populations of aquatic organisms (e.g. aquatic plants, invertebrates, fish, aquatic birds and mammals) in surface water	Comparison of surface water concentrations to surface water quality benchmarks
Sustainability (survival, growth, reproduction) of local populations of benthic invertebrates in sediment	Comparison of sediment concentrations to sediment quality benchmarks

3.0 SCREENING BENCHMARKS

Screening benchmarks (also called screening values or benchmark values) represent conservative thresholds for adverse ecological effects. Screening values were based on conservative assumptions and represent no-observed-adverse-effect-levels (NOAELs) for chronic exposures to a toxicant when available. The screening level assessment used ecotoxicological screening benchmarks from various sources to assess the potential for ecological risk due to exposure of receptors in surface water, and sediment.

3.1 Surface Water Screening Criteria

Surface water benchmarks for parameters detected in surface water samples are summarized in Table 3.1. The following sources were used in the order presented as benchmarks for screening surface water for potential ecotoxicity:

- Rhode Island Ambient Water Quality Criteria (RI AWQC) (RIDEM, 2006)
- National Ambient Water Quality Criteria (NAWQC) (USEPA, 2002; 2004)
- Secondary Chronic Values (SCVs) for aquatic biota developed by Oak Ridge National Laboratory (Suter & Tsao, 1996)

The RI AWQC are the preferred surface water benchmarks for aquatic organisms because they are based on single chemical chronic toxicity tests with numerous species.

NAWQC were used for chemicals if RI AWQC were not identified. NAWQC are also based on single chemical chronic toxicity tests with numerous species.

Oak Ridge National Laboratory (ORNL) Secondary Chronic Values (SCVs) are derived using methods similar to the AWQC but using a fewer number of species. These are used only when no RI AWQC or NAWQC are available.

3.2 Sediment Screening Criteria

Sediment benchmarks for parameters detected in sediment samples are summarized in Table 3.2. The following sources were used in the order presented as benchmarks for screening sediment for potential ecotoxicity:

- MacDonald *et al.* (2000) Threshold Effects Concentrations (TECs)
- Oak Ridge National Laboratory Tier II Secondary Chronic Screening Values (Jones, Suter, and Hull, 1997)
- Ontario Ministry of Environment and Energy (OMEE) Lowest Effects Levels (LELs) (Persaud *et al.*, 1993)
- Washington State Sediment Quality Values (SQVs) (Cubbage, *et al.*, 1997)

Threshold Effects Concentrations (TECs) are sediment quality assessment values that were developed using matching biological and chemical data (i.e. sediment chemistry and toxicity data provided for the same samples) from modeling, laboratory, and field studies performed with freshwater sediment throughout North America (MacDonald, 1994); MacDonald, *et al*., 2000). The authors used the matching data to associate chemical concentrations in sediment with the absence or occurrence of adverse effects. They established an "effect" and "no effect" data set and based their derivation of the TECs on both of these datasets. The TECs represent chemical concentrations above which effects frequently occurred in the laboratory tests. TECs were derived for 8 metals, 10 PAHs, total PCBs, and 8 pesticides.

Oak Ridge National Laboratory (ORNL) developed sediment screening benchmarks for nonionic organics (such as acetone) called secondary chronic values (SCVs) which are protective of sediment communities. SCVs are normalized to Site specific average TOC of 4.3%.

Ontario Ministry of the Environmental (OMOE) Provincial Sediment Quality Guideline Lowest Effect Levels (LELs) indicate a level of sediment contaminant at which most benthic organisms are unaffected. OMOE benchmarks are also normalized to Site specific average TOC of 4.3%.

Washington State Sediment Quality Values (SQVs) for sediment were created based on toxicity studies used to derive probable apparent effects thresholds (PAETs). Test organisms conducted *Hyalella azteca*, a sensitive sediment receptor.

4.0 SCREENING LEVEL EXPOSURE ESTIMATE AND RISK CALCULATION

For the SLERA, maximum detected concentrations of pooled Supplemental RI (2006) and 2011 Outer Cove Study Area data were used as exposure point concentrations. Maximum concentrations were compared to medium-specific screening values for surface water and sediment. Analytes with a frequency of detection (FOD) of 5 percent or less (by exposure area and medium) were eliminated from further screening. Analytes with maximum concentrations greater than benchmark screening values were identified as chemicals of potential concern (COPCs). Analytes that did not have screening benchmarks were also identified as COPCs.

4.1 Hazard Quotients

A hazard quotient (HQ) was used to calculate a screening level risk estimate for each COPC:

$$\text{Hazard Quotient} = \frac{\text{Maximum Concentration}}{\text{Benchmark Value}} \qquad \text{(Equation 1)}$$

Tables 4.1 and Table 4.2 summarize the screening process, present analytes which were identified as COPCs, and show the HQ calculated for each COPC. An HQ could not be calculated for COPCs which lacked benchmark values. An HQ less than or equal to 1 indicates that the analyte alone is unlikely to cause adverse ecological effects. However, an HQ > 1 does not in itself represent an unacceptable risk; an HQ >1 in the SLERA indicates the *potential* for adverse ecological risks. Other site-specific factors (e.g., bioavailability) present at the site may affect actual risk.

Because the screening-level risk calculation is meant to be a conservative estimate, the calculation assumes an area-use factor of 100 percent, bioavailability of 100 percent, that the exposed receptor life stage is the most sensitive stage, dietary composition is 100 percent, and that body weight and food ingestion rates are conservative.

4.2 Screening Results

4.2.1 Surface Water

No SVOCs were detected in surface water samples collected from the Outer Cove Study Area and thus were not identified as COPCs (Table 4.1). Two VOCs were detected in surface water below their respective screening benchmarks and therefore were not identified as COPCs. DDT was identified as a COPC because its maximum concentration exceeded its screening benchmark (HQ=80). Two metals were detected in surface water in the Outer Cove Study Area, copper and zinc. The maximum zinc concentration was below its screening benchmark and therefore not identified as a COPC. Copper was identified as a COPC because its maximum concentration exceeded its screening benchmark (HQ=24). Copper was not detected in the dissolved fraction in surface water. Since copper was only detected in surface water for the total metals analysis and not the dissolved metals analysis most likely the detections of copper are from suspended solids in the surface water sample. Dioxins were identified as COPCs using the TEQ calculation (see Section 4.3.3).

4.2.2 Sediment

Four VOCs were identified as COPCs in sediment samples collected from the Outer Cove Study Area (Table 4.2) because their maximum concentrations exceeded screening benchmarks. HQs for VOCs ranged from 1.6 to 18. Acetone and carbon disulfide are not considered site-related (MACTEC, 2006) and should be eliminated from further evaluation. One PAH was identified as COPCs because its maximum concentration was greater than the benchmark; HQ of 1.3. No PCBs or pesticides were detected in outer cove sediment samples. Dioxins were identified as COPCs using the TEQ calculation (see Section 4.3.3). Nine metals were identified as COPCs because their maximum concentrations exceeded screening benchmarks; two metals were identified as COPCs because they lacked screening benchmarks (Table 4.2). Inorganic HQs ranged between of 3.3 to 59.

4.3 Additional Evaluations

This section uses additional tools to evaluate COPCs. Acid-volatile sulfide-simultaneously extractable metals (AVS-SEM) data were evaluated to better understand bioavailability of metals in sediment. Bioavailability of PAHs was also further evaluated using the ΣPAH method. Dioxins and furans were evaluated using the toxicity equivalents (TEQ) calculation.

4.3.1 AVS-SEM

AVS-SEM analysis was conducted for 18 samples in the Outer Cove Study Area (USEPA, 2005; *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures*).

The bioavailability of metals in sediment can significantly affect their potential toxicity to benthic organisms. Bioavailability of certain divalent metals (cadmium, copper, lead, nickel, silver, and zinc) is influenced by the amount of sulfide contained within the substrate. If the amount of acid-volatile sulfide (AVS) exceeds the amount of simultaneously extracted metals (SEM), then the divalent metals are considered unavailable for leaching from the substrate into pore water or the overlying water column. The comparison between SEM and AVS consisted of calculating the amount of SEM and AVS in units of umol/g, subtracting the AVS value from the SEM value, and then normalizing this difference by the amount of organic carbon (expressed as a fraction) in the sediment (USEPA, 2005):

$$\text{Normalized Value} = \frac{(SEM-AVS)}{F_{oc}} \qquad \text{(Equation 2)}$$

Where;
Normalized Value = $umol/g_{OC}$
SEM=measured concentration of SEM metals (umol/g)
AVS=measured concentrations of AVS (umol/g)
F_{oc}=fraction of organic carbon in sediment (g_{OC}/g_{sed})

Per USEPA Guidance (USEPA, 2005), if the normalized value is less than 130 umol/g_{OC}, then divalent metals in the sample are unlikely to be bioavailable. If the normalized value is between 130 umol/g_{OC} and 3,000 umol/g_{OC}, then sample bioavailability is uncertain. If the normalized value exceeds 3,000 umol/g_{OC}, then samples are likely to be bioavailable. A negative value indicates that AVS exceeds SEM, thus the divalent metals are unavailable for leaching into pore water or the overlying water column.

Examination of AVS-SEM data normalized to sediment organic carbon content (Table 4.3) indicates that at 15 locations the normalized values are below 130 umol/g_{OC}, and thus divalent metals in sediment from these samples are categorized as unlikely to be bioavailable. The normalized AVS-SEM value for the remaining three sediment samples were between 130 umol/g_{OC} and 3,000 umol/g_{OC}, indicating that bioavailability is uncertain. Based on these results, it would appear divalent metals in sediments samples of the Outer Cove Study Area are not bioavailable.

4.3.2 Sum-PAH (ΣPAH) Method

The bioavailability of PAHs in sediment can significantly affect their potential toxicity to benthic organisms. Bioavailability of PAHs is influenced by the amount of total organic carbon within the substrate and depends on the properties of the individual PAH constituents. The bioavailability of PAHs was further assessed using the ΣPAH method (USEPA, 2003b; *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures*). This model calculates equilibrium partitioning sediment benchmarks (ESBs) and individual compound-specific toxicity quotients based on measured sediment concentrations of 34 individual PAHs and site-specific TOC concentrations. The individual toxicity quotients are summed to calculate the sediment benchmark toxic unit ($\Sigma ESBTU_{fcv}$). Freshwater sediments with a $\Sigma ESBTU_{fcv} \leq 1.0$ are considered protective of benthic organisms. If the $\Sigma ESBTU_{fcv} > 1.0$, sensitive benthic organisms may be potentially affected. Thus, the ΣPAH model is useful for predicting lack of toxicity. This method cannot be applied to sediment having ≤ 0.2% TOC by dry weight.

ΣPAH calculations are summarized in Table 4.4 and shown in detail in Attachment C. Because only a subset of the 34 recommended PAHs were analyzed, a correction factor was applied to the calculation to achieve a 90th confidence percentile in accordance with USEPA guidance (USEPA, 2003b). When an individual PAH was not detected, one-half of the detection limit was used in the calculation.

The ΣPAH calculations indicate that PAH concentrations in the Outer Cove Study Area (SED11, SED12, SED14, and SED15), would be unlikely to be toxic to benthic organisms. Although Table 4.4 shows a $\Sigma ESBTU_{fcv} > 1.0$ for SED13, toxicity may be ruled out because no PAHs were detected at this location (the calculated value is based entirely on one-half detection limit for all PAHs).

4.3.3 Dioxin/Furans TEQ Evaluation

Most dioxins, furans, and dioxin-like compounds lack individual screening benchmarks. However, the congener-specific dioxin and furan data can be consolidated into a single measure, called the toxic equivalence (TEQ) of the sample. The dioxin TEQ is calculated by multiplying the concentrations of each congener or congener containing chlorine at the 2,3,7, and 8 positions in a sample by a toxicity equivalence factor (TEF) and summing those products. The TEF normalizes the toxicity of those congeners to the toxicity of the 2,3,7,8-TCDD congener, generally considered to be the most toxic of the dioxin, furan, and dioxin-like compounds. In effect, the dioxin TEQ indicates the concentration of 2,3,7,8-TCDD that would have the same toxicity as the mixture of dioxins and furans being evaluated. Congeners that do not contain chlorine at the 2,3,7 and 8 positions are not assigned a TEF because they do not have the same stereochemistry (and toxicity) as the 2,3,7,8-TCDD congener. All OCDD and OCDF congeners have chlorine at the 2,3,7, and 8 positions. The TEFs used in this SLERA reference the World health Organization values for birds, and fish (Van den Berg *et al.*, 1998) and the USEPA for mammals (USEPA, 2010).

TEQ calculations for sediment are summarized in Table 4.5 and presented in full in Attachment D. The dioxin TEQ for each sample was compared to the ecological screening benchmarks of 0.0000072 mg/kg for sediment (Cubbage, 1997) to calculate a hazard quotient.

The dioxin TEQ-mammal concentration in sediment exceeded the screening benchmark at the following locations: SED/SW11, SED14, SED/SW36, SED/SW39, SED/SW41, SED/SW43, SED/SW44, SED/SW46, SED/SW47 and SED/SW48. The dioxin TEQ-bird and dioxin TEQ-fish concentrations in sediment exceeded the screening benchmark at the following locations: SED/SW11, SED14, SED/SW36, SED/SW39, SED/SW41, SED/SW43, SED/SW44, SED/SW45, SED/SW46, SED/SW47 and SED/SW48. The highest HQ (108, for birds) occurred at SED/SW41.

In the surface water sample which was analyzed for dioxin (SW11), the dioxin TEQ exceeded the screening benchmark with a maximum HQ of 1.6, for birds (Table 4.1). Dioxins and furans are virtually insoluble in water, so the reported surface water concentrations are likely associated with suspended particulate matter (likely sediment). When the remediation of sediments of the Inner Cove is completed, it is expected that surface water concentrations of dioxins and furans would be lower than reported for SW-11. This indicates that upon completion of sediment remediation in the Inner Cove, dioxins and furans in surface water would be associated with negligible risk to ecological receptors.

5.0 FOOD CHAIN MODELING

In order to further refine the list of COPCs which remained after the benchmark screening and refinement steps described in Section 4.0, food chain exposure models were run to estimate potential risk to semi-aquatic wildlife receptors exposed to COPCs in sediment. This section selects the assessment populations, presents measurement endpoints for food chain models, discusses model equations, parameters and assumptions (including exposure point concentrations), and then summarizes food chain model results. Food chain models were run only for those COPCs which were not eliminated by the benchmark screening or the subsequent refinement steps (dioxin/furan TEQ).

5.1 Selection of Assessment Populations

The Outer Cove Study Area provides habitat which may be used by bird species for feeding or nesting. The great blue heron (Ardea herodias) has been selected as a representative species of aquatic birds. Dioxin/furans were not detected in near shore sediment samples in the Outer Cove Study Area. Therefore, semi-aquatic mammals (e.g. raccoon) that would frequent the edge of the cove would not be exposed to dioxin/furans in contaminated sediment and are not evaluated in the SLERA.

Great blue herons tend to nest in dense colonies located close to foraging grounds. Fish are their preferred prey, but great blue herons also eat amphibians, crustaceans, insects, birds, and mammals (USEPA, 1993). When fishing, they generally employ one of two foraging techniques: standing still and waiting for fish to swim to within striking distance, or slow wading to catch sedentary prey. Great blue herons migrate from summer breeding grounds during mid-autumn and generally return by mid-spring. Great blue herons have not specifically been observed at the Site; however, they are representative of the wildlife receptors that may use the outer cove, and habitat present suggests that they could potentially use portions of the outer cove.

5.2 Assessment and Measurement Endpoints for Food Chain Models

Endpoints for the benchmark comparison were based on generic endpoints associated with screening ecotoxicity endpoints (Section 2.8). Assessment endpoints for the food chain models are consistent with those. However, additional measurement endpoints have been added to include specific receptors evaluated by the food chain models, as discussed below.

The assessment endpoint for individual assessment populations is sustainability of local populations, defined by survival, growth, and/or reproduction. Adverse effects to sustainability can be inferred by measuring effects of COPC exposures which directly impact sustainability. However, some COPC exposures may be associated with sub-lethal effects which do not directly affect survival and/or reproductive success. These sub-lethal effects may increase the probability of death or adversely influence reproduction by enhancing susceptibility to predation or parasitism, or weakening competitive ability. For this assessment, it is assumed that toxicity reference values (TRVs) based on sub-lethal and non-reproductive endpoints (such as

systemic, hematological, carcinogenic, neurological, hepatic, etc.) are representative of potential effects that indirectly affect survival or reproductive capacity and are therefore appropriate.

5.3 Exposure Calculations

The exposure parameters used for the great blue heron are shown in Table 5.1 and discussed below. The following general equation was used to calculate estimated daily intake (EDI) of a COPC by an indicator species, expressed as a daily dose (Sample *et al.*, 1996):

$$EDI_{total} = EDI_{sed} + EDI_{prey} + EDI_{water} \quad \text{(Equation 3)}$$

Where;
EDItotal = total amount of COPC ingested per day (mg COPC/kg body weight/day)
EDIsed = amount of COPC ingested from sediment (mg COPC/kg body weight/day)
EDIprey = amount of COPC ingested from prey (fish) (mg COPC/kg body weight/day)
EDIwater = amount of COPC ingested from water (mg COPC/kg body weight/day)

Each of the terms in this equation are discussed in detail, below.

Dose From Sediment. Receptors may be exposed to COPCs through the incidental ingestion of sediment while foraging. Doses of COPCs from sediment were estimated using the following general equation:

$$EDI_{sed} = C_{sed} * IR_{sed} * SFF * EF * 1/BW \quad \text{(Equation 4)}$$

Where;
EDIsed = amount of COPC ingested from sediment (mg COPC/kg body weight/day)
Csed = measured concentration of COPC in sediment (mg/kg)
IRsed = ingestion rate of sediment (kg/day)
SFF = site foraging factor (unitless)
EF = exposure frequency (unitless)
BW = body weight (kg)

Dose From Prey. Receptors may be exposed to COPCs through ingestion of prey (fish). COPC doses from fish were estimated using the following general equation:

$$EDI_{fish} = C_{fish} * IR_{fish} * P_{fish} * SFF * EF * 1/BW \quad \text{(Equation 5)}$$

Where;
EDIfish = amount of COPC ingested from fish (mg COPC/kg body weight/day)
Cfish = COPC concentration in fish tissue (mg/kg)
IRfish = ingestion rate of fish prey (kg/day)
Pfish = fraction of diet from fish prey (unitless)
SFF = site foraging factor (unitless)

EF = exposure frequency (unitless)
BW = body weight (kg)

Because COPC concentrations in fish prey tissue were not directly measured, they were modeled from sediment concentrations. The concentration of COPCs in fish tissue was modeled using the following general equation:

$$Cfish = Csed * BAFfish \quad \text{(Equation 6)}$$

Where;
Cfish = COPC concentration in fish tissue (mg/kg)
Csed = measured concentration of COPC in sediment (mg/kg)
BAFfish = bioaccumulation factor in fish (unitless)

Fish Prey BAFs. The fish BAF for dioxin TEQ was calculated using the USEPA ORD BSAF Dataset. The BAF used is the average BAF for 40 BAFs for dioxin like compounds for lake trout in Lake Michigan (USEPA, 2012). The fish BAF for dioxin TEQ was the adjusted using site specific average TOC and percent lipid for lake trout as reported by Burkhard and Lukasewycz (2000).

The fish BAF and calculated concentration in fish tissue are shown in Table 5.2. EDI's for fish and for sediment are shown in Table 5.3.

5.4 Model Parameters and Assumptions

For each assessment population within the Outer Cove Study Area, a maximum case was modeled by using the 95% UCL sediment concentration in the Outer Cove Study Area as the EPC. Data used in the calculation of the Outer Cove Study Area EPC are shown in Attachment A. The 95% UCL calculations are documented in Attachment E.

An oral bioavailability factor of 1 was assumed for each chemical evaluated in the ingestion pathway. The use of a factor of 1 assumes that 100% of the chemical ingested in the diet is bioavailable, and that bioavailability is similar to that of the bioassay from which the toxicity reference value (TRV) is derived. Use of a factor of 1 also assumes that there is no difference in uptake of a chemical between that of the receptor species and the species from which the TRV was derived.

Surface water intake rates are several times lower than food and incidental sediment ingestion rates. Therefore, surface water concentrations were not used in the model.

5.5 Dietary Parameters of Assessment Populations

Dietary exposure parameters and values for ingestion of prey and for incidental ingestion of sediment were selected from a range of values available in Wildlife Exposure Factors Handbook (USEPA, 1993).

The model assumed that a heron's diet consists entirely of fish and incidental sediment ingestion (9% of daily food intake rate). Because herons migrate, the model assumes that they spend approximately seven months at the site (EF= 0.58). For screening purposes it is assumed that all of the heron's diet comes from the Outer Cove area (SFF=1).

5.6 Hazard Calculation

Modeled COPC daily doses were compared to TRVs to evaluate the effect of exposure on assessment populations. This comparison was quantified as follows:

$$HQ = \frac{EDI_{total}}{TRV} \qquad \text{(Equation 7)}$$

Where ;
EDI_{total}= total dose of COPC calculated from food chain model (mg/kg-day)
TRV = toxicity reference value (mg/kg-day)

An HQ of less than or equal to 1 indicates that the chemical alone is unlikely to cause adverse ecological effects. An HQ greater than 1 suggests that a COPC is present at a concentration which may affect survival or reproductive capacity.

The avian toxicity reference value (TRV) for dioxin TEQ was obtained from Sample et al. (1996).

HQs resulting from the maximum exposure case and NOAEL TRVs illustrate the maximum potential risk which would occur following conservative assumptions. LOAEL TRVs represent a scenario which is less conservative than HQs resulting from the maximum case and are more realistic and therefore preferred. While NOAEL TRVs are doses at which ecological effects are not observed, LOAELs are represent doses at which effects are actually observed, and thus reduce model uncertainty. Therefore, the maximum exposure case LOAEL HQ was chosen as the basis for characterizing risk site risk and for drawing conclusions. If the HQs based on the maximum exposure case and LOAEL TRV is less than or equal to 1, then it is unlikely that COPC will result in an adverse effect on an assessment population. An HQ >1 indicates that a particular assessment population may be at risk of an adverse affect from that contaminant. NOAEL and LOAEL based HQs for the great blue heron are shown in Table 5.4.

5.7 Food Chain Modeling Results

Food chain models evaluated only those COPCs which were not eliminated by the benchmark screening or other refinement steps (dioxin/furan TEQ). Food chain models used conservative assumptions to estimate concentrations of dietary components (fish) because site-specific tissue data were not available, likely resulting in over-estimates of exposure and risk. If food chain models were to use site-specific tissue data measured from fish exposed to actual site conditions, the results might differ significantly from the estimated values in this assessment.

The NOAEL and LOAEL based HQs for the great blue heron are shown in Table 5.4. Both the NOAEL and LOAEL HQs for dioxin TEQ are less than one for the great blue heron.

6.0 RISK CHARACTERIZATION, UNCERTAINTY, AND CONCLUSIONS

This section evaluates the results of the screening level exposure estimates and other lines of evidence used to identify and to eliminate chemicals from further review, considers uncertainties, and summarizes final conclusions and recommendations.

6.1 Risk Characterization for Outer Cove Study Area

DDT and dioxin TEQ were identified as COPCs in outer cove surface water. DDT had an HQ of 80. However, there is no evidence that DDT is a site-related chemical. Furthermore, DDT commonly occurs in the environment as a persistent remnant of historical use in the ambient environment. Given the low concentration at which it was detected (0.080 ug/l), it is likely consistent with background concentrations and should be eliminated from further review. In the one Outer Cove Study Area surface water sample which was analyzed for dioxin (SW11), the dioxin TEQ was slightly greater than the screening benchmark with a maximum HQ of 1.6, for birds, suggesting that risk from dioxins is almost negligible. In addition, as previously discussed, dioxins and furans are virtually insoluble in water, so the reported surface water concentrations are likely associated with suspended particulate matter (likely sediment). When the remediation of sediments of the Inner Cove is completed, it is expected that surface water concentrations of dioxins and furans would decrease. This indicates that upon completion of sediment remediation in the Inner Cove, dioxins and furans in surface water would be associated with negligible risk to ecological receptors. Therefore it is recommended that pesticides and dioxin be eliminated from further review in surface water in the Outer Cove Study Area.

No dissolved metals were identified as COPCs in surface water from the Outer Cove Study Area. Total copper was identified as a COPC in surface water. Copper was not detected in the dissolved fraction in surface water. Since copper was only detected in surface water for the total metals analysis and not the dissolved metals analysis, most likely the detections of copper are from suspended solids in the surface water sample. Therefore it is recommended that metals be eliminated from further review in surface water in the Outer Cove Study Area.

Four VOCs were identified as COPCs in sediment from the Outer Cove Study Area. However, acetone and carbon disulfide are not considered site-related (MACTEC, 2006) and should be eliminated from further evaluation. HQs for 1,1,1-TCA and TCE are both below 10, and both parameters were only detected in one of four samples (both detected in SED15). SED15 is the only location were site-related VOCs were detected in the Outer Cove Study Area. As described in Attachment B VOCs generally do not accumulate in plant and animal tissue, because of their reactive and volatile nature. Since VOCs have low HQs and do not bioaccumulate, it is recommended that VOCs be eliminated from further review in sediment in the Outer Cove Study Area.

One PAH was detected in sediment at a concentration above its benchmark (pyrene). However, the ΣPAH calculations indicate that PAH concentrations in the Outer Cove Study Area (SED11, SED12, SED14, and SED15), would be unlikely to be toxic to benthic organisms.

Therefore it is recommended that PAHs be eliminated from further review in sediment in the Outer Cove.

Eleven metals were identified as COPCs in sediment as part of the benchmark screening. Priority pollutant metals, except for silver (HQ=59), had relatively low HQs (below 5 for arsenic, cadmium, chromium, nickel, and zinc; 13 for copper, 17 for lead and 7 for mercury; barium and beryllium lacked benchmarks). Based on further refinement using the AVS-SEM data it would appear divalent metals are not bioavailable in the Outer Cove Study Area. Since metals are not bioavailable in sediment, it is recommended that metals be eliminated from further review in sediment in the Outer Cove Study Area.

Dioxin TEQ was identified as a COPC in sediment because concentrations area greater than the screening benchmark. Dioxin TEQ in sediment was evaluated further using food chain modeling. The results of the food chain modeling showed NOAEL and LOAEL HQs for dioxin TEQ are less than one for the great blue heron. Therefore, it is recommended that dioxin be eliminated from further review in sediment in the Outer Cove Study Area.

6.2 Uncertainties

This section presents and discusses the uncertainties associated with the various measurements, calculations, and assumptions which form the basis of the risk characterization. Awareness of the uncertainties involved in each step of the risk assessment is critical to interpreting and understanding site risk.

Conservative assumptions were made about exposure factors. The screening level risk calculation assumes an area-use factor of 100 percent, bioavailability of 100 percent, that the receptor life stage is the most sensitive stage, dietary composition is 100 percent, and that body weight and food ingestion rates are conservative. This likely overestimates risk.

HQs based on maximum concentrations were used to characterize risk to benthic and aquatic invertebrates. Many benthic and aquatic invertebrates maintain very small home ranges and thus it is possible that some individuals could be exposed repeatedly to the maximum concentration. However, maximum concentrations do not represent exposures that would reasonably be expected to occur for an entire population over a given study area. As a result, risk to benthic and aquatic invertebrates is likely overestimated.

The TEQ methodology provides a mechanism to estimate potential health or ecological effects of exposure to a complex mixture of dioxins and dioxin-like compounds. However, the TEQ method must be used with an understanding of its limitations. This methodology estimates the dioxin-like effects of a mixture by assuming dose-additivity and describes the mixture in terms of an equivalent mass of 2,3,7,8-TCDD. Although the mixture may have the toxicological potential of 2,3,7,8-TCDD it should not be assumed that individual congeners follow the same environmental fate and transport mechanisms as 2,3,7,8-TCDD. Different congeners have different physical properties such as rate of photolysis, binding affinity to organic mater, and water solubility. Consequently, the makeup of the mixture will change as the congeners move

through the environment (USEPA, 2000). In addition, half the detection limit for congeners which were not detected was used to calculate the Dioxin TEQ value. This method of using half the detection limit likely over estimated the Dioxin TEQ concentration and therefore would likely over estimate risk to ecological receptors.

Toxicity values for indicator species and communities were based on literature values. As is the case for literature-based exposure parameter values, this is a major source of uncertainty in the ecological risk assessment. The results of different studies often varied several orders of magnitude, depending on various forms of the COPC, test species, and test endpoints. The sensitivity of receptors in the exposure areas may be different than the sensitivity of species used in tests reported in the literature. Assumptions about the similarity of the chemical speciation between laboratory tests and site conditions must also be made in the absence of speciation analyses. This is a source of uncertainty, since toxicity may vary with the form of the toxicant in the environment. Thus, the actual toxicities of COPCs evaluated in this ecological risk assessment could be higher or lower than indicated by the TRVs used in the development of HQs.

6.3 Conclusions

The SLERA concludes that in the Outer Cove Study Area surface water, VOCs, PAHs, pesticides, PCBs, metals, and dioxins pose negligible risk and thus do not require further evaluation.

The SLERA also concludes that in the Outer Cove Study Area sediment, VOCs, PAHs, pesticides, PCBs, metals and dioxins pose negligible risk and thus do not require further evaluation.

Given, the results, of the 2006 SLERA and this updated SLERA, the removal and replacement of surficial sediments from the Inner Cove will result in a condition of no significant risk to the environment.

7.0 REFERENCES

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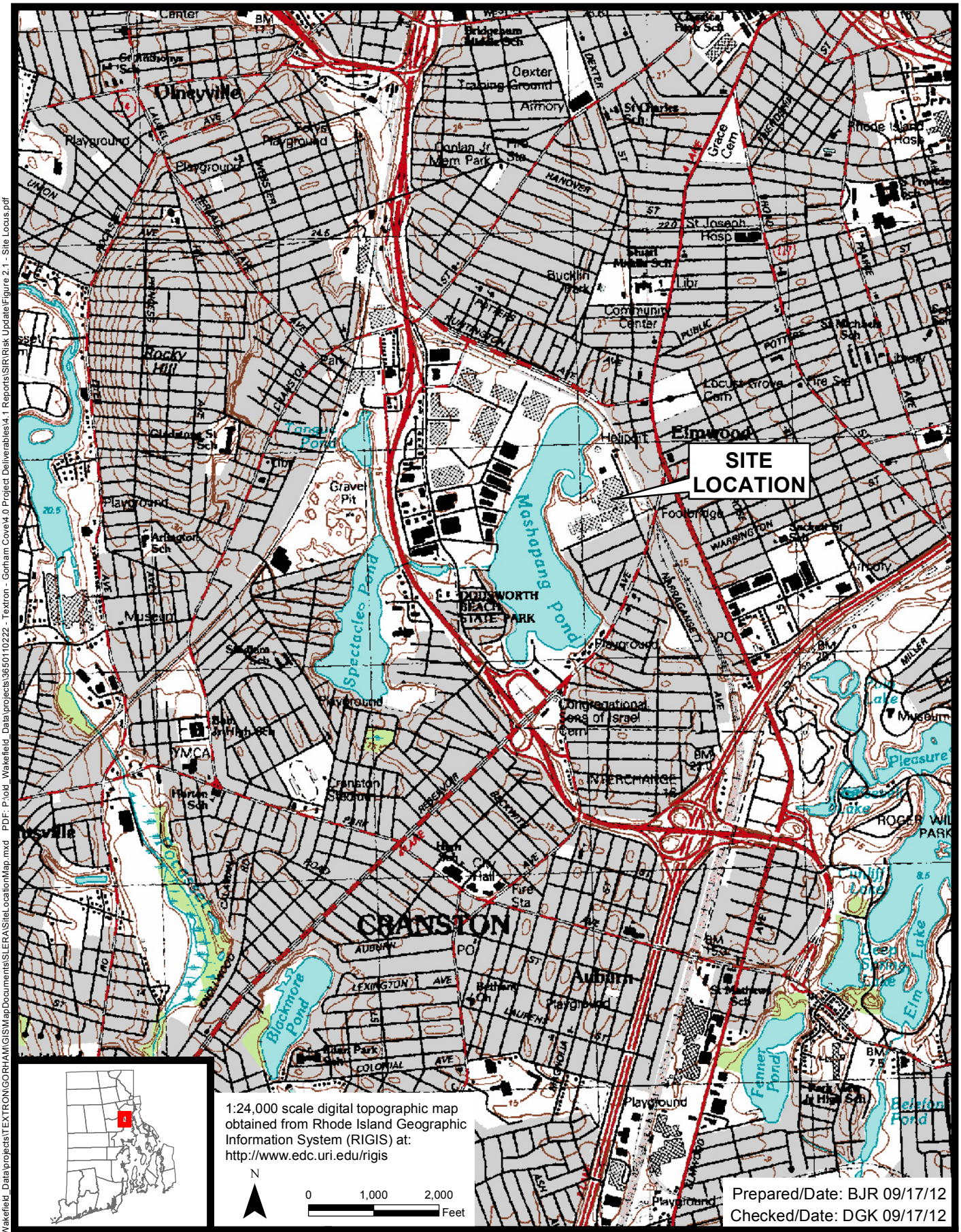
FIGURES



SLERA
Former Gorham Manufacturing Site
Providence, Rhode Island

amec

Figure 2.1
Site Locus

Document: P:\old_Wakefield_Data\projects\TEXTRON\GORHAM\GIS\MapDocuments\SLERA\SiteLocationMap.mxd PDF: P:\old_Wakefield_Data\projects\3650110222 - Textron - Gorham Cove\4.0 Project Deliverables\4.1 Reports\SIR\Risk Update\Figure 2.1 - Site Locus.pdf

Mashapaug Pond

SED/SW48

SED/SW45

SED/SW47

SED/SW44

SED/SW46

SED/SW60

SED/SW42

SED/SW11

SED/SW43

SED/SW59

SED13

SED/SW41

SED/SW40

SED/SW39

SED/SW38

SED14

SED/SW37

Mashapaug Outer Cove

SED/SW36

SED/SW35

SED15

SED/SW34

SED/SW33

Mashapaug Inner Cove

Legend

- Surface Water and Sediment Sample Location
- Sediment Sample Location
- Approximate Site Boundary
- Approximate Pond
- Elevation Contour

N

0 35 70 Feet

Prepared/Date: BJR 09/18/12
Checked/Date: DGK 09/18/12

SLERA
333 Adelaide Avenue Site
Providence, Rhode Island

amec

Figure 2.2
Sample Locations Used for the SLERA

Document: P:\old_Wakefield_Data\projects\TEXTRON\GORHAM\GIS\MapDocuments\SLERA\Cove_Investigation_11x17P.mxd PDF: P:\old_Wakefield_Data\projects\3650110222 - Textron - Gorham Cove\4.0 Project Deliverables\4.1 Reports\SIR\Risk Update\Figure 2.2 - Sample Locations Used for the SLERA.pdf

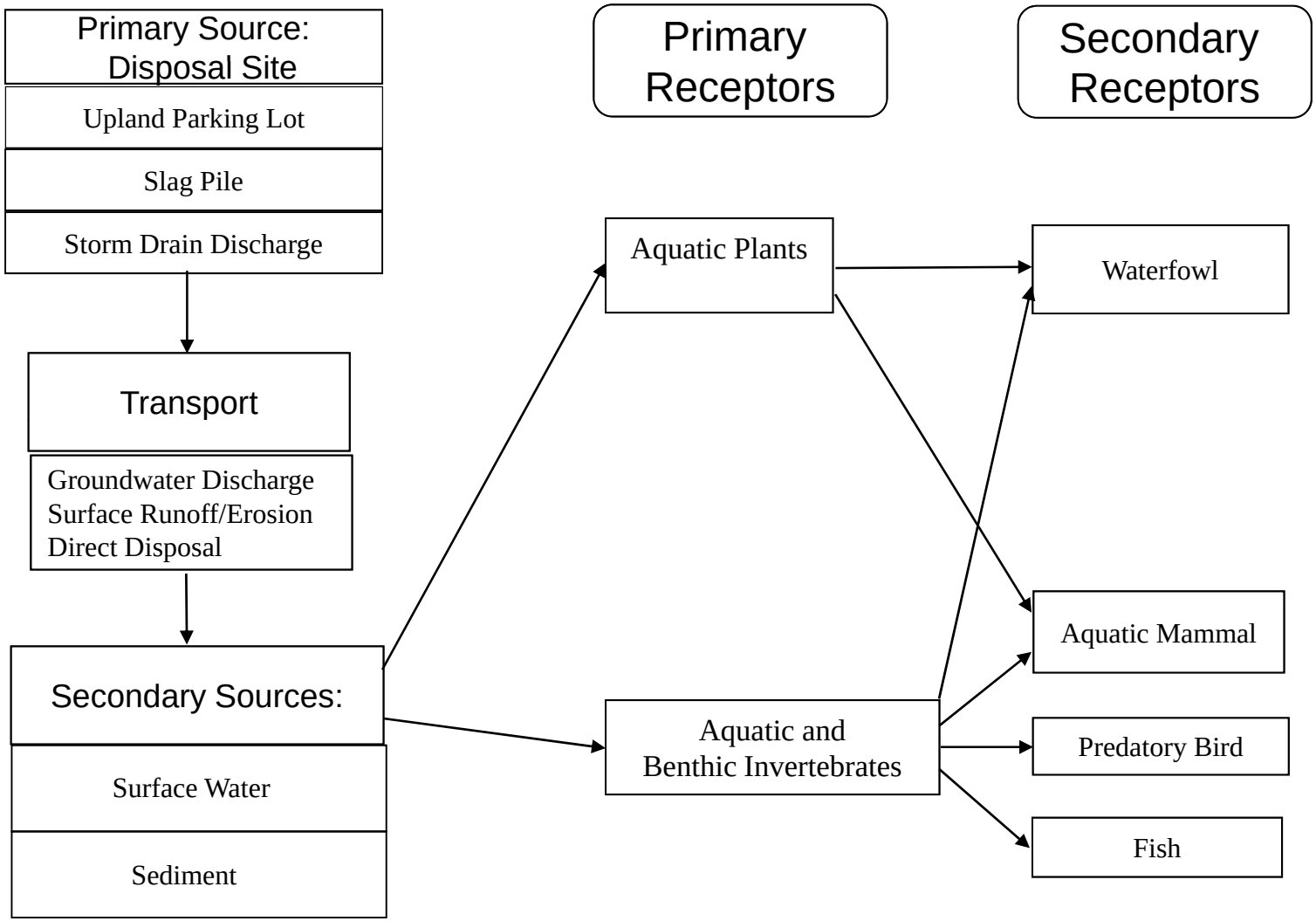


Figure 2.3
Site Ecological Conceptual Model
SLERA
333 Adelaide Avenue
Providence, MA

TABLES

Table 3.1
Surface Water Screening Values
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	RIDEM AWQC [a]	NAWQC [b]	ORNL Tier II SCV [c]	Final Selected Benchmark
Volatile Organics (mg/L)				
cis-1,2-Dichloroethene			0.59	0.59
Trichloroethene	0.043			0.043
Pesticides (mg/L)				
4,4'-DDT	0.0000010			0.0000010
Metals, Total (mg/L)				
Copper	0.0063			0.0063
Zinc	0.081			0.081
Metals, Dissolved (mg/L)				
Zinc	0.079			
Dioxins/Furans (mg/L)				
Dioxin TEQ as 2,3,7,8-TCDD		0.00000001 [1]		0.00000001

Benchmarks selected from the following sources in the order presented:

[a] Rhode Island Department of Environmental Management. 2006. Water Quality Regulations July, 2006. Amended May 2009.

[b] Federal Chronic Ambient Water Quality Criteria for Freshwater (AWQC) (USEPA, 2004). An estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. Value is equal to the 4-day average concentration that should not be exceeded more than once every 3 years.

[1] Chronic Lowest Observed Effect Level.

[c] Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Screening Potential Contaminants of Concern (COCs) for effects on aquatic biota (Suter and Tsao, 1996). Value presented is secondary chronic value.

mg/L = milligrams per liter

Table 3.2
Sediment Screening Values
Updated Screening Level Ecological Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	TEC [a]	ORNL SCV [b]	OMOE LEL [c]	WA SCV [d]	Final Selected Benchmark
Volatile Organics (mg/kg)					
1,1,1-Trichloroethane		0.132			0.132
1,1-Dichloroethane		0.119			0.119
1,1-Dichloroethene		0.136			0.136
Acetone		0.038			0.038
Carbon Disulfide		0.0037			0.0037
cis-1,2-Dichloroethene		1.8			1.8
Tetrachloroethene		1.8			1.8
trans-1,2-Dichloroethene		1.8			1.8
Trichloroethene		0.97			0.97
Semivolatile Organics (mg/kg)					
Benzo(b)fluoranthene			1.06		1.06
Fluoranthene	0.423				0.423
Phenanthrene	0.204				0.204
Pyrene	0.195				0.195
Inorganics (mg/kg)					
Arsenic	9.79				9.79
Barium					NA
Beryllium					NA
Cadmium	0.99				0.99
Chromium	43.4				43.4
Copper	31.6				31.6
Lead	35.8				35.8
Mercury	0.18				0.18
Nickel	22.7				22.7
Silver			0.5		0.5
Zinc	121				121
Dioxins/Furans (mg/kg)					
Dioxin TEQ as 2,3,7,8-TCDD				0.0000072	0.0000072

Notes:
Units in mg/kg (milligram per kilogram [dry weight]).

Benchmarks selected from the following sources in the order presented:

[a] TEC - Threshold Effect Concentrations, levels below which harmful effects are unlikely to be observed; values as presented in MacDonald, et al., 2000a,b.

[b] Sediment screening benchmarks derived using equilibrium partitioning assumptions and based on Chronic Tier II values; values as summarized in Jones et al., 1997. Normalized to 4.4% TOC.

[c] Ontario Ministry of the Environment Lowest Effect Level (LELs) Provincial Sediment Quality Guidelines as presented in Persaud et al., 1993. LELs are levels of sediment contamination that can be tolerated by the majority of benthic organisms. For organic compounds, generally based on the 5th percentile of the Screening Level Concentration (SLC). Normalized to 4.4% TOC.

[d] Washington State Sediment Quality Values (SCVs) probable apparent effects thresholds (PAETs) for *Hyalella azteca* normalized to 4.3% TOC, as presented in Cubbage, et al. 1997.

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Table 4.1
Selection of Chemicals of Potential Concern - Outer Cove Surface Water
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	Frequency of Detection			Range of Non Detects			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Final Selected Benchmark [b]	Number of Benchmark Exceedances	COPC? [c]	Rationale [c]	Maximum HQ [d]
Volatile Organics (mg/L)																
cis-1,2-Dichloroethene	1	/	1				0.0108	-	0.0108	SW11	0.0108	0.59	0	No	BSL	
Trichloroethene	1	/	1				0.0023	-	0.0023	SW11	0.0023	0.043	0	No	BSL	
Pesticides (mg/L)																
4,4'-DDT	1	/	1				0.00008	-	0.00008	SW11	0.000080	0.000001	1	Yes	ASL	80
Metals, Total (mg/L)																
Copper	2	/	19	0.01	:	0.02	0.02	-	0.15	SW-42	0.014	0.0063	2	Yes	ASL	24
Zinc	11	/	19	0.025	:	0.05	0.026	-	0.059	SW-41	0.025	0.081	0	No	BSL	
Hardness	18	/	18				58.5	-	71.9	SW11	62.6					
Metals, Dissolved (mg/L)																
Zinc	9	/	19	0.025	:	0.05	0.025	-	0.032	SW-44	0.021	0.079	0	No	BSL	
Dioxins/Furans (mg/L)																
TEQ-Mammal	1	/	1				0.000000013	-	0.000000013	SW11	0.000000013	0.000000010	1	Yes	ASL	1.3
TEQ-Bird	1	/	1				0.000000016	-	0.000000016	SW11	0.000000016	0.000000010	1	Yes	ASL	1.6
TEQ-Fish	1	/	1				0.000000014	-	0.000000014	SW11	0.000000014	0.000000010	1	Yes	ASL	1.4

Notes:

Prepared by: BJR
Checked by: KJC

[a] Average (arithmethic mean) was calculated using one-half the detection limit for non detects.
[b] Screening benchmarks can be found on Table 3.1
TEQ - Dioxin-related compounds evaluated as 2,3,7,8-TCDD using Toxicity Equivalence (TEQs) for mammals, birds, and fish.
[c] Chemical is selected as a contaminant of potential concern (COPC) if the maximum detected concentration is greater than the screening benchmark or a screening benchmark is unavailable, unless the frequency of detection (FOD) is less than 5%.
ASL - Above Screening Level
BSL - Below Screening Level
[d] Hazard quotient (HQ) is the maximum detected concentration divided by the screening benchmark. HQs are only calculated for COPCs.

mg/L - milligrams per liter

Table 4.2
Selection of Chemicals of Potential Concern - Outer Cove Study Area Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	Frequency of Detection			Range of Non Detects			Range of Detected Concentrations			Location of Maximum Detection	Average (arithmetic mean) [a]	Final Selected Benchmark [b]	Number of Benchmark Exceedances	COPC? [c]	Rationale [d]	Maximum HQ [e]
Volatile Organics (mg/kg)																
1,1,1-Trichloroethane	1	/	4	0.0045	:	0.0427	0.863	-	0.863	SED15	0.223	0.132	1	Yes	ASL	7
1,1-Dichloroethane	1	/	4	0.0045	:	0.0427	0.0518	-	0.0518	SED15	0.020	0.119	0	No	BSL	
1,1-Dichloroethene	1	/	4	0.0045	:	0.0427	0.0467	-	0.0467	SED15	0.019	0.136	0	No	BSL	
Acetone	3	/	4	0.0461	:	0.0461	0.105	-	0.649	SED11	0.24	0.038	3	Yes	ASL	17
Carbon disulfide	2	/	4	0.012	:	0.0427	0.0046	-	0.021	SED15	0.013	0.0037	2	Yes	ASL	6
cis-1,2-Dichloroethene	1	/	4	0.0045	:	0.0427	0.296	-	0.296	SED15	0.081	1.8	0	No	BSL	
Tetrachloroethene	1	/	4	0.0045	:	0.0427	0.0161	-	0.0161	SED15	0.011	1.8	0	No	BSL	
trans-1,2-Dichloroethene	1	/	4	0.0045	:	0.0427	0.0053	-	0.0053	SED15	0.0087	1.8	0	No	BSL	
Trichloroethene	1	/	4	0.0045	:	0.0427	1.47	-	1.47	SED15	0.37	0.97	1	Yes	ASL	1.5
Semivolatile Organics (mg/kg)																
Benzo(b)fluoranthene	2	/	4	0.0315	:	0.0943	0.0378	-	0.245	SED11	0.086	1.06	0	No	BSL	
Fluoranthene	3	/	4	0.0315	:	0.0315	0.0833	-	0.327	SED11	0.16	0.423	0	No	BSL	
Phenanthrene	2	/	4	0.0315	:	0.163	0.0333	-	0.0999	SED14	0.058	0.204	0	No	BSL	
Pyrene	3	/	4	0.0315	:	0.0315	0.0513	-	0.258	SED11	0.12	0.195	1	Yes	ASL	1.3
Dioxnins/Furans (mg/kg)																
TEQ-Mammal	13	/	22	0.0000057	:	0.0000057	0.00000091	-	0.00027	SED-41	0.000052	0.0000072	10	Yes	ASL	38
TEQ-Bird	13	/	22	0.0000077	:	0.0000077	0.0000012	-	0.00078	SED-41	0.00014	0.0000072	11	Yes	ASL	108
TEQ-Fish	13	/	22	0.0000068	:	0.0000068	0.0000011	-	0.00040	SED-41	0.000070	0.0000072	11	Yes	ASL	55
Metals, Total (mg/kg)																
Arsenic	21	/	22	2	:	2	3.7	-	47.6	SED14	16.4	9.8	13	Yes	ASL	4.9
Barium	4	/	4				9.7	-	156	SED11	77	NA		Yes	NSL	NA
Beryllium	18	/	22	0.07	:	0.08	0.1	-	0.91	SED-48	0.34	NA		Yes	NSL	NA
Cadmium	8	/	22	0.35	:	0.71	1.57	-	3.24	SED11	1.1	1.0	8	Yes	ASL	3.3
Chromium	22	/	22				1.8	-	213	SED11	56	43	8	Yes	ASL	4.9
Copper	21	/	22	2	:	2	3.1	-	423	SED11	131	32	10	Yes	ASL	13
Lead	17	/	22	3.9	:	6.7	3.5	-	611	SED-48	191	36	11	Yes	ASL	17
Mercury	9	/	22	0.015	:	0.208	0.07	-	1.32	SED-39	0.30	0.18	6	Yes	ASL	7.3
Nickel	22	/	22				2.1	-	85.7	SED11	28	23	9	Yes	ASL	3.8
Silver	13	/	22	0.35	:	0.67	0.38	-	29.7	SED11	8.0	0.5	12	Yes	ASL	59
Zinc	22	/	22				10.5	-	620	SED11	194	121	9	Yes	ASL	5.1

Notes:

Prepared by: BJR
Checked by: KJC

[a] Average (arithmethic mean) was calculated using one-half the detection limit for non detects.

[b] Screening benchmarks can be found on Table 3.2

TEQ - Dioxin-related compounds evaluated as 2,3,7,8-TCDD using Toxicity Equivalence (TEQs) for mammals, birds, and fish.

[c] Chemical is selected as a contaminant of potential concern (COPC) if the maximum detected concentration is greater than the screening benchmark or a screening benchmark is unavailable, unless the frequency of detection (FOD) is less than 5%.

ASL - Above Screening Level

BSL- Below Screening Level

NSL - No Screening Level

[d] Hazard quotient (HQ) is the maximum detected concentration divided by the screening benchmark. HQs are only calculated for COPCs.

NA - HQ not calculated because no screening level benchmark was available.

mg/Kg - milligrams per kilogram

Table 4.3
AVS-SEM Data Outer Cove
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Location	Sample Date	SEM (umol/g)	AVS (umol/g)	SEM-AVS (umol/g)	Foc	SEM-AVS/Foc (umol/g)
SED15	6/29/2006	0.80	0.041	0.76	0.0070	108
SED-33-01	12/19/2011	1.6	0.018	1.6	0.0089	179
SED-34-01	12/20/2011	0.98	0.080	0.90	0.0015	600
SED-35-01	12/16/2011	0.22	0.0085	0.21	0.010	21
SED-36-01	12/14/2011	3.0	0	3.0	0.037	82
SED-37-01	12/15/2011	0.13	0.0079	0.13	0.0067	19
SED-38-01	12/13/2011	0.98	0.015	0.97	0.0054	179
SED-39-01	12/14/2011	14.3	4.2	10.1	0.14	72
SED-40-01	12/16/2011	0.17	0	0.17	0.0020	85
SED-41-01	12/15/2011	15.2	6.5	8.8	0.13	67
SED-42-01	12/14/2011	0.36	0	0.36	0.0043	83
SED-43-01	12/19/2011	1.3	2.2	-0.91	0.038	-24
SED-44-01	12/15/2011	11.50	6.5	5.0	0.099	50
SED-45-01	12/14/2011	0.84	0.21	0.63	0.019	33
SED-46-01	12/20/2011	17.0	15.6	1.4	0.12	11
SED-47-01	12/15/2011	15.9	5.3	10.6	0.13	81
SED-48-01	12/14/2011	14.5	5.0	9.6	0.11	87
SED-59-01	12/20/2011	0.27	0	0.27	0.0045	61
SED-60-01	12/20/2011	0.29	0.012	0.28	0.0012	230

If (SEM-AVS)/Foc <130 umol/gOC then divalent metals unlikely to be bioavailable.
130-3,000 umol/gOC then divalent metals bioavailability is uncertain.
> 3,000 umol/gOC then divelent metals likely to be bioavailable.
< 0 umol/gOC indicates AVS > SEM, and divalent metals are unavailable for leaching into pore water.

AVS - acid volatile sulfides (umol/g)
SEM - simultaneously extractable metals (umol/g)
Foc - fraction organic carbon (gOC / gSED)

gOC - grams organic carbon
gSED - grams sediment
umol/g - micromoles per gram

Table 4.4
Summary of Sediment ΣPAH Calculations
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Location	Calculated $\Sigma ESBTU_{FCV}$[a]	Notes
SED11	0.32	
SED13	1.64	[b]
SED14	0.39	
SED15	0.39	

Notes

A $\Sigma ESBTU_{FCV}$ value < 1.0 indicates that samples PAH concentrations are protective of benthic organisms.

[a] 1/2 the detection limit was used for PAHs reported as non detect.

[b] Although the ΣPAH >1 for SED13, PAHs were not detected and thus calculations are based entirely on 1/2 detection limits.

Table 4.5
Summary of Sediment TEQ Calculations
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Location	TEQ Mammal (mg/kg)	HQ	TEQ Bird (mg/kg)	HQ	TEQ Fish (mg/kg)	HQ
SED/SW11	0.00018	25	0.00048	66	0.00026	36
SED13	0.0000010	0.1	0.0000018	0.2	0.0000013	0.2
SED14	0.000063	8.8	0.00017	24	0.000093	13
SED15	0.00000091	0.1	0.0000012	0.2	0.0000011	0.2
SED/SW33	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW34	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW35	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW36	0.0000089	1.2	0.000019	2.6	0.000011	1.5
SED/SW37	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW38	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW39	0.00011	15	0.00023	32	0.00012	17
SED/SW40	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW41	0.00027	38	0.00078	108	0.00040	55
SED/SW42	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW43	0.0000087	1.2	0.000017	2.4	0.000011	1.5
SED/SW44	0.00019	26	0.00054	75	0.00028	38
SED/SW45	0.0000071	1.0	0.000013	1.9	0.0000085	1.2
SED/SW46	0.000043	6.0	0.00010	14	0.000045	6.2
SED/SW47	0.00011	15	0.00030	42	0.00014	20
SED/SW48	0.00012	16	0.00031	44	0.00013	18
SED/SW59	0.0000057 U		0.0000077 U		0.0000068 U	
SED/SW60	0.0000057 U		0.0000077 U		0.0000068 U	

TCDD Screening Value = 7.2E-06 mg/kg (WA SCV; Cubbage, 1997)
TEQ - Toxic Equivalence was calculated from toxicity equivalence factors published by the World Health Organization (Van den Berg et al., 1998) for birds and fish. TEQ for mammals calculated using toxicity equivalence factors from USEPA, 2010.
HQ - Hazard Quotient
mg/kg - milligrams per kilogram

Prepared by: BJR
Checked by: KJC

Table 5.1
Exposure Parameters for Great Blue Heron
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Common Name	**Great Blue Heron**				
Scientific Name	***Ardea herodias***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.6	Feeding territory size for freshwater rookery in Oregon in the fall.	Bayer, 1978
Site Foraging Frequency	SFF	unitless	1.0	calculated: SFF=exposure area/home range, maximum of 1.	Screening
Exposure Frequency	EF	days/year	213	Summer resident; most migrating herons leave breeding ground by October and return between February and April.	USEPA, 1993
Dietary Composition				Fish are the preferred prey, but Great Blue Herons will also consume small amounts of amphibians and other organisms.	USEPA, 1993
fish	Pfish	unitless	100%		Alexander, 1977
insects	Pinsect	unitless	0%		
crustaceans	Pcrust	unitless	0%		
amphibians	Pamphib	unitless	0%		Alexander, 1977
mammalsb	Pmam	unitless	0%		
seeds	Pseed	unitless	0%		
vegetation	Pveg	unitless	0%		
Food Ingestion Rate	IRfood	kg/day	0.39	Calculated using regression equation for non-passerines: IRfood (g/day) = 0.301 * BW $^{0.751}$ (g)b.	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.101	Calculated using regression equation for birds: IRwater (l/day) = 0.059 * BW $^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.0354	Assume 9% of daily food ingestion rate.	Beyer *et al.* , 1993
Body Weight	BW	kg	2.2	Average weight for adult males and females in eastern North America.	Quinney, 1982

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that birds, mammals, invertebrates, amphibians, seeds, and plants contain 63%, 64%, 80%, 73%, 12%, and 85% water content, respectively (Suter, 1993).

References:

Alexander, G., 1977. Food of vertebrate predators on trout waters in north central lower Michigan. Michigan Academician. 10: 181-195.

Bayer, R.D., 1978. Aspects of an Oregon estuarine great blue heron population. *Cited in:* Sprunt, A., J. Ogden, S. Winckler, eds. Wading birds. National Audubon Society Research Report 7:213-217.

Beyer, N.; Connor, E.; Gerould, S. (1993). Estimates of soil ingestion by wildlife. J. Wildl. Manage. 1993.

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds, Am. J. Physiol., 244: R601-R606.

Quinney, T.E., 1982. Growth, diet, and mortality of nestling great blue herons. Wilson Bulletin, 94:571-577.

USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

Table 5.2
Calculated Exposure Point Concentrations - Great Blue Heron - Fish Ingestion - RME

Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Receptor:	Great Blue Heron
Scenario:	Current/Future - RME
Expousre Point:	Fish Ingestion

Chemical	C_{sw} (mg/L)	C_{sed} (mg/kg)	BSAF Fish	C_{fish} (mg/kg)
TCDD TEQ	--	2.17E-04	1.8E-01	3.86E-05

Prepared by: tls
Checked by: BJR

RME - Reasonable Maximum Exposure
C_{sw} - Chemical concentration in surface water
C_{sed} - Chemical concentration in sediment
C_{fish} - Chemical concentration in fish
BSAF - Bioaccumulation Factor
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

Table 5.3
Summary of Doses - Great Blue Heron - Fish Ingestion - RME

Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Receptor:	Great Blue Heron
Scenario:	Current/Future - RME
Expousre Point:	Fish Ingestion

Chemical	C_{sed} (mg/kg)	C_{fish} (mg/kg)	Dose sed (mg/Kg BW day)	Dose Fish (mg/Kg BW day)	Total Dose (mg/Kg BW day) [a]	TRV NOAEL	NOAEL Based Total HQ [b]	TRV LOAEL	LOAEL Based Total HQ [b]
TCDD TEQ	2.17E-04	3.86E-05	2.01E-06	3.97E-06	6.0E-06	1.40E-05	4.3E-01	1.40E-04	4.3E-02

[a] - Total Dose is the sum of all doses.
[b] - NOAEL and LOAEL HQs are calculated by dividing the Total Dose by the TRV.

Prepared by: tls
Checked by: BJR

RME - Reasonable Maximum Exposure
C_{sed} - Chemical concentration in sediment
C_{fish} - Chemical concentration in fish tissue
mg/L - milligrams per liter
mg/kg - milligrams per kilogram
BW - body weight
TRV - Toxicity Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
HQ - Hazard Quotient

Table 5.4
Summary of NOAEL and LOAEL Risks - Great Blue Heron - Fish Ingestion - RME

Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Receptor:	Great Blue Heron
Scenario:	Current/Future - RME
Exposure Point:	Fish Ingestion

	NOAEL HQ				LOAEL HQ			
Chemical	Sediment	Fish	Total	Percent of Total HQ	Sediment	Fish	Total	Percent of Total HQ
TCDD TEQ	1.43E-01	2.84E-01	4.3E-01	100%	1.43E-02	2.84E-02	4.27E-02	100%
Total HQ	1.4E-01	2.8E-01	**4.3E-01**		1.4E-02	2.8E-02	**4.3E-02**	
Percent of Total	34%	66%			34%	66%		

RME - Reasonable Maximum Exposure
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
HQ - Hazard Quotient

Prepared by: tls
Checked by: BJR

ATTACHMENT A

DATA USED FOR THE SLERA

Table A-1
Surface Water Data Used For the SLERA
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SW11 6/21/2006	SW-33 12/19/2011	SW-34 12/20/2011	SW-35 12/16/2011	SW-36 12/14/2011	SW-37 12/15/2011	SW-38 12/13/2011	SW-39 12/14/2011	SW-40 12/16/2011	SW-41 12/15/2011	SW-42 12/13/2011	SW-43 12/19/2011	SW-44 12/15/2011
Volatile Organics (mg/L)													
1,1,1,2-Tetrachloroethane	0.001 U												
1,1,1-Trichloroethane	0.001 U												
1,1,2,2-Tetrachloroethane	0.0005 U												
1,1,2-Trichloroethane	0.001 U												
1,1-Dichloroethane	0.001 U												
1,1-Dichloroethene	0.001 U												
1,1-Dichloropropene	0.002 U												
1,2,3-Trichlorobenzene	0.001 U												
1,2,3-Trichloropropane	0.001 U												
1,2,4-Trichlorobenzene	0.001 U												
1,2,4-Trimethylbenzene	0.001 U												
1,2-Dibromo-3-chloropropane	0.005 U												
1,2-Dibromoethane (EDB)	0.001 U												
1,2-Dichlorobenzene	0.001 U												
1,2-Dichloroethane	0.001 U												
1,2-Dichloropropane	0.001 U												
1,3,5-Trimethylbenzene	0.001 U												
1,3-Dichlorobenzene	0.001 U												
1,3-Dichloropropane	0.001 U												
1,4-Dichlorobenzene	0.001 U												
1,4-Dioxane	0.5 U												
1-Chlorohexane	0.001 U												
2,2-Dichloropropane	0.001 U												
2-Butanone	0.025 U												
2-Chlorotoluene	0.001 U												
2-Hexanone	0.01 U												
4-Chlorotoluene	0.001 U												
4-Isopropyltoluene	0.001 U												
4-Methyl-2-Pentanone	0.025 U												
Acetone	0.025 U												
Benzene	0.001 U												
Bromobenzene	0.002 U												
Bromochloromethane	0.001 U												
Bromodichloromethane	0.001 U												
Bromoform	0.001 U												
Bromomethane	0.002 U												
Carbon disulfide	0.001 U												
Carbon tetrachloride	0.001 U												
Chlorobenzene	0.001 U												
Chloroethane	0.002 U												
Chloroform	0.001 U												
Chloromethane	0.002 U												
cis-1,2-Dichloroethene	0.0108												
cis-1,3-Dichloropropene	0.0005 U												
Dibromochloromethane	0.001 U												
Dibromomethane	0.001 U												
Dichlorodifluoromethane	0.002 U												
Diethyl ether	0.001 U												
Diisopropyl ether	0.001 U												
Ethyl tertiary-butyl ether	0.001 U												
Ethylbenzene	0.001 U												
Hexachlorobutadiene	0.0006 U												

Table A-1
Surface Water Data Used For the SLERA
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SW11 6/21/2006	SW-33 12/19/2011	SW-34 12/20/2011	SW-35 12/16/2011	SW-36 12/14/2011	SW-37 12/15/2011	SW-38 12/13/2011	SW-39 12/14/2011	SW-40 12/16/2011	SW-41 12/15/2011	SW-42 12/13/2011	SW-43 12/19/2011	SW-44 12/15/2011
Isopropylbenzene	0.001 U												
m,p-Xylene	0.002 U												
Methylene chloride	0.005 U												
Methyl-t-butyl ether	0.001 U												
Naphthalene	0.001 U												
n-Butylbenzene	0.001 U												
n-Propyl Benzene	0.001 U												
o-Xylene	0.001 U												
sec-Butylbenzene	0.001 U												
Styrene	0.001 U												
tert-Butylbenzene	0.001 U												
Tertiary-amyl methyl ether	0.001 U												
Tetrachloroethene	0.001 U												
Tetrahydrofuran	0.005 U												
Toluene	0.001 U												
trans-1,2-Dichloroethene	0.001 U												
trans-1,3-Dichloropropene	0.0005 U												
Trichloroethene	0.0023												
Trichlorofluoromethane	0.002 U												
Vinyl acetate	0.005 U												
Vinyl chloride	0.001 U												
Xylenes, Total	0.003 U												
Semivolatile Organics (mg/L)													
2-Methylnaphthalene	0.0002 U												
Acenaphthene	0.0002 U												
Acenaphthylene	0.0002 U												
Anthracene	0.0002 U												
Benzo(a)anthracene	0.0002 U												
Benzo(a)pyrene	0.0002 U												
Benzo(b)fluoranthene	0.0002 U												
Benzo(g,h,i)perylene	0.0002 U												
Benzo(k)fluoranthene	0.0003 U												
Chrysene	0.0002 U												
Dibenzo(a,h)anthracene	0.0002 U												
Fluoranthene	0.0002 U												
Fluorene	0.0002 U												
Indeno(1,2,3-cd)pyrene	0.0003 U												
Naphthalene	0.0002 U												
Phenanthrene	0.0002 U												
Pyrene	0.0002 U												
Pesticides/PCBs (mg/L)													
4,4'-DDD	0.00005 U												
4,4'-DDE	0.00005 U												
4,4'-DDT	0.00008 P												
Aldrin	0.00005 U												
alpha-BHC	0.00005 U												
alpha-Chlordane	0.00005 U												
beta-BHC	0.00005 U												
Chlordane	0.0005 U												
delta-BHC	0.00005 U												
Dieldrin	0.00005 U												
Endosulfan I	0.00005 U												
Endosulfan II	0.00005 U												

Table A-1
Surface Water Data Used For the SLERA
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Parameter	SW11 6/21/2006	SW-33 12/19/2011	SW-34 12/20/2011	SW-35 12/16/2011	SW-36 12/14/2011	SW-37 12/15/2011	SW-38 12/13/2011	SW-39 12/14/2011	SW-40 12/16/2011	SW-41 12/15/2011	SW-42 12/13/2011	SW-43 12/19/2011	SW-44 12/15/2011
Endosulfan sulfate	0.00005 U												
Endrin	0.00005 U												
Endrin aldehyde	0.00005 U												
Endrin ketone	0.00005 U												
gamma-BHC (Lindane)	0.00005 U												
gamma-Chlordane	0.00005 U												
Heptachlor	0.00005 U												
Heptachlor epoxide	0.00005 U												
Hexachlorobenzene	0.00005 U												
Methoxychlor	0.00005 U												
Toxaphene	0.0025 U												
Aroclor-1016	0.0001 U												
Aroclor-1221	0.0001 U												
Aroclor-1232	0.0001 U												
Aroclor-1242	0.0001 U												
Aroclor-1248	0.0001 U												
Aroclor-1254	0.0001 U												
Aroclor-1260	0.0001 U												
Aroclor-1262	0.0001 U												
Aroclor-1268	0.0001 U												
Dioxin/Furans (mg/L)													
1,2,3,4,6,7,8-HpCDD	0.000000024 BJ												
1,2,3,4,6,7,8-HpCDF	0.00000001 U												
1,2,3,4,7,8,9-HpCDF	0.00000001 U												
1,2,3,4,7,8-HxCDD	0.00000001 U												
1,2,3,4,7,8-HxCDF	0.00000001 U												
1,2,3,6,7,8-HxCDD	0.00000001 U												
1,2,3,6,7,8-HxCDF	0.00000001 U												
1,2,3,7,8,9-HxCDD	0.00000001 U												
1,2,3,7,8,9-HxCDF	0.00000001 U												
1,2,3,7,8-PeCDD	0.00000001 U												
1,2,3,7,8-PeCDF	0.00000001 U												
2,3,4,6,7,8-HxCDF	0.00000001 U												
2,3,4,7,8-PeCDF	0.00000001 U												
2,3,7,8-TCDD	0.0000000021 UA												
2,3,7,8-TCDF	0.0000000021 UA												
OCDD	0.00000018 B												
OCDF	0.000000021 U												
Total HpCDD	0.000000043 BJ												
Total HpCDF	0.000000012 J												
Total HxCDD	0.00000001 U												
Total HxCDF	0.00000001 U												
Total PeCDD	0.00000001 U												
Total PeCDF	0.00000001 U												
Total TCDD	0.0000000021 U												
Total TCDF	0.0000000021 U												
TEQ-Mammal (1)	0.000000013												
TEQ-Bird (1)	0.000000016												
TEQ-Fish (1)	0.000000014												
Metals, Total (mg/L)													
Antimony	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Arsenic	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Barium	0.05 U												

Table A-1
Surface Water Data Used For the SLERA
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Parameter	SW11 6/21/2006	SW-33 12/19/2011	SW-34 12/20/2011	SW-35 12/16/2011	SW-36 12/14/2011	SW-37 12/15/2011	SW-38 12/13/2011	SW-39 12/14/2011	SW-40 12/16/2011	SW-41 12/15/2011	SW-42 12/13/2011	SW-43 12/19/2011	SW-44 12/15/2011
Beryllium	0.001 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Cadmium	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Chromium	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.15	0.01 U	0.01 U	0.01 U
Lead	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Nickel	0.05 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Selenium	0.05 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Silver	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Zinc	0.05 U	0.029	0.026	0.029	0.025 U	0.029	0.025 U	0.026	0.027	0.059	0.025 U	0.025 U	0.03
Metals, Dissolved (mg/L)													
Antimony	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Arsenic	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Barium	0.05 U												
Beryllium	0.001 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Cadmium	0.005 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Chromium	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Nickel	0.05 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Selenium	0.05 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Silver	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	0.002 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
Zinc	0.05 U	0.025 U	0.025 U	0.031	0.025 U	0.028	0.025 U	0.025 U	0.028	0.031	0.025 U	0.029	0.032
Inorganics (mg/L)													
Hardness	71.9	61.1	60.1	65.7	67.2	60.7	60.7	65.7	58.5	61.4	60.1	61.4	60.4
Dissolved Organic Carbon		2.8 B	2.8 B	3.7	3.8	4	4.8	3.7	4.3	4	4	2.9 B	3.8

(1) - TEQs calculated in Attachement B

A - Detection limit based on
signal-to-noise measurement
B - Less than 10 times higher than
method blank level
J - Value is estimated
U - Not detected, value is detection limit

mg/l - milligrams per liter

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Parameter	SW-45 12/14/2011	SW-46 12/20/2011	SW-47 12/16/2011	SW-48 12/14/2011	SW-59 12/20/2011	SW-60 12/20/2011
Volatile Organics (mg/L)						
1,1,1,2-Tetrachloroethane						
1,1,1-Trichloroethane						
1,1,2,2-Tetrachloroethane						
1,1,2-Trichloroethane						
1,1-Dichloroethane						
1,1-Dichloroethene						
1,1-Dichloropropene						
1,2,3-Trichlorobenzene						
1,2,3-Trichloropropane						
1,2,4-Trichlorobenzene						
1,2,4-Trimethylbenzene						
1,2-Dibromo-3-chloropropane						
1,2-Dibromoethane (EDB)						
1,2-Dichlorobenzene						
1,2-Dichloroethane						
1,2-Dichloropropane						
1,3,5-Trimethylbenzene						
1,3-Dichlorobenzene						
1,3-Dichloropropane						
1,4-Dichlorobenzene						
1,4-Dioxane						
1-Chlorohexane						
2,2-Dichloropropane						
2-Butanone						
2-Chlorotoluene						
2-Hexanone						
4-Chlorotoluene						
4-Isopropyltoluene						
4-Methyl-2-Pentanone						
Acetone						
Benzene						
Bromobenzene						
Bromochloromethane						
Bromodichloromethane						
Bromoform						
Bromomethane						
Carbon disulfide						
Carbon tetrachloride						
Chlorobenzene						
Chloroethane						
Chloroform						
Chloromethane						
cis-1,2-Dichloroethene						
cis-1,3-Dichloropropene						
Dibromochloromethane						
Dibromomethane						
Dichlorodifluoromethane						
Diethyl ether						
Diisopropyl ether						
Ethyl tertiary-butyl ether						
Ethylbenzene						
Hexachlorobutadiene						

Table A-1
Surface Water Data Used For the SLERA
Updated Screening Level Ecological Risk Assessment
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Parameter	SW-45 12/14/2011	SW-46 12/20/2011	SW-47 12/16/2011	SW-48 12/14/2011	SW-59 12/20/2011	SW-60 12/20/2011
Isopropylbenzene						
m,p-Xylene						
Methylene chloride						
Methyl-t-butyl ether						
Naphthalene						
n-Butylbenzene						
n-Propyl Benzene						
o-Xylene						
sec-Butylbenzene						
Styrene						
tert-Butylbenzene						
Tertiary-amyl methyl ether						
Tetrachloroethene						
Tetrahydrofuran						
Toluene						
trans-1,2-Dichloroethene						
trans-1,3-Dichloropropene						
Trichloroethene						
Trichlorofluoromethane						
Vinyl acetate						
Vinyl chloride						
Xylenes, Total						
Semivolatile Organics (mg/L)						
2-Methylnaphthalene						
Acenaphthene						
Acenaphthylene						
Anthracene						
Benzo(a)anthracene						
Benzo(a)pyrene						
Benzo(b)fluoranthene						
Benzo(g,h,i)perylene						
Benzo(k)fluoranthene						
Chrysene						
Dibenzo(a,h)anthracene						
Fluoranthene						
Fluorene						
Indeno(1,2,3-cd)pyrene						
Naphthalene						
Phenanthrene						
Pyrene						
Pesticides/PCBs (mg/L)						
4,4'-DDD						
4,4'-DDE						
4,4'-DDT						
Aldrin						
alpha-BHC						
alpha-Chlordane						
beta-BHC						
Chlordane						
delta-BHC						
Dieldrin						
Endosulfan I						
Endosulfan II						

Table A-1
Surface Water Data Used For the SLERA
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Parameter	SW-45 12/14/2011	SW-46 12/20/2011	SW-47 12/16/2011	SW-48 12/14/2011	SW-59 12/20/2011	SW-60 12/20/2011
Endosulfan sulfate						
Endrin						
Endrin aldehyde						
Endrin ketone						
gamma-BHC (Lindane)						
gamma-Chlordane						
Heptachlor						
Heptachlor epoxide						
Hexachlorobenzene						
Methoxychlor						
Toxaphene						
Aroclor-1016						
Aroclor-1221						
Aroclor-1232						
Aroclor-1242						
Aroclor-1248						
Aroclor-1254						
Aroclor-1260						
Aroclor-1262						
Aroclor-1268						
Dioxin/Furans (mg/L)						
1,2,3,4,6,7,8-HpCDD						
1,2,3,4,6,7,8-HpCDF						
1,2,3,4,7,8,9-HpCDF						
1,2,3,4,7,8-HxCDD						
1,2,3,4,7,8-HxCDF						
1,2,3,6,7,8-HxCDD						
1,2,3,6,7,8-HxCDF						
1,2,3,7,8,9-HxCDD						
1,2,3,7,8,9-HxCDF						
1,2,3,7,8-PeCDD						
1,2,3,7,8-PeCDF						
2,3,4,6,7,8-HxCDF						
2,3,4,7,8-PeCDF						
2,3,7,8-TCDD						
2,3,7,8-TCDF						
OCDD						
OCDF						
Total HpCDD						
Total HpCDF						
Total HxCDD						
Total HxCDF						
Total PeCDD						
Total PeCDF						
Total TCDD						
Total TCDF						
TEQ-Mammal (1)						
TEQ-Bird (1)						
TEQ-Fish (1)						
Metals, Total (mg/L)						
Antimony	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Arsenic	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Barium						

Table A-1
Surface Water Data Used For the SLERA
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Parameter	SW-45 12/14/2011	SW-46 12/20/2011	SW-47 12/16/2011	SW-48 12/14/2011	SW-59 12/20/2011	SW-60 12/20/2011
Beryllium	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Cadmium	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Chromium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	0.01 U	0.01 U	0.02	0.01 U	0.01 U	0.01 U
Lead	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Nickel	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Selenium	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Silver	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Zinc	0.025 U	0.033	0.037	0.025 U	0.029	0.025 U
Metals, Dissolved (mg/L)						
Antimony	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Arsenic	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Barium						
Beryllium	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Cadmium	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
Chromium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Mercury	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Nickel	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Selenium	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Silver	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
Zinc	0.025 U	0.025	0.025	0.025 U	0.032	0.025 U
Inorganics (mg/L)						
Hardness	65.6	61.5	60.4	65.5	59.3	61.9
Dissolved Organic Carbon	3.8	2.8 B	3.7	4	2.8 B	2.7 B

(1) - TEQs calculated in Attachement B

A - Detection limit based on
signal-to-noise measurement
B - Less than 10 times higher than
method blank level
J - Value is estimated
U - Not detected, value is detection limit

mg/l - milligrams per liter

Table A-2
Sediment Data Used For the SLERA
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED1101 6/22/2006 0 - 1 ft	SED1301 6/22/2006 0 - 0_5 ft	SED1401 6/22/2006 0 - 1 ft	SED1501 6/22/2006 0 - 1 ft	SED-33-01 12/19/2011 0 - 1 ft	SED-34-01 12/20/2011 0 - 1 ft	SED-35-01 12/16/2011 0 - 1 ft	SED-36-01 12/14/2011 0 - 1 ft	SED-37-01 12/15/2011 0 - 1 ft
Volatile Organics (mg/kg)									
1,1,1,2-Tetrachloroethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,1,1-Trichloroethane	0.0427 U	0.0045 U	0.012 U	0.863					
1,1,2,2-Tetrachloroethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,1,2-Trichloroethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,1-Dichloroethane	0.0427 U	0.0045 U	0.012 U	0.0518					
1,1-Dichloroethene	0.0427 U	0.0045 U	0.012 U	0.0467					
1,1-Dichloropropene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2,3-Trichlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2,3-Trichloropropane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2,4-Trichlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2,4-Trimethylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2-Dibromo-3-chloropropane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2-Dibromoethane (EDB)	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2-Dichlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2-Dichloroethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,2-Dichloropropane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,3,5-Trimethylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,3-Dichlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,3-Dichloropropane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,4-Dichlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
1,4-Dioxane	2.14 U	0.223 U	0.601 U	0.23 U					
1-Chlorohexane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
2,2-Dichloropropane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
2-Butanone	0.427 U	0.0446 U	0.12 U	0.0461 U					
2-Chlorotoluene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
2-Hexanone	0.427 U	0.0446 U	0.12 U	0.0461 U					
4-Chlorotoluene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
4-Isopropyltoluene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
4-Methyl-2-Pentanone	0.427 U	0.0446 U	0.12 U	0.0461 U					
Acetone	0.649	0.105	0.202	0.0461 U					
Benzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Bromobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Bromochloromethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Bromodichloromethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Bromoform	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Bromomethane	0.0855 U	0.0089 U	0.024 U	0.0092 U					
Carbon disulfide	0.0427 U	0.0046	0.012 U	0.021					
Carbon tetrachloride	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Chlorobenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Chloroethane	0.0855 U	0.0089 U	0.024 U	0.0092 U					
Chloroform	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Chloromethane	0.0855 U	0.0089 U	0.024 U	0.0092 U					
cis-1,2-Dichloroethene	0.0427 U	0.0045 U	0.012 U	0.296					
cis-1,3-Dichloropropene	0.0427 U	0.0045 U	0.012 U	0.0046 U					

Table A-2
Sediment Data Used For the SLERA
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Providence, Rhode Island

Parameter	SED1101 6/22/2006 0 - 1 ft	SED1301 6/22/2006 0 - 0_5 ft	SED1401 6/22/2006 0 - 1 ft	SED1501 6/22/2006 0 - 1 ft	SED-33-01 12/19/2011 0 - 1 ft	SED-34-01 12/20/2011 0 - 1 ft	SED-35-01 12/16/2011 0 - 1 ft	SED-36-01 12/14/2011 0 - 1 ft	SED-37-01 12/15/2011 0 - 1 ft
Dibromochloromethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Dibromomethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Dichlorodifluoromethane	0.0855 U	0.0089 U	0.024 U	0.0092 U					
Diethyl ether	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Diisopropyl ether	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Ethyl tertiary-butyl ether	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Ethylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Hexachlorobutadiene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Isopropylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
m,p-Xylene	0.0855 U	0.0089 U	0.024 U	0.0092 U					
Methylene chloride	0.214 U	0.0223 U	0.0601 U	0.023 U					
Methyl-t-butyl ether	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Naphthalene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
n-Butylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
n-Propyl Benzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
o-Xylene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
sec-Butylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Styrene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
tert-Butylbenzene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Tertiary-amyl methyl ether	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Tetrachloroethene	0.0427 U	0.0045 U	0.012 U	0.0161					
Tetrahydrofuran	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Toluene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
trans-1,2-Dichloroethene	0.0427 U	0.0045 U	0.012 U	0.0053					
trans-1,3-Dichloropropene	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Trichloroethene	0.0427 U	0.0045 U	0.012 U	1.47					
Trichlorofluoromethane	0.0427 U	0.0045 U	0.012 U	0.0046 U					
Vinyl acetate				0.259 U					
Vinyl chloride	0.0855 U	0.0089 U	0.024 U	0.0092 U					
Xylenes, Total	0.128 U	0.0134 U	0.036 U	0.0138 U					
Semivolatile Organics (mg/kg)									
1-Methylnaphthalene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
2-Methylnaphthalene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Acenaphthene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Acenaphthylene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Anthracene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Benzo(a)anthracene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Benzo(a)pyrene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Benzo(b)fluoranthene	0.245	0.0378	0.0943 U	0.0315 U					
Benzo(g,h,i)perylene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Benzo(k)fluoranthene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Chrysene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Dibenzo(a,h)anthracene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Fluoranthene	0.327	0.0833	0.204	0.0315 U					
Fluorene	0.163 U	0.0321 U	0.0943 U	0.0315 U					

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Indeno(1,2,3-cd)pyrene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Naphthalene	0.163 U	0.0321 U	0.0943 U	0.0315 U					
Phenanthrene	0.163 U	0.0333	0.0999	0.0315 U					
Pyrene	0.258	0.0513	0.153	0.0315 U					
Pesticide/PCBs (mg/kg)									
4,4'-DDD	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
4,4'-DDE	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
4,4'-DDT	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Aldrin	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
alpha-BHC	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
alpha-Chlordane	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
beta-BHC	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Chlordane	0.351 U	0.0631 U	0.192 U	0.0594 U					
delta-BHC	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Dieldrin	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endosulfan I	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endosulfan II	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endosulfan sulfate	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endrin	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endrin aldehyde	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Endrin ketone	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
gamma-BHC (Lindane)	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
gamma-Chlordane	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Heptachlor	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Heptachlor epoxide	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Hexachlorobenzene	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Methoxychlor	0.0351 U	0.00631 U	0.0192 U	0.00594 U					
Toxaphene	1.75 U	0.316 U	0.962 U	0.297 U					
Aroclor-1016	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1221	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1232	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1242	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1248	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1254	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1260	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1262	0.351 U	0.0631 U	0.192 U	0.0593 U					
Aroclor-1268	0.351 U	0.0631 U	0.192 U	0.0593 U					
Dioxin/Furans (mg/kg)									
1,2,3,4,6,7,8-HpCDD	0.00028	0.0000022 J	0.000071	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000014	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.00014	0.00000076 U	0.000037	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000013	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.000018	0.00000076 U	0.0000044 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.0000095 J	0.00000076 U	0.0000033 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.000036 A	0.00000076 U	0.0000017 UE	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000025	0.00000076 U	0.0000068 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.000086 A	0.00000076 U	0.000026	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.0000058	0.000005 U

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1,2,3,7,8,9-HxCDD	0.000017	0.00000076 U	0.0000034 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.00003 A	0.00000076 U	0.0000084 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8-PeCDD	0.000011 J	0.00000076 U	0.0000048 J	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8-PeCDF	0.000032 A	0.00000076 U	0.0000084 JA	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 UP	0.000005 U
2,3,4,6,7,8-HxCDF	0.00008	0.00000076 U	0.000051	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.0000056	0.000005 U
2,3,4,7,8-PeCDF	0.00043 A	0.00000086 J	0.00015 A	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000009	0.000005 U
2,3,7,8-TCDD	0.0000042 A	0.00000015 U	0.0000014 JA	0.00000016 U	0.000001 U	0.000001 U	0.000001 U	0.000001 U	0.000001 U
2,3,7,8-TCDF	0.00000057 UEA	0.00000019 J	0.0000076 A	0.00000016 U	0.000001 U	0.000001 U	0.000001 U	0.0000041	0.000001 U
OCDD	0.0018	0.000016 B	0.00047	0.0000044 BJ	0.00001 U	0.00001 U	0.00001 U	0.0001	0.00001 U
OCDF	0.000087	0.0000016 J	0.000036	0.0000016 U	0.00001 U	0.00001 U	0.00001 U	0.000014	0.00001 U
Total HpCDD	0.00063	0.0000039	0.00014	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000028	0.000005 U
Total HpCDF	0.00033	0.0000011 J	0.000089	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000021	0.000005 U
Total HxCDD	0.0003	0.00000076 U	0.000087	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000007	0.000005 U
Total HxCDF	0.0023	0.000003 J	0.00051	0.0000011 J	0.000005 U	0.000005 U	0.000005 U	0.00014	0.000005 U
Total PeCDD	0.00014	0.00000076 U	0.000047	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
Total PeCDF	0.0055	0.0000074	0.0013	0.0000031 J	0.000005 U	0.000005 U	0.000005 U	0.00026	0.000005 U
Total TCDD	0.000089	0.00000015 U	0.000029	0.00000016 U	0.000001 U	0.000001 U	0.000001 U	0.0000026	0.000001 U
Total TCDF	0.0016	0.0000031	0.00042	0.0000013	0.000001 U	0.000001 U	0.000001 U	0.00013	0.000001 U
TEQ-Mammal	0.0001785	0.0000010	0.0000635	0.0000009	0.0000057 U	0.0000057 U	0.0000057 U	0.0000089	0.0000057 U
TEQ-Bird	0.0004764	0.0000018	0.0001744	0.0000012	0.0000077 U	0.0000077 U	0.0000077 U	0.0000186	0.0000077 U
TEQ-Fish	0.0002622	0.0000013	0.0000929	0.0000011	0.0000068 U	0.0000068 U	0.0000068 U	0.0000110	0.0000068 U
Inorganics (mg/kg)									
Antimony	25.7 U	6.7 U	15.1 U	6.6 U	3.8 U	4.2 U	5.8 U	7.1 U	3.9 U
Arsenic	4.8	11.5	47.6	12.6	5	3.7	18.5	16.3	4.6
Barium	156	11.5	130	9.7					
Beryllium	0.47	0.07 U	0.35	0.07 U	0.16	0.11	0.18	0.32	0.13
Cadmium	3.24	0.67 U	2.26	0.66 U	0.38 U	0.42 U	0.58 U	0.71 U	0.39 U
Chromium	213	4.7	49.1	2.9	4.3	4.5	7.6	27.9	3.5
Copper	423	5.3	215	5.8	18	210	5.9	82.7	3.1
Lead	590	6.7 U	250	6.6 U	127	23.6	8.1	88.1	3.9 U
Mercury	0.208 U	0.04 U	0.116 U	0.041 U	0.018 U	0.015 U	0.023 U	0.141	0.018 U
Nickel	85.7	22.5	31.4	6.8	41	3.8	8.5	18.7	3.3
Selenium	25.7 U	6.7 U	15.1 U	6.6 U	3.8 U	4.2 U	5.8 U	7.1 U	3.9 U
Silver	29.7	0.67 U	18.5	0.66 U	0.38	6.79	0.58 U	6.38	0.39 U
Thallium	6.4 U	1.7 U	3.8 U	1.6 U	0.93 DU	1.03 DU	1.43 DU	1.75 DU	0.97 DU
Zinc	620	41.4	363	12.6	35.1	30.7	17.4	157	10.5
Percent Solid **(%)**					76.7	83.8			
Total Organic Carbon (TOC)	65000	2700	31000	7000	8870 H	1500	10000	37000	6700
AVS-SEM Metals (mg/kg)									
Antimony					24.6 U	25 U	25.2 U	43.9 U	25.6 U
Arsenic					40 U	40.6 U	104	125	41.6 U
AVS					18.3	80.2	8.46	3.39 U	7.91
Beryllium					10.9	6.75 U	6.8 U	21.7	6.92 U
Cadmium					2.67 U	2.71 U	2.73 U	5.01	2.77 U
Chromium					23.1 U	27.5	28.1	229	24 U

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Copper					119	482	47.6	674	26
Lead					170	79.6	17.4	313	12.9
Mercury					0.149 U	0.152 U	0.153 U	0.266 U	0.155 U
Nickel					733	51.8 U	52.2 U	149	53.1 U
Selenium					38 U	38.5 U	38.8 U	67.7 U	39.5 U
Silver					13.1	8.11	5.68 U	19.4	5.78 U
Thallium					29.3 U	29.8 U	30 U	52.3 U	30.5 U
Zinc					581	415	157	1880	94.4
TPH (mg/kg)									
Total Petroleum Hydrocarbon	253 U	48.1 U	147 U	44.9 U					

(1) - TEQs calculated in Attachement D

A - Detection limit based on
signal-to-noise measurement
B - Less than 10 times higher than
method blank level
J - Value is estimated
U - Not detected, value is detection limit

mg/kg - milligrams per kilogram

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Volatile Organics (mg/kg)										
1,1,1,2-Tetrachloroethane										
1,1,1-Trichloroethane										
1,1,2,2-Tetrachloroethane										
1,1,2-Trichloroethane										
1,1-Dichloroethane										
1,1-Dichloroethene										
1,1-Dichloropropene										
1,2,3-Trichlorobenzene										
1,2,3-Trichloropropane										
1,2,4-Trichlorobenzene										
1,2,4-Trimethylbenzene										
1,2-Dibromo-3-chloropropane										
1,2-Dibromoethane (EDB)										
1,2-Dichlorobenzene										
1,2-Dichloroethane										
1,2-Dichloropropane										
1,3,5-Trimethylbenzene										
1,3-Dichlorobenzene										
1,3-Dichloropropane										
1,4-Dichlorobenzene										
1,4-Dioxane										
1-Chlorohexane										
2,2-Dichloropropane										
2-Butanone										
2-Chlorotoluene										
2-Hexanone										
4-Chlorotoluene										
4-Isopropyltoluene										
4-Methyl-2-Pentanone										
Acetone										
Benzene										
Bromobenzene										
Bromochloromethane										
Bromodichloromethane										
Bromoform										
Bromomethane										
Carbon disulfide										
Carbon tetrachloride										
Chlorobenzene										
Chloroethane										
Chloroform										
Chloromethane										
cis-1,2-Dichloroethene										
cis-1,3-Dichloropropene										

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Dibromochloromethane										
Dibromomethane										
Dichlorodifluoromethane										
Diethyl ether										
Diisopropyl ether										
Ethyl tertiary-butyl ether										
Ethylbenzene										
Hexachlorobutadiene										
Isopropylbenzene										
m,p-Xylene										
Methylene chloride										
Methyl-t-butyl ether										
Naphthalene										
n-Butylbenzene										
n-Propyl Benzene										
o-Xylene										
sec-Butylbenzene										
Styrene										
tert-Butylbenzene										
Tertiary-amyl methyl ether										
Tetrachloroethene										
Tetrahydrofuran										
Toluene										
trans-1,2-Dichloroethene										
trans-1,3-Dichloropropene										
Trichloroethene										
Trichlorofluoromethane										
Vinyl acetate										
Vinyl chloride										
Xylenes, Total										
Semivolatile Organics (mg/kg)										
1-Methylnaphthalene										
2-Methylnaphthalene										
Acenaphthene										
Acenaphthylene										
Anthracene										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Benzo(g,h,i)perylene										
Benzo(k)fluoranthene										
Chrysene										
Dibenzo(a,h)anthracene										
Fluoranthene										
Fluorene										

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Indeno(1,2,3-cd)pyrene										
Naphthalene										
Phenanthrene										
Pyrene										
Pesticide/PCBs (mg/kg)										
4,4'-DDD										
4,4'-DDE										
4,4'-DDT										
Aldrin										
alpha-BHC										
alpha-Chlordane										
beta-BHC										
Chlordane										
delta-BHC										
Dieldrin										
Endosulfan I										
Endosulfan II										
Endosulfan sulfate										
Endrin										
Endrin aldehyde										
Endrin ketone										
gamma-BHC (Lindane)										
gamma-Chlordane										
Heptachlor										
Heptachlor epoxide										
Hexachlorobenzene										
Methoxychlor										
Toxaphene										
Aroclor-1016										
Aroclor-1221										
Aroclor-1232										
Aroclor-1242										
Aroclor-1248										
Aroclor-1254										
Aroclor-1260										
Aroclor-1262										
Aroclor-1268										
Dioxin/Furans (mg/kg)										
1,2,3,4,6,7,8-HpCDD	0.000005 U	0.0003	0.000005 U	0.00032	0.000005 U	0.000018	0.00023	0.000014	0.00032	0.00034
1,2,3,4,6,7,8-HpCDF	0.000005 U	0.00018	0.000005 U	0.00018	0.000005 U	0.0000095	0.00014	0.0000075	0.00011	0.00014
1,2,3,4,7,8,9-HpCDF	0.000005 U	0.000023	0.000005 U	0.00002	0.000005 U	0.000005 U	0.000016	0.000005 U	0.000009	0.000012
1,2,3,4,7,8-HxCDD	0.000005 U	0.00001	0.000005 U	0.00001	0.000005 U	0.000005 U	0.0000077	0.000005 U	0.0000065	0.0000092
1,2,3,4,7,8-HxCDF	0.000005 U	0.000005 UP	0.000005 U	0.000075	0.000005 U	0.000005 U	0.000056	0.000005 U	0.000018	0.000036
1,2,3,6,7,8-HxCDD	0.000005 U	0.000033	0.000005 U	0.000032	0.000005 U	0.000005 U	0.000023	0.000005 U	0.000018	0.000024
1,2,3,6,7,8-HxCDF	0.000005 U	0.00015	0.000005 U	0.00013	0.000005 U	0.0000066	0.000099	0.000005 U	0.000037	0.000058

Table A-2
Sediment Data Used For the SLERA
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Parameter	SED-38-01 12/13/2011 0 - 1 ft	SED-39-01 12/14/2011 0 - 1 ft	SED-40-01 12/16/2011 0 - 1 ft	SED-41-01 12/15/2011 0 - 1 ft	SED-42-01 12/14/2011 0 - 1 ft	SED-43-01 12/19/2011 0 - 1 ft	SED-44-01 12/15/2011 0 - 1 ft	SED-45-01 12/14/2011 0 - 1 ft	SED-46-01 12/20/2011 0 - 1 ft	SED-47-01 12/15/2011 0 - 1 ft
1,2,3,7,8,9-HxCDD	0.000005 U	0.000021	0.000005 U	0.000022	0.000005 U	0.000005 U	0.000016	0.000005 U	0.000016	0.000019
1,2,3,7,8,9-HxCDF	0.000005 U	0.000013	0.000005 U	0.000041	0.000005 U	0.000005 U	0.00003	0.000005 U	0.000005 U	0.000012
1,2,3,7,8-PeCDD	0.000005 U	0.00002	0.000005 U	0.000018	0.000005 U	0.000005 U	0.000012	0.000005 U	0.0000074	0.00001
1,2,3,7,8-PeCDF	0.000005 U	0.000005 UP	0.000005 U	0.000043	0.000005 U	0.000005 UP	0.000023	0.000005 UP	0.000005 UP	0.000018
2,3,4,6,7,8-HxCDF	0.000005 U	0.00011	0.000005 U	0.000082	0.000005 U	0.0000053	0.000084	0.000005 U	0.000025	0.000046
2,3,4,7,8-PeCDF	0.000005 U	0.00011	0.000005 U	0.00066	0.000005 U	0.0000082	0.00045	0.0000057	0.000038	0.00021
2,3,7,8-TCDD	0.000001 U	0.00001	0.000001 U	0.0000052	0.000001 U	0.000001 U	0.0000031	0.000001 U	0.0000024	0.0000024
2,3,7,8-TCDF	0.000001 U	0.000054	0.000001 U	0.000054	0.000001 U	0.0000036	0.000038	0.0000029	0.000043	0.000057
OCDD	0.00001 U	0.0021	0.00001 U	0.0021	0.00001 U	0.00012	0.0015	0.00012	0.0025	0.0025
OCDF	0.00001 U	0.00014	0.00001 U	0.00012	0.00001 U	0.00001 U	0.000081	0.00001 U	0.00014	0.00012
Total HpCDD	0.000005 U	0.00071	0.000005 U	0.00078	0.000005 U	0.00004	0.00056	0.000031	0.00073	0.00082
Total HpCDF	0.000005 U	0.00045	0.000005 U	0.00022	0.000005 U	0.000019	0.00016	0.000014	0.00024	0.00026
Total HxCDD	0.000005 U	0.00042	0.000005 U	0.00043	0.000005 U	0.0000087	0.00032	0.000005 U	0.00022	0.00033
Total HxCDF	0.000005 U	0.0038	0.000005 U	0.0038	0.000005 U	0.00015	0.0027	0.000058	0.00081	0.0015
Total PeCDD	0.000005 U	0.00023	0.000005 U	0.00018	0.000005 U	0.000005 U	0.00012	0.000005 U	0.000066	0.000095
Total PeCDF	0.000005 U	0.0075 E	0.000005 U	0.0062 E	0.000005 U	0.00023	0.0045 E	0.000098	0.0013	0.0018
Total TCDD	0.000001 U	0.00011	0.000001 U	0.00012	0.000001 U	0.000001 U	0.000089	0.000001	0.000031	0.000062
Total TCDF	0.000001 U	0.0021 E	0.000001 U	0.0022 E	0.000001 U	0.00011	0.0018 E	0.000043	0.00042	0.0011
TEQ-Mammal	0.0000057 U	0.000108127	0.0000057 U	0.00027	0.0000057 U	0.0000087	0.0001905	0.0000071	0.0000431	0.0001078
TEQ-Bird	0.0000077 U	0.000227284	0.0000077 U	0.00078	0.0000077 U	0.0000173	0.0005365	0.0000134	0.0001032	0.0003011
TEQ-Fish	0.0000068 U	0.000123469	0.0000068 U	0.00040	0.0000068 U	0.0000105	0.0002762	0.0000085	0.0000447	0.0001435
Inorganics (mg/kg)										
Antimony	3.9 U	12.4 U	5.4 U	16 U	4 U	6.3 U	13.9 U	6.1 U	21 U	18.2 U
Arsenic	4.1	24.7	5.6	25.2	2 U	20.2	23	7.1	42	26.4
Barium										
Beryllium	0.1	0.77	0.17	0.83	0.08 U	0.2	0.82	0.16	0.65	0.9
Cadmium	0.39 U	2.11	0.54 U	2.27	0.4 U	0.63 U	1.57	0.61 U	2.64	2.83
Chromium	3.7	127	3.2	150	1.8	12.7	87.6	8	127	196
Copper	6.6	328	4.6	333	2 U	24.7	189	14	336	342
Lead	6.6	475	5.4 U	467	4 U	43.4	393	25.1	490	580
Mercury	0.019 U	1.32	0.02 U	1.01	0.016 U	0.102	0.972	0.07	0.482	1.03
Nickel	7	50.7	3.2	58.8	2.1	6.4	34.2	4.1	69.4	77.3
Selenium	3.9 U	12.4 U	5.4 U	16 U	4 U	6.3 U	13.9 U	6.1 U	21 U	18.2 U
Silver	0.39 U	23.8	0.54 U	22.9	0.4 U	1.12	13.9	0.66	17	16.7
Thallium	0.96 DU	3.07 DU	1.32 DU	3.97 DU	0.99 DU	1.55 DU	3.43 DU	1.5 DU	5.19 DU	4.5 DU
Zinc	37.8	491	13.1	494	10.7	40.8	363	31.8	467	496
Percent Solid **(%)**						45.4			14.7	
Total Organic Carbon (TOC)	5400	140000	2000	130000	4300	37700 H	99000	19000	123000	130000
AVS-SEM Metals (mg/kg)										
Antimony	24.4 U	84.4 U	23.9 U	101 U	25 U	47.2 U	88.4 U	38.6 U	133 U	126 U
Arsenic	44.6	186	38.8 U	197	40.7 U	118	205	63.3	372	235
AVS	14.8	4160 D	1.83 U	6490 D	1.93 U	2180 D	6530 D	205	15600 D	5300 D
Beryllium	6.6 U	60.9	6.44 U	58.1	7.69	17.6	66.9	11	75.2	67.6
Cadmium	2.65 U	20.2	2.58 U	24.1	2.71 U	5.11 U	17	4.18 U	33	27.6
Chromium	22.9 U	1370	22.3 U	1780	24.1	105	1010	72.3	1450	1730

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Parameter	SED-38-01 12/13/2011 0 - 1 ft	SED-39-01 12/14/2011 0 - 1 ft	SED-40-01 12/16/2011 0 - 1 ft	SED-41-01 12/15/2011 0 - 1 ft	SED-42-01 12/14/2011 0 - 1 ft	SED-43-01 12/19/2011 0 - 1 ft	SED-44-01 12/15/2011 0 - 1 ft	SED-45-01 12/14/2011 0 - 1 ft	SED-46-01 12/20/2011 0 - 1 ft	SED-47-01 12/15/2011 0 - 1 ft
Copper	48.7	3870	33	4130	27.6	274	2680	172	4960	4480
Lead	18.4	2320	13.2	2460	12.3	265	2300	138	2640	2950
Mercury	0.148 U	0.513 U	0.145 U	0.614 U	0.152 U	0.286 U	0.536 U	0.234 U	0.809 U	0.767 U
Nickel	138	416	49.5 U	502	51.9 U	97.8 U	291	80 U	767	737
Selenium	37.7 U	130 U	36.8 U	156 U	38.6 U	72.7 U	136 U	59.5 U	205 U	195 U
Silver	5.51 U	64.2	5.38 U	75.8	5.65 U	10.6 U	37.1	8.71 U	81.6	61.7
Thallium	29.1 U	101 U	28.4 U	120 U	29.8 U	56.2 U	105 U	46 U	159 U	151 U
Zinc	775	7640	123	8090	319	727	6190	525	8540	7640
TPH (mg/kg)										
Total Petroleum Hydrocarbon										

(1) - TEQs calculated in Attachement D

A - Detection limit based on
signal-to-noise measurement
B - Less than 10 times higher than
method blank level
J - Value is estimated
U - Not detected, value is detection limit

mg/kg - milligrams per kilogram

Table A-2
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333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED-48-01 12/14/2011 0 - 1 ft	SED-59-01 12/20/2011 0 - 1 ft	SED-60-01 12/20/2011 0 - 1 ft
Volatile Organics (mg/kg)			
1,1,1,2-Tetrachloroethane			
1,1,1-Trichloroethane			
1,1,2,2-Tetrachloroethane			
1,1,2-Trichloroethane			
1,1-Dichloroethane			
1,1-Dichloroethene			
1,1-Dichloropropene			
1,2,3-Trichlorobenzene			
1,2,3-Trichloropropane			
1,2,4-Trichlorobenzene			
1,2,4-Trimethylbenzene			
1,2-Dibromo-3-chloropropane			
1,2-Dibromoethane (EDB)			
1,2-Dichlorobenzene			
1,2-Dichloroethane			
1,2-Dichloropropane			
1,3,5-Trimethylbenzene			
1,3-Dichlorobenzene			
1,3-Dichloropropane			
1,4-Dichlorobenzene			
1,4-Dioxane			
1-Chlorohexane			
2,2-Dichloropropane			
2-Butanone			
2-Chlorotoluene			
2-Hexanone			
4-Chlorotoluene			
4-Isopropyltoluene			
4-Methyl-2-Pentanone			
Acetone			
Benzene			
Bromobenzene			
Bromochloromethane			
Bromodichloromethane			
Bromoform			
Bromomethane			
Carbon disulfide			
Carbon tetrachloride			
Chlorobenzene			
Chloroethane			
Chloroform			
Chloromethane			
cis-1,2-Dichloroethene			
cis-1,3-Dichloropropene			

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Parameter	SED-48-01 12/14/2011 0 - 1 ft	SED-59-01 12/20/2011 0 - 1 ft	SED-60-01 12/20/2011 0 - 1 ft
Dibromochloromethane			
Dibromomethane			
Dichlorodifluoromethane			
Diethyl ether			
Diisopropyl ether			
Ethyl tertiary-butyl ether			
Ethylbenzene			
Hexachlorobutadiene			
Isopropylbenzene			
m,p-Xylene			
Methylene chloride			
Methyl-t-butyl ether			
Naphthalene			
n-Butylbenzene			
n-Propyl Benzene			
o-Xylene			
sec-Butylbenzene			
Styrene			
tert-Butylbenzene			
Tertiary-amyl methyl ether			
Tetrachloroethene			
Tetrahydrofuran			
Toluene			
trans-1,2-Dichloroethene			
trans-1,3-Dichloropropene			
Trichloroethene			
Trichlorofluoromethane			
Vinyl acetate			
Vinyl chloride			
Xylenes, Total			
Semivolatile Organics (mg/kg)			
1-Methylnaphthalene			
2-Methylnaphthalene			
Acenaphthene			
Acenaphthylene			
Anthracene			
Benzo(a)anthracene			
Benzo(a)pyrene			
Benzo(b)fluoranthene			
Benzo(g,h,i)perylene			
Benzo(k)fluoranthene			
Chrysene			
Dibenzo(a,h)anthracene			
Fluoranthene			
Fluorene			

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Indeno(1,2,3-cd)pyrene			
Naphthalene			
Phenanthrene			
Pyrene			
Pesticide/PCBs (mg/kg)			
4,4'-DDD			
4,4'-DDE			
4,4'-DDT			
Aldrin			
alpha-BHC			
alpha-Chlordane			
beta-BHC			
Chlordane			
delta-BHC			
Dieldrin			
Endosulfan I			
Endosulfan II			
Endosulfan sulfate			
Endrin			
Endrin aldehyde			
Endrin ketone			
gamma-BHC (Lindane)			
gamma-Chlordane			
Heptachlor			
Heptachlor epoxide			
Hexachlorobenzene			
Methoxychlor			
Toxaphene			
Aroclor-1016			
Aroclor-1221			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260			
Aroclor-1262			
Aroclor-1268			
Dioxin/Furans (mg/kg)			
1,2,3,4,6,7,8-HpCDD	0.00059	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.00028	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.000024	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.000014	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.00007	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000044	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.000005 UP	0.000005 U	0.000005 U

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Parameter	SED-48-01 12/14/2011 0 - 1 ft	SED-59-01 12/20/2011 0 - 1 ft	SED-60-01 12/20/2011 0 - 1 ft
1,2,3,7,8,9-HxCDD	0.000031	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.000005 UP	0.000005 U	0.000005 U
1,2,3,7,8-PeCDD	0.000022	0.000005 U	0.000005 U
1,2,3,7,8-PeCDF	0.000005 UP	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.000096	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.00014	0.000005 U	0.000005 U
2,3,7,8-TCDD	0.000006 A	0.000001 U	0.000001 U
2,3,7,8-TCDF	0.00012 A	0.000001 U	0.000001 U
OCDD	0.0045	0.00001 U	0.00001 U
OCDF	0.00027	0.00001 U	0.00001 U
Total HpCDD	0.0014	0.000005 U	0.000005 U
Total HpCDF	0.00056	0.000005 U	0.000005 U
Total HxCDD	0.00056	0.000005 U	0.000005 U
Total HxCDF	0.003	0.000005 U	0.000005 U
Total PeCDD	0.00023	0.000005 U	0.000005 U
Total PeCDF	0.0054	0.000005 U	0.000005 U
Total TCDD	0.000053	0.000001 U	0.000001 U
Total TCDF	0.0019	0.000001 U	0.000001 U
TEQ-Mammal	0.0001184	0.0000057 U	0.0000057 U
TEQ-Bird	0.0003137	0.0000077 U	0.0000077 U
TEQ-Fish	0.0001331	0.0000068 U	0.0000068 U
Inorganics (mg/kg)			
Antimony	18.3 U	3.7 U	3.5 U
Arsenic	23.7	28.1	4.3
Barium			
Beryllium	0.91	0.08 U	0.12
Cadmium	2.66	0.37 U	0.35 U
Chromium	189	3.9	3.2
Copper	327	5.6	5.1
Lead	611	4.5	3.5
Mercury	1.22	0.016 U	0.019 U
Nickel	69.2	5	2.8
Selenium	18.3 U	3.7 U	3.5 U
Silver	16	0.37 U	0.35 U
Thallium	4.54 DU	0.92 DU	0.86 DU
Zinc	501	18.3	15.3
Percent Solid **(%)**		78.6	83.4
Total Organic Carbon (TOC)	110000	4500	1200 U
AVS-SEM Metals (mg/kg)			
Antimony	113 U	25.3 U	23.5 U
Arsenic	223	121	38.3 U
AVS	4970 D	1.95 U	11.7
Beryllium	75.4	6.85 U	9.59
Cadmium	24.5	2.74 U	2.55 U
Chromium	1730	35.8	64.2

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Copper	3510	40.6	57.6
Lead	3070	14.8	15.7
Mercury	0.0687 U	0.154 U	0.143 U
Nickel	498	52.6 U	48.8 U
Selenium	174 U	39.1 U	36.3 U
Silver	33.8	5.72 U	5.31 U
Thallium	135 U	30.2 U	28 U
Zinc	7410	219	214
TPH (mg/kg)			
Total Petroleum Hydrocarbon			

(1) - TEQs calculated in Attachement D

A - Detection limit based on
signal-to-noise measurement
B - Less than 10 times higher than
method blank level
J - Value is estimated
U - Not detected, value is detection limit

mg/kg - milligrams per kilogram

ATTACHMENT B

ECOTOXICOLOGICAL PROFILES

ECOTOXICOLOGICAL PROFILES

1.0 Volatile Organic Compounds (VOCs). VOCs rapidly dissociate from a liquid into a gaseous state, and exhibit varying degrees of solubility in water. Many VOCs, such as carbon tetrachloride, react with light to form highly unstable free-radicals. VOCs can range from low to high toxicity to aquatic and terrestrial life (Crosby, 1998). Acute damage to vertebrates typically involves damage to liver and kidneys (e.g. tetrachloroethylene and perchloroethylene), while chronic toxicity typically involves cancer (1,2-dichloroethane). Effects on invertebrates involve reduced growth and mortality. For example, the LC50 of 1,2,4-trichlorobenzene after fourteen days of exposure to earthworms is as low as 127 ppm. Because of their reactive and volatile nature, VOCs generally do not accumulate in plant and animal tissue.

2.0 Semi Volatile Organic Compounds (SVOCs). In aquatic environments, SVOCs (including polyaromatic hydrocarbons, or PAHs) rapidly become adsorbed to organic and inorganic particulate materials and are deposited in sediments (Neff, 1985). Sediment associated SVOCs can be accumulated by bottom-dwelling invertebrates and fish (Eisler 1987) and can be toxic to benthic invertebrates (Lotufo and Fleeger, 1996).

SVOC-induced phytotoxic effects are rare, however toxicological data are limited. Some higher plants can catabolize SVOCs, but this metabolic pathway is not well defined. Certain plants contain substances that can protect against SVOC effects, inactivating their cancer-causing and mutation-causing potential. Additionally, SVOCs synthesized by plants may act as growth hormones.

Most animals and microorganisms (shellfish and algae are notable exceptions) can metabolize and transform SVOCs to breakdown products that may ultimately completely degrade (Eisler, 1987). Biodegradation probably occurs more slowly in aquatic systems (especially under anaerobic systems) than soil (USEPA, 1985).

Some SVOCs rapidly bioaccumulate in animals because of their high lipid solubility (Eisler, 1987). The rate of bioaccumulation is inversely related to the rate of SVOC metabolism and is also influenced by the concentration of SVOC to which an organism is exposed. Both rates are dependent on the size of the specific SVOC molecule; for example PAHs with less than four rings are readily metabolized and not bioaccumulated, while PAHs with more than four rings are more slowly metabolized and tend to bioaccumulate on a short-term basis (USEPA, 1985; Eisler, 1987). Other effects in terrestrial organisms are poorly characterized, but may include adverse effects on reproduction, development, and immunity (ATSDR, 1995).

PAHs are highly potent carcinogens that can produce tumors in some organisms as well as other non-cancer-causing effects (Eisler, 1987). Effects have been found in many types of organisms, including mammals, birds, invertebrates, plants, amphibians, and fish. Effects on

benthic invertebrates include inhibited reproduction, delayed emergence, sediment avoidance, and mortality. Fish exposed to PAH contamination have exhibited fin erosion, liver abnormalities, cataracts, and immune system impairments leading to increased susceptibility to disease (Fabacher *et al*., 1991; Weeks and Warinner 1984; O'Conner and Huggett 1988).

Pesticides

Pesticides may be very persistent in aquatic systems, absorbing strongly to sediments, and bioconcentrating in aquatic organisms, including fish and other organisms (HSDB, 2000). Pesticides may be toxic to many types of aquatic organisms, even at low concentrations. Birds show a wide range of susceptibility to pesticides including dieldrin (less toxic than in aquatic organisms), heptachlor (moderately to high toxicity), gamma-BHC (slightly to moderately toxic), and DDT (slightly to non-toxic). However, DDT causes eggshell thinning and embryo mortality, especially in predatory birds. DDT also changes courtship behavior and induces other reproductive impairments.

Many pesticides are highly persistent and lipophilic compounds subject to pronounced biomagnification. The extremely low water solubilities result in strong adsorption to soil particles and very low leaching losses. Microbes biodegrade DDT to DDE and DDD under aerobic and anaerobic conditions, respectively. Both metabolites are more persistent than DDT. Plants adsorb DDT and its metabolites form soil, but they are poorly translocated and remain primarily in the roots. Foliar herbivory is therefore not a significant route of exposure to soil DDT. The toxicity of DDT to earthworms is low (Edwards and Bolgen, 1992), so bioaccumulation by earthworms is a significant route of exposure to vermivores and can results in lethal doses (Barker, 1958).

4.0 Dioxins/Furans

Dioxins and furans belong to a family of compounds divided into groups based on the number of chlorine atoms in the compound. (USEPA, 2003). They are typically produced from the incomplete combustion of fossil fuels or waste, but area also associated with several smelting and manufacturing processes. Dioxins do not dissolve easily in water; aquatic forms will attach strongly to small particles of soil or organic matter and eventually settle to the bottom. Dioxins may also attach to microscopic plants and animals (plankton) which serve as prey for other organisms. Concentrations of chemicals such as the most toxic form, 2,3,7,8-TCDD, are difficult for organisms to metabolize, and thus biomagnify. In certain animal species, 2,3,7,8-TCDD is especially harmful and can cause death after a single exposure to small amounts. Exposure to non-lethal doses can cause a variety of adverse effects in animals, such as weight loss, biochemical and degenerative changes in the liver, and chloracne (USEPA, 2003). At relatively low levels 2,3,7,8-TCDD can also weaken the immune system. Exposure to 2,3,7,8-

TCDD can cause reproductive damage and birth defects in animals. Less is known about other, less toxic forms of dioxins.

5.0 Metals.

Many inorganic compounds occur naturally in the environment (Shacklette *et al*, 1971). Assessing the mobility and persistence of metals in environmental media is complicated and often difficult because of the many inorganic and organic complexes and salts they form. In addition, metals undergo a variety of processes in soils and water, which included hydrolysis, reduction, oxidation, and adsorption. These reactions are highly dependant on factors such as pH, salinity, sulfides, oxygen, ionic strength, particle-surface reactions, and the presence of anions and natural organic acids (humics and fulvics). Adsorption of metals through cation exchange, specific adsorption, coprecipitation, or organic complexation by oils and sediments is the dominant fate mechanisms in natural systems. Consequently, metals transported to surface water via runoff, groundwater, or suspended sediment derived from soil erosion would be predicted to accumulate. Metals vary in the extent to which they are adsorbed, and the adsorbents range in selectivity for metals.

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ATTACHMENT C

CALCULATIONS FOR ΣPAH MODELS

TABLE C-1
EVALUATION OF PAH ESBs FOR BENTHIC INVERTEBRATES
333 Adelaide Avenue
Providence, Rhode Island

SED11

PAH	FCV (ug/g_{oc})	Maxi (ug/g_{oc})	Measured Conc. (ug/g dry wt.)	C_{OC} (ug/g_{oc})	ESBTU
Acenaphthene	491	33400	0.0815	1.25	0.003
Acenaphthylene	452	2400	0.0815	1.25	0.003
Anthracene	594	1300	0.0815	1.25	0.002
Benz(a)anthracene	841	4153	0.0815	1.25	0.001
Benzo(a)pyrene	965	3840	0.0815	1.25	0.001
Benzo(b)fluoranthene	979	2169	0.245	3.77	0.004
Benzo(k)fluoranthene	981	1220	0.0815	1.25	0.001
Chrysene	844	826	0.0815	1.25	0.001
Fluoranthene	707	23870	0.327	5.03	0.007
Fluorene	538	26000	0.0815	1.25	0.002
Naphthalene	385	61700	0.0815	1.25	0.003
Phenanthrene	596	34300	0.0815	1.25	0.002
Pyrene	697	9090	0.258	3.97	0.006
$\Sigma ESBTU_{FCV,13}$					0.037
Correction Factor for 90th Percentile					8.5
Calculated $SESBTU_{FCV,34}$					**0.316**

Source:
USEPA (2003) Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. November 2003.

Assumes TOC of : 6.50%

TABLE C-2
EVALUATION OF PAH ESBs FOR BENTHIC INVERTEBRATES
333 Adelaide Avenue
Providence, Rhode Island

SED13

PAH	FCV (ug/g_{oc})	Maxi (ug/g_{oc})	Measured Conc. (ug/g dry wt.)	C_{OC} (ug/g_{oc})	ESBTU
Acenaphthene	491	33400	0.01605	5.94	0.012
Acenaphthylene	452	2400	0.01605	5.94	0.013
Anthracene	594	1300	0.01605	5.94	0.010
Benz(a)anthracene	841	4153	0.01605	5.94	0.007
Benzo(a)pyrene	965	3840	0.01605	5.94	0.006
Benzo(b)fluoranthene	979	2169	0.0378	14.00	0.014
Benzo(k)fluoranthene	981	1220	0.01605	5.94	0.006
Chrysene	844	826	0.01605	5.94	0.007
Fluoranthene	707	23870	0.0833	30.85	0.044
Fluorene	538	26000	0.01605	5.94	0.011
Naphthalene	385	61700	0.01605	5.94	0.015
Phenanthrene	596	34300	0.0333	12.33	0.021
Pyrene	697	9090	0.0513	19.00	0.027
$\Sigma ESBTU_{FCV,13}$					0.194
Correction Factor for 90th Percentile					8.5
Calculated $SESBTU_{FCV,34}$					**1.639**

Source:
USEPA (2003) Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. November 2003.

Assumes TOC of : 0.27%

TABLE C-3
EVALUATION OF PAH ESBs FOR BENTHIC INVERTEBRATES
333 Adelaide Avenue
Providence, Rhode Island

SED14

PAH	FCV (ug/g_{oc})	Maxi (ug/g_{oc})	Measured Conc. (ug/g dry wt.)	C_{OC} (ug/g_{oc})	ESBTU
Acenaphthene	491	33400	0.04715	1.52	0.003
Acenaphthylene	452	2400	0.04715	1.52	0.003
Anthracene	594	1300	0.04715	1.52	0.003
Benz(a)anthracene	841	4153	0.04715	1.52	0.002
Benzo(a)pyrene	965	3840	0.04715	1.52	0.002
Benzo(b)fluoranthene	979	2169	0.04715	1.52	0.002
Benzo(k)fluoranthene	981	1220	0.04715	1.52	0.002
Chrysene	844	826	0.04715	1.52	0.002
Fluoranthene	707	23870	0.204	6.58	0.009
Fluorene	538	26000	0.04715	1.52	0.003
Naphthalene	385	61700	0.04715	1.52	0.004
Phenanthrene	596	34300	0.0999	3.22	0.005
Pyrene	697	9090	0.153	4.94	0.007
$\Sigma ESBTU_{FCV,13}$					0.046
Correction Factor for 90th Percentile					8.5
Calculated $SESBTU_{FCV,34}$					**0.388**

Source:
USEPA (2003) Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. November 2003.

Assumes TOC of : 3.10%

TABLE C-4
EVALUATION OF PAH ESBs FOR BENTHIC INVERTEBRATES
333 Adelaide Avenue
Providence, Rhode Island

SED15

PAH	FCV (ug/g_{oc})	Maxi (ug/g_{oc})	Measured Conc. (ug/g dry wt.)	C_{OC} (ug/g_{oc})	ESBTU
Acenaphthene	491	33400	0.01575	2.25	0.005
Acenaphthylene	452	2400	0.01575	2.25	0.005
Anthracene	594	1300	0.01575	2.25	0.004
Benz(a)anthracene	841	4153	0.01575	2.25	0.003
Benzo(a)pyrene	965	3840	0.01575	2.25	0.002
Benzo(b)fluoranthene	979	2169	0.01575	2.25	0.002
Benzo(k)fluoranthene	981	1220	0.01575	2.25	0.002
Chrysene	844	826	0.01575	2.25	0.003
Fluoranthene	707	23870	0.01575	2.25	0.003
Fluorene	538	26000	0.01575	2.25	0.004
Naphthalene	385	61700	0.01575	2.25	0.006
Phenanthrene	596	34300	0.01575	2.25	0.004
Pyrene	697	9090	0.01575	2.25	0.003
$\Sigma ESBTU_{FCV,13}$					0.046
Correction Factor for 90th Percentile					8.5
Calculated $SESBTU_{FCV,34}$					**0.387**

Source:
USEPA (2003) Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. November 2003.

Assumes TOC of : 0.70%

ATTACHMENT D

TEQ CALCULATIONS

Table D-1
Calculation of TEQ Mammal for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	TEF-Mammal	SED/SW11 SED1101 6/22/2006 0-1 ft	SED13 SED1301 6/22/2006 0-0_5 ft	SED14 SED1401 6/22/2006 0-1 ft	SED15 SED1501 6/22/2006 0-1 ft	SED/SW33 SED-33-01 12/19/2011 0-1 ft	SED/SW34 SED-34-01 12/20/2011 0-1 ft	SED/SW35 SED-35-01 12/16/2011 0-1 ft	SED/SW36 SED-36-01 12/14/2011 0-1 ft
2,3,7,8-TCDD	1	0.0000042	0.00000015 U	0.0000014	0.00000016 U	0.000001 U	0.000001 U	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	1	0.000011	0.00000076 U	0.0000048	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.1	0.0000095	0.00000076 U	0.0000033	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.1	0.000025	0.00000076 U	0.0000068	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.1	0.000017	0.00000076 U	0.0000034	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.01	0.00028	0.0000022	0.000071	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000014
OCDD	0.0003	0.0018	0.000016	0.00047	0.0000044	0.00001 U	0.00001 U	0.00001 U	0.0001
2,3,7,8-TCDF	0.1	0.00000057 U	0.00000019	0.0000076	0.00000016 U	0.000001 U	0.000001 U	0.000001 U	0.0000041
1,2,3,7,8-PeCDF	0.03	0.000032	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.3	0.00043	0.00000086	0.00015	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000009
1,2,3,4,7,8-HxCDF	0.1	0.000036	0.00000076 U	0.0000017 U	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.1	0.000086	0.00000076 U	0.000026	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.0000058
1,2,3,7,8,9-HxCDF	0.1	0.00003	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.1	0.00008	0.00000076 U	0.000051	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.0000056
1,2,3,4,6,7,8-HpCDF	0.01	0.00014	0.00000076 U	0.000037	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000013
1,2,3,4,7,8,9-HpCDF	0.01	0.000018	0.00000076 U	0.0000044	0.0000008 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U
OCDF	0.0003	0.000087	0.0000016	0.000036	0.0000016 U	0.00001 U	0.00001 U	0.00001 U	0.000014
TEQ-Mammal		0.00018	0.0000010	0.000063	0.00000091	0.0000057 U	0.0000057 U	0.0000057 U	0.0000089

Table D-1
Calculation of TEQ Mammal for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW37 SED-37-01 12/15/2011 0-1 ft	SED/SW38 SED-38-01 12/13/2011 0-1 ft	SED/SW39 SED-39-01 12/14/2011 0-1 ft	SED/SW40 SED-40-01 12/16/2011 0-1 ft	SED/SW41 SED-41-01 12/15/2011 0-1 ft	SED/SW42 SED-42-01 12/14/2011 0-1 ft	SED/SW43 SED-43-01 12/19/2011 0-1 ft	SED/SW44 SED-44-01 12/15/2011 0-1 ft
2,3,7,8-TCDD	0.000001 U	0.000001 U	0.00001	0.000001 U	0.0000052	0.000001 U	0.000001 U	0.0000031
1,2,3,7,8-PeCDD	0.000005 U	0.000005 U	0.00002	0.000005 U	0.000018	0.000005 U	0.000005 U	0.000012
1,2,3,4,7,8-HxCDD	0.000005 U	0.000005 U	0.00001	0.000005 U	0.00001	0.000005 U	0.000005 U	0.0000077
1,2,3,6,7,8-HxCDD	0.000005 U	0.000005 U	0.000033	0.000005 U	0.000032	0.000005 U	0.000005 U	0.000023
1,2,3,7,8,9-HxCDD	0.000005 U	0.000005 U	0.000021	0.000005 U	0.000022	0.000005 U	0.000005 U	0.000016
1,2,3,4,6,7,8-HpCDD	0.000005 U	0.000005 U	0.0003	0.000005 U	0.00032	0.000005 U	0.000018	0.00023
OCDD	0.00001 U	0.00001 U	0.0021	0.00001 U	0.0021	0.00001 U	0.00012	0.0015
2,3,7,8-TCDF	0.000001 U	0.000001 U	0.000054	0.000001 U	0.000054	0.000001 U	0.0000036	0.000038
1,2,3,7,8-PeCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000043	0.000005 U	0.000005 U	0.000023
2,3,4,7,8-PeCDF	0.000005 U	0.000005 U	0.00011	0.000005 U	0.00066	0.000005 U	0.0000082	0.00045
1,2,3,4,7,8-HxCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000075	0.000005 U	0.000005 U	0.000056
1,2,3,6,7,8-HxCDF	0.000005 U	0.000005 U	0.00015	0.000005 U	0.00013	0.000005 U	0.0000066	0.000099
1,2,3,7,8,9-HxCDF	0.000005 U	0.000005 U	0.000013	0.000005 U	0.000041	0.000005 U	0.000005 U	0.00003
2,3,4,6,7,8-HxCDF	0.000005 U	0.000005 U	0.00011	0.000005 U	0.000082	0.000005 U	0.0000053	0.000084
1,2,3,4,6,7,8-HpCDF	0.000005 U	0.000005 U	0.00018	0.000005 U	0.00018	0.000005 U	0.0000095	0.00014
1,2,3,4,7,8,9-HpCDF	0.000005 U	0.000005 U	0.000023	0.000005 U	0.00002	0.000005 U	0.000005 U	0.000016
OCDF	0.00001 U	0.00001 U	0.00014	0.00001 U	0.00012	0.00001 U	0.00001 U	0.000081
TEQ-Mammal	0.0000057 U	0.0000057 U	0.00011	0.0000057 U	0.00027	0.0000057 U	0.0000087	0.00019

Table D-1
Calculation of TEQ Mammal for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW45 SED-45-01 12/14/2011 0-1 ft	SED/SW46 SED-46-01 12/20/2011 0-1 ft	SED/SW47 SED-47-01 12/15/2011 0-1 ft	SED/SW48 SED-48-01 12/14/2011 0-1 ft	SED/SW59 SED-59-01 12/20/2011 0-1 ft	SED/SW60 SED-60-01 12/20/2011 0-1 ft
2,3,7,8-TCDD	0.000001 U	0.0000024	0.0000024	0.000006	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	0.000005 U	0.0000074	0.00001	0.000022	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.000005 U	0.0000065	0.0000092	0.000014	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000005 U	0.000018	0.000024	0.000044	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.000005 U	0.000016	0.000019	0.000031	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.000014	0.00032	0.00034	0.00059	0.000005 U	0.000005 U
OCDD	0.00012	0.0025	0.0025	0.0045	0.00001 U	0.00001 U
2,3,7,8-TCDF	0.0000029	0.000043	0.000057	0.00012	0.000001 U	0.000001 U
1,2,3,7,8-PeCDF	0.000005 U	0.000005 U	0.000018	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.0000057	0.000038	0.00021	0.00014	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.000005 U	0.000018	0.000036	0.00007	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.000005 U	0.000037	0.000058	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.000005 U	0.000005 U	0.000012	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.000005 U	0.000025	0.000046	0.000096	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.0000075	0.00011	0.00014	0.00028	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.000005 U	0.000009	0.000012	0.000024	0.000005 U	0.000005 U
OCDF	0.00001 U	0.00014	0.00012	0.00027	0.00001 U	0.00001 U
TEQ-Mammal	0.0000071	0.000043	0.00011	0.00012	0.0000057 U	0.0000057 U

TEQ-Mammal is calculated by multipling each congener
by its coressponding TEF then summing all of the results.
TEF-Mammal values obtained from USEPA, 2010.
U - Compound was not detected and half the detection limit was used to calculate the TEQ.

USEPA, 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds, EPA/100/R/ 10/005, December.

Table D-2
Calculation of TEQ Bird for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	TEF-Bird	SED/SW11 SED1101 6/22/2006 0-1 ft	SED13 SED1301 6/22/2006 0-0_5 ft	SED14 SED1401 6/22/2006 0-1 ft	SED15 SED1501 6/22/2006 0-1 ft	SED/SW33 SED-33-01 12/19/2011 0-1 ft	SED/SW34 SED-34-01 12/20/2011 0-1 ft	SED/SW35 SED-35-01 12/16/2011 0-1 ft
2,3,7,8-TCDD	1	0.0000042	0.00000015 U	0.0000014	0.00000016 U	0.000001 U	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	1	0.000011	0.00000076 U	0.0000048	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.05	0.0000095	0.00000076 U	0.0000033	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.01	0.000025	0.00000076 U	0.0000068	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.1	0.000017	0.00000076 U	0.0000034	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.001	0.00028	0.0000022	0.000071	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
OCDD	0.0001	0.0018	0.000016	0.00047	0.0000044	0.00001 U	0.00001 U	0.00001 U
2,3,7,8-TCDF	1	0.00000057 U	0.00000019	0.0000076	0.00000016 U	0.000001 U	0.000001 U	0.000001 U
1,2,3,7,8-PeCDF	0.1	0.000032	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	1	0.00043	0.00000086	0.00015	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.1	0.000036	0.00000076 U	0.0000017 U	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.1	0.000086	0.00000076 U	0.000026	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.1	0.00003	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.1	0.00008	0.00000076 U	0.000051	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.01	0.00014	0.00000076 U	0.000037	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.01	0.000018	0.00000076 U	0.0000044	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
OCDF	0.0001	0.000087	0.0000016	0.000036	0.0000016 U	0.00001 U	0.00001 U	0.00001 U
TEQ-Brid		0.00048	0.0000018	0.000174	0.00000123	0.0000077 U	0.0000077 U	0.0000077 U

Table D-2
Calculation of TEQ Bird for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW36 SED-36-01 12/14/2011 0-1 ft	SED/SW37 SED-37-01 12/15/2011 0-1 ft	SED/SW38 SED-38-01 12/13/2011 0-1 ft	SED/SW39 SED-39-01 12/14/2011 0-1 ft	SED/SW40 SED-40-01 12/16/2011 0-1 ft	SED/SW41 SED-41-01 12/15/2011 0-1 ft	SED/SW42 SED-42-01 12/14/2011 0-1 ft	SED/SW43 SED-43-01 12/19/2011 0-1 ft
2,3,7,8-TCDD	0.000001 U	0.000001 U	0.000001 U	0.00001	0.000001 U	0.0000052	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	0.000005 U	0.000005 U	0.000005 U	0.00002	0.000005 U	0.000018	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.00001	0.000005 U	0.00001	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.000033	0.000005 U	0.000032	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.000021	0.000005 U	0.000022	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.000014	0.000005 U	0.000005 U	0.0003	0.000005 U	0.00032	0.000005 U	0.000018
OCDD	0.0001	0.00001 U	0.00001 U	0.0021	0.00001 U	0.0021	0.00001 U	0.00012
2,3,7,8-TCDF	0.0000041	0.000001 U	0.000001 U	0.000054	0.000001 U	0.000054	0.000001 U	0.0000036
1,2,3,7,8-PeCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000043	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.000009	0.000005 U	0.000005 U	0.00011	0.000005 U	0.00066	0.000005 U	0.0000082
1,2,3,4,7,8-HxCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000075	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.0000058	0.000005 U	0.000005 U	0.00015	0.000005 U	0.00013	0.000005 U	0.0000066
1,2,3,7,8,9-HxCDF	0.000005 U	0.000005 U	0.000005 U	0.000013	0.000005 U	0.000041	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.0000056	0.000005 U	0.000005 U	0.00011	0.000005 U	0.000082	0.000005 U	0.0000053
1,2,3,4,6,7,8-HpCDF	0.000013	0.000005 U	0.000005 U	0.00018	0.000005 U	0.00018	0.000005 U	0.0000095
1,2,3,4,7,8,9-HpCDF	0.000005 U	0.000005 U	0.000005 U	0.000023	0.000005 U	0.00002	0.000005 U	0.000005 U
OCDF	0.000014	0.00001 U	0.00001 U	0.00014	0.00001 U	0.00012	0.00001 U	0.00001 U
TEQ-Brid	0.0000186	0.0000077 U	0.0000077 U	0.00023	0.0000077 U	0.00078	0.0000077 U	0.0000173

Table D-2
Calculation of TEQ Bird for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW44 SED-44-01 12/15/2011 0-1 ft	SED/SW45 SED-45-01 12/14/2011 0-1 ft	SED/SW46 SED-46-01 12/20/2011 0-1 ft	SED/SW47 SED-47-01 12/15/2011 0-1 ft	SED/SW48 SED-48-01 12/14/2011 0-1 ft	SED/SW59 SED-59-01 12/20/2011 0-1 ft	SED/SW60 SED-60-01 12/20/2011 0-1 ft
2,3,7,8-TCDD	0.0000031	0.000001 U	0.0000024	0.0000024	0.000006	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	0.000012	0.000005 U	0.0000074	0.00001	0.000022	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.0000077	0.000005 U	0.0000065	0.0000092	0.000014	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000023	0.000005 U	0.000018	0.000024	0.000044	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.000016	0.000005 U	0.000016	0.000019	0.000031	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.00023	0.000014	0.00032	0.00034	0.00059	0.000005 U	0.000005 U
OCDD	0.0015	0.00012	0.0025	0.0025	0.0045	0.00001 U	0.00001 U
2,3,7,8-TCDF	0.000038	0.0000029	0.000043	0.000057	0.00012	0.000001 U	0.000001 U
1,2,3,7,8-PeCDF	0.000023	0.000005 U	0.000005 U	0.000018	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.00045	0.0000057	0.000038	0.00021	0.00014	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.000056	0.000005 U	0.000018	0.000036	0.00007	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.000099	0.000005 U	0.000037	0.000058	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.00003	0.000005 U	0.000005 U	0.000012	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.000084	0.000005 U	0.000025	0.000046	0.000096	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.00014	0.0000075	0.00011	0.00014	0.00028	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.000016	0.000005 U	0.000009	0.000012	0.000024	0.000005 U	0.000005 U
OCDF	0.000081	0.00001 U	0.00014	0.00012	0.00027	0.00001 U	0.00001 U
TEQ-Brid	0.00054	0.0000134	0.000103	0.00030	0.00031	0.0000077 U	0.0000077 U

TEQ-Bird is calculated by multipling each congener
by its coressponding TEF then summing all of the results.
TEF-Bird values obtained from Van den Berg et al., 1998.
U - Compound was not detected and half the detection limit was used to calculate the TEQ.

Van den Berg et al., 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs
for humans and wildlife. Environ Health Perspect 106 (12):775-792.

Table D-3
Calculation of TEQ Fish for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	TEF-Fish	SED/SW11 SED1101 6/22/2006 0-1 ft	SED13 SED1301 6/22/2006 0-0_5 ft	SED14 SED1401 6/22/2006 0-1 ft	SED15 SED1501 6/22/2006 0-1 ft	SED/SW33 SED-33-01 12/19/2011 0-1 ft	SED/SW34 SED-34-01 12/20/2011 0-1 ft	SED/SW35 SED-35-01 12/16/2011 0-1 ft
2,3,7,8-TCDD	1	0.0000042	0.00000015 U	0.0000014	0.00000016 U	0.000001 U	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	1	0.000011	0.00000076 U	0.0000048	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.5	0.0000095	0.00000076 U	0.0000033	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.01	0.000025	0.00000076 U	0.0000068	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.01	0.000017	0.00000076 U	0.0000034	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.001	0.00028	0.0000022	0.000071	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
OCDD	0.0001	0.0018	0.000016	0.00047	0.0000044	0.00001 U	0.00001 U	0.00001 U
2,3,7,8-TCDF	0.05	0.00000057 U	0.00000019	0.0000076	0.00000016 U	0.000001 U	0.000001 U	0.000001 U
1,2,3,7,8-PeCDF	0.05	0.000032	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.5	0.00043	0.00000086	0.00015	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.1	0.000036	0.00000076 U	0.0000017 U	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.1	0.000086	0.00000076 U	0.000026	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.1	0.00003	0.00000076 U	0.0000084	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.1	0.00008	0.00000076 U	0.000051	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.01	0.00014	0.00000076 U	0.000037	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.01	0.000018	0.00000076 U	0.0000044	0.0000008 U	0.000005 U	0.000005 U	0.000005 U
OCDF	0.0001	0.000087	0.0000016	0.000036	0.0000016 U	0.00001 U	0.00001 U	0.00001 U
TEQ-Fish		0.00026	0.0000013	0.000093	0.00000108	0.0000068 U	0.0000068 U	0.0000068 U

Table D-3
Calculation of TEQ Fish for Sediment
Updated Screening Level Ecological Risk Assessment
333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW36 SED-36-01 12/14/2011 0-1 ft	SED/SW37 SED-37-01 12/15/2011 0-1 ft	SED/SW38 SED-38-01 12/13/2011 0-1 ft	SED/SW39 SED-39-01 12/14/2011 0-1 ft	SED/SW40 SED-40-01 12/16/2011 0-1 ft	SED/SW41 SED-41-01 12/15/2011 0-1 ft	SED/SW42 SED-42-01 12/14/2011 0-1 ft	SED/SW43 SED-43-01 12/19/2011 0-1 ft
2,3,7,8-TCDD	0.000001 U	0.000001 U	0.000001 U	0.00001	0.000001 U	0.0000052	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	0.000005 U	0.000005 U	0.000005 U	0.00002	0.000005 U	0.000018	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.00001	0.000005 U	0.00001	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.000033	0.000005 U	0.000032	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.000005 U	0.000005 U	0.000005 U	0.000021	0.000005 U	0.000022	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.000014	0.000005 U	0.000005 U	0.0003	0.000005 U	0.00032	0.000005 U	0.000018
OCDD	0.0001	0.00001 U	0.00001 U	0.0021	0.00001 U	0.0021	0.00001 U	0.00012
2,3,7,8-TCDF	0.0000041	0.000001 U	0.000001 U	0.000054	0.000001 U	0.000054	0.000001 U	0.0000036
1,2,3,7,8-PeCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000043	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.000009	0.000005 U	0.000005 U	0.00011	0.000005 U	0.00066	0.000005 U	0.0000082
1,2,3,4,7,8-HxCDF	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000005 U	0.000075	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.0000058	0.000005 U	0.000005 U	0.00015	0.000005 U	0.00013	0.000005 U	0.0000066
1,2,3,7,8,9-HxCDF	0.000005 U	0.000005 U	0.000005 U	0.000013	0.000005 U	0.000041	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.0000056	0.000005 U	0.000005 U	0.00011	0.000005 U	0.000082	0.000005 U	0.0000053
1,2,3,4,6,7,8-HpCDF	0.000013	0.000005 U	0.000005 U	0.00018	0.000005 U	0.00018	0.000005 U	0.0000095
1,2,3,4,7,8,9-HpCDF	0.000005 U	0.000005 U	0.000005 U	0.000023	0.000005 U	0.00002	0.000005 U	0.000005 U
OCDF	0.000014	0.00001 U	0.00001 U	0.00014	0.00001 U	0.00012	0.00001 U	0.00001 U
TEQ-Fish	0.0000110	0.0000068 U	0.0000068 U	0.00012	0.0000068 U	0.00040	0.0000068 U	0.0000105

Table D-3
Calculation of TEQ Fish for Sediment
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333 Adelaide Avenue
Providence, Rhode Island

Parameter	SED/SW44 SED-44-01 12/15/2011 0-1 ft	SED/SW45 SED-45-01 12/14/2011 0-1 ft	SED/SW46 SED-46-01 12/20/2011 0-1 ft	SED/SW47 SED-47-01 12/15/2011 0-1 ft	SED/SW48 SED-48-01 12/14/2011 0-1 ft	SED/SW59 SED-59-01 12/20/2011 0-1 ft	SED/SW60 SED-60-01 12/20/2011 0-1 ft
2,3,7,8-TCDD	0.0000031	0.000001 U	0.0000024	0.0000024	0.000006	0.000001 U	0.000001 U
1,2,3,7,8-PeCDD	0.000012	0.000005 U	0.0000074	0.00001	0.000022	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDD	0.0000077	0.000005 U	0.0000065	0.0000092	0.000014	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDD	0.000023	0.000005 U	0.000018	0.000024	0.000044	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDD	0.000016	0.000005 U	0.000016	0.000019	0.000031	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDD	0.00023	0.000014	0.00032	0.00034	0.00059	0.000005 U	0.000005 U
OCDD	0.0015	0.00012	0.0025	0.0025	0.0045	0.00001 U	0.00001 U
2,3,7,8-TCDF	0.000038	0.0000029	0.000043	0.000057	0.00012	0.000001 U	0.000001 U
1,2,3,7,8-PeCDF	0.000023	0.000005 U	0.000005 U	0.000018	0.000005 U	0.000005 U	0.000005 U
2,3,4,7,8-PeCDF	0.00045	0.0000057	0.000038	0.00021	0.00014	0.000005 U	0.000005 U
1,2,3,4,7,8-HxCDF	0.000056	0.000005 U	0.000018	0.000036	0.00007	0.000005 U	0.000005 U
1,2,3,6,7,8-HxCDF	0.000099	0.000005 U	0.000037	0.000058	0.000005 U	0.000005 U	0.000005 U
1,2,3,7,8,9-HxCDF	0.00003	0.000005 U	0.000005 U	0.000012	0.000005 U	0.000005 U	0.000005 U
2,3,4,6,7,8-HxCDF	0.000084	0.000005 U	0.000025	0.000046	0.000096	0.000005 U	0.000005 U
1,2,3,4,6,7,8-HpCDF	0.00014	0.0000075	0.00011	0.00014	0.00028	0.000005 U	0.000005 U
1,2,3,4,7,8,9-HpCDF	0.000016	0.000005 U	0.000009	0.000012	0.000024	0.000005 U	0.000005 U
OCDF	0.000081	0.00001 U	0.00014	0.00012	0.00027	0.00001 U	0.00001 U
TEQ-Fish	0.00028	0.0000085	0.000045	0.00014	0.00013	0.0000068 U	0.0000068 U

TEQ-Fish is calculated by multipling each congener
by its coressponding TEF then summing all of the results.
TEF-Fish values obtained from Van den Berg et al., 1998.
U - Compound was not detected and half the detection limit was used to calculate the TEQ.

Van den Berg et al., 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs
for humans and wildlife. Environ Health Perspect 106 (12):775-792.

ATTACHMENT E

PRO UCL CALCULATIONS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TEQ Bird

General Statistics

Number of Valid Data	22	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	9
		Percent Non-Detects	40.91%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.233E-06	Minimum Detected	-13.61
Maximum Detected	0.0007799	Maximum Detected	-7.156
Mean of Detected	0.000228	Mean of Detected	-9.59
SD of Detected	0.0002466	SD of Detected	2.173
Minimum Non-Detect	0.0000077	Minimum Non-Detect	-11.77
Maximum Non-Detect	0.0000077	Maximum Non-Detect	-11.77

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.867	Shapiro Wilk Test Statistic	0.88
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0001363	Mean	-10.77
SD	0.0002179	SD	2.19
95% DL/2 (t) UCL	0.0002163	95% H-Stat (DL/2) UCL	0.00201
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-11.08
		SD in Log Scale	2.617
		Mean in Original Scale	0.0001362
		SD in Original Scale	0.000218
		95% t UCL	0.0002161
		95% Percentile Bootstrap UCL	0.0002156
		95% BCA Bootstrap UCL	0.0002267
		95% H-UCL	0.00962

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.454	**Data appear Normal at 5% Significance Level**	
Theta Star	0.000502		
nu star	11.81		
A-D Test Statistic	0.412	**Nonparametric Statistics**	
5% A-D Critical Value	0.788	Kaplan-Meier (KM) Method	

K-S Test Statistic	0.788
5% K-S Critical Value	0.249

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	0.0007799
Mean	0.0001352
Median	7.572E-06
SD	0.0002186
k star	0.279
Theta star	0.0004843
Nu star	12.28
AppChi2	5.412
95% Gamma Approximate UCL (Use when n >= 40)	0.0003067
95% Adjusted Gamma UCL (Use when n < 40)	0.0003271

Note: DL/2 is not a recommended method.

Mean	0.0001354
SD	0.0002135
SE of Mean	4.737E-05
95% KM (t) UCL	0.0002169
95% KM (z) UCL	0.0002133
95% KM (jackknife) UCL	0.0002155
95% KM (bootstrap t) UCL	0.0002569
95% KM (BCA) UCL	0.0002194
95% KM (Percentile Bootstrap) UCL	0.0002166
95% KM (Chebyshev) UCL	0.0003418
97.5% KM (Chebyshev) UCL	0.0004312
99% KM (Chebyshev) UCL	0.0006067

Potential UCLs to Use

95% KM (t) UCL	0.0002169
95% KM (Percentile Bootstrap) UCL	0.0002166

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.