Final
Newark Bay Study

Revised Pathways Analysis Report

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ACRONYMS

ABS	dermal absorption factor
ADAF	age dependent adjustment factors
ADD	average daily dose
AF	adherence factor
ALM	Adult Lead Model
ATSDR	Agency for Toxic Substances Disease Registry
AOC	Administrative Order on Consent
BHHRA	baseline human health risk assessment
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CalEPA	State of California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CL	cooking loss
cm^2	square centimeter
COPC	contaminant of potential concern
CSF	cancer slope factor
CSM	conceptual site model
CSO	combined sewer overflow
CTE	central tendency exposure
DAD	dermally absorbed dose
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
D/F	dioxin/furan
DQO	data quality objective
ED	exposure duration
EF	exposure frequency
EMPC	estimated maximum possible concentration
EPC	exposure point concentration
FDA	Food and Drug Administration
FI	fraction ingested
g/day	gram per day
GSH	Glenn Springs Holdings, Inc.
HI	hazard index
HQ	hazard quotient
IC	institutional control
IEUBK	Integrated Exposure Uptake Biokinetic Model for lead
IR	ingestion rate
IRIS	Integrated Risk Information System
IUR	inhalation unit risk factor

kg	kilogram
KM	Kaplan Meier
K_p	permeability constant
LADD	lifetime average daily dose
LPRSA	Lower Passaic River Study Area
mg	milligram
mg/cm^2	milligram per square centimeter
mg/kg bw-day	milligram per kilogram of body weight per day
MRL	minimal risk level
NBSA	Newark Bay Study Area
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NJDOH	New Jersey Department of Health
NOAA	National Oceanic and Atmospheric Administration
OLEM	Office of Land and Emergency Management
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PAR	Pathways Analysis Report
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PFD	problem formulation document
POTW	publicly owned treatment works
PPRTV	provisional peer-reviewed toxicity value
PRP	potentially responsible party
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RfC	inhalation reference concentration
RfD	reference dose (oral)
RI/FS	Remedial Investigation/Feasibility Study
RM	river mile
RME	reasonable maximum exposure
RPF	relative potency factor
RSL	regional screening level
SA	surface area
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SIU	significant industrial user
STSC	Superfund Technical Support Center
SVOC	semivolatile organic compound

TCDD	tetrachlorodibenzo-*p*-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalence
TPH	total petroleum hydrocarbons
Tierra	Tierra Solutions, Inc.
UCL	upper confidence limit of the mean
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WHO	World Health Organization
WRDA	Water Resources Development Act

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1.0 INTRODUCTION

1.1 Objectives and Purpose

Pursuant to the Administrative Order on Consent (AOC) issued in February 2004 by the United States Environmental Protection Agency (USEPA), a Remedial Investigation and Feasibility Study (RI/FS) will be conducted within the Newark Bay Study Area (NBSA), which is described as including Newark Bay and portions of the Hackensack River, Arthur Kill, and the Kill van Kull (USEPA, 2004a). The purpose of the RI/FS is to characterize the nature and extent of chemical contamination within the NBSA, determine the cancer risks and non-cancer hazards and whether remedial action is needed, develop and evaluate cleanup options, and gather necessary information to select an appropriate remedy for the site. A baseline human health risk assessment (BHHRA) will be performed as part of the RI/FS to assess current and future health risks to human receptors in the absence of any remedial actions and institutional controls (ICs), such as fish consumption advisories, needed to assess the potential need for remedial actions. Results of the RI/FS and BHHRA will be used to make a series of site-specific risk management decisions, depending on the need for remedial action as part of the Superfund remedy-selection process.

1.2 Regulatory Framework and Partnerships

The RI/FS for the NBSA is being performed as part of the Diamond Alkali Superfund Site under the authority of USEPA, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Operable Units (OUs) of the Diamond Alkali Superfund Site are the 80-120 Lister Avenue facility (OU1), the lower 8.3 miles of the Lower Passaic River (OU2), the 17 miles of the Lower Passaic River Study Area (LPRSA) (OU3), and the NBSA (OU4). A Record of Decision was issued for the lower 8.3 miles of the Passaic River in March 2016 (USEPA, 2016a) and is available for download at: http://passaic.sharepointspace.com/Public%20Documents/Passaic%20Lower%208.3%20Mile%20ROD%20Main%20Text%20396055.pdf.

The NBSA RI/FS is being conducted to address the presence of contaminants transported to Newark Bay from various sources, including tributaries to the Bay. Contamination in the Lower Passaic River is being addressed by a joint effort of several state and federal agencies, known as the LPRSA, which consists of a comprehensive study of a 17-mile stretch of the Lower Passaic River, extending from the Dundee Dam to Newark Bay. The integrated LPRSA study is being conducted pursuant to both CERCLA and the Water Resources Development Act (WRDA). The LPRSA represents an expansion of the original 6-mile Passaic River Study Area for which Tierra Solutions, Inc. (Tierra) initiated an RI/FS under a previous AOC in 1994 (USEPA, 1994a). In June 2004, an additional AOC was signed between USEPA and a group of over 70 potentially responsible parties (PRPs), including Tierra, requiring the PRPs to fund the CERCLA portion of the LPRSA, which is led by USEPA (USEPA, 2004a).

Up until May 2017, the RI/FS work was being conducted by Tierra on behalf of Occidental Chemical Corporation (the successor to Diamond Shamrock Chemicals Company [formerly known as Diamond Alkali Company]), one of the PRPs; however, the RI/FS work now is being conducted by Glenn Springs Holdings, Inc. (GSH). Where the necessary investigations to support the human health and ecological risk assessments have been conducted by the PRPs, the AOC assigns the planning of the risk assessments to USEPA.

This Pathways Analysis Report (PAR) prepared by USEPA serves as a preliminary planning and scoping document that evaluates the potential impacts of exposure to contaminants from sediment, surface water, and biota on humans in the NBSA. This document is a revision of the draft final PAR (Battelle, 2006), which has been updated to reflect current understanding of chemical contamination, ecological resources, and potential human exposure pathways associated with the NBSA based on more recent analytical data from sediment and biota samples collected by Tierra under the RI/FS Phase III sampling program. Due to the size and complexity of the NBSA, USEPA and Tierra agreed in 2005 that the RI would be implemented in multiple phases. Collectively, the Phase I and Phase II investigations gathered information on NBSA sediment, as described in the Final Newark Bay Study Area Remedial Investigation Phase I and Phase II Sediment Deposition Report, Revision 1 (Tierra, 2011) and the Final Data Evaluation and Analysis Report, Revision 2 (Tierra, 2014a). The Phase III investigation gathered information for risk assessment purposes and included additional sediment sampling to fill RI/FS data gaps. A synoptic LPRSA/NBSA water column program was conducted between 2010 and 2013 (AECOM, 2012a; 2012b).

The Phase III sampling program was developed based on several technical meetings (including a risk assessment workshop held in June 2011) between Tierra, USEPA and other regulatory stakeholders. The Phase III sampling program was conducted in accordance with approved planning documents including the problem formulation document (PFD) (Tierra, 2013), a risk assessment scoping memorandum (Tierra, 2015a) and various quality assurance project plans (QAPPs) for crab sampling, fish sampling, and sediment analysis (Tierra, 2014b; 2014c; 2015b).

For human health, contaminant screening using the Phase III data collected by Tierra was conducted as part of the PAR to identify contaminants of potential concern (COPCs). In addition, a preliminary conceptual site model (CSM) is provided along with an exposure assessment that defines estimates of the magnitude, frequency, duration, and routes of current and future human exposure to COPCs associated with the NBSA. Detailed exposure assessment parameters and values, as summarized later in this document, are presented in Risk Assessment Guidance for Superfund (RAGS) Part D format (USEPA, 2001a) in Attachment A.

This PAR has been prepared to outline the exposure pathways and initial assumptions for the BHHRA. In addition, this document updates risk assessment guidance, policies, and guidelines to reflect current approaches in the development of risk assessments under the Superfund Program. Future steps of the risk assessment process will be developed by GSH with oversight by the USEPA and input from stakeholders. Although elements of the BHHRA are presented here, this document is not intended to be a BHHRA and does not include a data usability analysis. All elements of the risk assessment process will be completed as part of the BHHRA.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description

Newark Bay is part of the New York/New Jersey Harbor Estuary and is located at the confluence of the Passaic and Hackensack Rivers. The cities of Newark and Elizabeth are located to the west of the Bay, Jersey City and Bayonne are to the east, and Staten Island is to the south. Newark Bay is approximately 6 miles long and 1 mile wide and is linked to Upper New York Bay by the Kill van Kull and to Lower New York Bay by the Arthur Kill (Tierra, 2004) (Figure 2-1).

The two major rivers that drain into Newark Bay are the Passaic and Hackensack Rivers. The Passaic River drains a 935 square mile watershed, encompassing 10 counties from northeastern New Jersey and southeastern New York, into Newark Bay (HydroQual, 2005). The Hackensack River spans 32 miles from New York to Newark Bay. These rivers are surrounded by one of the most heavily populated regions of the country (Hackensack Riverkeeper, 2005). Each of these two rivers has a downstream confluence with Newark Bay which, along with its other tributaries and associated wetlands, is one of the world's largest urbanized and industrialized estuarine systems (Gunster *et al.*, 1993).

For centuries, land use in the Newark Bay area has been primarily urban, consisting of a mix of residential, commercial, and industrial uses (Figure 2-2). During the 1700s, the City of Newark was recognized as a leading manufacturer of leather goods, carriages, and iron and brass products (Urquhart, 1913). Following World War II, Newark blossomed as a leading transportation center that included a developed infrastructure of highway, railway, and marine services. On the western shore of Newark Bay lies Port Newark, which is part of the port system maintained by the Port Authority of New York and New Jersey. This is one of the nation's largest and busiest ports for containerized cargo, including petroleum products and various hazardous cargo. Both the eastern and western banks of Newark Bay are dominated by numerous active or abandoned commercial and industrial properties. These banks are extensively developed and consist of miles of paved shoreline. A developed network of combined sewer overflows (CSOs), stormwater outfalls, and publicly owned treatment works (POTWs) also exists throughout the study area (Mueller *et al.*, 1982).

To maintain the status of Newark Bay and its tributaries as one of the premier commercial ports in the nation, the U.S. Army Corps of Engineers (USACE) has conducted extensive dredging operations since the 1930s to accommodate the expanding fleet of cargo vessels. Various engineering projects, including the construction of dams to create mill ponds, canals to divert water into municipal water supplies, and extensive dredging, have altered the area's hydrology. Increases of saltwater to the Hackensack and Passaic Rivers have transformed the ecology of the upstream wetlands. The original 42-plus square miles of tidal and freshwater wetlands, known as the Hackensack Meadowlands, were reduced to around 13 square miles by 1969, much of which were polluted by sewage and solid waste (Marshall, 2004).

Sediment and chemical fluxes in the Newark Bay estuary are influenced by the ebb and flow of the semidiurnal tides of Newark Bay. These tides, in combination with freshwater flows from river inputs, result in density stratification in Newark Bay with a distinct counter-current transport flux in the surface and bottom layers of the water column (HydroQual, 2005). This results in a northern transport of materials (*i.e.*, sediment and chemicals) from Newark Bay into the lower reaches of these rivers. Spills and releases of petroleum products and hazardous waste from ships and cargo in Newark Bay are a likely source of pollution to these tributaries. Likewise, the downstream transport of sediment and chemicals from the mixed freshwater/saline surface water of the rivers is deposited into the Bay (HydroQual, 2005).

2.2 Historical Sources of Contamination

Over the past two centuries, Newark Bay and its tributaries have been subjected to expanding urban and industrial development, resulting in the dramatic degradation of the Newark Bay area (Iannuzzi *et al.*, 2002). By the early twentieth century, Newark was one of the largest industrial cities in the US with established industries such as petroleum refineries, shipping facilities, tanneries, and various manufacturers. Anthropogenic influence on the natural habitat from this industrialization included the direct release of large amounts of chemicals and human wastes into the Bay, as well as habitat destruction, wetlands drainage, and land alteration.

Numerous industrial and manufacturing facilities in the NBSA served as potential point and non-point source discharges to the sediment environment. These industries included metals refining, dye manufacturing, tanning, soap and candle making, lumber processing, hat manufacturing, carriage building, shoe making, petroleum processing, chemical manufacturing, pesticide and herbicide production, paper and textile manufacturing, copper rolling, wire manufacturing, silver manufacturing, and platinum refining (Iannuzzi *et al*., 2002). Also, ship building, coke making, decommissioning, manufactured gas plants, and other heavy manufacturing companies utilized the waterways (Tierra, 2013).

A number of chemicals including metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) are present in the sediments and aquatic organisms within Newark Bay's waterways. Direct input of manufacturing waste and raw sewage were significant sources of this contamination to the waterway. Sources of contaminants to Newark Bay have been categorized as follows:

- Industrial dischargers
- CSOs/significant industrial users (SIUs)/storm sewers
- POTWs
- Spills, leaks, and accidental discharges from marine and industrial discharger sources
- Miscellaneous sources

Industrial dischargers located along the waterfront and inland areas of the lower 3 miles of the Passaic River have contributed to sediment contamination of the NBSA, in particular, the Diamond Alkali Superfund Site, a former manufacturing facility located at 80-120 Lister Avenue in Newark, New Jersey, at River Mile (RM) 3. Manufacturing of dichlorodiphenyltrichloroethane (DDT) and other products began at this facility in the 1940s. In the 1950s and 1960s, the facility was used for the manufacture of the defoliant chemical known as "Agent Orange," among other products. A byproduct of this manufacturing process was 2,3,7,8-TCDD (2,3,7,8- tetrachlorodibenzo-*p*-dioxin, the most toxic form of dioxin), which was released into the river.

3.0 CONCEPTUAL SITE MODEL

A CSM was developed for the human health risk assessment. The purpose of the CSM is to summarize the sources of contaminants, routes of transport of contaminants, contaminated media, routes of exposures, and receptors. Figure 3-1 presents the CSM for human health[1]. The selection of exposure pathways and the rationale for inclusion of each pathway using either quantitative or qualitative methods is presented in RAGS Part D Table 1 (USEPA, 2001a) in Attachment A. The CSM can be updated and further developed as additional information comes forward (*e.g.*, hydrodynamic and sediment transport modeling, contaminant fate and transport modeling, bioaccumulation modeling).

Increased urbanization has contributed to extensive habitat loss and degradation which has greatly reduced the functional and structural integrity of ecosystems within the NBSA. Severe loss of the natural habitat, especially wetlands, for many indigenous and migratory animals has occurred for decades. Since 1940, over 88 percent of wetlands in the Newark Bay estuary have been eliminated (Iannuzzi *et al.*, 2002). Shorelines covered by bulkheads, rip-rap, structures, and pavement limit the nesting and foraging areas for birds along the Bay. In addition, tidal creeks and marshes that provide critical habitat to juvenile and migratory fish have been depleted by pollution and loss of habitat, resulting in a decline of fish and shellfish populations in the estuary. A reconnaissance survey conducted by Tierra (2015c) confirms that approximately two-thirds of the shoreline consists of riprap and bulkhead that limit potential access to the NBSA. The percentage of each shoreline habitat category in the NBSA is as follows (Tierra, 2015c): bulkhead (40%), mixed intertidal (10%), rip-rap (30%), and vegetation (20%).

With respect to human health, pollution and habitat degradation have limited the recreational and economic use of the Bay. The State of New Jersey, recognizing the widespread chemical contamination (mainly from dioxins/furans and PCBs) of fish and shellfish in Newark Bay, has posted advisories regarding the consumption of fish and shellfish from this area (New Jersey Department of Environmental Protection [NJDEP] and New Jersey Department of Health [NJDOH], 2017). Despite the increased urbanization of the area and fish/shellfish consumption advisories, anglers/sportsmen continue to fish and crab in the Bay and several studies have indicated they consume their catch (Burger *et al.*, 1999; Burger, 2002; Pflugh and Kerry 2002; Pflugh *et al.*, 1999). In addition, individuals enjoy the area for other recreational purposes, such as boating, swimming, wading, bird watching, dog walking, and photography (Tierra, 2015c). Observations have also been made that transient individuals (*i.e.*, homeless residents) live in temporary makeshift shelters along the banks of the NBSA (Tierra, 2015c; Proctor *et al.*, 2002). Port workers (*i.e.*, individuals loading and unloading ship cargo) are identified as potential receptors who may indirectly be exposed to contaminants that volatilize from surface water. However, the potential for exposure to port workers is minimal; therefore, another likely worker receptor has been included. This is an outdoor worker tasked with collecting shoreline trash or other work activities that lead to contact with sediment along the Bay. Inhalation may occur if activities are in mudflat areas and volatiles are present; contact with surface water is not typically expected to occur.

Thus, potential receptors that may be directly exposed to contaminants in the environment include the angler/sportsman, swimmer, wader, boater, transient, and shoreline worker (outdoor worker). Depending on the activities of these receptors, the assessment will evaluate exposures to the young child (1 to < 7 years), adolescent (7 to < 19 years) and the adult (19 years or older) using appropriate exposure asssumptions for the age group. Potential receptors or exposure routes not quantitatively assessed in the BHHRA will be qualitatively addressed in the uncertainty section of the BHHRA.

[1] The CSM presented in this document is consistent with the CSM developed for the 17-mile LPRSA BHHRA in terms of recreational receptors and shoreline workers.

Urbanization, the expansion of industry, and the subsequent release of chemicals into the Newark Bay estuary have resulted in elevated levels of chemical contamination in sediments (National Oceanic and Atmospheric Administration [NOAA], 1998). Some of these contaminants are known to bioaccumulate in tissue and to subsequently be transferred up the food chain to upper-trophic level organisms, including humans (Suedel *et al.*, 1994). Physical and chemical processes that control the transport and fate of contaminants in Newark Bay and their availability to ecological or human receptors are described below.

Some species of metals, PCBs, PAHs, pesticides, and dioxins/furans are hydrophobic, nonpolar contaminants that tend to tightly adsorb to sediment particles. Therefore, their transport and fate in estuarine systems are controlled by the movement of sediment particles. Surface and subsurface sediments can be mixed by physical processes such as currents, wave resuspension, grounding of ship keels and propellers, and liquefaction or slumping, or by biological processes (*e.g.*, bioturbation). Sediments and the bound contaminants are likely moved around the system due to these processes. Sediment accumulation, vertical mixing, storms, floods, and anthropogenic disturbances (*e.g.*, dredging) control the rate at which contaminants are being buried and removed from receptor pathways.

The physical characteristics of the system can also impact the movement of chemicals through sediments. In anoxic environments, metals such as cadmium, lead, copper, and zinc are typically immobilized as sulfides. These metals can be mobilized via a change in redox potential (*i.e.*, oxidation) and/or drop in pH (which is unlikely in an estuarine environment). Microbial processes can transform elemental mercury into methylmercury, which is more toxic and more bioavailable than the elemental form. In estuaries, methylation tends to occur at higher rates in coastal wetlands and tidal flats under anaerobic conditions.

In contrast, VOCs are somewhat soluble in water, but volatilization rapidly removes them from the water column. Moderate adsorption to sediment occurs and VOCs may accumulate. However, they are susceptible to biodegradation in the sediment under appropriate physiochemical conditions.

Although SVOCs in the water column are susceptible to volatilization, they have a strong propensity to bind to sediments. Once bound, they are less likely to volatilize than if in the water column. They are, however, susceptible to biodegradation in sediment matrices with ample oxygen content.

Many contaminants are known to bioaccumulate in organisms and move through the food chain. This occurs when contaminants are retained within the tissues of primary consumers and are subsequently moved to other components of the ecosystem when higher-level consumers feed on them. This trophic transfer of contaminants through the marine food web has important human health implications because humans tend to consume organisms from higher-trophic levels that are likely to have high concentrations of contaminants. Certain metals, PCBs, chlorinated pesticides, and dioxins/furans are known to bind to tissue and bioaccumulate in upper-trophic level organisms. PAHs are not known to bioaccumulate at high rates in tissues (Suedel *et al.*, 1994); PAH toxicity generally occurs via direct ingestion, dermal contact, or inhalation.

The CSM in Figure 3-1 for human health risk identifies three distinct categories of exposure pathways: 1) a complete quantitative pathway exists based on sufficient current and historical data, as indicated by a dark blue oval; 2) a complete qualitative pathway, which currently lacks sufficient data, but is believed to exist based on anecdotal evidence and professional judgment, as indicated by a green oval; and 3) an incomplete pathway if there is no exposure pathway to a potential receptor group, as indicated by having no colored oval.

4.0 SUMMARY OF AVAILABLE DATA AND EVALUATION

Sediment and biota tissue data included in this evaluation were obtained during Phase III of the RI/FS collected from within the NBSA by Tierra between September 2014 and April 2016. Surface water data collected between August 2011 and June 2013 as part of the synoptic LPRSA RI/FS (as part of the small volume and high volume chemical water column monitoring effort) were also included in this evaluation.

Data used to identify COPCs for the BHHRA included surface sediment (defined as the top 0-6 inches) easily accessible to human receptors recreating within the bay[2], surface water (down to 3 feet below surface), and biological tissue data from fish and blue crabs (muscle and hepatopancreas). Biological tissue data for the BHHRA evaluation included fillet tissue samples of American eel, bluefish, striped bass, summer flounder, and white perch. In addition, blue crab tissue samples, comprised of reconstructed muscle and hepatopancreas tissue samples, were evaluated in the BHHRA for the selection of COPCs. Surface water data included analytical chemistry data from both small volume and high volume chemical water column monitoring efforts. These surface water data, collected under a variety of flow conditions and tidal phases, aid in characterizing the variability in fluxes and mixing processes in the NBSA.

Sediment and tissue samples were collected and analyzed in accordance with agency-approved Sampling and Analysis Plans (SAPs) and QAPPs (Tierra, 2014b, 2014c, 2015b). All analytical chemistry data have undergone independent full data validation in accordance with the QAPPs. Appropriate quality assurance/quality control (QA/QC) procedures were conducted on these datasets by a third-party reviewer. The use of qualified data followed guidelines presented in USEPA guidance (USEPA, 1989; 1992a; 1992b), and all analytical data that qualified as useable for the risk assessment were used in the COPC selection process. Estimated data (*e.g.*, J-qualified and EMPC-qualified [estimated maximum possible concentration]) were included in the dataset used for COPC selection; data rejected during data validation (R-qualified) were not included. Other data standardization and summary procedures are as follows:

<u>Treatment of Duplicates</u>: For the purposes of the preliminary screening, duplicate samples were treated as follows: 1) where a chemical was not detected in either the sample or the duplicate, the higher of the reporting limits for these data was used, 2) where a chemical was detected in both the sample and the duplicate, the higher of the detected results was used, and 3) where a chemical was reported in one of the samples as not detected and the other was detected, the detected concentration was used.

<u>Treatment of Non-detects</u>: If the chemical was not detected in any of the medium-specific samples, that chemical was not evaluated in the screening assessment. If a chemical was detected in at least one medium-specific sample, that chemical was evaluated in the screening assessment.

<u>Treatment of Dioxins/Furans (D/F)</u>: The toxic equivalence (TEQ) has been calculated for each sample for the group of PCDDs/PCDFs, which are structurally and toxicologically related to 2,3,7,8-TCDD in accordance with the USEPA (2010). The toxic equivalency factors (TEFs) used to calculate TEQs for the PCDDs/PCDFs congeners were the World Health Organization (WHO) consensus values from the WHO 2005 (Van den Berg et al., 2006) mammalian TEFs, which were adopted by USEPA (2010). The TEFs were used to calculate a toxicity weighted concentration for each of the PCDD/PCDF congeners. For

[2] Sediment samples include NB03SED-CHM136, NB03SED-CHM140, NB03SED-CHM142, NB03SED-CHM143, NB03SED-CHM145, NB03SED-CHM149, NB03SED-CHM155, NB03SED-CHM160, NB03SED-CHM161, NB03SED-CHM164, NB03SED-CHM166, NB03SED-CHM167, NB03SED-CHM168, NB03SED-DUP-01, NB03SED-CHM169, NB03SED-CHM170, NB03SED-CHM171, NB03SED-CHM172, NB03SED-CHM173, NB03SED-CHM174, NB03SED-CHM175, NB03SED-CHM176, NB03SED-CHM177, and NB03SED-CHM178

each sample, the TCDD-TEQ (D/F) total was calculated by summing the toxicity weighted concentration for each detected congener. Non-detected congeners were treated at the reporting limit.

Treatment of Dioxin-like PCBs: TCDD-TEQ (PCB) values were calculated for the dioxin-like PCBs using the WHO consensus values for fish and birds from Van den Berg *et al*. (1998) and mammalian TEFs from Van den Berg *et al*. (2006) for the 12 coplanar PCBs (USEPA, 2010). The same method used to treat non-detect congeners in the calculation of TCDD-TEQ (D/F) concentrations was also used for calculating the TCDD-TEQ (PCB) values. In addition, consistent with the recommendations in the 1996 USEPA document *PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures* (USEPA, 1996), the dioxin-like and non-dioxin like PCBs will be evaluated for potential enhancement of PCB cancer toxicity in the BHHRA.

Treatment of Total PCBs: Total PCBs have been calculated for each sample by summing the individual PCB congener results. For congeners flagged as non-detect in a sample, the reporting limit was used as the concentration for summing the congeners. If none of the individual PCB congeners were detected, the total concentration was flagged as non-detected with a reporting limit equal to the maximum reporting limit of the individual PCB congener. For purposes of screening performed for this PAR, all dioxin and non-dioxin like PCB congeners were included in the Total PCB sum and labeled as "TPCB209" in the screening tables. Some of the non-dioxin like PCB congeners were identified as co-eluting congeners. The reporting value assigned to the group of co-eluting congeners was included in the sum of the Total PCB value.

Treatment of PAHs: Relative potency factors (RPFs) were applied for PAHs; the individual PAH was evaluated based on the RPF calculated value (Schoeny and Poirier, 1993).

5.0 BASELINE HUMAN HEALTH RISK ASSESSMENT APPROACH

This section describes the methodology and results of the human health pathways assessment based on potential exposure of human receptors to COPCs. The report includes a description of the initial chemical screen to identify COPCs in sediment, surface water, and biota tissue (Section 5.1); an exposure assessment for development of the preliminary CSM (Section 3.0); and summary of exposure factors to support the BHHRA (Section 5.2). This section presents the information necessary to provide a hazard identification/dose response and exposure assessment, the first three elements that comprise all human health risk assessments in accordance with USEPA guidance, policy and guidelines. These elements answer the basic questions:

- Hazard Identification/Dose-Response: Which contaminants at the site could potentially pose a risk to human health under current and future site conditions in the absence of remedial action and ICs?
- Exposure Assessment: Who is exposed to what contaminants, how and where are they exposed, and how much are they exposed to?

This report is intended to be a scoping document and the other elements of the BHHRA process, including an assessment of data usability, refinements of CSMs and identification of exposure pathways, toxicity assessment, and risk characterization will be developed in the final BHHRA. The BHHRA will be conducted in accordance with USEPA risk assessment guidance, guidelines, and policies (USEPA, 1986, 1989; 1991a,b,c; 2001a; 2003; 2004b; 2005a,b; 2009a; 2011; 2014a).

5.1 Preliminary Identification of Contaminants of Potential Concern

A subset of chemicals detected in sediment, biota tissue (*i.e.,* fish and crabs), and surface water were identified as COPCs for quantitative evaluation in the BHHRA. COPCs were identified through a screening process intended to identify chemicals that pose negligible risks (e.g., risk of 10^{-6} or one in a million and a hazard quotient [HQ] = 0.1 based on residential exposure assumptions) which can be eliminated from further evaluation, and chemicals that merit further evaluation, either quantitatively or qualitatively, based on their potential to adversely affect humans depending on specific route of exposures.

Summaries of the screening process for sediment, biota tissue, and surface water samples are provided in Figures 5-1, 5-2, and 5-3, respectively. Each of the key steps is outlined below. Maximum concentrations were used for screening purposes. RAGS Tables 2.1 through 2.4 in Attachment A provide the screening of COPCs for sediment, biota tissue, and surface water.

<u>Identification of Compounds Known to be Carcinogenic to Humans</u>

As an initial step, compounds available in the database known to be carcinogenic to humans were considered COPCs if detected in the data. Chemicals within this category include benzene, arsenic, trichloroethene, and chromium VI.

<u>Frequency of Detection</u>

In the next step in the identification of COPCs, the frequency of detection of each chemical was evaluated. Chemicals detected in less than five percent of the samples were eliminated from further consideration unless identified as a known human carcinogen. In addition, those chemicals that were not detected, but had maximum detection limits above the screening value were identified as COPCs. Including these non-detects as COPCs addressed the uncertainty when using historical analytical data having detection limits considerably higher than current analytical methods. As part of the data screening, chemicals detected in less than five percent of the samples will be further examined to consider the total number of samples, the magnitude of the concentration, and spatial relationship (*i.e*., relative distance and direction) to potential "hot spot" areas. Identification of potential "hot spot" areas will be identified prior to the BHHRA and further data evaluation will be conducted in the BHHRA.

<u>Essential Nutrients</u>

Inorganic constituents considered to be "essential nutrients," which are not likely to be toxic at anticipated environmental levels, were excluded from consideration as COPCs. These included calcium, potassium, sodium, and magnesium.

<u>Risk-Based Screening Values</u>

The maximum concentrations of all constituents that were detected in greater than five percent of the samples, and known to be human carcinogens regardless of screening level, and not considered essential nutrients, were screened against residential risk-based soil screening values obtained from the November 2017 Regional Screening Level (RSL) tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) or later updates to these tables, to represent exposures to sediment, tissue based on consumption of fish or crabs, and tap water to represent surface water screening values. Constituents with maximum concentrations exceeding the risk-based screening values at risk levels of 1×10^{-6} or a HQ = 0.1 were identified as COPCs, while constituents with concentrations below the risk-based screening values were excluded from further analysis. Over time, risk-based screening values may change as a result of updates to toxicity and/or updates in exposure assumptions; therefore, rescreening of the constituents may be necessary to address updates while the BHHRA is in progress.

Where no screening value was available, an appropriate surrogate chemical was identified based on structural or toxicological similarities and consultation with USEPA's Superfund Technical Support Center (STSC). Chemicals for which surrogate values have been identified are presented in Table 5-1. The surrogates have been approved by USEPA STSC (USEPA, 2015a,b,c). Where no appropriate surrogate chemical was identified, that chemical was retained as a COPC and will be qualitatively presented in the uncertainty section of the BHHRA. In addition, background and ambient conditions were not considered during the screening process. Because of the conservative nature of the COPC selection process, the COPCs identified during the screening process may include constituents that are not site related or those that are typical of background conditions. Further analysis of these chemicals will be included in the FS. It is anticipated that COPCs may be updated as part of the BHHRA and the list of COPCs may change as a result of this analysis (*e.g*., updates in toxicity or exposure assumptions used in the RSL tables).

For sediment samples (Figure 5-1), the risk-based screening values are based on the USEPA RSLs for residential soils (USEPA, 2017a). The RSLs were developed using default exposure assumptions for an integrated child/adult receptor based on exposure through ingestion, dermal contact, and/or inhalation of vapors and fugitive dust from soil for carcinogens. Chemicals with only noncarcinogenic health effects are based on exposures to a young child (1 to 6 years). Because no screening values are available for sediment, the soil screening values are likely to overestimate exposures since it is anticipated that individuals will spend less time offshore in the intertidal areas of Newark Bay as compared to onshore recreational/residential areas. To account for potential cumulative effects from exposures to multiple chemicals, the risk-based screening values derived for noncarcinogenic effects were decreased by a factor of 10 (*i.e.*, HQ = 0.1, not 1.0) for this assessment. Sediment screening values are provided in RAGS Part D (USEPA, 2001a) Table 2.1 in Attachment A.

For surface water samples (Figure 5-2), RSLs for tap water were used as surrogate risk-based criteria to identify COPCs in river surface water. These values were derived for the protection of human health based on ingestion and inhalation of contaminants in water at a residential location and may overestimate exposures to surface water based on frequency of exposure and recreational activities. Surface water screening values are provided in RAGS Part D (USEPA, 2001a) Table 2.2 in Attachment A.

For fish and crab tissue samples (Figure 5-3), the USEPA RSL calculator (USEPA, 2017a) was used to calculate one set of risk-based screening levels for consumption of biota. For a conservative screening evaluation, RSLs were derived based on an adult exposure, assuming an ingestion rate (IR) of 54 grams/day and an IR of 18 grams/day for a young child for the noncancer screening assessment. The IR for the adult was based on the 1991 Standard Default Exposure Assumptions (USEPA, 1991b) and the IR for the child was modified based on bodyweight. To account for potential cumulative effects, the RSLs for noncarcinogenic effects were decreased by a factor of 10 for this assessment (e.g., HQ = 0.1). Fish and crab tissue screening values are provided in RAGS Part D (USEPA, 2001a) Tables 2.3 and 2.4, respectively, in Attachment A.

In the absence of speciated data, it is assumed that all chromium data are in the +6 valence state and this is further discussed in the uncertainty section of the BHHRA.

Groups of compounds (*e.g.*, total petroleum hydrocarbons [TPH], benzene, toluene, ethylbenzene and total xylenes [BTEX]) are not provided on the screening tables. None of these compound groups have screening values, however the individual constituents (*i.e.*, benzene, toluene, xylenes) do have screening values and COPC determination was based on the individual constituents if these data were available.

<u>Lead</u>

Screening values for lead are estimated using blood-lead modeling. The Office of Land and Emergency Management (OLEM) (formerly known as the Office of Solid Waste and Emergency Response) recommends the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) as a risk assessment tool to support environmental cleanup decisions at residential sites. The current residential USEPA RSL for lead in soil is 400 mg/kg (USEPA, 2017a) based on the regulatory target of at least 95% of young children in a population potentially exposed to lead having blood lead levels below 10 µg/dL. However, the most recent OLEM Directive (OLEM Directive 9285.6-56 available at: https://semspub.epa.gov/work/HQ/196766.pdf) recommends using lower blood levels lower than the 10 µg/dL (e.g., 4 to 8 µg/dL) which lowers the residential soil RSL to a concentration of 200 mg/kg. Therefore, the screening value used for lead in sediment was 200 mg/kg.

The USEPA RSL table recommends the use of the USEPA National Primary Drinking Water Regulations Action Level of Lead in Drinking Water to evaluate Lead and Compounds (USEPA, 2016b; 2009b) and this value was used in the screening assessment for surface water.

Due to the lack of a fish or crab tissue RSL for lead, the U.S. Food and Drug Administration's (FDA's) action level of 1.5 mg/kg for lead in crustacea was used (FDA, 2007) in the screening assessment for both fish tissue and crab tissue.

5.1.1 Preliminary COPC Selection

5.1.1.1 Sediment

The results of the sediment screen to identify COPCs for the BHHRA are provided in RAGS Part D (USEPA, 2001a) Table 2.1 in Attachment A. COPCs were identified for five classes of chemical constituents in sediments: inorganic constituents, PAHs, pesticides, PCBs, and dioxins/furans. The COPCs identified for each of the individual chemical classes are described below and detailed in RAGS Part D Table 2.1 in Attachment A.

Inorganic Constituents

A total of 23 inorganic constituents were detected in sediment. Thirteen of these 23 constituents were selected as COPCs because the maximum concentrations detected were above the screening level. The remaining 10 of the 23 constituents were not selected as COPCs because the maximum concentration detected was not greater than the screening level and not classified as known human carcinogens.

Volatile Organic Compounds (VOCs)

No VOCs were detected in sediment samples collected from the NBSA.

Semivolatile Organic Compounds (SVOCs)

Fourteen SVOCs were detected in surface sediment samples. None of the maximum concentrations exceeded screening values.

Polycyclic Aromatic Hydrocarbons (PAHs)

Thirty-eight PAHs were detected in sediment samples. Of the 38 PAHs detected, the maximum concentration of benzo(a)pyrene was the only concentration that exceeded the screening level. To be conservative, however, all seven carcinogenic PAHs were selected as COPCs. Maximum concentrations of the other 31 PAHs detected are less than their screening levels.

Polychlorinated Biphenyls (PCBs)

Surface sediment samples were analyzed for all 209 PCB congeners. Screening of PCBs consisted of evaluating Total PCBs (*i.e.*, sum of 209 congeners) as well as TCDD-TEQ (PCB) (*i.e.*, sum of 12 coplanar PCBs adjusted for TEFs and summed to develop a TEQ).

Maximum concentrations of Total PCBs and TCDD-TEQ (PCB) exceed their screening levels and, therefore, both Total PCBs and TCDD-TEQ (PCB) were selected as COPCs.

Pesticides/Herbicides

Twenty-four pesticides/herbicides were detected in sediment samples. None of the maximum concentrations detected exceeded screening levels.

Dioxins/Furans

As explained in Section 4, TCDD-TEQ (D/F) was calculated for each sediment sample for the group of PCDDs/PCDFs. The maximum concentration of TCDD-TEQ (D/F) detected exceeds the screening level based on TEFs and therefore TCDD-TEQ (D/F) was selected as a COPC.

5.1.1.2 Surface Water

The results of the surface water screen for the human health risk assessment are provided in RAGS Part D Table 2.2 in Attachment A. COPCs were selected from several classes of chemical constituents: inorganic constituents, VOCs, PCBs, PAHs, dioxins/furans, and pesticides. The COPCs identified for each of the individual chemical classes are described below and detailed in RAGS Part D Table 2.2 in Attachment A.

Inorganic Constituents

Twenty-two inorganic constituents were detected in surface water samples. Maximum concentrations of eight of these constituents were above the screening level and were identified as COPCs. Cyanide was detected in less than five percent of samples; however, analytical detection limits for cyanide exceeded the screening level so cyanide also was identified as a COPC. Maximum concentrations for the remaining constituents were below screening levels and therefore were not selected as COPCs.

Volatile Organic Compounds (VOCs)

Ten VOCs were detected in surface water samples. Trichloroethene was the only constituent to exceed the screening level. Maximum concentrations of the other nine VOCs were less than the screening level.

Semivolatile Organic Compounds (SVOCs)

Twenty-one SVOCs were detected in surface water samples. All concentrations were below screening levels.

Polycyclic Aromatic Hydrocarbons (PAHs)

Thirty-eight PAHs were detected in surface water samples. Only the seven carcinogenic PAHs were selected as COPCs. Five of the carcinogenic PAHs exceeded the screening level, while the other two were included because they are carcinogenic PAHs. Maximum concentrations of the other 31 PAH constituents were below screening levels.

Polychlorinated Biphenyls (PCBs)

Surface water samples were analyzed for 209 PCB congeners. Screening of PCBs consisted of evaluating Total PCBs (*i.e*., sum of 209 congeners) as well as TCDD-TEQ (PCB) (*i.e*., sum of 12 coplanar PCBs). Maximum concentration of the Total PCBs was below the screening level, while the maximum concentration of TCDD-TEQ (PCB) exceeded the screening level.

Pesticides/Herbicides

Twenty-six pesticides/herbicides were detected in surface water samples. All concentrations were below screening levels.

Dioxins/Furans

TCDD-TEQ (D/F) was calculated for the surface water samples. The maximum concentration of TCDD-TEQ (D/F) detected exceeds the screening level and, therefore, TCDD-TEQ (D/F) was selected as a COPC.

5.1.1.3 Fish Tissue

The results of the fish tissue screen (all fish species combined) for the human health risk assessment are presented in RAGS Part D Table 2.3 in Attachment A. COPCs were identified for four classes of chemical constituents: inorganic constituents, pesticides/herbicides, PCBs, and dioxins/furans. VOCs were not measured in tissue because they do not bioaccumulate and are not lipophillic in nature. The COPCs identified for each of the individual chemical classes are described below and detailed in RAGS Part D Table 2.3 in Attachment A.

Inorganic Constituents

Seventeen inorganic constituents were detected in fish tissue samples from the NBSA. Seven of these inorganic constituents were selected as COPCs because maximum concentrations exceed the screening level. Titanium was selected as a COPC because it did not have a screening value. Arsenic was selected based on classification as a known human carcinogen and exceedance of the screening level. Of the eight not selected as COPCs, seven constituents are below screening levels and one constituent has a frequency of detection less than five percent.

The maximum concentration of lead in fish tissue (4.8 mg/kg) exceeded the FDA limit of 1.5 mg/kg and therefore lead was selected as a COPC. However, a concentration of 4.8 mg/kg is unusually high for fish tissue and is much higher than the other fish tissue concentrations which ranged from 0.018 mg/kg to 0.103 mg/kg. This elevated lead concentration may be an outlier and further evaluation of the data will be performed as part of the BHHRA.

Semivolatile Organic Compounds (SVOCs)

Five SVOCs were detected in fish tissue samples. None of the maximum concentrations were above screening levels.

Polycyclic Aromatic Hydrocarbons (PAHs)

Sixteen PAHs were detected in tissue samples. None of the maximum concentrations were above screening levels.

Polychlorinated Biphenyls (PCBs)

Tissue samples were analyzed for all 209 PCB congeners. Screening of PCBs consisted of evaluating Total PCBs (*i.e*., sum of 209 congeners) as well as TCDD-TEQ (PCB) (*i.e*., sum of 12 coplanar PCBs).

Maximum concentrations of Total PCBs and TCDD-TEQ (PCB) exceeded their screening levels and, therefore, both Total PCBs and TCDD-TEQ (PCB) were selected as COPCs.

Pesticides/Herbicides

Twenty-eight pesticides/herbicides were detected in fish tissue samples. Of these, 16 pesticides were identified as COPCs because maximum concentrations exceed the screening level. Maximum concentrations of the other 12 constituents did not exceed their respective screening value.

Dioxins/Furans

TCDD-TEQ (D/F) was calculated for each tissue sample for the group of PCDDs/PCDFs. The maximum concentration of TCDD-TEQ (D/F) detected exceeds the screening level and therefore TCDD-TEQ (D/F) was selected as a COPC.

5.1.1.4 Crab Tissue

The results of the crab tissue screen for the human health risk assessment are provided in RAGS Part D Table 2.4 in Attachment A. COPCs were identified for six classes of chemical constituents: inorganic constituents, SVOCs, PAHs, pesticides/herbicides, PCBs, and dioxins/furans. VOCs were not measured in tissue because they do not bioaccumulate and are not lipophillic in nature. The COPCs identified for each of the individual chemical classes are described below and detailed in RAGS Part D Table 2.4 in Attachment A.

Inorganic Constituents

Eighteen inorganic constituents were detected in crab tissue samples from the NBSA. Twelve of these inorganic constituents were selected as COPCs because maximum concentrations exceeded the screening level and titanium was selected as a COPC because it does not have a screening value. Arsenic was selected as a COPC based on the cancer classification and the maximum concentration exceeded the screening level. Maximum concentrations of the five constituents not selected as COPCs are below screening levels.

Semivolatile Organic Compounds (SVOCs)

Ten SVOCs were detected in crab tissue samples. Three of these constituents were selected as COPCs because maximum concentrations exceeded the screening level. Of the remaining constituents detected, five of them did not exceed screening levels, while the other two constituents had frequencies of detection less than five percent.

Polycyclic Aromatic Hydrocarbons (PAHs)

Thirty-two PAHs were detected in crab tissue samples. Only the seven carcinogenic PAHs were selected as COPCs. Five of the carcinogenic PAHs exceeded the screening level, while the other two were included because they are carcinogenic PAHs. Maximum concentrations of the other 25 PAH constituents were below screening levels.

Polychlorinated Biphenyls (PCBs)

Crab tissue samples were analyzed for all 209 PCB congeners. Screening of PCBs consisted of evaluating Total PCBs (*i.e.*, sum of 209 congeners) as well as TCDD-TEQ (PCB) (*i.e.*, sum of 12 coplanar PCBs).

Maximum concentrations of Total PCBs and TCDD-TEQ (PCB) exceeded their screening levels and, therefore, both Total PCBs and TCDD-TEQ (PCB) were selected as COPCs.

Pesticides/Herbicides

Twenty-six pesticides/herbicides were detected in crab tissue samples. Of these, nine pesticides were identified as COPCs because maximum concentrations exceed the screening level. Maximum concentrations of the other 17 constituents did not exceed their respective screening value.

Dioxins/Furans

TCDD-TEQ (D/F) was calculated for each crab tissue sample for the group of PCDDs/PCDFs. The maximum concentration of TCDD-TEQ (D/F) detected exceeded the screening level and therefore TCDD-TEQ (D/F) was selected as a COPC.

5.2 Exposure Assessment

The objective of the exposure assessment is to estimate the magnitude, frequency, duration, and routes of current and reasonably anticipated future human exposure to COPCs associated with the NBSA. The exposure assessment is based on the receptor scenarios that define the conditions of exposure to site-related COPCs. The exposure assessment will include both a reasonable maximum exposure (RME) and for exposure routes greater than 10^{-4} (one in ten thousand) or a hazard index (HI) = 1, a central tendency exposure (CTE) calculation to describe the magnitude of exposure incurred by the receptor groups. USEPA (1989) defines the RME as the highest exposure that is reasonably expected to occur at a site. Per USEPA guidance (1989), central-tendency estimates are intended to reflect central estimates of exposure or dose. The objective of providing both the RME and CTE exposure cases is so that the resulting range of exposures provides some measure of uncertainty surrounding these estimates. However, remedial decisions are based on the RME individual as outlined in the NCP (USEPA, 1990).

5.2.1 Exposure Pathways and Populations

An exposure pathway defines the most reasonable means in which a receptor may come into contact with the contaminated media. For an exposure pathway to be complete, the following four elements must be present:

- A source and mechanism of chemical release;
- A retention or transport medium;
- A point of contact between the human receptor and the medium; and,
- A route of exposure for the potential human receptor at the contact point.

There must be a complete exposure pathway from the source of chemicals in the environment (*i.e.*, from sediment or biota tissue) to human receptors for chemical intake to occur. If all exposure pathways, under current and future exposures, are incomplete for human receptors, no chemical intake occurs, and no human health effects are associated with site-related COPCs.

The NBSA is one of the most urbanized and industrialized areas in the US. Land use surrounding the estuary is comprised of typical urban activities including residential, commercial, and industrial areas (Figure 2-2). The Port of Newark serves as an important transportation link for the transfer of goods from cargo vessels to railroad and truck lines (Tierra, 2004). Newark Bay, therefore, is used primarily as a commercial waterway for heavy marine traffic such as ships and barges. A developed network of CSOs, stormwater outfalls, and POTWs exists throughout the study area. Local residents use the waterway for recreational activities, including boating, fishing, crabbing, and birdwatching (May and Burger, 1996).

Based on the above information and ongoing initiatives to restore Newark Bay, it was assumed that exposure to contaminants in the Bay would be associated with current and future recreational activities such as fishing, crabbing, and boating. Individuals of varying ages identified as engaging in these activities include the angler, swimmer, wader, and boater. In addition, the NBSA is populated by many transient or homeless people, as well as recent immigrants, who rely on subsistence fishing, which includes fish and crabs (Martin, 2005). Although there is limited information regarding the length of their occupancy and their specific activities while in the Bay, their exposure will be evaluated qualitatively as part of the uncertainty assessment. The receptors and exposure scenarios associated with future use are not expected to differ significantly from those being evaluated under the current use scenarios. Consumption of fish and crabs is anticipated to be the primary exposure pathway based on the bioaccumulative COPCs (*e.g*., PCBs, TCDD, and mercury from previous evaluations of risks from fish consumption in the Lower 8.3 miles of the Passaic River, the 17 Mile Study, and other evaluations of river systems). A summary of each of these receptors and the associated exposure pathways is provided below and summarized in RAGS Part D Table 1 in Attachment A.

<u>Angler/Crabber</u>. The angler is defined as adult or adolescent individuals that catch and consume a variety of fish (*i.e*., American eel, bluefish, striped bass, summer flounder and white perch), and other local species (*i.e*., blue crab) from the banks of the NBSA for recreational purposes (*i.e*., not for subsistence fishing). It is assumed that the adult or adolescent angler will provide fish/shellfish to young child receptors (1 to <7 years) in the household and that the young child will rarely accompany the family member who is fishing. The collection and consumption of fish and shellfish from the NBSA have been well documented (Burger *et al*., 1999; Burger, 2002; Pflugh and Kerry 2002; and Pflugh *et al*., 1999). Therefore, it is clear this exposure pathway is complete for the angler and the transient individual. In addition, it is possible that individuals might also catch and consume other species such as waterfowl, turtles, or frogs from the Bay. Consumption of other species will be assessed qualitatively in the uncertainty assessment of the BHHRA.

Other potential exposure pathways relevant to the adult and adolescent angler receptor include direct exposures (*i.e*., dermal contact and incidental ingestion) to sediments and surface water contacted while fishing/crabbing. Inhalation exposures may also occur if activities occur in intertidal areas, or if VOCs are present in sediments or surface waters.

The assessment will calculate risks/hazards from fishing and crabbing separately. The pathways will include consumption of fish/crabs combined with direct exposures through dermal contact and incidental ingestion of sediments and surface water.

<u>Swimmer.</u> It is assumed that recreational users of the NSBA may occasionally engage in swimming. Recreational swimmers include children (1 to < 7 years), adolescents (7 to <19 years), and adults (>19 years). Given the visible deterrents to swimming along large sections of the water body, including the presence of trash and debris, pathogenic contamination, and the generally urban setting of the NSBA, the exposure frequency (EF) and exposure duration (ED) for swimming is assumed to be relatively low, both currently and in the future. The number of exposed individuals may increase if improvements to the shoreline and the Bay are made, but the EF and ED for some individuals who already engage in this scenario are not likely to increase. It is assumed that the current/future swimmer may be exposed to COPCs in sediment and surface water while swimming via:

- Direct contact (*i.e*., incidental ingestion and dermal contact) with accessible nearshore and mudflat surface sediment, and
- Direct contact (*i.e*., incidental ingestion and dermal contact) with NSBA surface water.

The assessment will evaluate combined risks/hazards from direct contact with nearshore and mudflat surface sediment and NBSA surface water.

Wader: It is assumed that recreational users of the NSBA may wade along the water's edge. Waders include children (1 to < 7 years), adolescents (7 to <19 years), and adults (>19 years). Wading is defined as walking around the intertidal areas and along shallower parts of the Bay; thus, exposure is primarily to sediment, but may include exposure to surface water as well. It is also assumed that the current/future wader may be exposed to COPCs in sediment and surface water while wading in the NSBA via:

- Direct contact (incidental ingestion and dermal contact) with accessible nearshore and mudflat surface sediment, and
- Direct contact (incidental ingestion and dermal contact) with NBSA surface water.

As with swimming exposures, the likelihood and frequency of wading exposures are expected to differ depending on the location in the NBSA and age of the receptor.

The assessment will evaluate combined risks/hazards from direct contact with accessible nearshore and mudflat surface sediment and NBSA surface water.

Boater: A variety of boating activities occur on the NBSA, including commercial boat and marine traffic, pleasure boating, sculling/crew, kayaking, and canoeing as described below. Boaters include older children (7 to <14 years), teens (14 to <19 years), and adults (> 18 years). Although children 7 to <14 years old are too young for team rowing, children within this age group may participate in recreational boating activities such as canoeing or kayaking. Young children (1 to < 7 years) are not expected to participate in boating activities on the Bay; any such exposure would be rare and much less than that experienced by young children visiting the bay to wade or swim along the shoreline. Therefore, a young child boater scenario is not evaluated. It is assumed that the boater's potential for exposure to Bay sediment and surface water is greatest while boating in small crafts such as sculls, kayaks, or canoes.

Pleasure (motor) boating is limited, primarily due to huge cargo ships that offload and onload on the western side of the Bay at the terminals. Canoeing and kayaking are occasionally observed. The canoe and kayak season typically runs from March to November (AECOM, 2017). The recently opened Newark Riverfront Park located on Raymond Boulevard includes a dock intended for boarding boats, such as canoes and kayaks.

Exposure to sediment or surface water while boating is likely to be limited to occasional contact when entering or leaving the boat, such as a canoe or kayak, or during a fall into the water. Scullers and paddlers can also get wet from the splashing of oars, rough water, and wakes. It is assumed that the current/future boater may be exposed to COPCs in sediment and surface water while boating via:

- Direst contact (incidental ingestion and dermal contact) with accessible nearshore and mudflat and surface sediment.
- Direct contact (incidental ingestion and dermal contact) with NBSA surface water.

Potential exposure pathways identified include direct contact (ingestion and dermal contact) with sediment and surface water. Inhalation exposures to VOCs may also occur if activities occur in intertidal areas or near sediments.

The assessment will evaluate combined risks/hazards from direct contact with accessible nearshore and mudflat surface sediment and NBSA surface water.

Worker: Workers (the outdoor worker) at properties adjacent to the NBSA may perform outdoor activities such as trash collection and grounds maintenance along the shoreline. It is assumed that the worker receptor is more than 18 years of age and may be exposed to COPCs via:

- Direct contact (incidental ingestion and dermal contact) with nearshore and mudflat surface sediment.

Workers are not expected to have contact with surface water during outdoor activities. Inhalation exposures to VOCs may also occur if activities occur in intertidal areas or near sediments.

The assessment will evaluate combined risks/hazards from direct contact with nearshore and mudflat surface sediment.

Transient: Anecdotal observations have been made that transient or homeless individuals live in temporary makeshift shelters along the banks of the NBSA (Proctor *et al.*, 2002; Tierra, 2015c). Transient people may be exposed to NBSA sediment and surface water, as well as outfall effluent and sediment (*i.e.*, from ongoing CSOs, SWOs, and other permitted outfall discharges) via incidental ingestion and dermal contact. Transient individuals may also ingest fish or crab. Evaluating risks and hazards to a transient population quantitatively is difficult because of the high uncertainty associated with these exposures. There is a lack of specific information on the exposure patterns for this population, and it is difficult to collect exposure information. Transient receptors are addressed qualitatively in the uncertainty section of the BHHRA. Transient exposures could be less frequent or more frequent than the angler/sportsman, depending on the extent of their exposure (including sediment) along the shoreline and further discussed in the BHHRA.

Residential: Residential properties are present in the NSBA and adjacent to the shoreline (Tierra, 2015c). Residents may come in contact with NBSA sediment and surface water adjacent to their property, as well as sediment that may have deposited in yards during flooding events. Residents may also be exposed via inhalation to chemicals that may volatilize from exposed sediment and surface water into ambient air. The resident receptor will be evaluated qualitatively in the uncertainty section of the BHHRA. Potential exposure of residents to accessible sediments along the shoreline in the vicinity of existing or planned residential developments located along the Bay could be more extensive than those quantified under the other exposure scenarios (i.e., wader, boater).

RAGS Part D Table 1 in Attachment A summarizes the exposure pathways selected for quantitative and qualitative evaluation for the NBSA BHRRA.

5.2.2 Determination of Exposure Point Concentrations

Estimates of chemical concentrations at points of potential human exposure are necessary for evaluating chemical intakes by potentially exposed individuals. The concentrations of COPCs in the exposure medium at the exposure point are termed "exposure point concentrations" (EPCs). USEPA recommends using the average concentration to represent "a reasonable estimate of the concentration likely to be contacted over time" (USEPA, 1989; 1992b) and "because of the uncertainty associated with estimating the true average concentration at a site" recommends that the 95 percent upper confidence limit (UCL) on the mean be used.

Calculation of the EPC for the COPCs identified from the screening (Section 5.1.1) was conducted following guidance provided by USEPA (2002a), using distribution shift tests to determine the underlying population distribution. Specifically, the current version of the ProUCL software package developed by USEPA will be used to determine the underlying distributions and to determine the most applicable EPC based on the characteristics of the data. Depending on the statistical distributions identified by the software application, the most appropriate measure of central tendency will be selected as the EPC. In addition, USEPA's online Advanced Kaplan Meier (KM) TEQ Calculator, Version 9.1, issued July 31, 2014 (USEPA, 2014b) was used to calculate sample-specific concentrations of TCDD-TEQ (D/F) and TCDD-TEQ (PCB). Summaries of the calculated EPCs for the identified COPCs are provided in RAGS Part D Tables 3.1 through 3.4 in Attachment A.

Prior to using any analytical data, the data must undergo a thorough evaluation. Review of the data follows guidance from USEPA including RAGS Human Health Evaluation Manual Part A, Chapters 4 and 5 (USEPA, 1989), Data Quality Objectives Process for Hazardous Waste Site Investigations (USEPA, 2000a), and Guidance for Data Usability in Risk Assessment (USEPA, 1992a). The data evaluation involves an examination of the analytical data (historical and existing) to determine its usefulness for evaluation in the risk assessment. The data quality objectives (DQOs) for the project and the performance criteria necessary to meet these DQOs will be used to guide the data evaluation. The overall QC objective during data evaluation is to generate data that are of known, documented, and defensible quality. The data will be reviewed for precision, accuracy, and completeness. Precision quantifies the repeatability of a given measurement. Accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. Completeness refers to the percentage of valid data received from actual testing performed in the laboratory.

All project data will be reviewed to determine if the qualitative parameters of representativeness and comparability have been achieved. Specific data quality parameters that will be examined include analytical methods and quantitation limits, laboratory qualifiers and codes, and presence of blank contamination.

Chemicals that are not measured in any samples above the detection limit will be assumed to not be present and are eliminated from further evaluation unless other supporting information exists to indicate otherwise. Other supporting information that will be examined include the magnitude of the detection limit, the presence of the chemical in other environmental media, the presence of related degradative compounds, and whether the chemical is expected to be present based on historical uses on and around the site and/or fate and transport of related compounds.

For completion of the BHHRA, the EPCs used in the RME and CTE evaluations will be the same. The RME and CTE exposures will differ with regard to the receptor-specific exposure variables. For any additional COPCs identified in the BHHRA, the methodology described above will be used to calculate EPCs and results summarized in RAGS Part D tables provided as part of the BHHRA.

An EPC will be derived for both fish and crab exposures. A mixed fish diet comprised of equal fractions (20%) of the fish species (i.e., American eel, bluefish, striped bass, summer flounder, and white perch) will be evaluated. The mixed fish diet EPCs will be calculated using a single set of COPCs across all five species, such that any chemical identified as a COPC in one of the five species will be included as a COPC for all species comprising the mixed fish diet. The five species included in the mixed fish diet will provide a mix of fish that may be targeted by NBSA anglers. The five species also represent different habitats, home ranges, and feeding guilds, including bottom feeders (e.g., catfish, carp, eel) and predators (e.g., bass), and, therefore, reflect different exposures and contaminant uptake. While there is uncertainty in the species preferences of anglers who fish in the LPRSA, the assumption that each species comprises an equal percentage of the total diet reflects the available data on relative abundance and angler preferences. The impact of alternative fractions will be presented in the uncertainty evaluation. The EPCs for crab will be based on the concentrations in the composite samples of edible crab tissue (*i.e.*, muscle and hepatopancreas combined). The risk/hazard associated with consumption of a crab diet consisting of muscle-only tissue will be evaluated for informational purposes in the uncertainty evaluation.

Current exposures will be based on measured data to the extent possible; however, modeling is required to predict contaminant concentrations at the point of exposure when measured concentrations are not available (*i.e*., ambient air concentrations), as well as to predict contaminant concentrations for future exposure scenarios. Estimation of future EPCs for sediment, surface water, and fish tissue will be based on modeling. A fate and transport model will be used to estimate future exposure conditions. The model will include hydrodynamic, sediment transport, sediment transport-organic carbon production, contaminant fate and transport, and bioaccumulation components and will be calibrated (in part) using the analytical data collected to support the risk assessment of current conditions. Details regarding the models and parameter assumptions will be provided in the BHHRA. The EPCs for estimates of current exposure for the NBSA BHHRA will be based on the contaminant concentrations in the area of concern (*i.e*., Newark Bay), not their presence in and potential transport from adjacent areas (*e.g*., the Passaic River). However, modeling of future EPCs may need to consider contributions from the Passaic River and/or other contributing waters; therefore, detailed information regarding future EPC derivation is reserved for subsequent planning documents. It is expected that the contaminant transport models and bioaccumulation models that may be used to estimate future concentrations for evaluation in the risk assessment will be reviewed and approved by USEPA prior to completing the risk assessment under a future conditions scenario.

5.2.3 Estimation of Chemical Intake

Intake is estimated by combining EPCs with the variables that describe exposure:

- Rate of contact with the medium;
- Frequency of contact;
- Duration of contact; and
- Body weight of the exposed individual.

Intake of a chemical as a result of exposure will be estimated following USEPA (1989, 2001a) guidance, using standard default parameters (USEPA, 1991a,b; 2014a) and literature-derived values for conservative exposure conditions. An intake factor is the concentration of a chemical in a quantity of a medium (*e.g.*, fish tissue) taken into the body through an exposure route (*e.g.*, ingestion) and available for absorption. It is expressed in units of milligram (mg) of chemical per kilogram (kg) body weight per day (mg/kg bw-day).

Intake of a chemical that results in carcinogenic effects is calculated by averaging the dose over a lifetime (70 years x 365 days/year). The intake factor for carcinogenic effects is termed lifetime average daily dose (LADD). Following USEPA guidance USEPA (2005a), unless there is evidence to the contrary in a particular case, the cumulative dose received over a lifetime, expressed as average daily exposure prorated over a lifetime, is recommended as an appropriate measure of exposure to a carcinogen. Conversely, USEPA (2005a) also points out that for less than lifetime exposures, averaging over the duration of a lifestage or a critical exposure period may be more appropriate (*e.g*., chemicals identified as having a mutagenic mode of action). Thus, cumulative exposure or potential dose may be replaced by a more appropriate dose metric when data are available in accordance with USEPA (2005a). In addition, the potential for increased susceptibility to cancer from early-life exposure to chemicals identified with a mutagenic mode of action, relative to comparable exposure later in life, generally warrants explicit consideration for each assessment as indicated in USEPA (2005b). The mutagenic mode of action also will be taken into consideration for the BHHRA with the application of Age Dependent Adjustment Factors (ADAFs) for chemicals identified as having a mutagenic mode of action (e.g., PAHs, chromium VI, trichloroethene, and vinyl chloride).

Intake of constituents that produce noncarcinogenic effects is averaged over the period of exposure (ED x 365 days/year). The intake factor for EDs equal to or longer than seven years is termed the chronic average daily dose (ADD). The standardized equations for estimating a receptor's intake (both chronic and lifetime) are presented below. Receptor- and chemical-specific parameters are presented in Attachment A. Doses will be quantified for the receptors and corresponding exposure pathways as indicated in RAGS part D Table 1 in Attachment A. The equations used to calculate intake for each exposure scenario are as follows:

<u>Incidental Ingestion of Sediment:</u>

$$\text{Intake} = \frac{CS \times IR \times FI \times EF \times ED \times CF}{BW \times AT}$$ (Equation 5-1)

where:

Intake = intake (mg/kg-day)
CS = sediment concentration (mg/kg sediment)
IR = ingestion rate of sediment (mg sediment/day)
FI = fraction ingested from NBSA (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (year)
CF = unit conversion factor (kg sediment/10^6 mg sediment)
BW = body weight (kg)
AT = averaging time (days)

<u>Dermal Contact with Sediment:</u>

$$\text{Intake} = \frac{CS \times SA \times AF \times ABS \times FI \times EF \times ED \times CF}{BW \times AT}$$ (Equation 5-2)

where:

Intake = intake (mg/kg-day)
CS = sediment concentration (mg/kg sediment)
SA = exposed skin surface area (cm^2/day)
AF = sediment to skin adherence factor (mg sediment/cm^2)
EF = exposure frequency (days/year)
ED = exposure duration (year)
ABS = dermal absorption factor (chemical-specific) (unitless)
FI = fraction from source (unitless)
CF = unit conversion factor (kg sediment /10^6 mg sediment)
BW = body weight (kg)
AT = averaging time (days)

Incidental Ingestion of Surface Water:

$$\text{Intake} = \frac{CW \times IR \times FI \times EF \times ED}{BW \times AT} \qquad \text{(Equation 5-3)}$$

where:

Intake = intake (mg/kg-day)
CW = water concentration (mg/L)
IR = ingestion rate of water (L/hour)
EF = exposure frequency (days/year)
ED = exposure duration (year)
FI = fraction from source) (unitless)
BW = body weight (kg)
AT = averaging time (days)

Dermal Contact with Surface Water:

$$DAD = \frac{DA_{event} \times EV \times EF \times ED \times SA}{BW \times AT} \qquad \text{(Equation 5-4)}$$

where:

DAD = daily dermal absorbed dose (mg/kg-day)
DA_{event} = absorbed dose per event (mg/cm^2-event)
SA = surface area (cm^2)
EV = event frequency (events per day)
EF = exposure frequency (days per year)
ED = exposure duration (years)
BW = body weight (kilograms)
AT = averaging time (years)

The calculation of DA_{event} is as follows for organics (USEPA, 2004b).

If the exposure time (t_{event}), < t*, then:

$$DA_{event} = 2\,FA \text{ x } K_p \text{ x } C_w \text{ x } CF \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}} \qquad \text{(Equation 5-5)}$$

If the exposure time (t_{event}) > t*, then:

$$DAevent = FA \text{ x } K_p \text{ x } C_W \text{ x } CF \text{ x} \left[\frac{t_{event}}{1+B} + 2\,\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right] \qquad \text{(Equation 5-6)}$$

For inorganics or highly ionized organics:

$$DA_{event} = Kp \text{ x } Cw \text{ x } CF \text{ x } t_{event}$$

(Equation 5-7)

where:

DA_{event}	=	absorbed dose per event (mg/cm^2-event)
FA	=	fraction absorbed water (dimensionless)
K_p	=	permeability constant (centimeters per hour)
C_W	=	concentration in water (mg/L)
τ_{event}	=	lag time per event (hours per event)
t_{event}	=	exposure time (hours per event)
t*	=	time to steady state (hour) = $2.4t_{event}$
B	=	dimensionless ratio of the PC of a chemical through the stratum corneum relative to its permeability constant across the viable epidermis
CF	=	conversion factor (l liter per 1,000 cm^3)

Ingestion of Biota (fish and crab):

$$\text{Intake} = \frac{\text{Ct} \times \text{IR} \times (1 - \text{Loss}) \times \text{FI} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

(Equation 5-8)

where:

Intake = intake (mg/kg-day)
C_t = concentration in biota (mg/kg)
IR = ingestion rate (kg/day)
FI = fraction ingested from NBSA (unitless)
Loss = preparation/cooking loss (unitless)
EF = exposure frequency (days/year)
CF = conversion factor (kg/g)
ED = exposure duration (years)
AT = averaging time (days)
BW = body weight (kg)

Inhalation of Ambient Air:

$$EC = \frac{C_{air} \times ET \times EF \times ED}{AT}$$

(Equation 5-9)

where:

EC = exposure concentration ($\mu g/m^3$)
C_{air} = concentration of chemical in ambient air ($\mu g/m^3$)

EF = exposure frequency (days per year)
ED = exposure duration (years)
ET = exposure time (hours per day per 24 hours per day)
AT = averaging time (years)

5.2.4 Exposure Factors

The specific values for each proposed exposure parameter are presented in RAGS Part D tables (Tables 4-1 through 4-10) in Attachment A. These values estimate the dose to the RME and CTE for each unique exposure scenario and receptor. A description of each of the key exposure parameters and the rationale for their selection is provided below. The exposure parameters have been selected to be as consistent as possible with the exposure parameters used in the BHHRA for the LPRSA RI/FS (AECOM, 2017).

5.2.4.1 Fish and Crab Consumption Exposure Parameters

Exposure parameters specific to the assessment of fish and crab consumption, including IR, fraction ingested from contaminated source, and cooking loss, are described below.

5.2.4.2 Fish and Crab Ingestion Rates

The IRs for fish and crab have been annualized and are presented in grams consumed per day (g/day). The IR assumes the fish and crab are caught only from the NBSA. It is expected that ingestion of fish and crab from other sources would add to the amount an individual ingested annually.

Fish and crab IRs are the same as those developed for the LPRSA RI/FS. These rates were derived from a detailed evaluation of LPRSA-pertinent angler and creel surveys and related literature, which were documented in the USEPA Region 2 Technical Memorandum, *Fish and Crab Consumption Rates for the LPRSA Human Health Risk Assessment* (USEPA, 2012a). This analysis provided a weight-of-evidence approach for evaluating consumption for the RME and CTE individual. The USEPA-directed adult fish IRs for use in the NBSA BHHRA are as follows (USEPA, 2012a):

- RME adult angler = 34.6 g/day; this rate was calculated by averaging the high end (90th percentile) estimates from Burger (2002) (37.3 g/day) and Connelly *et al*. (1992) (31.9 g/day).
- CTE adult angler = 3.9 g/day; this rate is the average of the 50th percentile value of 3.7 g/day from Burger (2002) and the 50th percentile value of 4.0 g/day from Connelly *et al*. (1992).

The RME fish IR equates to approximately 56 fish meals per year assuming a half-pound (227 grams) meal size. The CTE fish IR equates to approximately six half-pound fish meals per year. IRs for the adolescent and child were based on the assumption that the intake for the adolescent will be approximately two-thirds that of the adult, and the intake for the child will be approximately one-third that of the adult (USEPA, 2011). These assumptions are based on ratios of adolescent-to-adult and child-to-adult fish IRs for total fish consumption provided in Table 10-1 of the Exposure Factors Handbook (USEPA, 2011) using data for a child aged 0 to 9 years, an adolescent aged 10 to 19 years, and an adult aged 20 to 70+ years (intake averaged over six adult age groups). Therefore, the USEPA-directed adolescent and young child fish IRs to be used in the NBSA BHHRA are as follows:

- RME young child angler = 11.5 g/day,
- RME adolescent angler = 23.1 g/day,
- CTE young child angler = 1.3 g/day, and
- CTE adolescent angler = 2.6 g/day.

The following adult crab IRs are directed by USEPA Region 2 for use in the BHHRA (USEPA, 2012a):

- RME adult crabber = 21 g/day; this rate is the 90th percentile crab IR; and
- CTE adult crabber = 3 g/day; this rate is the 50th percentile crab IR.

The RME crab consumption rate equates to approximately 28 to 43 crab meals per year assuming four to six crabs per meal and 45 grams of edible muscle and hepatopancreas tissue per crab. The CTE crab consumption rate equates to approximately four to six crab meals per year. As was assumed for fish, crab IRs for the child and adolescent receptors were estimated assuming rates that are one-third and two-thirds of the adult IRs, respectively. Therefore, the adolescent and young child crab IRs to be used in the NBSA BHHRA are as follows:

- RME young child crab consumer = 7 g/day,
- RME adolescent crabber = 14 g/day,
- CTE young child crab consumer = 1 g/day, and
- CTE adolescent crabber = 2 g/day.

5.2.4.3 Fraction Ingested for Fish and Crab

The fraction ingested (FI) from the contaminated source is applied to account for possible exposures to COPCs from other sources. This is particularly relevant for the site given that the NBSA is a highly developed urban area that supports a large population of people. Consistent with the recommendations in RAGS Part A, an FI of 1 is used for the RME and CTE scenarios for all three angler populations for the following reasons (USEPA, 2012a):

- The NBSA has an adequate quantity and quality of some species of fish and blue crab to support the estimated level of fish and crab ingestion for the RME individual, both currently (as found in the fish community surveys conducted in 2009 and 2010 [Windward, 2010; 2011]) and in the future.
- The NBSA is in a highly developed urban area that supports a large population, with access to the Bay for fishing and crabbing at parks, boat docks, publicly accessible parking lots that abut the Bay, and residences on the NBSA shorelines. Therefore, anglers have ample opportunity to return to areas where they have successfully caught fish or crab, especially adolescents or individuals that may have limited means of transportation, and workers who may have the opportunity to fish and/or crab during the work day or on their way to and from work.
- In addition, it is possible that individuals who move may stay within the NBSA and continue to fish and crab from the Bay and consume the fish and/or crab that they catch.

Although it is possible that anglers catch and consume fish and crab from other rivers and water bodies in the area, this site-specific risk assessment IR assumes that 100% of the catch is obtained from the NBSA for both the RME and CTE scenarios.

5.2.4.4 Cooking Loss for Fish and Crab

Review of the published literature on cooking loss (CL) found that some chemicals, such as PCBs, are lost from tissues during preparation and cooking. For the purpose of evaluating the RME, this factor will be assumed to be 0. For the RME scenarios, a cooking loss of 0% is used for all chemicals to account for the potential that individuals may consume cooking juices and pan drippings. For the CTE scenarios, chemical-specific cooking loss factors are to be used for the COPCs. For metals, including mercury, a cooking loss of 0% is used for both the RME and CTE scenarios, because cooking loss adjustments are not appropriate for metals in most cases (USEPA, 2000b). It is recommended that for the CTE exposures, an estimated CL be included for those chemicals for which sufficient data exist based on the literature and consistent with the risk assessments for the Passaic River (AECOM, 2017). These chemical-specific CL values for RME and CTE fish consumption scenarios are summarized below:

Chemical	Fish Tissue RME CL Value (%)	Fish Tissue CTE CL Value (%)
DDD	0	30
DDE	0	35
DDT	0	30
Chlordane	0	33
Dieldrin	0	30
Dioxins	0	49
PCBs	0	30
Mercury	0	0

5.2.5 Sediment and Surface Water Exposure Parameters

Exposure parameters specific to the assessment of sediment and surface water exposure, including incidental IRs of sediment and surface water, body surface areas in contact with sediment and surface water, sediment to skin adherence factors, surface water exposure time, and sediment and surface water EFs, are described below.

5.2.5.1 Incidental Ingestion of Sediment

The sediment IR is intended to provide an estimate of incidental intake of sediment occurring during the described activities. The incidental sediment IRs of anglers, swimmers, waders, boaters, and workers are assumed to be half the default residential soil IRs of 100 mg/day (USEPA, 2014a) for adults and 200 mg/day for children (USEPA, 2014a) for the RME scenario, as follows:

- 50 mg/day for adults and adolescents (7 to 18 years old) for the RME scenario. One half of the RME rate, 25 mg/day, is used for the CTE scenario.
- 100 mg/day for young child swimmers and waders for RME scenarios. One half of the RME rate, 50 mg/day, for the CTE scenario.

5.2.5.2 Incidental Ingestion of Surface Water

Exposure data for incidental surface water ingestion are lacking, especially for activities such as wading or boating. However, USEPA (2011) provides incidental water IRs during swimming. For both RME and CTE, swimming IR will be based on the mean values of 0.049 L/hr (rounded to 0.05 L/hr) for adolescents (7 to <19 years) and children (1 to <7 years) and 0.021 L/hr for adults.

The incidental surface water IR for anglers, waders, and boaters is assumed to be half of what occurs during swimming, or 0.025 L/hr for children and adolescents and 0.011 L/hr for adults, for both RME and CTE. The national average for time spent swimming is 2.6 hours/day and will be used in the assessment (USEPA, 1989).

5.2.5.3 Dermal Contact with Sediment and Surface Water

Body Surface Areas

The skin surface area (SA) exposed to sediment and surface water varies with the type of activity being performed. In accordance with USEPA (2004b), all SA estimates are based on the 50th percentile values to correlate with average body weights used for all scenarios and pathways. The same skin SA for media contact are used in the RME and CTE scenarios.

For dermal contact with sediment and surface water, the angler and wader are assumed to wear a short-sleeved shirt and shorts (no shoes); therefore, the exposed skin surface is limited to the head (face), hands, forearms, lower legs, and feet. The exposed skin SA for adult anglers and waders is 6,492 square centimeters (cm^2), the average of the 50th percentile for males and females 21 years of age and older (USEPA, 2011). The exposed skin SA for adolescent anglers and waders is 4,436 cm^2, based on the weighted average surface area for males and females aged 7 to < 19 years (USEPA, 2011). The exposed skin SA for child waders is 2,272 cm^2, based on the weighted average SA for children ages 1 to < 7 years (USEPA, 2011).

For dermal contact with sediment and surface water, the adolescent and adult boaters that participate are assumed to wear shoes and, when splashed by water, exposure would be limited to the hands, forearms, and face. When the SA is limited to these body parts (*i.e*., hands, forearms and face), the exposed skin SA for adult boaters is 2,692 cm^2, the average of the 50th percentile for males and females 21 years of age and older (USEPA, 2011). The exposed skin SA for adolescent boaters is assumed to be the same SA as the wader (i.e., 4,436 cm^2) assuming a mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA, 2011).

For the swimming receptor, the entire skin SA is used for contact with surface water: 20,900 cm^2 for adults 21 years of age and older (USEPA, 2014a), 14,825 cm^2 for adolescents (USEPA, 2011), and 7,500 cm^2 for children (USEPA, 2011). However, swimmers' dermal contact with sediment as they enter and leave the water is not likely to involve the entire body but would be similar to that of the wader. Therefore, the exposed skin surface for sediment is assumed to be limited to the head, hands, forearms, lower legs, and feet. The exposed skin SA of these body parts for adults is 6,492 cm^2, the average of the 50th percentile for males and females 21 years of age and older (USEPA, 2011). The exposed skin SA for adolescents is 4,436 cm^2, based on the weighted average SA for males and females aged 7 to <18 years (USEPA, 2011). The exposed skin SA for children is 2,272 cm^2, based on the weighted average SA for children aged 1 to < 7 years (USEPA, 2011).

For dermal contact with sediment, the worker is assumed to wear a short-sleeved shirt, long pants, and shoes; therefore, the exposed skin surface is limited to the head, hands, and forearms. The resulting exposed skin SA is 3,527 cm^2, the average of the 50th percentile for males and females 21 years of age and older (USEPA, 2011).

Sediment to Skin Adherence Factors

The soil-to-skin adherence factor (AF) values are based on the USEPA's Dermal Guidance (Exhibit 3-3 in USEPA, 2004b) and are used to evaluate dermal exposure to sediment. The AF for the adult receptor is 0.3 milligrams per square centimeter (mg/cm^2) based on the values derived for reed gatherers and the AF for adolescents and children is 0.2 mg/cm^2 based on the value derived for children playing in wet soil. USEPA (2004b) does not recommend a high-end soil contact activity be used with a high-end weighted AF for that activity because it would not be consistent with the RME scenario. As such, the AF values for the RME and for the CTE are the same. The same skin adherence values will be used for the RME and CTE individual.

Dermal Absorption Fractions

The dermal absorption factor (ABS) represents the amount of a chemical in contact with skin that is absorbed through the skin and into the bloodstream. The chemical-specific ABS values will be based on data obtained from current USEPA sources (USEPA, 2004b). Other values will be discussed with USEPA before being used in the HHRA.

5.2.5.4 Surface Water Exposure Time

Professional judgement was used to inform the selection of the surface water exposure times. Swimming under current conditions may be limited by the generally urban setting of the Bay. The exposure times are designed to reflect both current and future use. The angler and wader exposure times are based on best professional judgment; CTE exposure times are assumed to be one half of the RME exposure time. The swimmer exposure time is the national average for swimming, as reported in USEPA (1989), for both the RME and CTE scenarios. CTE exposure time for boaters is assumed to be three quarters of the RME exposure time.

5.2.5.5 Sediment and Surface Water Exposure Frequencies

EFs for recreational scenarios involving direct contact with sediment and surface water are based on site-specific factors, such as:

- Nature of the activity (*e.g.*, swimming versus boating),
- The characteristics of the exposure area, including access, waterway use, and nearby land use, and
- Climate factors such as temperature and precipitation (*e.g.*, sediment contact is curtailed during cold weather months when the sediment is frozen, or snow covered).

The EFs for the angler, swimmer, wader, and boater reflect both current and future conditions. The numbers of exposed individuals will likely increase as improvements to the shoreline and Bay are made, but the EF and ED for individuals who already engage in these scenarios are not likely to increase in the future.

Adult anglers, swimmers, and waders are assumed to fish, swim, or wade in locations where they would contact sediment and surface water once a week during the summer months, which are assumed to be June, July, and August (13 weeks per year), or 13 days per year, for the RME scenario, and once every 2 weeks, or 7 days per year, for the CTE scenario.

Young child swimmers and waders are assumed to swim, or wade in locations where they would contact sediment and surface water once a week during the summer months (13 weeks per year), or 13 days per year, for the RME scenario, and once every 2 weeks, or 7 days per year, for the CTE scenario. It is assumed that the young child will be accompanied by an adult.

Adolescent anglers, swimmers, and waders are assumed to fish, swim or wade in locations where they would contact sediment and surface water three times a week during the summer months or 39 days/year, listed above for the RME scenario and 20 days/year for the CTE scenario.

Surface water EFs for adult and adolescent boaters are based on information provided in the LPRSA RI/FS BHHRA (AECOM, 2017) which was obtained from the Passaic River Rowing Association and the Nereid Boat Club, which supports a rowing season extending from March through mid-November (37 weeks) and the amount of time rowers spend on the water. Adult boaters row up to 7 days per week, for 1 to 2 hours per day; average frequency is about three to four times per week. Based on this information, the RME frequency for adult boaters is 259 days per year (7 days per week x 37 weeks per year), and the CTE frequency is 111 days per year (3 days per week x 37 weeks per year). For the adolescent boaters, EF was based on the high school rowing season, which is primarily from late February through the end of May, and sometimes includes minimal rowing in the fall. The high school teams row 5 to 7 days per week for 1 to 2 hours per day. Based on this information, the RME frequency for adolescent boaters is 98 days per year (7 days per week x 14 weeks per year), and the CTE frequency is 70 days per year (5 days per week x 14 weeks per year).

Exposure to sediment for adult and adolescent boaters is expected to occur at a much lower frequency than exposure to surface water. Contact with nearshore sediment is expected to be limited to occasions when rowers flip out of their boats and wade to get to shore or to get back into their boat. It is therefore assumed that sediment contact occurs once a month for the RME scenario and once every 2 months for the CTE scenario. Accounting for the length of the rowing season (37 weeks for adults and 14 weeks for adolescents), the adult sediment EF is 9 days per year for RME and 4 days per year for CTE; the adolescent boater EF is 4 days per year for RME and 2 days per year for CTE.

Workers are assumed to be exposed once a week throughout the year for the RME scenario and once every 2 weeks for the CTE scenario, or 50 days per year and 25 days per year, respectively (50 work weeks per year, assuming a 2-week vacation).

5.2.5.6 Exposure Duration

The ED is the estimate of the total time (in years) that a receptor engages in a particular activity that could result in exposure. Because of the differences in activity patterns and sensitivity to potential chemical exposures, various age groups for the recreational receptors are evaluated. The receptor- and age group-specific EDs are given below. Unless otherwise stated, the CTE duration is assumed to be one half of the RME duration.

The EDs are as follows:

- Adult (from 19th birthday for remainder of life) – The RME ED for adult receptors is assumed to be 20 years (USEPA, 2014a), based on a 26-year upper-bound residential tenure at a single location (USEPA, 1989) minus 6 years as a child. The CTE ED for adult receptors is 9 years, based on the 50th percentile value for years living in the current residence (USEPA, 2011).
- Adolescent (ages 7 to <19 years, from 7th birthday to the day before 19th birthday) – The ED is based on the number of years in the age group, which is 12 years for the RME scenario and 6 years for the CTE scenario.
- Child (ages 1 to <7 years, from 1st birthday to the day before 7th birthday) – The ED is 6 years for the RME scenario and 3 years for the CTE scenario.
- Adult (worker) – The ED is 25 years for the RME scenario, which is based on the 95th percentile for the number of years worked at the same location as reported by the U.S. Bureau of Labor Statistics in 1990 (USEPA, 2014a), and 7 years for the CTE, which is the median occupational tenure of the working population ages 16 and older in 1987 (USEPA, 2011).

5.2.5.7 Body Weight

Receptor body weights were taken from USEPA guidance (USEPA, 2014a; 2011), and represent the averages for males and females in the applicable age ranges (*e.g.*, 1 to <7 years for young child, 7 to <19 years for adolescent, and adult). A body weight of 80 kg was used for adults based on the standard default exposure assumptions (USEPA, 2014a) and 17 kg (mean, ages 1 to <7) for young children is based on USEPA (2011).

Body weights for adolescent age groups were derived by averaging the mean body weight estimates for males and females by year of age from the National Health and Nutrition Examination Survey, as summarized in Table 8-24 of the 2011 Exposure Factors Handbook (USEPA, 2011). The mean body weight is 52 kg for the 7 to <19 year-old adolescent angler, wader, and swimmer.

5.3 Toxicity Assessment

The purpose of the PAR is to identify COPCs and summarize the exposure pathways and receptors based on the preliminary CSM that was developed using available data collected to date. The BHHRA also will include a toxicity assessment and a risk characterization as summarized below.

The toxicity assessment determines the relationship between the magnitude of exposure to a COPC and the nature and magnitude of adverse health effects that may result from such exposure. For purposes of this assessment, COPCs are classified into two broad categories: noncarcinogens and carcinogens. Toxicity studies with laboratory animals or human epidemiological studies provide the data used to develop toxicity values (*e.g.*, cancer slope factor [CSF], inhalation unit risk factor [IUR], oral reference dose [RfD] and inhalation reference concentration [RfC]).

A table summarizing the toxicity criteria, target organ, and other relevant information for each COPC is provided as RAGS Part D (USEPA, 2001a) Tables 5.1 and 6.1 in Attachment A. Toxicity criteria are selected per USEPA (2003) which recommends a hierarchy of human health toxicity values for use in risk assessments at Superfund sites. The hierarchy is as follows: 1) USEPA's Integrated Risk Information System (IRIS); 2) USEPA's (Office of Research and Development, National Center for Environmental Assessment, Superfund Health Risk Technical Support Center, and the Provisional Peer-Reviewed Toxicity Values (PPRTVs), and 3) other sources of information such toxicity values from the State of California's Environmental Protection Agency (CalEPA) and the Agency for Toxic Substances Disease Registry (ATSDR) minimal risk levels (MRLs) for noncarcinogenic constituents; and the Superfund Health Effects Assessment Summary Tables (USEPA, 1997).

The dioxin-like assessment incorporates the WHO TEF approach described in Van den Berg *et al.* (2006; USEPA, 2010). The assessment evaluates total PCBs for carcinogenicity using a CSF of 2 mg/kg-day and the RfD for Aroclor 1254. Consistent with USEPA's Reassessment of the Carcinogenicity of PCBs document titled "PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures" (USEPA, 1996), the risks from exposures to dioxin-like PCBs and non-dioxin like PCBs will be evaluated as outlined in the document. The CSF identified in the PCB document referenced above of 150,000 mg/kg-day will be used to assess the cancer risks from dioxin and dioxin-like congeners. The oral RfD for dioxin will be used to evaluate noncancer hazards from dioxins.

During completion of the BHHRA, coordination with the USEPA risk assessor will occur to assist in the decision-making process for selection of appropriate toxicity values and/or for selection of surrogate values should toxicity information not be available for a COPC. The most current toxicity values and toxicological assessment approaches will be used during completion of the BHHRA, including the specific approach for evaluating inhalation exposures and exposures to dioxins/furans and PCBs. The STSC is to be contacted for assistance in identifying surrogate toxicity values.

5.3.1 Chemicals with Mutagenic Mode of Action

Consistent with the Cancer Guidelines and Supplemental Guidance for Assessing Susceptibility for Early-Life Exposure to Carcinogens (USEPA, 2005b), ADAFs will be applied for chemicals with a mutagenic mode of action (e.g., PAHs, chromium VI, and trichloroethene).

5.4 Risk Characterization

Risk characterization involves an estimation of the magnitude of the potential adverse health effects associated with the identified COPCs. The risk characterization combines the results of the dose-response (toxicity assessment) and exposure assessment to calculate cancer risks and noncancer hazards for the

COPCs. In accordance with USEPA's guidelines for evaluating the potential toxicity of complex mixtures, this assessment assumes that the effects of all constituents are additive (USEPA, 1986; 2000c).

Risks are estimated as probabilities for constituents that elicit a carcinogenic response. The excess lifetime cancer risk is the incremental increase in the probability of developing cancer associated with exposures to contaminated media at the site. A risk of 1×10^{-6}, for example, represents the probability that one person in one million persons exposed to a carcinogen over a lifetime (70 years) will develop cancer. The upper-bound excess lifetime cancer risks derived in this assessment will be compared to the NCP risk range of 10^{-4} (one in ten thousand) to 10^{-6} (one in a million) (USEPA, 1990; 1992c).

The excess cancer risk will be estimated using the following linear dose-response relation where risk is directly related to intake (USEPA, 1989):

$$\text{Risk} = \text{CSF} \times \text{LADD} \qquad \text{(Equation 5-10)}$$

where:
Risk = Excess lifetime cancer risk (probability)
CSF = Cancer slope factor $(\text{mg/kg-day})^{-1}$
LADD = Lifetime average daily dose (mg/kg-day)

Only LADDs are used in conjunction with CSFs to obtain excess lifetime cancer risk estimates. CSFs are derived for specific routes of exposure including inhalation, dermal and oral exposures and will be calculated for all COPCs with appropriate toxicity values. Cancer risks from exposure to multiple carcinogens will be assumed to be additive (USEPA, 1989; 2000c). To estimate the total excess cancer risks from all carcinogens, cancer risks from each compound will be summed across exposure pathways. Excess cancer risks that are less than the acceptable USEPA risk range will be assumed to indicate that no adverse health effects are predicted from exposures. As discussed above, where appropriate, calculations will include ADAFs for chemicals with a mutagenic mode of action (USEPA, 2005a, b).

The potential for noncarcinogenic health effects is estimated by comparing the ADD of a compound with the chronic RfD or RfC based on the specific route of exposure (*e.g.,* oral, inhalation). The ratio of the intake to reference dose (ADD/RfD or ADD/RfC) for an individual chemical is termed the HQ. An HQ greater than 1 indicates the potential for adverse health effects, as the RfD is exceeded by the intake (USEPA, 1986; 1989; 2000c). These ratios are calculated for each chemical that elicits a noncarcinogenic health effect when a RfD or RfC is available for the chemical. HQs less than 1 indicate that no adverse health effects are predicted from exposure to COPCs. An HQ greater than 1 indicates that exposure to that contaminant may cause adverse health effects in exposed populations. It is important to note, however, that the level of concern associated with exposure to noncarcinogenic constituents does not increase linearly as the HQ exceeds 1.

Typically, chemical-specific HQs are summed to calculate pathway HI values. The HI is calculated by summing all HQs for all noncarcinogenic constituents through an exposure pathway:

$$\begin{aligned} HI &= HQ_1 + HQ_2 + \ldots + HQ_j \\ &= (ADD_1/RfD_1) + (ADD_2/RfD_2) + \ldots + (ADD_j/RfD_j) \qquad \text{(Equation 5-11)} \end{aligned}$$

where:
HI = Hazard Index
HQ_j = Hazard quotient of the j^{th} chemical
ADD_j = Average daily dose of the j^{th} chemical
RfD_j = Reference dose for the j^{th} chemical

This approach can result in a situation where HI values exceed 1 even though no chemical-specific HQs exceed 1 (*i.e.*, adverse systemic health effects would be expected to occur only if the receptor was exposed to several contaminants simultaneously). In this case, chemicals are segregated by similar effect on a target organ, and a separate HI value for each effect/target organ is calculated (USEPA, 1989). If any of the separate HI values exceed 1, adverse noncarcinogenic health effects are possible.

The risk characterization for the BHHRA will contain an evaluation of all uncertainties, including the uncertainties associated with data gaps that could not be fully addressed during the RI. The risk characterization will be prepared in accordance with USEPA guidance for risk characterization (USEPA, 1992c, 1995). A qualitative assessment of uncertainty will be included in the risk characterization unless a workplan is submitted to USEPA and approved.

5.4.1 Evaluation of Background

Consistent with USEPA's Background Guidance (OSWER 9285.7-41 [USEPA, 2002b]) following the development of the risk assessment, including all appropriate calculations of cancer risks and noncancer hazards, an assessment of background may be appropriate for those chemicals exceeding the risk range or the goal of protection for noncancer of an HI = 1. The discussion of background needs to provide: a summary of the background data set(s), identification of COPCs that will be evaluated in the individual media, appropriate statistical analyses, and a summary of the results.

5.4.2 Risk Characterization for Lead

For the BHHRA, it is anticipated that exposure to lead in environmental media will be evaluated using available pharmacokinetic models, such as USEPA's IEUBK Model for lead in children (USEPA, 1994b,c) and USEPA's Adult Lead Model (ALM) (USEPA, 2009c, 2013), as appropriate. Exposure to lead in fish tissue (or other biota) will be evaluated using pharmacokinetic modeling (*e.g.*, ALM model for adults and IEUBK model for young children).

5.4.3 Total Risks and Hazards by Receptor

Recreational anglers are assumed to be exposed to COPCs in accessible surface sediment via incidental ingestion and dermal contact, to COPCs in surface water via incidental ingestion and dermal contact, and to COPCs in fish or crab caught recreationally in the NBSA. Three age groups will be evaluated: a young child, an adolescent, and an adult. Exposures of a young child angler to sediment and surface water is not evaluated under the angling scenario. Risks and hazards to the adult and child will be combined with 20 years for the adult and 6 years for the child for a total of 26 years based on the standard default exposure assumptions for residential exposures (USEPA, 2014a). The risk characterization will include total cancer risks and noncancer hazards for all COPCs across all pathways. For noncancer HIs greater than 1, the chemicals will be evaluated and endpoint specific HIs calculated.

Swimmers are assumed to be exposed to COPCs in accessible surface sediment via incidental ingestion and dermal contact and to COPCs in surface water via incidental ingestion and dermal contact. The three age groups that will be evaluated are the young child, an adolescent, and an adult. Additionally, a combined young child and adult will be evaluated for potential carcinogenic effects assuming a 26-year ED. Calculations will be presented for the receptors who do not fish or crab. For noncancer HIs greater than 1, the chemicals will be evaluated and endpoint specific HIs calculated.

Waders are assumed to be exposed to COPCs in accessible surface sediment and surface water via incidental ingestion and dermal contact. Three age groups will be evaluated separately: a young child, an adolescent, and an adult. Additionally, a combined young child and adult will be evaluated for potential carcinogenic effects assuming a 26-year residential ED based on the standard default exposure assumptions for residence (USEPA, 2014a). For noncancer HIs greater than 1, the chemicals will be evaluated and endpoint specific HIs calculated.

Boaters are assumed to be exposed to COPCs in accessible surface sediment via incidental ingestion and dermal contact and to COPCs in surface water via incidental ingestion and dermal contact. Three age groups will be evaluated separately, reflecting different boating activities along the NBSA. An older child is assumed to participate in canoeing or kayaking, while a teenager and adult boater are assumed to participate in sculling. Additionally, a combined young child and adult will be evaluated for potential carcinogenic effects assuming a 26-year residential ED based on the standard default exposure assumptions for residents (USEPA, 2014a). For noncancer HIs greater than 1, the chemicals will be evaluated and endpoint specific HIs calculated.

Workers at properties adjacent to the river may perform outdoor activities such as trash collection and grounds maintenance and may therefore be exposed to COPCs in accessible surface sediment via incidental ingestion and dermal contact. For noncancer HIs greater than 1, the chemicals will be evaluated and endpoint specific HIs calculated.

5.4.4 Completing the BHHRA

Upon approval of the PAR a complete BHHRA will be developed.

5.4.5 Probabilistic Risk Assessment

The results of the BHHRA will be used to inform the potential need to conduct a Probabilistic Risk Assessment consistent with RAGS Volume III, Part A (USEPA, 2001b).

6.0 SUMMARY AND RECOMMENDATIONS

The primary objectives of this PAR were to:

- Develop a preliminary CSM for human receptors by identifying potentially complete exposure pathways;
- Identify a preliminary list of COPCs for further evaluation in the BHHRA; and
- Present proposed exposure pathways for assessment in the BHHRA.

Sections 1, 2, and 3 of this PAR provide a summary of background information and present an initial CSM depicting complete exposure pathways for human receptors based on the available data. The CSM will be updated accordingly for the BHHRA as new data are obtained and data evaluations continue during the RI/FS. Section 4 provides a summary of the available data and the data evaluation completed as part of the PAR. A list of preliminary COPCs was identified for the BHHRA and the BHHRA approach described in Section 5.

Based on available information regarding current activities in Newark Bay, it was assumed that human exposure to contaminants in sediments (primarily intertidal mudflat sediments) would be associated with recreational activities such as fishing, crabbing, wading, boating and working. In addition, anecdotal information suggests that a transient community occasionally constructs temporary housing along the banks of the NBSA. Limited information is available regarding the length of their occupancy and their activities while on the Bay, however, a residential scenario was also included in the CSM to qualitatively address potential exposures to these individuals. The receptors and exposure scenarios associated with future use are not expected to differ significantly from those being evaluated under the current use scenarios. The scenarios and exposure parameter assumptions presented in Attachment A are intended to capture exposures under both current and future site conditions. While expected improvements to the Bay and shoreline will likely increase, the number of individuals using the Bay, the EF and ED for some individuals already using the Bay, will not likely increase. Accordingly, the use of combined current/future exposure assumptions is appropriate.

The preliminary COPCs for human receptors for sediment, surface water, and tissue are provided in RAGS Part D tables in Attachment A (Tables 2.1 through 2.4). In general, the classes of chemicals identified are those that would be expected based on knowledge of their persistence in the environment and tendency to bioaccumulate. For example, total PCBs and dioxins/furans have been identified as chemicals of concern for human health in the Focused Feasibility Study for the lower 8.3 miles of the Passaic and the full 17 Mile Study Area for the Passaic River. In addition, several metals, including mercury and chromium, pesticides such as DDT, and carcinogenic PAHs are selected for further evaluation. In addition, there are compounds that were not included as COPCs due to the fact that all the results were non-detects.

It was beyond the scope of this PAR to assess the potential sources or links to anthropogenic activities that could account for exposures. However, further formulation of the CSM in conjunction with the findings of the RI will be used to evaluate uncertainties.

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FIGURES

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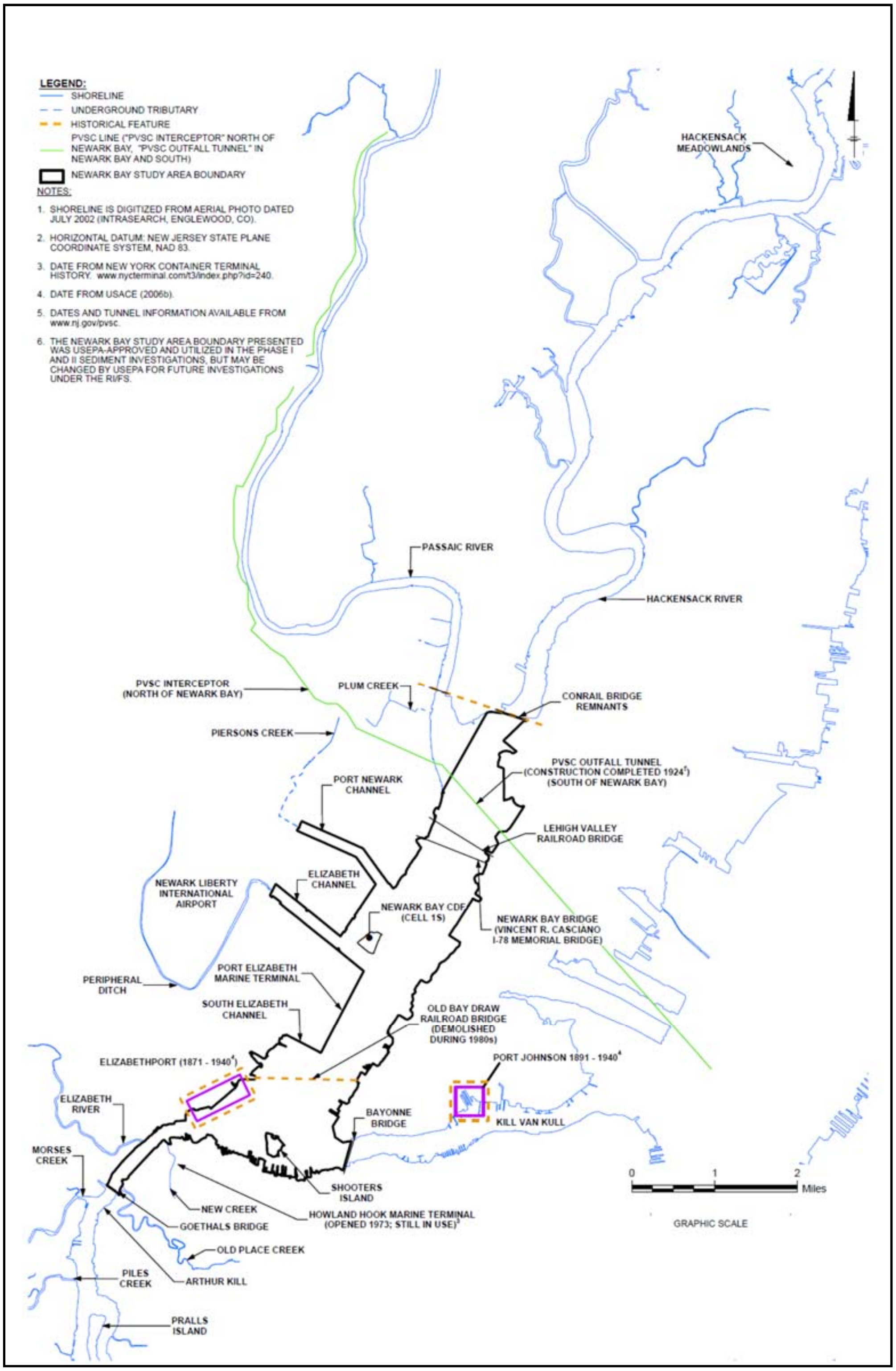


Figure 2-1. The Newark Bay Study Area (Tierra, 2013)

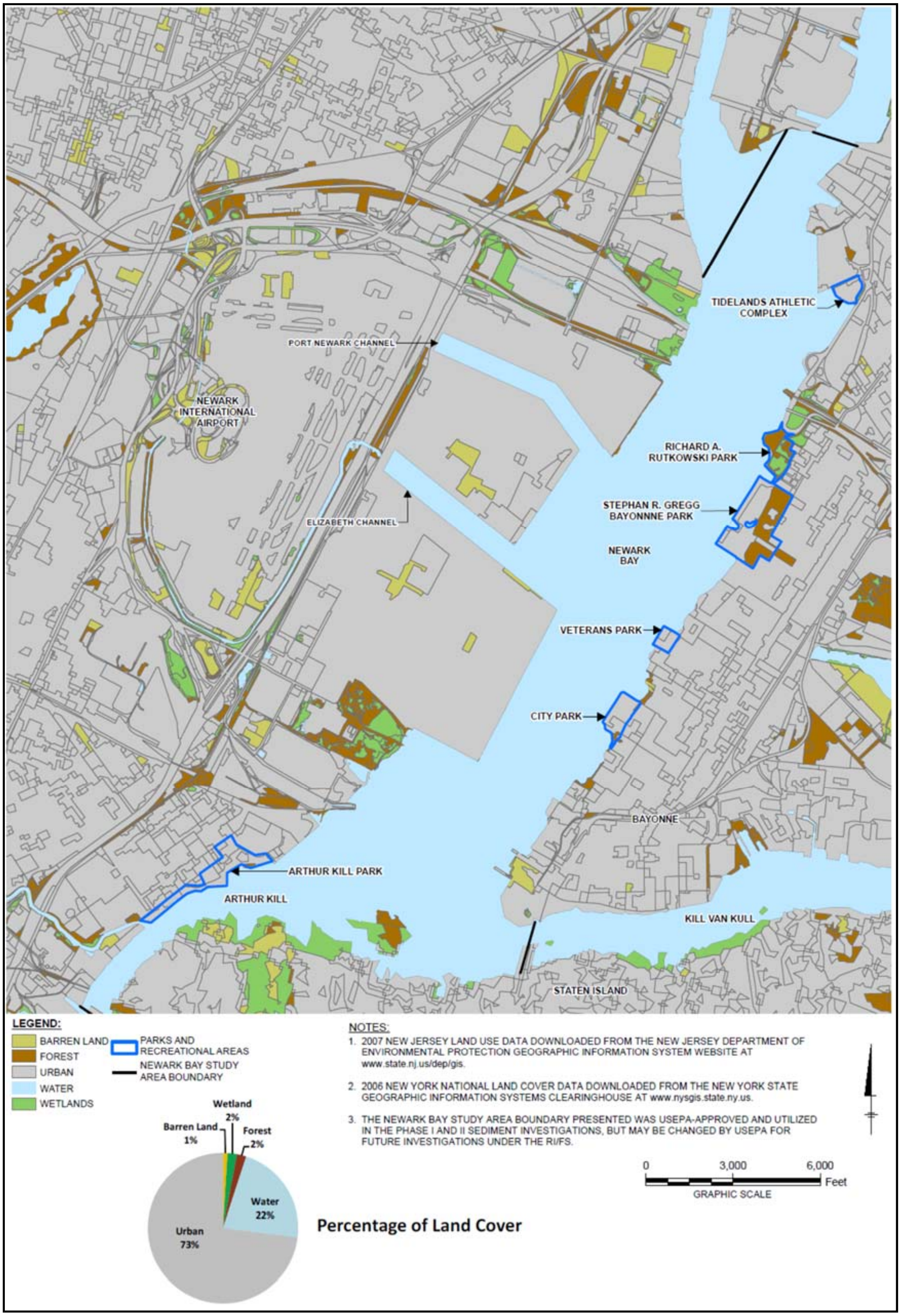


Figure 2-2. Land Use Map for Newark Bay Study Area (Tierra, 2013)

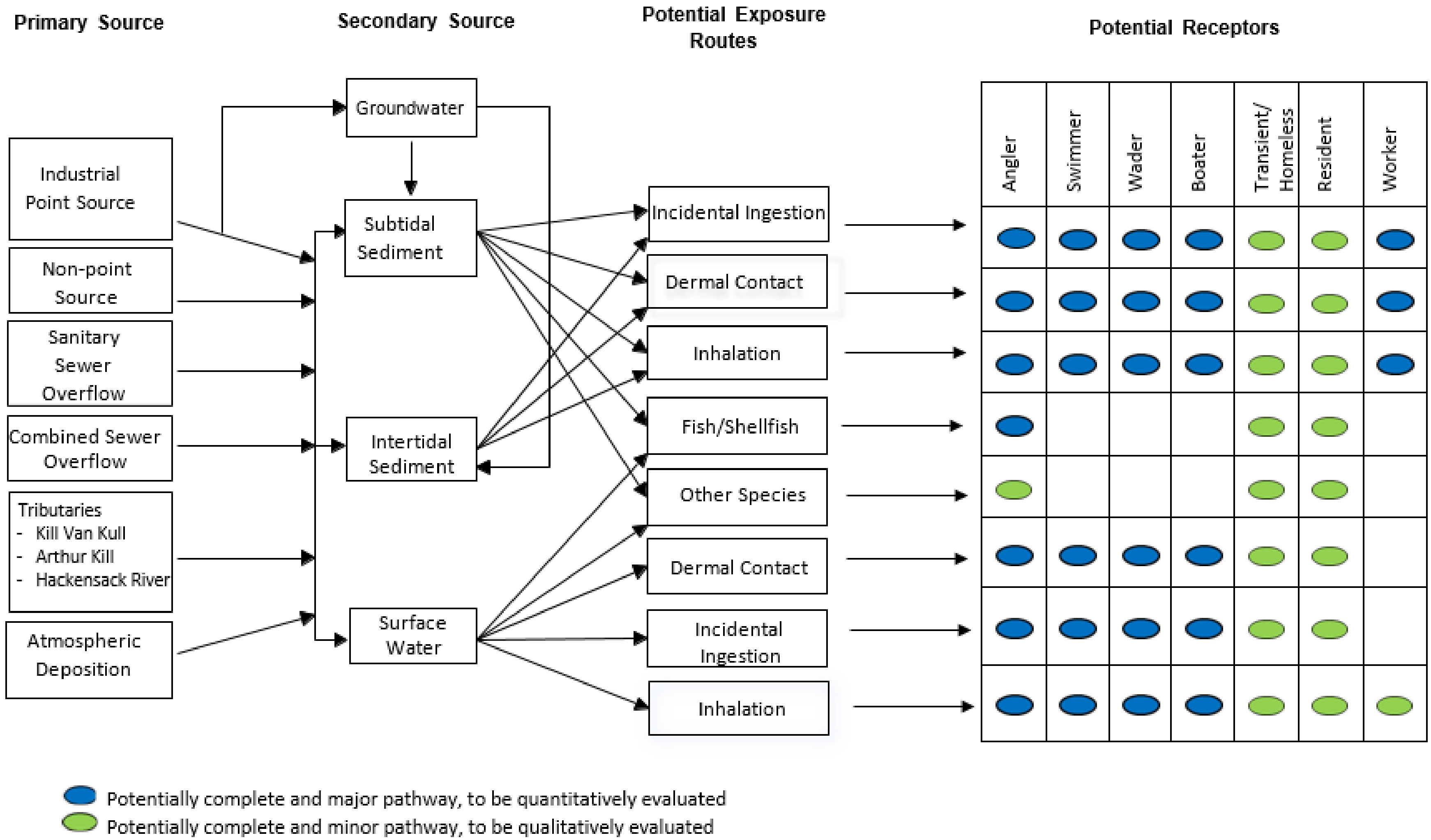
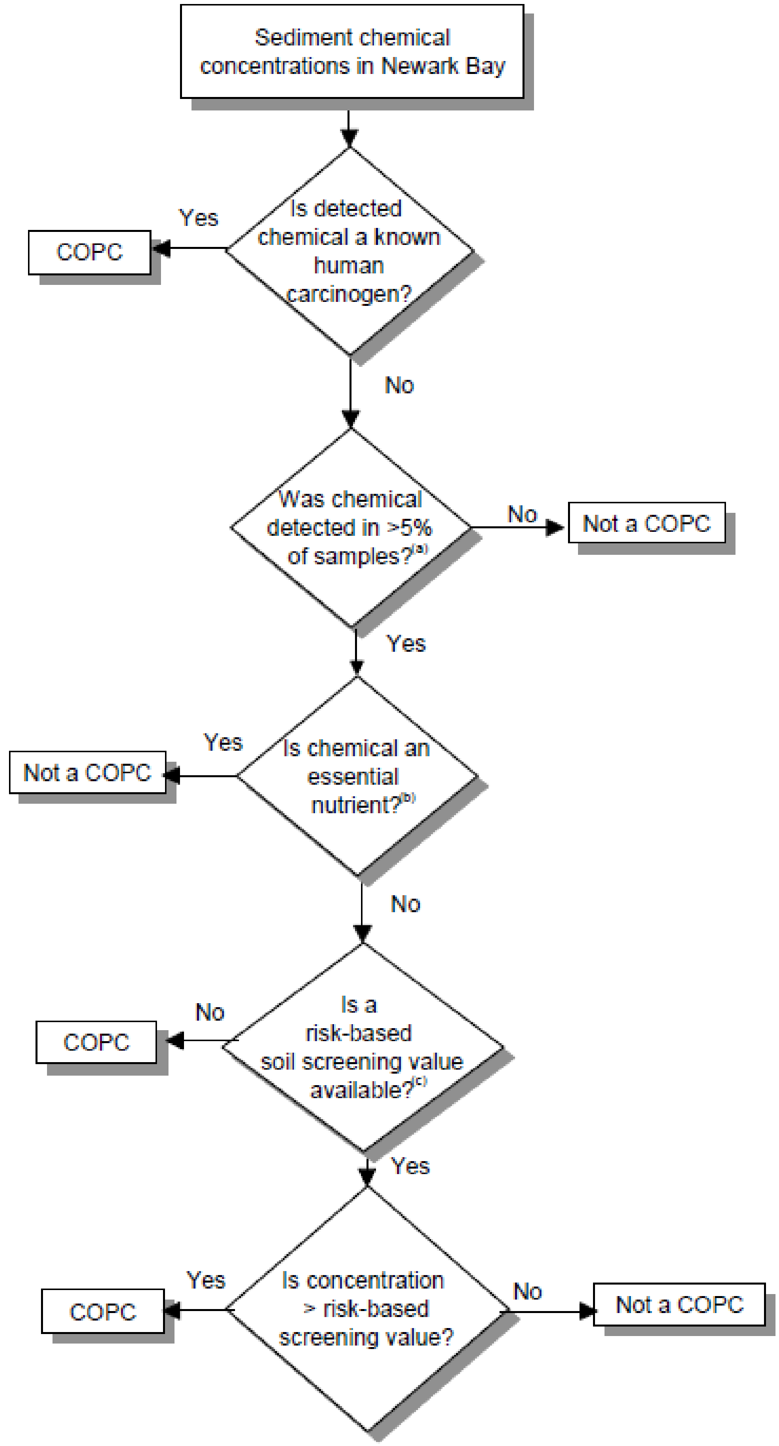
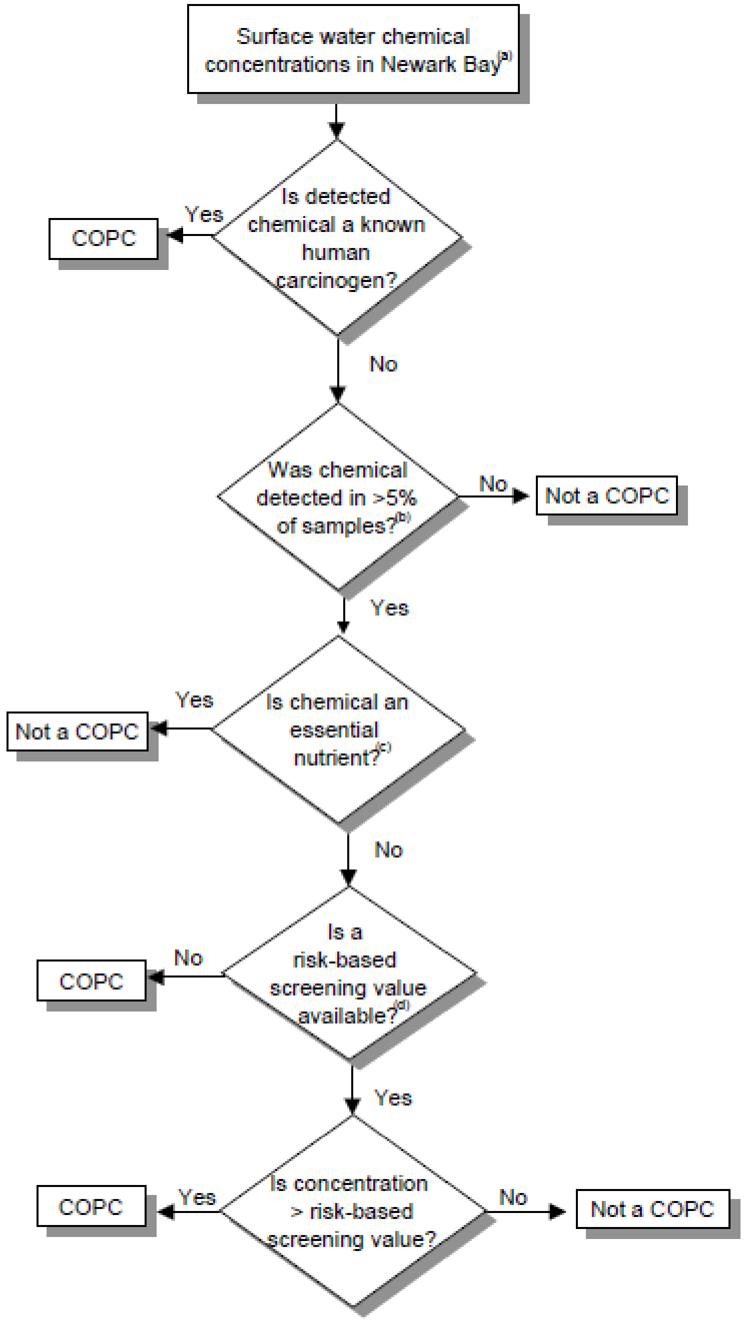


Figure 3-1. Preliminary Human Health Conceptual Site Model



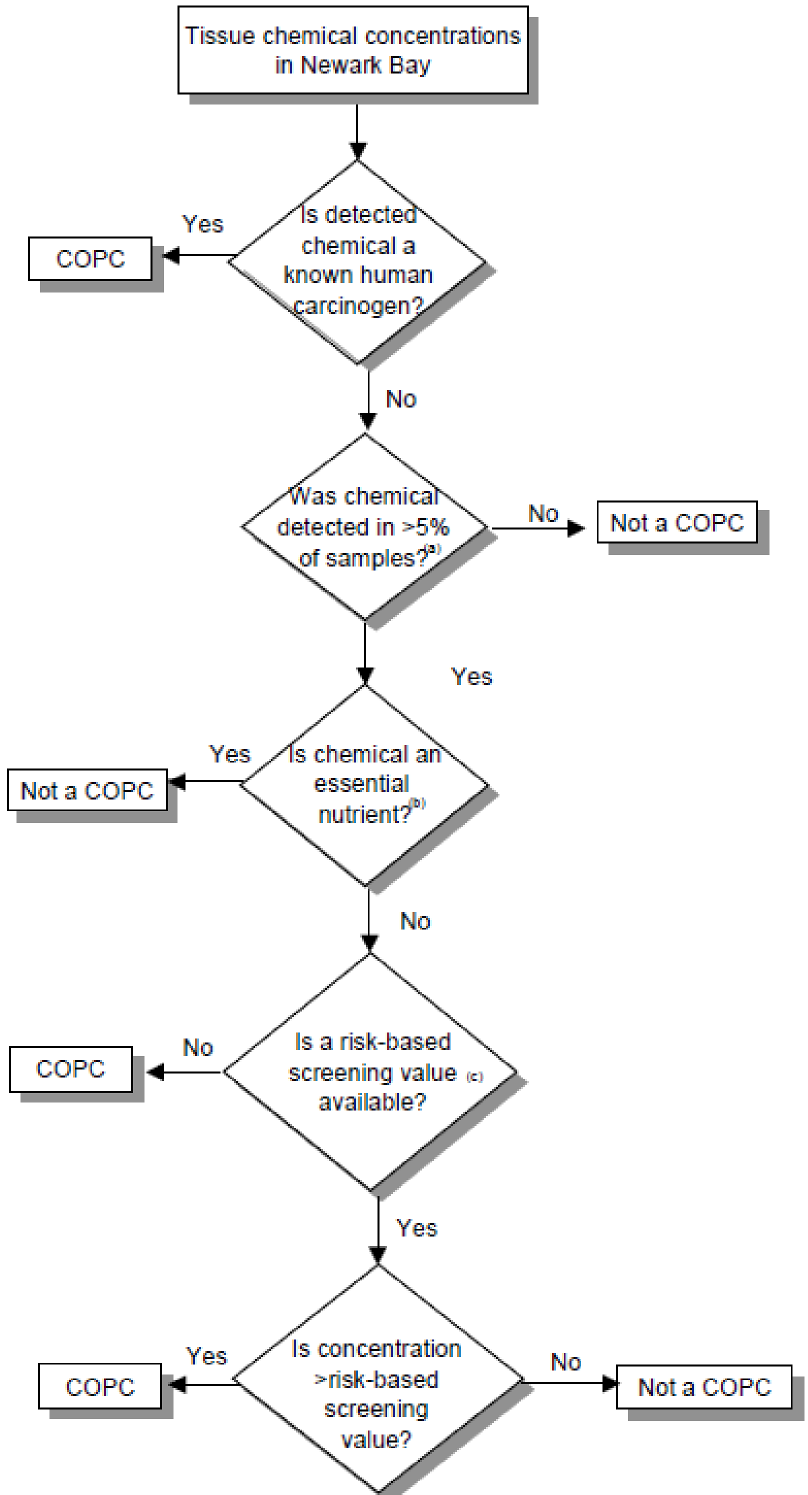
(a) Detection limits were at or below screening criteria.
(b) Essential nutrients with toxicity data will be compared to RSLs.
(c) Screening values are based on EPA RSLs for residential exposure to soil.

Figure 5-1. Sediment COPC Decision Diagram for Newark Bay Human Health Risk Assessment



[a] The COPCs for Newark Bay are selected based on their presence in the study area, not their presence in and potential transport from adjacent waterbodies (e.g., the Passaic River).
[b] Detection limits were at or below screening criteria.
[c] Essential nutrients with toxicity data will be compared to risk based screening values.
[d] Screening values are based on EPA RSLs for tapwater.

Figure 5-2. Surface Water COPC Decision Diagram for Newark Bay Human Health Assessment



(a) Detection limits were at or below screening criteria.
(b) Essential nutrients with toxicity data will be evaluated basedon comparison to RSLs.
(c) Screening values are based on EPA RSLs for fish consumption.

Figure 5-3. Tissue COPC Decision Diagram for Newark Bay Human Health Risk Assessment

TABLES

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Table 5-1. Surrogate Compounds Identified for COPC Screening Process

Chemical	Surrogate	Chemical	Surrogate
C2-Dibenzothiophenes	Dibenzothiophene	C1-Benzanthracene/chrysenes	Chrysene
C3-Dibenzothiophenes	Dibenzothiophene	C2-Benzanthracene/chrysenes	Chrysene
C4-Dibenzothiophenes	Dibenzothiophene	C3-Benzanthracene/chrysenes	Chrysene
C1-Chrysenes	Chrysene	C2-Phenanthrene/anthracenes	Anthracene
C1-Fluoranthenes/Pyrenes	Pyrene	C3-Phenanthrene/anthracenes	Anthracene
C1-Fluorenes	Fluorene	Total PCB Congeners (209)	PCB High Risk Value
C1-Naphthalenes	Naphthalene	Total Dioxin TEQ	2,3,7,8-TCDD
C1-Phenanthrenes/Anthracenes	Anthracene	Total PCB TEQ	2,3,7,8-TCDD
C2-Chrysenes	Chrysene	Sum of Non-Dioxin-Like PCB congeners	PCB Low Risk
C2-Fluorenes	Fluorene	Endosulfan Sulfate	Endosulfan
C2-Naphthalenes	Naphthalene	Oxychlordane	Chlordane
C3-Chrysenes	Chrysene	trans-Heptachlor Epoxide	Heptachlor Epoxide
C3-Fluorenes	Fluorene	Delta-hexachlorocyclohexane	Alpha-hexachlorocyclohexane
C3-Naphthalene	Naphthalene	Endosulfan II	Endosulfan
C4-Chrysenes	Chrysene	2,4'-DDE	4,4'-DDE
C4-Naphthalene	Naphthalene	Nonachlor, trans-	Chlordane
C4-Phenanthrenes/anthracenes	Anthracene	4,4'-DDT	DDT
C2-Fluoranthenes/Pyrenes	Pyrene	cis-Nonachlor	Chlordane
C3-Fluoranthenes/Pyrenes	Pyrene	trans-Chlordane	Chlordane
Benzo(g,h,i)perylene	Pyrene	2,4'-DDD	4,4'-DDD
Benzo(e)pyrene	Pyrene	Endrin Ketone	Endrin
Perylene	Pyrene	Endrin aldehyde	Endrin
benzo(j,k)fluroanthene	Benzo(j)fluroanthene	2,4'-DDT	4,4'-DDT
Acenaphthylene	Acenaphthene	Endosulfan I	Endosulfan
1-Methylphenanthrene	Anthracene	Total Alpha + Gamma Chlordane	Chlordane
Phenanthrene	Anthracene	Dibutyltin	Dibutyltin compounds
Carbazole	Fluorene	Tetrabutyltin	Dibutyltin compounds

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ATTACHMENT A

Risk Assessment Guidance for Superfund (RAGS) Part D Tables 1 through 6

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Table 1. Selection of Exposure Pathways

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/ Future	Biota Tissue	Fish Tissue	Fish from NBSA	Angler/ Sportsman	Young Child (1 to <7 years)	Ingestion	Quantitative	Site-related contaminants have been detected in fish. Studies have found that despite health consumption advisories for eating fish and crabs caught in New Jersey waters, individuals do fish in Newark Bay and consume fish. This pathway assumes the receptor will consume fish caught from Newark Bay by other family members.
					Adolescent (7 to <19 years)	Ingestion	Quantitative	Site-related contaminants have been detected in fish. Studies have found that despite health consumption advisories for eating fish and crabs caught in New Jersey waters, individuals do fish in Newark Bay and consume fish. This pathway assumes the receptor will consume fish caught from Newark Bay.
					Adult (>18 years)	Ingestion	Quantitative	
		Crab Tissue	Crabs from NBSA	Angler/ Sportsman	Young Child (1 to <7 years)	Ingestion	Quantitative	Site-related contaminants have been detected in crabs. Studies have found that despite health consumption advisories for eating fish and crabs in New Jersey waters, individuals do crab in the Newark Bay area and consume crabs. This pathway assumes the receptor will consume crabs caught from Newark Bay and share it with family members. The assessment assumes the individual will consum the muscle and hepatopancreas.
					Adolescent (7 to <19 years)	Ingestion	Quantitative	
					Adult (>18 years)	Ingestion	Quantitative	
		Waterfowl, turtles, etc	Other species from NBSA	Angler/ Sportsman	Young Child (1 to <7 years)	Ingestion	Qualitative	Limited data; ingestion of animals other than fish/crabs likely to be minimal.
					Adolescent (7 to <19 years)	Ingestion	Qualitative	
					Adult (>18 years)	Ingestion	Qualitative	
		Fish/crab/ other species	Fish/crab/other species	Transient Person	Multiple ages	Ingestion	Qualitative	Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section.
	Intertidal/ Subtidal Surface Sediment	Accessible Surface Sediment	Accessible Surface Sediment	Angler/ Sportsman	Child (1 to <7 years)	Incidental Ingestion	None	Angler may contact sediment while fishing or crabbing from the banks of the Bay. It is assumed that the young child (1 to <7 years) would not typically accompany adult anglers due to safety
						Dermal Contact	None	
						Inhalation of Vapors	None	

Table 1. Selection of Exposure Pathways (continued)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/ Future (Continued)					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	concerns. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Swimmer	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Swimming does occur in Newark Bay. Swimmers may contact sediment while entering and leaving the bay from the banks of the Bay. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Wader	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Families visiting parks along the banks or wading down by the bay to bird watch may contact sediment along the banks. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	

Table 1. Selection of Exposure Pathways (continued)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/ Future (Continued)				Boater	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Recreational boating, including some kayaking takes place in the bay. Docks are typically used, but boaters may occasionally contact sediment when a boat flips and wading is necessary. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Worker	Adult (>18 years)	Incidental Ingestion Dermal Contact Inhalation of Vapors	Quantitative Quantitative Quantitative	Workers may be tasked with collecting shoreline trash or other work that leads to contact with sediment along the river. Inhalation may occur if activities are in mudflat areas and volatiles are present. Contact with surface water is not typically expected to occur.
				Resident	Child (1 to <7 years)	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	Residential properties are located near the bay. Residents may contact sediment during activities near their homes. Potential risks relative to other receptors are discussed in the uncertainty section. Potential risks are addressed qualitatively.
					Adult (>18 years)	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	
				Transient Person	Multiple ages	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section.
	Surface Water	Surface Water	Baywide	Angler/ Sportsman	Child (1 to <7 years)	Incidental Ingestion	None	Anglers may contact surface water while fishing or crabbing from the bank. Assumes that young children (1 to <7 years) would not typically accompany adult anglers due to safety concerns. Inhalation may occur if volatiles are present.

Table 1. Selection of Exposure Pathways (continued)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/ Future (Continued)						Dermal Contact	None	
						Inhalation of Vapors	None	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Swimmer	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Swimming is a completed exposure pathway. Swimmers may contact surface water while swimming or wading into the Bay. A wading scenario where the receptor does more than walk into the water up to his knees is encompassed by the swimming scenario. Inhalation may occur if volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Wader	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Families visiting parks along the banks or wading down by the bay to bird watch may come into contact with surface water along the banks. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
Current/ Future (Continued)					Adult (>18 years)	Incidental Ingestion	Quantitative	

Table 1. Selection of Exposure Pathways (continued)

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Boater	Child (1 to <7 years)	Incidental Ingestion	Quantitative	Recreational boating, including some kayaking, takes place in the bay. Docks are typically used, but boaters may occasionally contact surface water when a boat flips and wading is necessary. Inhalation may occur if activities are in mudflat areas and volatiles are present.
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adolescent (7 to <19 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
					Adult (>18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Inhalation of Vapors	Quantitative	
				Resident	Child (1 to <7 years)	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	Residents may contact surface water during activities near their homes. Potential risks relative to other receptors are discussed in the uncertainty section. Potential risks are addressed qualitatively.
					Adult (>18 years)	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	
				Transient Person	Multiple ages	Incidental Ingestion Dermal Contact Inhalation of Vapors	Qualitative Qualitative Qualitative	Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section.

Table 2.1. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Sediment

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)		Maximum Concentration (Qualifier) (mg/kg) (a)		Location of Maximum Concentration	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (b)	Screening Level (N/C) (mg/kg) (c)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
VOCS																	
No VOCs were detected																	
SVOCs																	
105-67-9	2,4-Dimethylphenol	0.023	U	0.13		NB03SED178	19	2	11%	0.023	0.043	0.13	130	N	N	N	Maximum Does Not Exceed SL
88-74-4	2-Nitroaniline	0.023	U	0.043	UJ	NB03SED177	19	1	5%	0.023	0.043	0.043	63	N	N	N	Maximum Does Not Exceed SL
106-44-5	4-Methylphenol	0.023	U	0.19	J	NB03SED143	20	11	55%	0.023	0.043	0.19	630	N	N	N	Maximum Does Not Exceed SL
98-86-2	Acetophenone	0.023	U	0.18	J	NB03SED168	24	12	50%	0.023	0.046	0.18	780	N	N	N	Maximum Does Not Exceed SL
92-52-4	1,1-Biphenyl	0.023	U	0.06	J	NB03SED178	19	2	11%	0.023	0.043	0.06	4.7	N	N	N	Maximum Does Not Exceed SL
117-81-7	bis(2-Ethylhexyl)phthalate	0.090	U	38	DJ	NB03SED172	23	19	83%	0.09	1.4	38	39	C	N	N	Maximum Does Not Exceed SL
86-74-8	Carbazole	0.023	U	0.48	J	NB03SED172	20	9	45%	0.023	0.043	0.48	240	N	N	N	Maximum Does Not Exceed SL
132-64-9	Dibenzofuran	0.023	U	0.24	J	NB03SED172	20	9	45%	0.023	0.043	0.24	7.3	N	N	N	Maximum Does Not Exceed SL
84-74-2	Di-n-Butylphthalate	0.090	U	0.17	J	NB03SED149, NB03SED166, NB03SED177	19	1	5%	0.09	0.17	0.17	630	N	N	N	Maximum Does Not Exceed SL
117-84-0	Di-n-Octylphthalate	0.090	U	0.25	J	NB03SED160	19	1	5%	0.09	0.17	0.25	63	N	N	N	Maximum Does Not Exceed SL
118-74-1	Hexachlorobenzene	0.00021	JB	0.0038	B	NB03SED176	24	24	100%	5.3E-06	5.3E-06	0.0038	0.21	C	N	N	Maximum Does Not Exceed SL
1002-53-5	Dibutyltin	0.0017	U	0.015	J	NB03SED176	24	4	17%	0.0017	0.0036	0.015	1.9	N	N	N	Maximum Does Not Exceed SL
688-73-3	Tributyltin	0.0020	U	0.016	PJ	NB03SED164	24	5	21%	0.002	0.0042	0.016	2.3	N	N	N	Maximum Does Not Exceed SL
108-95-2	Phenol	0.023	U	0.14		NB03SED164	19	3	16%	0.023	0.043	0.14	1900	N	N	N	Maximum Does Not Exceed SL
PAHs																	
90-12-0	1-Methylnaphthalene	0.0010	U	0.046		NB03SED167	24	17	71%	0.0009	0.016	0.046	18	C	N	N	Maximum Does Not Exceed SL
91-57-6	2-Methylnaphthalene	0.0013	J	0.076		NB03SED167	24	23	96%	0.0009	0.016	0.076	24	N	N	N	Maximum Does Not Exceed SL
83-32-9	Acenaphthene	0.0010	U	0.053		NB03SED167	24	22	92%	0.0009	0.016	0.053	360	N	N	N	Maximum Does Not Exceed SL
208-96-8	Acenaphthylene	0.0017	U	0.081		NB03SED164	24	23	96%	0.0009	0.016	0.081	360	N	N	N	Maximum Does Not Exceed SL
120-12-7	Anthracene	0.0020	J	0.091		NB03SED164	24	24	100%	0.0009	0.016	0.091	1800	N	N	N	Maximum Does Not Exceed SL
56-55-3	Benzo(a)anthracene	0.0063		0.32	J-	NB03SED164	24	24	100%	0.0009	0.016	0.32	1.1	C	N	Y	Include as carcinogenic PAH
50-32-8	Benzo(a)pyrene	0.0072		0.39	J-	NB03SED164, NB03SED149	24	24	100%	0.0009	0.016	0.39	0.11	C	N	Y	Maximum Exceeds SL
205-99-2	Benzo(b)fluoranthene	0.0067		0.31	J-	NB03SED149	24	24	100%	0.0009	0.016	0.31	1.1	C	N	Y	Include as carcinogenic PAH
192-97-2	Benzo(e)pyrene	0.0056		0.27		NB03SED149	24	24	100%	0.0009	0.016	0.27	180	N	N	N	Maximum Does Not Exceed SL
191-24-2	Benzo(g,h,i)perylene	0.0051		0.24	J-	NB03SED149	24	24	100%	0.0009	0.016	0.24	180	N	N	N	Maximum Does Not Exceed SL
207-08-9-JK	Benzo(j,k)fluoranthene	0.0059		0.31	J-	NB03SED149	24	24	100%	0.0009	0.016	0.31	11	C	N	Y	Include as carcinogenic PAH
30037	C1-Chrysenes	0.0059		0.29		NB03SED164	24	24	100%	0.0009	0.016	0.29	110	C	N	N	Maximum Does Not Exceed SL
30039	C1-Fluoranthenes/Pyrenes	0.0092		0.44		NB03SED164, NB03SED149	24	24	100%	0.0009	0.016	0.44	180	N	N	N	Maximum Does Not Exceed SL
30040	C1-Fluorenes	0.0013	J	0.042		NB03SED164	24	22	92%	0.0009	0.016	0.042	240	N	N	N	Maximum Does Not Exceed SL
30041	C1-Naphthalenes	0.0016	J	0.083		NB03SED167	24	23	96%	0.0009	0.016	0.083	3.8	C	N	N	Maximum Does Not Exceed SL
30042	C1-Phenanthrenes/Anthracenes	0.0038	J	0.19		NB03SED164, NB03SED170	24	24	100%	0.0009	0.016	0.19	1800	N	N	N	Maximum Does Not Exceed SL
30058	C2-Chrysenes	0.0059		0.26		NB03SED149	24	24	100%	0.0009	0.016	0.26	110	C	N	N	Maximum Does Not Exceed SL
30367	C2-Fluoranthenes/Pyrenes	0.0059		0.31		NB03SED149	24	24	100%	0.0009	0.016	0.31	180	N	N	N	Maximum Does Not Exceed SL
30060	C2-Fluorenes	0.0010	U	0.044		NB03SED164	24	11	46%	0.0009	0.016	0.044	240	N	N	N	Maximum Does Not Exceed SL
30061	C2-Naphthalenes	0.0017	U	0.064		NB03SED170	24	23	96%	0.0009	0.016	0.064	3.8	C	N	N	Maximum Does Not Exceed SL
PHENANTHC2	C2-Phenanthrene/anthracenes	0.0067		0.24		NB03SED178	24	24	100%	0.0009	0.016	0.24	1800	N	N	N	Maximum Does Not Exceed SL
30068	C3-Chrysenes	0.0029	J	0.17		NB03SED149	24	24	100%	0.0009	0.016	0.17	110	C	N	N	Maximum Does Not Exceed SL
30368	C3-Fluoranthenes/Pyrenes	0.0043	J	0.25		NB03SED149	24	24	100%	0.0009	0.016	0.25	180	N	N	N	Maximum Does Not Exceed SL
30070	C3-Fluorenes	0.0010	U	0.078		NB03SED178	24	4	17%	0.0009	0.016	0.078	240	N	N	N	Maximum Does Not Exceed SL
30071	C3-Naphthalene	0.0027		0.090		NB03SED178	24	24	100%	0.0009	0.016	0.090	3.8	C	N	N	Maximum Does Not Exceed SL
PHENANTHC3	C3-Phenanthrene/anthracenes	0.0066		0.22		NB03SED178	24	24	100%	0.0009	0.016	0.22	1800	N	N	N	Maximum Does Not Exceed SL
30074	C4-Chrysenes	0.0010	U	0.13		NB03SED149	24	15	63%	0.0009	0.016	0.13	110	C	N	N	Maximum Does Not Exceed SL
30077	C4-Naphthalene	0.0030		0.13		NB03SED178	24	24	100%	0.0009	0.016	0.13	3.8	C	N	N	Maximum Does Not Exceed SL
30078	C4-Phenanthrenes/anthracenes	0.00090	U	0.20		NB03SED173	24	4	17%	0.0009	0.016	0.20	1800	N	N	N	Maximum Does Not Exceed SL
218-01-9	Chrysene	0.0067		0.35	J-	NB03SED149	24	24	100%	0.0009	0.016	0.35	110	C	N	Y	Include as carcinogenic PAH
53-70-3	Dibenzo(a,h)anthracene	0.0017	U	0.068	J-	NB03SED149	24	23	96%	0.0009	0.016	0.068	0.11	C	N	Y	Include as carcinogenic PAH

Table 2.1. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Sediment (continued)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)		Maximum Concentration (Qualifier) (mg/kg) (a)		Location of Maximum Concentration	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (b)	Screening Level (N/C) (mg/kg) (c)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
206-44-0	Fluoranthene	0.011		0.54	J-	NB03SED170	24	24	100%	0.0009	0.016	0.54	240	N	N	N	Maximum Does Not Exceed SL
86-73-7	Fluorene	0.0010	U	0.046		NB03SED167	24	21	88%	0.0009	0.016	0.046	240	N	N	N	Maximum Does Not Exceed SL
193-39-5	Indeno(1,2,3-cd)pyrene	0.0054		0.26	J-	NB03SED149	24	24	100%	0.0009	0.016	0.26	1.1	C	N	Y	Include as carcinogenic PAH
91-20-3	Naphthalene	0.0018	J	0.14		NB03SED164	24	24	100%	0.0009	0.016	0.14	3.8	C	N	N	Maximum Does Not Exceed SL
198-55-0	Perylene	0.0028	J	0.096		NB03SED149	24	24	100%	0.0009	0.016	0.096	180	N	N	N	Maximum Does Not Exceed SL
85-01-8	Phenanthrene	0.0028	J	0.34		NB03SED170	24	24	100%	0.0009	0.016	0.34	1800	N	N	N	Maximum Does Not Exceed SL
129-00-0	Pyrene	0.010		0.55	J-	NB03SED170	24	24	100%	0.0009	0.016	0.55	180	N	N	N	Maximum Does Not Exceed SL
PCBs/Dioxins/Furans																	
WHOPCBTEQ(H)	PCB TEQ	1.1E-07	BT	2.1E-05	BT	NB03SED176	24	24	100%	NA	NA	2.1E-05	4.8E-06	C	N	Y	Maximum Exceeds SL
WHODIOXTEQ(H)	Dioxin/Furan TEQ	3.6E-06	BJ	0.00030	BJ	NB03SED173	24	24	100%	NA	NA	0.00030	4.8E-06	C	N	Y	Maximum Exceeds SL
TPCB Cong-209	Total PCBs	0.0025	BT	0.54	BT	NB03SED176	24	24	100%	NA	NA	0.54	0.23	C	N	Y	Maximum Exceeds SL
Pesticides/Herbicides																	
93-76-5	2,4,5-T	0.0011	UJ	0.0070	J	NB03SED174	24	6	25%	0.0011	0.0022	0.0070	63	N	N	N	Maximum Does Not Exceed SL
53-19-0	2,4'-DDD	0.00024		0.044	D	NB03SED173	24	24	100%	5.0E-06	5.0E-06	0.044	0.19	C	N	N	Maximum Does Not Exceed SL
3424-82-6	2,4'-DDE	0.00031		0.11	D	NB03SED173	24	24	100%	5.0E-06	5.0E-06	0.11	2	C	N	N	Maximum Does Not Exceed SL
789-02-6	2,4'-DDT	6.1E-06	UJ	0.0013		NB03SED177	24	20	83%	6.1E-06	6.1E-06	0.0013	1.9	C	N	N	Maximum Does Not Exceed SL
72-54-8	4,4'-DDD	0.00086	B	0.073	BD	NB03SED176	24	24	100%	5.2E-06	5.2E-06	0.073	0.19	C	N	N	Maximum Does Not Exceed SL
72-55-9	4,4'-DDE	0.0011	B	0.24	BD	NB03SED173	24	24	100%	8.1E-06	8.1E-06	0.24	2	C	N	N	Maximum Does Not Exceed SL
50-29-3	4,4'-DDT	0.00024	B	0.0099	JB	NB03SED164	24	24	100%	9.2E-06	9.2E-06	0.0099	1.9	C	N	N	Maximum Does Not Exceed SL
319-84-6	Alpha-BHC	8.1E-06	J	0.00036		NB03SED174	24	24	100%	7.9E-06	7.9E-06	0.00036	0.086	C	N	N	Maximum Does Not Exceed SL
5103-71-9	Alpha-Chlordane	9.6E-06	U	0.0075	J	NB03SED161	24	23	96%	9.6E-06	9.6E-06	0.0075	1.7	C	N	N	Maximum Does Not Exceed SL
319-85-7	Beta-BHC	6.6E-06	J	0.00016	J	NB03SED161	24	17	71%	1.3E-05	1.3E-05	0.00016	0.3	C	N	N	Maximum Does Not Exceed SL
5103-73-1	cis-Nonachlor	1.0E-05	UJ	0.0021	J	NB03SED136	24	22	92%	1.0E-05	1.0E-05	0.0021	1.7	C	N	N	Maximum Does Not Exceed SL
319-86-8	Delta-BHC	7.3E-06	UJ	2.2E-05	J	NB03SED161	24	2	8%	7.3E-06	7.3E-06	2.2E-05	0.086	C	N	N	Maximum Does Not Exceed SL
60-57-1	Dieldrin	1.1E-05	U	0.0035	B	NB03SED149	24	23	96%	1.1E-05	1.1E-05	0.0035	0.034	C	N	N	Maximum Does Not Exceed SL
959-98-8	Endosulfan I	2.1E-05	UJ	0.00022	UJ	NB03SED166	24	2	8%	2.1E-05	2.1E-05	0.00022	47	N	N	N	Maximum Does Not Exceed SL
58-89-9	Gamma-BHC (Lindane)	6.3E-06	J	0.00011		NB03SED174	24	6	25%	7.3E-06	7.3E-06	0.00011	0.57	C	N	N	Maximum Does Not Exceed SL
76-44-8	Heptachlor	1.0E-05	UJ	0.00015		NB03SED174	24	4	17%	1.0E-05	1.0E-05	0.00015	0.13	C	N	N	Maximum Does Not Exceed SL
1024-57-3	Heptachlor Epoxide	9.4E-06	U	0.00055	J	NB03SED136	24	16	67%	9.4E-06	9.4E-06	0.00055	0.07	C	N	N	Maximum Does Not Exceed SL
72-43-5	Methoxychlor	1.2E-05	UJ	0.0014	J	NB03SED161	20	1	5%	1.2E-05	1.2E-05	0.0014	32	N	N	N	Maximum Does Not Exceed SL
2385-85-5	Mirex	4.9E-06	UJ	0.00021	J	NB03SED167	22	3	14%	4.9E-06	4.9E-06	0.00021	0.036	C	N	N	Maximum Does Not Exceed SL
39765-80-5	Nonachlor, trans-	7.6E-06	U	0.0040	J	NB03SED136	24	23	96%	7.6E-06	7.6E-06	0.0040	1.7	C	N	N	Maximum Does Not Exceed SL
27304-13-8	Oxychlordane	1.1E-05	UJ	4.2E-05		NB03SED142, NB03SED175	24	4	17%	1.1E-05	1.1E-05	4.2E-05	1.7	C	N	N	Maximum Does Not Exceed SL
TOT_AGChlor	Total Alpha + Gamma Chlordane	1.1E-05	U	0.014	J	NB03SED161	24	23	96%	1.1E-05	1.1E-05	0.014	1.7	C	N	N	Maximum Does Not Exceed SL
5103-74-2	trans-Chlordane	1.1E-05	U	0.0072	J	NB03SED170	24	23	96%	1.1E-05	1.1E-05	0.0072	1.7	C	N	N	Maximum Does Not Exceed SL
28044-83-9	trans-Heptachlor Epoxide	1.3E-05	UJ	0.00060		NB03SED176	24	14	58%	1.3E-05	1.3E-05	0.00060	0.07	C	N	N	Maximum Does Not Exceed SL
Inorganics																	
7429-90-5	Aluminum	4670		23300	J	NB03SED178	24	24	100%	7.44	14.8	23300	7700	N	N	Y	Maximum Exceeds SL
7440-36-0	Antimony	0.088	U	4.4	J	NB03SED161	24	23	96%	0.0877	0.175	4.4	3.1	N	N	Y	Maximum Exceeds SL
7440-38-2	Arsenic	2.4		56	J	NB03SED178	24	24	100%	0.199	0.397	56	0.68	C	Y	Y	Maximum Exceeds SL
7440-39-3	Barium	32		374	J	NB03SED178	24	24	100%	0.244	0.487	374	1500	N	N	N	Maximum Does Not Exceed SL
7440-41-7	Beryllium	0.31		1.8	J	NB03SED176	24	24	100%	0.0189	0.0376	1.8	16	N	N	N	Maximum Does Not Exceed SL
7440-43-9	Cadmium	0.14		4.1	J	NB03SED176	24	24	100%	0.0611	0.122	4.1	7.1	N	N	N	Maximum Does Not Exceed SL
7440-47-3	Chromium (total)	21		280	J	NB03SED173	24	24	100%	0.133	0.265	280	12000	N	N	N	Maximum Does Not Exceed SL
7440-48-4	Cobalt	4.3		19	J	NB03SED178	24	24	100%	0.0266	0.053	19	2.3	N	N	Y	Maximum Exceeds SL
7440-50-8	Copper	19		366	J	NB03SED176	24	24	100%	0.106	0.212	366	310	N	N	Y	Maximum Exceeds SL
18540-29-9	Chromium (VI)	0.68	U	2.0	B	NB03SED140	23	2	9%	0.68	1.4	2.0	0.3	C	Y	Y	Maximum Exceeds SL
7439-89-6	Iron	9060		47600	J	NB03SED178	24	24	100%	6.14	12.2	47600	5500	N	N	Y	Maximum Exceeds SL
7439-92-1	Lead	39		441	J	NB03SED178	24	24	100%	0.0345	0.0689	441	200	N	N	Y	Maximum Exceeds SL
7439-96-5	Manganese	77		589	J	NB03SED178	24	24	100%	0.223	0.445	589	180	N	N	Y	Maximum Exceeds SL
7439-97-6	Mercury	0.17	J	4.5	J	NB03SED176	24	24	100%	0.00321	0.0116	4.5	2.3	N	N	Y	Maximum Exceeds SL
22967-92-6	Methyl Mercury	0.00033	J	0.0050	J	NB03SED149	24	24	100%	1.9E-05	4.2E-04	0.0050	0.78	N	N	N	Maximum Does Not Exceed SL

Table 2.1. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Sediment (continued)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)		Maximum Concentration (Qualifier) (mg/kg) (a)		Location of Maximum Concentration	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (b)	Screening Level (N/C) (mg/kg) (c)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
7440-02-0	Nickel	17		182	J	NB03SED172	24	24	100%	0.25	0.498	182	150	N	N	Y	Maximum Exceeds SL
7723-14-0	Phosphorus	158		1590		NB03SED161	24	24	100%	13.3	268	1590	380000	N	N	N	Maximum Does Not Exceed SL
7782-49-2	Selenium	0.15	B	3.7	J	NB03SED178	24	24	100%	0.133	0.265	3.7	39	N	N	N	Maximum Does Not Exceed SL
7440-22-4	Silver	0.19		4.6	J	NB03SED176	24	24	100%	0.0266	0.053	4.6	39	N	N	N	Maximum Does Not Exceed SL
7440-28-0	Thallium	0.059	B	0.72	J	NB03SED161	24	24	100%	0.0398	0.0795	0.72	0.078	N	N	Y	Maximum Exceeds SL
7440-32-6	Titanium	200		675	J	NB03SED174	24	24	100%	0.226	0.45	675	NA		N	N	Maximum Does Not Exceed SL
7440-62-2	Vanadium	12		67	J	NB03SED178	24	24	100%	0.0398	0.0795	67	39	N	N	Y	Maximum Exceeds SL
7440-66-6	Zinc	80		752	J	NB03SED176	24	24	100%	0.983	1.96	752	2300	N	N	N	Maximum Does Not Exceed SL

Footnotes:
(a) Data Qualifiers:
"J " estimated value
"J-" estimated value, but the result may be biased high
"U" analyzed for but not detected
"T" indicates a summed quantity
"B" the associated analyte was also detected in the method blank for organics; or for inorganics, reported value was obtained from an instrument reading that was less than the project quantitation limit (PQL)
"P" the percent difference between the primary and confirmation column for pesticide/Aroclor analyses is greater than 25%
"D" the organic analyte was quantitated from a diluted analysis
(b) Maximum detected concentration selected for the Concentration Used for Screening.
(c) USEPA Regional Screening Levels for Residential Soil. November 2017. Values based on noncarcinogenic effects are adjusted for a target hazard quotient of 0.1 to account for potential cumulative effects on the same target organ. N - noncarcinogenic; C - carcinogenic. Chemicals for which surrogate values have been identified are presented in Section 5.0, Table 5-1.
(d) See the COPC Selection Process (Section 5.1 of the PAR) for details.

CAS - Chemical Abstracts Service
COPC - Chemical of Potential Concern
FOD - Frequency of Detection
mg/kg - Milograms per kilogram

N - No
NA - Not Available
Y - Yes
SL - screening level

Table 2.2. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Surface Water

CAS Number	Chemical	Minimum Concentration (ug/L) (a)		Maximum Concentration (ug/L) (a)		Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (ug/L)		Concentration Used for Screening (b)	Screening Level (N/C) (ug/L)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
VOCs																
71-55-6	1,1,1-Trichloroethane	0.075	U	0.50	U	81	4	5%	0.075	0.075	0.50	800	N	N	N	Maximum Does Not Exceed SL
67-66-3	Chloroform	0.072	U	0.16	J	81	29	36%	0.072	0.072	0.16	0.22	C	N	N	Maximum Does Not Exceed SL
74-87-3	Chloromethane	0.068	U	0.50	U	81	21	26%	0.068	0.068	0.50	19	N	N	N	Maximum Does Not Exceed SL
156-59-2	cis-1,2-Dichloroethylene	0.070	J	0.19	J	81	81	100%	0.067	0.067	0.19	3.6	N	N	N	Maximum Does Not Exceed SL
100-41-4	Ethylbenzene	0.050	J, U	0.50	U	80	2	3%	0.05	0.05	0.50	1.5	C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
179601-23-1	m,p-Xylenes	0.091	U	0.50	U	81	9	11%	0.091	0.11	0.50	19	N	N	N	Maximum Does Not Exceed SL
75-09-2	Methylene Chloride	0.100	U	2	U	81	2	2%	0.1	0.1	2.0	11	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
127-18-4	Tetrachloroethylene	0.099	U	0.50	U	81	44	54%	0.099	0.099	0.50	4.1	N	N	N	Maximum Does Not Exceed SL
108-88-3	Toluene	0.052	U	0.23	J	80	4	5%	0.052	0.054	0.23	110	N	N	N	Maximum Does Not Exceed SL
79-01-6	Trichloroethene	0.10	J, U	0.50	U	81	46	57%	0.1	0.141	0.50	0.28	N	Y	Y	Maximum Exceeds SL
106-46-7	1,4-Dichlorobenzene	0.12	J, U	0.50	U	80	1	1%	0.12	0.12	0.50	0.48	C	N	N	Less than 5% FOD
SVOCs																
108-60-1	2,2'-oxybis(1-Chloropropane)	0.019	U, UJ	0.045	J	82	1	1%	0.019	0.021	0.045	71	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
2245-38-7	2,3,5-Trimethylnaphthalene	0.0016	U, UJ	0.0070	J	79	48	61%	0.0016	0.0016	0.0070	0.17	C	N	N	Maximum Does Not Exceed SL
120-83-2	2,4-Dichlorophenol	0.032	U	0.038	J	82	1	1%	0.032	0.036	0.038	4.6	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
121-14-2	2,4-Dinitrotoluene	0.051	U	0.21	J	82	1	1%	0.051	0.058	0.21	0.24	C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
581-42-0	2,6-Dimethylnaphthalene	0.0022	J, U	0.0206		79	58	73%	0.0022	0.0022	0.021	0.17	C	N	N	Maximum Does Not Exceed SL
91-58-7	2-Chloronaphthalene	0.014	U	0.043	J	82	1	1%	0.014	0.016	0.043	75	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
106-44-5	4-Methylphenol (p-Cresol)	0.085	U	0.098	U	82	1	1%	0.085	0.098	0.098	190	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
100-52-7	Benzaldehyde	0.14	U, UJ	0.87	J	82	6	7%	0.14	0.16	0.87	19	C	N	N	Maximum Does Not Exceed SL
117-81-7	bis-(2-Ethylhexyl)phthalate	1.2	U, UJ	2.7		82	3	4%	1.2	1.4	2.7	5.6	C	N	N	Maximum Does Not Exceed SL
74-83-9	Bromomethane	0.090	U, UJ	0.50	U, UJ	81	1	1%	0.09	0.10	0.50	0.75	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
85-68-7	Butylbenzylphthalate	0.13	U	0.61	J	82	27	33%	0.13	0.15	0.61	16	C	N	N	Maximum Does Not Exceed SL
105-60-2	Caprolactam	1.1	U, UJ	2.2	J	82	4	5%	1.1	1.3	2.2	990	N	N	N	Maximum Does Not Exceed SL
86-74-8	Carbazole	0.015	U	0.047	J	82	1	1%	0.015	0.017	0.047	29	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
132-65-0	Dibenzothiophene	0.00069	U	0.0058	J	79	57	72%	0.00069	0.00069	0.0058	6.5	N	N	N	Maximum Does Not Exceed SL
84-66-2	Diethylphthalate	0.14	J, U	0.32	J	82	14	17%	0.14	0.16	0.32	1500	N	N	N	Maximum Does Not Exceed SL
84-74-2	Di-n-butylphthalate	0.12	U	0.36	J	82	4	5%	0.12	0.14	0.36	90	N	N	N	Maximum Does Not Exceed SL
118-74-1	Hexachlorobenzene	4.0E-07	U	0.0002	J	80	5	6%	4.0E-07	1.3E-05	0.00019	0.0098	C	N	N	Maximum Does Not Exceed SL
78-59-1	Isophorone	0.061	U	0.070	U	82	1	1%	0.061	0.07	0.07	78	C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
108-95-2	Phenol	0.055	U	0.063	U	82	1	1%	0.055	0.063	0.063	580	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
14488-53-0	Dibutyltin	0.0073	U, UJ	0.11		81	1	1%	0.0073	0.014	0.11	0.60	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
78763-54-9	Monobutyltin	0.029	U, UJ	0.18	J	81	2	2%	0.029	0.029	0.18	0.60	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
36643-28-4	Tributyltin	0.012	U, UJ	0.050	U, UJ	81	1	1%	0.012	0.012	0.05	0.60	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
PAHs																
90-12-0	1-Methylnaphthalene	0.0041	U, UJ	0.035		79	36	46%	0.0041	0.0041	0.035	1.1	C	N	N	Maximum Does Not Exceed SL
832-69-9	1-Methylphenanthrene	0.0007	U	0.011		79	71	90%	0.0007	0.0007	0.011	180	N	N	N	Maximum Does Not Exceed SL
91-57-6	2-Methylnaphthalene	0.0083	U, UJ	0.043		161	32	20%	0.0083	0.013	0.043	3.6	N	N	N	Maximum Does Not Exceed SL
83-32-9	Acenaphthene	0.0039	J	0.046		161	80	50%	0.0024	0.016	0.046	53	N	N	N	Maximum Does Not Exceed SL
208-96-8	Acenaphthylene	0.0002	U	0.045	J	161	58	36%	0.00015	0.017	0.045	53	N	N	N	Maximum Does Not Exceed SL
120-12-7	Anthracene	0.0012	J	0.039	J	53	53	100%	0.00071	0.015	0.039	180	N	N	N	Maximum Does Not Exceed SL
56-55-3	Benzo(a)anthracene	0.0015	U, UJ	0.33		161	65	40%	0.0015	0.016	0.33	0.03	C	N	Y	Maximum Exceeds SL
50-32-8	Benzo(a)pyrene	0.0004	U, UJ	0.24		161	53	33%	0.0004	0.015	0.24	0.025	C	N	Y	Maximum Exceeds SL
205-99-2	Benzo(b)fluoranthene	0.0015	U, UJ	0.64		161	57	35%	0.0015	0.017	0.64	0.25	C	N	Y	Maximum Exceeds SL
192-97-2	Benzo(E)pyrene	0.0014	U, UJ	0.040		79	59	75%	0.0014	0.0014	0.040	12	N	N	N	Maximum Does Not Exceed SL
191-24-2	Benzo(g,h,i)perylene	0.00051	U	0.19	J	161	55	34%	0.00051	0.016	0.19	12	N	N	N	Maximum Does Not Exceed SL
207-08-9	Benzo(k)fluoranthene	0.001	U, UJ	0.18	J	161	59	37%	0.001	0.059	0.18	2.5	C	N	Y	Include as Carcinogenic PAH
BACC1	C1-Benzanthracene/chrysenes	0.010	U, UJ	0.053		79	30	38%	0.01	0.01	0.053	25	C	N	N	Maximum Does Not Exceed SL
FLRC1	C1-Fluorenes	0.010	U, UJ	0.015		79	2	3%	0.01	0.01	0.015	29	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
PATAC1	C1-Phenanthrene/anthracenes	0.010	U, UJ	0.033		79	36	46%	0.01	0.01	0.033	180	N	N	N	Maximum Does Not Exceed SL
PFLAC1	C1-Pyrene/fluoranthenes	0.010	U	0.076		79	64	81%	0.01	0.01	0.076	12	N	N	N	Maximum Does Not Exceed SL
BACC2	C2-Benzanthracene/chrysenes	0.010	U, UJ	0.024		79	5	6%	0.01	0.01	0.024	25	C	N	N	Maximum Does Not Exceed SL
DTPC2	C2-Dibenzothiophenes	0.010	U, UJ	0.014		79	2	3%	0.01	0.01	0.014	6.5	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
FLRC2	C2-Fluorenes	0.010	U, UJ	0.020		79	8	10%	0.01	0.01	0.020	29	N	N	N	Maximum Does Not Exceed SL

Table 2.2. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Surface Water (continued)

CAS Number	Chemical	Minimum Concentration (ug/L) (a)		Maximum Concentration (ug/L) (a)		Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (ug/L)		Concentration Used for Screening (b)	Screening Level (N/C) (ug/L)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
NPHC2	C2- Naphthalenes	0.010	U, UJ	0.051		79	30	38%	0.01	0.01	0.051	0.17	C	N	N	Maximum Does Not Exceed SL
PATAC2	C2-Phenanthrene/anthracenes	0.010	U, UJ	0.039		79	44	56%	0.01	0.01	0.039	180	N	N	N	Maximum Does Not Exceed SL
BACC3	C3-Benzanthracene/chrysenes	0.010	U, UJ	0.011		79	1	1%	0.01	0.01	0.011	25	C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
DTPC3	C3-Dibenzothiophenes	0.010	U, UJ	0.014		79	2	3%	0.01	0.01	0.014	6.5	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
FLRC3	C3-Fluorenes	0.010	U, UJ	0.021		79	3	4%	0.01	0.01	0.021	29	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
NPHC3	C3-Naphthalene	0.010	U, UJ	0.023		79	27	34%	0.01	0.01	0.023	0.17	C	N	N	Maximum Does Not Exceed SL
PATAC3	C3-Phenanthrene/anthracenes	0.010	U, UJ	0.028		79	12	15%	0.01	0.01	0.028	180	N	N	N	Maximum Does Not Exceed SL
DTPC4	C4-Dibenzothiophenes	0.010	U, UJ	0.050		79	1	1%	0.01	0.01	0.050	6.5	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
NPHC4	C4- Naphthalene	0.010	U, UJ	0.024		79	32	41%	0.01	0.01	0.024	0.17	C	N	N	Maximum Does Not Exceed SL
PATAC4	C4-Phenanthrenes/anthracenes	0.010	U, UJ	0.016		79	2	3%	0.01	0.01	0.016	180	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
218-01-9	Chrysene	0.00022	U	0.31		161	81	50%	0.00022	0.015	0.31	25	C	N	Y	Include as Carcinogenic PAH
53-70-3	Dibenzo(a,h)anthracene	0.00078	U	0.46		161	51	32%	0.00078	0.017	0.46	0.025	C	N	Y	Maximum Exceeds SL
206-44-0	Fluoranthene	0.011		0.45		161	100	62%	0.0024	0.018	0.45	80	N	N	N	Maximum Does Not Exceed SL
86-73-7	Fluorene	0.0015	U	0.042	J	161	41	25%	0.0015	0.023	0.042	29	N	N	N	Maximum Does Not Exceed SL
193-39-5	Indeno(1,2,3-cd)pyrene	0.001	U	0.36		161	61	38%	0.001	0.022	0.36	0.25	C	N	Y	Maximum Exceeds SL
91-20-3	Naphthalene	0.013	U	0.095	J	161	48	30%	0.013	0.016	0.095	0.17	C	N	N	Maximum Does Not Exceed SL
198-55-0	Perylene	0.00081	U	0.022		79	55	70%	0.00081	0.00081	0.022	12	N	N	N	Maximum Does Not Exceed SL
85-01-8	Phenanthrene	0.011	U, UJ	0.097	J	161	52	32%	0.011	0.046	0.097	180	N	N	N	Maximum Does Not Exceed SL
129-00-0	Pyrene	0.015	U, UJ	0.32		161	95	59%	0.0017	0.017	0.32	12	N	N	N	Maximum Does Not Exceed SL
PCBs/Dioxins/Furans																
	PCB TEQ	4.9E-08		1.5E-06		121	121	100%	NA	NA	1.5E-06	1.2E-07	C	N	Y	Maximum Exceeds SL
	Dioxin/Furan TEQ	1.5E-06		9.9E-06		122	119	98%	NA	NA	9.9E-06	1.2E-07		N	Y	Maximum Exceeds SL
	Total PCBs	0.0022		0.015		121	121	100%	NA	NA	0.015	0.044	C	N	N	Maximum Does Not Exceed SL
Pesticides/Herbicides																
53-19-0	2,4'-DDD	1.9E-05	U	0.0003	J	79	63	80%	9.3E-06	0.00025	0.00033	0.0063	N	N	N	Maximum Does Not Exceed SL
3424-82-6	2,4'-DDE	1.7E-05	U	0.00049	U	79	31	39%	1.1E-05	0.00049	0.00049	0.046	C	N	N	Maximum Does Not Exceed SL
789-02-6	2,4'-DDT	1.3E-05	U	0.00033	U	79	4	5%	1.3E-05	0.00033	0.00033	0.23	C	N	N	Maximum Does Not Exceed SL
72-54-8	4,4'-DDD	1.1E-05	U	0.0012		80	70	88%	0.00001	0.00026	0.0012	0.0063	N	N	N	Maximum Does Not Exceed SL
72-55-9	4,4'-DDE	4.5E-05	U	0.0012		79	61	77%	1.3E-05	0.00069	0.0012	0.046	C	N	N	Maximum Does Not Exceed SL
50-29-3	4,4'-DDT	2.1E-05	U	0.0006		79	41	52%	1.3E-05	0.00036	0.00064	0.23	C	N	N	Maximum Does Not Exceed SL
309-00-2	Aldrin	3.3E-06	U	0.0002	J	79	9	11%	3.3E-06	0.0001	0.00016	0.00092	C	N	N	Maximum Does Not Exceed SL
319-84-6	alpha-BHC	3.9E-06	U	0.001	J	80	69	86%	3.6E-06	0.00013	0.00097	0.0072	C	N	N	Maximum Does Not Exceed SL
319-85-7	beta-BHC	5.5E-06	U	0.001	J	80	56	70%	5.5E-06	0.00016	0.00098	0.025	C	N	N	Maximum Does Not Exceed SL
5103-71-9	cis-Chlordane	5.8E-05	EMPC-J	0.00053		80	80	100%	6.1E-06	0.00018	0.00053	0.020	C	N	N	Maximum Does Not Exceed SL
5103-73-1	cis-Nonachlor	8.8E-06	U	0.00018	U	79	46	58%	8.1E-06	0.00018	0.00018	0.020	C	N	N	Maximum Does Not Exceed SL
319-86-8	delta-BHC	6.7E-06	U	0.0014	J	79	14	18%	6.3E-06	0.0002	0.0014	0.0072	C	N	N	Maximum Does Not Exceed SL
60-57-1	Dieldrin	9.6E-06	U	0.0016	J	80	77	96%	7.6E-06	0.00011	0.0016	0.0018	C	N	N	Maximum Does Not Exceed SL
959-98-8	Endosulfan I	1.8E-05	U	0.0005		79	6	8%	1.5E-05	0.0005	0.00054	10	N	N	N	Maximum Does Not Exceed SL
33213-65-9	Endosulfan II	2.7E-05	U	0.0008		79	5	6%	2.7E-05	0.00054	0.00079	10	N	N	N	Maximum Does Not Exceed SL
1031-07-8	Endosulfan Sulfate	3.1E-06	U	0.0002	J	79	39	49%	2.9E-06	5.9E-05	0.00023	10	N	N	N	Maximum Does Not Exceed SL
72-20-8	Endrin	8.4E-06	U	0.0018	J	79	13	16%	8.4E-06	0.00014	0.0018	0.23	N	N	N	Maximum Does Not Exceed SL
7421-93-4	Endrin aldehyde	1.2E-05	U	0.0004	J	79	6	8%	1.2E-05	0.00035	0.00036	0.23	N	N	N	Maximum Does Not Exceed SL
53494-70-5	Endrin ketone	9.3E-06	U	0.0005		79	25	32%	9.3E-06	0.00037	0.00048	0.23	N	N	N	Maximum Does Not Exceed SL
58-89-9	gamma-BHC (Lindane)	5.2E-06	U	0.0003	J	80	62	78%	5.2E-06	0.00017	0.00029	0.042	C	N	N	Maximum Does Not Exceed SL
76-44-8	Heptachlor	1.5E-06	U	0.0003	J	79	29	37%	1.4E-06	7.3E-05	0.00028	0.0014	C	N	N	Maximum Does Not Exceed SL
1024-57-3	Heptachlor Epoxide	4.7E-06	U	0.00047		80	73	91%	3.1E-06	0.00019	0.00047	0.0014	C	N	N	Maximum Does Not Exceed SL
72-43-5	Methoxychlor	6.8E-06	U	0.0004	EMPC-J	79	20	25%	6.7E-06	0.00013	0.00043	3.7	N	N	N	Maximum Does Not Exceed SL
27304-13-8	Oxy-chlordane	4.2E-06	U	0.0002	U	79	8	10%	3.0E-06	0.0002	0.00020	0.020	C	N	N	Maximum Does Not Exceed SL
5103-74-2	trans-Chlordane	7.5E-06	U	0.0004		80	75	94%	5.4E-06	0.00018	0.00044	0.020	C	N	N	Maximum Does Not Exceed SL
39765-80-5	trans-Nonachlor	1.0E-05	U	0.00033	J	80	77	96%	6.5E-06	0.00021	0.00033	0.020	C	N	N	Maximum Does Not Exceed SL
Inorganics																
7429-90-5	Aluminum	42	J	974		81	81	100%	0.5	2	974	2000	N	N	N	Maximum Does Not Exceed SL
7440-36-0	Antimony	0.10	U	2.4		82	16	20%	0.1	0.4	2.4	0.78	N	N	Y	Maximum Exceeds SL
7440-38-2	Arsenic	0.73		1.8		81	81	100%	0.03	0.04	1.8	0.052	C	Yes	Y	Maximum Exceeds SL
7440-39-3	Barium	17		38		81	81	100%	0.4	1	38	380	N	N	N	Maximum Does Not Exceed SL

Table 2.2. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Surface Water (continued)

CAS Number	Chemical	Minimum Concentration (ug/L) (a)		Maximum Concentration (ug/L) (a)		Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (ug/L)		Concentration Used for Screening (b)	Screening Level (N/C) (ug/L)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (d)
7440-41-7	Beryllium	0.0003	U, UJ	0.124		81	23	28%	0.0003	0.001	0.12	2.5	N	N	N	Maximum Does Not Exceed SL
7440-43-9	Cadmium	0.027		0.233		142	142	100%	0.001	0.002	0.23	0.92	N	N	N	Maximum Does Not Exceed SL
7440-47-3	Chromium (total)	0.43		5.61		81	81	100%	0.02	0.03	5.6	3.5E-02	C	N	Y	Maximum Exceeds SL
7440-48-4	Cobalt	0.098		0.473		81	81	100%	0.001	0.002	0.47	0.6	N	N	N	Maximum Does Not Exceed SL
7440-50-8	Copper	1.29		8.1		142	142	100%	0.003	0.004	8.1	80	N	N	N	Maximum Does Not Exceed SL
57-12-5	Cyanide	3.0	U	10	U	81	1	1%	3	3	10	0.15	N	N	Y	Detection Limits Exceed SL
7439-89-6	Iron	130	J	2320		81	81	100%	3	5	2320	1400	N	N	Y	Maximum Exceeds SL
7439-92-1	Lead	0.53		8.5		142	142	100%	0.009	0.01	8.5	15	N	N	N	Maximum Does Not Exceed SL
7439-96-5	Manganese	29	J	117		81	81	100%	0.2	0.4	117	43	N	N	Y	Maximum Exceeds SL
7439-97-6	Mercury	0.0017	J	0.076		142	142	100%	0.00015	0.0049	0.076	0.063	N	N	Y	Maximum Exceeds SL
22967-92-6	Methyl Mercury	0.000020	U, UJ	0.00029		81	72	89%	1.9E-05	2.1E-05	0.00029	0.2	N	N	N	Maximum Does Not Exceed SL
7440-02-0	Nickel	0.89		2.4		81	81	100%	0.03	0.04	2.4	39	N	N	N	Maximum Does Not Exceed SL
7782-49-2	Selenium	0.20	J, U	1.0	U	81	13	16%	0.2	0.2	1.0	10	N	N	N	Maximum Does Not Exceed SL
7440-22-4	Silver	0.0040	J, U	0.84		81	70	86%	0.002	0.004	0.84	9.4	N	N	N	Maximum Does Not Exceed SL
7440-28-0	Thallium	0.0020	U, UJ	0.048		81	42	52%	0.002	0.004	0.048	0.020	N	N	Y	Maximum Exceeds SL
7440-32-6	Titanium	0.40	U, UJ	43	J	81	65	80%	0.4	0.7	43	0.021	N	N	Y	Maximum Exceeds SL
7440-62-2	Vanadium	1.7	J	7.1		81	70	86%	1	2	7.1	8.6	N	N	N	Maximum Does Not Exceed SL
7440-66-6	Zinc	4.1		21		81	81	100%	0.06	0.1	21	600	N	N	N	Maximum Does Not Exceed SL

Footnotes:
(a) Data Qualifiers:
"EMPC" - Estimated Maximum Possible Concentration
"J " estimated value
"U" analyzed for but not detected

EMPC Estimated Maximum Possible Concentration
CAS - Chemical Abstracts Service
COPC - Chemical of Potential Concern
FOD - Frequency of Detection

ug/L - micrograms per liter
N - No
SL - screening level
Y - Yes
SL - screening level

(b) Maximum detected concentration selected for the concentration used for screening.
(c) USEPA Regional Screening Levels for tap water. November 2017. Values based on noncarcinogenic effects are adjusted for a target hazard quotient of 0.1 to account for potential cumulative effects on the same target organ. N - noncarcinogenic; C - carcinogenic. Chemicals for which surrogate values have been identified are presented in Section 5.0, Table 5-1.
(d) See the COPC Selection Process (Section 5.1 of the PAR) for details.

Table 2.3. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Fish Tissue (Species Combined)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)		Maximum Concentration (Qualifier) (mg/kg) (a)		Location of Maximum Concentration (b)	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (c)	Screening Level (N/C) (mg/kg) (d)		Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (e)
SVOCs																	
65-85-0	Benzoic Acid	0.65	U	5.8	J	S	95	1	1%	0.65	3.3	5.8	348	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
1002-53-5	Dibutyltin	0.0012	UJ	0.0030	J	S	92	1	1%	0.0012	0.0013	0.003	0.026	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
108-95-2	Phenol	0.065	U	1.2	J	S	95	1	1%	0.065	0.33	1.2	26	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
1461-25-2	Tetrabutyltin	0.0015	U	0.011	J	S	92	1	1%	0.0015	0.0017	0.011	0.026	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
688-73-3	Tributyltin	0.0014	UJ	0.0064	J	S	92	8	9%	0.0014	0.0015	0.0064	0.026	N	N	N	Maximum Does Not Exceed SL
PAHs																	
90-12-0	1-Methylnaphthalene	0.0027	U	0.029		N	95	11	12%	0.0027	0.013	0.029	0.14	C	N	N	Maximum Does Not Exceed SL
91-57-6	2-Methylnaphthalene	0.0027	U	0.054		N	95	10	11%	0.0027	0.013	0.054	0.35	N	N	N	Maximum Does Not Exceed SL
83-32-9	Acenaphthene	0.0042	J	0.028		N	95	18	19%	0.0027	0.013	0.028	5.2	N	N	N	Maximum Does Not Exceed SL
120-12-7	Anthracene	0.0027	U	0.013	UJ	C, N, S	95	2	2%	0.0027	0.013	0.013	26	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30040	C1-Fluorenes	0.0027	U	0.013	UJ	C, N, S	95	1	1%	0.0027	0.013	0.013	3.5	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30041	C1-Naphthalenes	0.0027	U	0.055		N	95	13	14%	0.0027	0.013	0.055	1.7	N	N	N	Maximum Does Not Exceed SL
30042	C1-Phenanthrenes/Anthracenes	0.0027	U	0.013	UJ	C, N, S	95	2	2%	0.0027	0.013	0.013	26	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30061	C2-Naphthalenes	0.0027	U	0.077		N	95	10	11%	0.0027	0.013	0.077	1.7	N	N	N	Maximum Does Not Exceed SL
PHENANTHC2	C2-Phenanthrene/anthracenes	0.0027	U	0.013	UJ	C, N, S	95	1	1%	0.0027	0.013	0.013	26	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30071	C3-Naphthalene	0.0027	U	0.056		N	95	6	6%	0.0027	0.013	0.056	1.7	N	N	N	Maximum Does Not Exceed SL
30077	C4-Naphthalene	0.0027	U	0.025		N	95	1	1%	0.0027	0.013	0.025	1.7	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
206-44-0	Fluoranthene	0.0027	UJ	0.013	UJ	C, N, S	95	8	8%	0.0027	0.013	0.013	3.5	N	N	N	Maximum Does Not Exceed SL
86-73-7	Fluorene	0.0027	J	0.015		S	95	6	6%	0.0027	0.013	0.015	3.5	N	N	N	Maximum Does Not Exceed SL
91-20-3	Naphthalene	0.0027	U	0.18		C	95	17	18%	0.0027	0.013	0.18	1.7	N	N	N	Maximum Does Not Exceed SL
85-01-8	Phenanthrene	0.0027	U	0.032		S	95	7	7%	0.0027	0.013	0.032	26	N	N	N	Maximum Does Not Exceed SL
129-00-0	Pyrene	0.0027	UJ	0.017		C	95	4	4%	0.0027	0.013	0.017	2.6	N	N	N	Maximum Does Not Exceed SL
PCBs/Dioxins/Furans																	
WHODIOXTEQ(H)	Dioxin/Furan TEQ	3.6E-07	BJ	3.4E-05	BJ	C	95	95	100%	NA	NA	3.4E-05	3.2E-08	C	N	Y	Maximum Exceeds SL
WHOPCBTEQ(H)	PCB TEQ	2.5E-07	BJ, BT	5.8E-05	BT	S	95	95	100%	NA	NA	5.8E-05	3.2E-08	C	N	Y	Maximum Exceeds SL
TPCB Cong-209	Total PCBs	0.024	BT	2.2	BT	S	95	95	100%	NA	NA	2.2	0.0021	C	N	Y	Maximum Exceeds SL
Pesticides/Herbicides																	
53-19-0	2,4'-DDD	5.7E-05	J	0.103	DJ	S	95	95	100%	5.0E-06	5.0E-06	0.103	0.0026	N	N	Y	Maximum Exceeds SL
3424-82-6	2,4'-DDE	0.00013	JB	0.040	DJ	S	95	95	100%	1.0E-05	1.0E-05	0.040	0.012	C	N	Y	Maximum Exceeds SL
789-02-6	2,4'-DDT	1.1E-05	UDJ	0.030	D	N	95	89	94%	1.1E-05	0.0000108	0.030	0.012	C	N	Y	Maximum Exceeds SL
72-54-8	4,4'-DDD	0.00045	J	0.42	DJ	S	95	95	100%	7.4E-06	7.4E-06	0.42	0.0026	N	N	Y	Maximum Exceeds SL
72-55-9	4,4'-DDE	0.0012	J	0.68	JBED	S	95	95	100%	7.6E-06	7.6E-06	0.68	0.012	C	N	Y	Maximum Exceeds SL
50-29-3	4,4'-DDT	9.4E-06	UJ	0.069	DJ	S	95	94	99%	9.4E-06	9.4E-06	0.069	0.012	C	N	Y	Maximum Exceeds SL
309-00-2	Aldrin	2.3E-06	J	0.00024	J	S	95	69	73%	9.2E-06	9.2E-06	0.00024	0.00025	C	N	N	Maximum Does Not Exceed SL
319-84-6	Alpha-BHC	5.5E-06	J	0.00027	J	C	94	88	94%	6.4E-06	6.4E-06	0.00027	0.00066	C	N	N	Maximum Does Not Exceed SL
5103-71-9	Alpha-Chlordane	0.00023	J	0.13	DJ	S	95	95	100%	8.8E-06	8.8E-06	0.13	0.012	C	N	Y	Maximum Exceeds SL
319-85-7	Beta-BHC	5.4E-06	J	0.00015	J	N	95	87	92%	1.1E-05	1.1E-05	0.00015	0.0023	C	N	N	Maximum Does Not Exceed SL
5103-73-1	cis-Nonachlor	9.2E-05	J	0.036	DJ	S	95	95	100%	1.3E-05	1.3E-05	0.036	0.012	C	N	Y	Maximum Exceeds SL
319-86-8	Delta-BHC	2.7E-06	J	9.1E-06	J	N	95	18	19%	5.1E-06	5.1E-06	9.1E-06	0.00066	C	N	N	Maximum Does Not Exceed SL
60-57-1	Dieldrin	0.00026	J	0.036	DJ	S	95	95	100%	1.5E-05	1.5E-05	0.036	0.00026	C	N	Y	Maximum Exceeds SL
1031-07-8	Endosulfan Sulfate	2.6E-05	J	8.4E-05	J	N	95	6	6%	6.3E-05	6.3E-05	8.4E-05	0.52	N	N	N	Maximum Does Not Exceed SL
72-20-8	Endrin	8.3E-06	J	7.5E-05		S	95	45	47%	1.4E-05	1.4E-05	7.5E-05	0.026	N	N	N	Maximum Does Not Exceed SL
53494-70-5	Endrin Ketone	3.6E-05	J	0.00010	J	S	85	5	6%	7.6E-05	7.6E-05	0.00010	0.026	N	N	N	Maximum Does Not Exceed SL
58-89-9	Gamma-BHC (Lindane)	3.3E-06	J	7.0E-05		S	95	76	80%	7.7E-06	7.7E-06	7.0E-05	0.0038	C	N	N	Maximum Does Not Exceed SL
76-44-8	Heptachlor	4.9E-06	J	4.3E-05	J	S	95	25	26%	3.3E-05	3.3E-05	4.3E-05	0.00092	C	N	N	Maximum Does Not Exceed SL
1024-57-3	Heptachlor Epoxide	5.9E-05	J	0.0063	J	N	95	95	100%	7.0E-06	7.0E-06	0.0063	0.00046	C	N	Y	Maximum Exceeds SL
118-74-1	Hexachlorobenzene	0.00010	BJ	0.0066	JB	S	95	95	100%	4.1E-06	4.1E-06	0.0066	0.0026	C	N	Y	Maximum Exceeds SL
78-59-1	Isophorone	0.066	U	0.33	UJ	C, N, S	95	3	3%	0.065	0.33	0.33	4.4	C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
72-43-5	Methoxychlor	3.0E-05	J	3.9E-05	UJ	C, N, S	87	1	1%	3.9E-05	3.9E-05	3.9E-05	0.43	N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
2385-85-5	Mirex	9.3E-06	UJ	0.00094		N	90	87	97%	9.3E-06	9.3E-06	0.00094	0.00023	C	N	Y	Maximum Exceeds SL
39765-80-5	Nonachlor, trans-	0.00020	J	0.087	DJ	S	95	95	100%	1.0E-05	1.0E-05	0.087	0.012	C	N	Y	Maximum Exceeds SL
27304-13-8	Oxychlordane	1.0E-05	U	0.029	DJ	N	95	94	99%	0.00001	1.0E-05	0.029	0.012	C	N	Y	Maximum Exceeds SL
5103-74-2	trans-Chlordane	0.00012	J	0.023	DJ	S	95	95	100%	1.4E-05	1.4E-05	0.023	0.012	C	N	Y	Maximum Exceeds SL

Table 2.3. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Fish Tissue (Species Combined) (continued)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)	Maximum Concentration (Qualifier) (mg/kg) (a)	Location of Maximum Concentration (b)	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (c)	Screening Level (N/C) (mg/kg) (d)	Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (e)
28044-83-9	trans-Heptachlor Epoxide	1.7E-05 UJ	0.0015 J	C	95	2	2%	1.7E-05	1.7E-05	0.0015	0.00046 C	N	N	Less than 5% FOD
TOT_AGChlor	Total Alpha + Gamma Chlordane	0.00036 J	0.15 DJ	S	95	95	100%	NA	NA	0.15	0.012 C	N	Y	Maximum Exceeds SL
Inorganics														
7429-90-5	Aluminum	3.8 U	15 B	C	95	9	9%	3.7	5.6	15	87 N	N	N	Maximum Does Not Exceed SL
7440-36-0	Antimony	0.044 U	0.076 B	S	95	1	1%	0.044	0.066	0.076	0.035 N	N	N	Less than 5% FOD
7440-38-2	Arsenic	0.26 B	3.6	S	95	95	100%	0.10	0.15	3.6	0.0028 C	Y	Y	Maximum Exceeds SL
7440-39-3	Barium	0.13 U	0.37	S	95	6	6%	0.12	0.18	0.37	17 N	N	N	Maximum Does Not Exceed SL
7440-47-3	Chromium (total)	0.067 U	2.4	N	95	26	27%	0.067	0.10	2.4	0.0083 C	N	Y	Maximum Exceeds SL
7440-48-4	Cobalt	0.014 B	2.2	N	95	6	6%	0.013	0.02	2.2	0.026 N	N	Y	Maximum Exceeds SL
7440-50-8	Copper	0.055 U	1.1	C	95	88	93%	0.053	0.08	1.1	3.5 N	N	N	Maximum Does Not Exceed SL
7439-89-6	Iron	3.2 U	21	N	95	59	62%	3.1	4.6	21	61 N	N	N	Maximum Does Not Exceed SL
7439-92-1	Lead	0.018 B	4.8	N	95	24	25%	0.017	0.026	4.8	1.5	N	Y	Maximum Exceeds SL
7439-96-5	Manganese	0.11 U	0.87	S	95	47	49%	0.11	0.17	0.87	12 N	N	N	Maximum Does Not Exceed SL
7439-97-6	Mercury	0.067	0.64	N	95	95	100%	0.00038	0.0028	0.64	0.026 N	N	Y	Maximum Exceeds SL
22967-92-6	Methyl Mercury	0.066	0.76	N	91	91	100%	0.0016	0.0096	0.76	0.008 N	N	Y	Maximum Exceeds SL
7440-02-0	Nickel	0.13 U	0.46	N	95	2	2%	0.13	0.19	0.46	1.7 N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
7782-49-2	Selenium	0.25 B	0.85	S	95	95	100%	0.0667	0.10	0.85	0.43 N	N	Y	Maximum Exceeds SL
7440-32-6	Titanium	0.16 U	0.37 U	N, S	95	2	2%	0.16	0.37	0.37	NA	N	Y	No Screening Value
7440-62-2	Vanadium	0.020 U	0.034 B	N	95	6	6%	0.020	0.030	0.034	0.44 N	N	N	Maximum Does Not Exceed SL
7440-66-6	Zinc	4.5	43	C	95	95	100%	0.37	0.74	43	26 N	N	Y	Maximum Exceeds SL

Footnotes:

CAS - Chemical Abstracts Service
COPC - Chemical of Potential Concern
FOD - Frequency of Detection
mg/kg - Milograms per kilogram
N - No
NA - Not Available
Y - Yes
SL - screening level

(a) Data Qualifiers:
"J " estimated value
"U" analyzed for but not detected
"T" indicates a summed quantity
"B" the associated analyte was also detected in the method blank for organics; or for inorganics, reported value was obtained from an instrument reading that was less than the project quantitation limit (PQL)
"D" the organic analyte was quantitated from a diluted analysis
"E" the associated compound concentration exceeded the calibration range of the instrument for organics

(b) Location of Maximum Concentration: N- northern portion of Bay; C - central portion of Bay; S -southern portion of Bay.

(c) Maximum detected concentration selected for the Concentration Used for Screening.

(d) USEPA Regional Screening Levels Calculator; for Consumption of fish. November 2017. Values based on noncarcinogenic effects are adjusted for a target hazard quotient of 0.1 to account for potential cumulative effects on the same target organ. N - noncarcinogenic; C - carcinogenic. Chemicals for which surrogate values have been identified are presented in Section 5.0, Table 5-1.

(e) See the COPC Selection Process (Section 5.1 of the PAR) for details.

Table 2.4. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Blue Crab (Muscle+Hepatopancreas Combined)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)	Maximum Concentration (Qualifier) (mg/kg) (a)	Location of Maximum Concentration (b)	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (c)	Screening Level (N/C) (mg/kg) (d)	Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (e)
SVOCs														
122-66-7	1,2-Diphenylhydrazine	0.065 U	0.49 U	S	36	1	3%	0.066	0.65	0.49	0.0052 C	N	N	Less than 5% FOD
91-94-1	3,3'-Dichlorobenzidine	0.39 U	2.9 U	S	36	1	3%	0.39	3.9	2.9	0.0092 C	N	N	Less than 5% FOD
106-44-5	4-Methylphenol	0.065 U	0.49 U	S	36	1	3%	0.066	0.65	0.49	8 N	N	N	Less than 5% FOD
98-86-2	Acetophenone	0.065 U	0.73	C	36	2	6%	0.066	0.65	0.73	8 N	N	N	Maximum Does Not Exceed SL
100-52-7	Benzaldehyde	0.28 J	3.2	S	36	25	69%	0.26	2.6	3.2	1.0 C	N	Y	Maximum Exceeds SL
65-85-0	Benzoic Acid	0.65 U	7.3	C	36	16	44%	0.66	6.5	7.3	348 N	N	N	Maximum Does Not Exceed SL
118-74-1	Hexachlorobenzene	0.00063 BD	0.0043 B	N	37	37	100%	4.1E-06	4.1E-06	0.0043	0.0026 C	N	Y	Maximum Exceeds SL
108-95-2	Phenol	0.065 U	0.50 J	S	36	7	19%	0.066	0.65	0.50	26 N	N	N	Maximum Does Not Exceed SL
110-86-1	Pyridine	0.0011 U	1.9 U	S	36	6	17%	0.26	2.6	1.9	0.08 N	N	Y	Maximum Exceeds SL
1002-53-5	Dibutyltin	0.0012 UJ	0.0015 UJ	N	37	4	11%	0.0012	0.0013	0.0015	0.026 N	N	N	Maximum Does Not Exceed SL
PAHs														
90-12-0	1-Methylnaphthalene	0.0026 U	0.018 J+	N	37	9	24%	0.0026	0.013	0.018	0.14 C	N	N	Maximum Does Not Exceed SL
91-57-6	2-Methylnaphthalene	0.0026 U	0.026 J+	N	37	24	65%	0.0026	0.013	0.026	0.35 N	N	N	Maximum Does Not Exceed SL
83-32-9	Acenaphthene	0.0027 U	0.059 J+	N	37	33	89%	0.0026	0.013	0.059	5.2 N	N	N	Maximum Does Not Exceed SL
208-96-8	Acenaphthylene	0.0026 U	0.013 U	S	37	11	30%	0.0026	0.013	0.013	5.2 N	N	N	Maximum Does Not Exceed SL
120-12-7	Anthracene	0.0026 U	0.098 J	C	37	24	65%	0.0026	0.013	0.098	26 N	N	N	Maximum Does Not Exceed SL
56-55-3	Benzo(a)anthracene	0.0026 U	0.013 U	S	37	9	24%	0.0026	0.013	0.013	0.042 C	N	Y	Include as carcinogenic PAH
50-32-8	Benzo(a)pyrene	0.0026 U	0.013 U	S	37	2	5%	0.0026	0.013	0.013	0.0042 C	N	Y	Maximum Exceeds SL
205-99-2	Benzo(b)fluoranthene	0.0026 U	0.013 U	S	37	2	5%	0.0026	0.013	0.013	0.042 C	N	Y	Include as carcinogenic PAH
192-97-2	Benzo(e)pyrene	0.0026 U	0.013 U	S	37	3	8%	0.0026	0.013	0.013	2.6 N	N	N	Maximum Does Not Exceed SL
191-24-2	Benzo(g,h,i)perylene	0.0026 UJ	0.013 U	S	37	4	11%	0.0026	0.013	0.013	2.6 N	N	N	Maximum Does Not Exceed SL
207-08-9-JK	Benzo(j,k)fluoranthene	0.0026 U	0.013 U	S	37	1	3%	0.0026	0.013	0.013	0.42 C	N	Y	Include as carcinogenic PAH
30040	C1-Fluorenes	0.0026 U	0.013 U	S	37	2	5%	0.0026	0.013	0.013	3.5 N	N	N	Maximum Does Not Exceed SL
30041	C1-Naphthalenes	0.0026 U	0.037	N	37	23	62%	0.0026	0.013	0.037	1.7 N	N	N	Maximum Does Not Exceed SL
30042	C1-Phenanthrenes/Anthracenes	0.0026 U	0.013 U	S	37	4	11%	0.0026	0.013	0.013	26 N	N	N	Maximum Does Not Exceed SL
30058	C2-Chrysenes	0.0026 U	0.013 U	S	37	1	3%	0.0026	0.013	0.013	4.2 C	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30060	C2-Fluorenes	0.0026 U	0.071	C	37	3	8%	0.0026	0.013	0.071	3.5 N	N	N	Maximum Does Not Exceed SL
30061	C2-Naphthalenes	0.0026 U	0.029	N	37	13	35%	0.0026	0.013	0.029	1.7 N	N	N	Maximum Does Not Exceed SL
PHENANTHC2	C2-Phenanthrene/anthracenes	0.0026 U	0.019	C	37	3	8%	0.0026	0.013	0.019	26 N	N	N	Maximum Does Not Exceed SL
30070	C3-Fluorenes	0.0026 U	0.013 U	S	37	3	8%	0.0026	0.013	0.013	3.5 N	N	N	Maximum Does Not Exceed SL
30071	C3-Naphthalene	0.0026 U	0.013 U	S	37	5	14%	0.0026	0.013	0.013	1.7 N	N	N	Maximum Does Not Exceed SL
PHENANTHC3	C3-Phenanthrene/anthracenes	0.0026 U	0.013 U	S	37	1	3%	0.0026	0.013	0.013	26 N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
30077	C4-Naphthalene	0.0026 U	0.013 U	S	37	2	5%	0.0026	0.013	0.013	1.7 N	N	N	Maximum Does Not Exceed SL
30078	C4-Phenanthrenes/anthracenes	0.0026 U	0.013 U	S	37	1	3%	0.0026	0.013	0.013	26 N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
218-01-9	Chrysene	0.0026 U	0.013 U	S	37	14	38%	0.0026	0.013	0.013	4.20 C	N	Y	Include as carcinogenic PAH
53-70-3	Dibenzo(a,h)anthracene	0.0026 U	0.013 U	S	37	3	8%	0.0026	0.013	0.013	0.0042 C	N	Y	Maximum Exceeds SL
206-44-0	Fluoranthene	0.0026 U	0.024 J+	N	37	32	86%	0.0026	0.013	0.024	3.5 N	N	N	Maximum Does Not Exceed SL
86-73-7	Fluorene	0.0026 U	0.26	C	37	3	8%	0.0026	0.013	0.26	3.5 N	N	N	Maximum Does Not Exceed SL
193-39-5	Indeno(1,2,3-cd)pyrene	0.0026 UJ	0.26 J+	N	37	2	5%	0.0026	0.013	0.26	0.042 C	N	Y	Maximum Exceeds SL
91-20-3	Naphthalene	0.0026 U	0.021 J+	N	37	14	38%	0.0026	0.013	0.021	1.7 N	N	N	Maximum Does Not Exceed SL
198-55-0	Perylene	0.0026 U	0.013 U	S	37	16	43%	0.0026	0.013	0.013	2.6 N	N	N	Maximum Does Not Exceed SL
85-01-8	Phenanthrene	0.0026 U	0.034	C	37	21	57%	0.0026	0.013	0.034	26 N	N	N	Maximum Does Not Exceed SL
129-00-0	Pyrene	0.0026 U	0.022 J+	N	37	33	89%	0.0026	0.013	0.022	2.6 N	N	N	Maximum Does Not Exceed SL
PCBs/Dioxins/Furans														
TPCB Cong-209	Total PCB TEQ	0.33 BT	1.0 BT	N	37	37	100%	NA	NA	1.0	0.0021 C	N	Y	Maximum Exceeds SL
WHOPCBTEQ(H)	PCB TEQ	4.0E-06 BT	3.7E-05 BT	N	37	37	100%	NA	NA	3.7E-05	3.2E-08 C	N	Y	Maximum Exceeds SL
WHODIOXTEQ(H)	Dioxin/Furan TEQ	9.0E-06 BJ	8.7E-05 BJ	N	37	37	100%	NA	NA	8.7E-05	3.2E-08 C	N	Y	Maximum Exceeds SL
Pesticides/Herbicides														
53-19-0	2,4'-DDD	5.0E-06 U	0.0016	S	37	36	97%	5.0E-06	5.0E-06	0.0016	0.0026 N	N	N	Maximum Does Not Exceed SL
3424-82-6	2,4'-DDE	1.0E-05 U	0.0022	S	36	35	97%	1.0E-05	1.0E-05	0.0022	0.012 C	N	N	Maximum Does Not Exceed SL
789-02-6	2,4'-DDT	1.1E-05 UD	0.0018	S	37	31	84%	1.1E-05	1.1E-05	0.0018	0.012 C	N	N	Maximum Does Not Exceed SL
72-54-8	4,4'-DDD	0.012 D	0.18 D	S	37	37	100%	7.4E-06	7.4E-06	0.18	0.0026 N	N	Y	Maximum Exceeds SL
72-55-9	4,4'-DDE	0.058 BDJ	0.30 BD	S	37	37	100%	7.6E-06	7.6E-06	0.30	0.012 C	N	Y	Maximum Exceeds SL

Table 2.4. Occurrence, Distribution, and Selection of Chemicals of Potential Concern – Blue Crab (Muscle+Hepatopancreas Combined) (continued)

CAS Number	Chemical	Minimum Concentration (Qualifier) (mg/kg) (a)	Maximum Concentration (Qualifier) (mg/kg) (a)	Location of Maximum Concentration (b)	Number of Samples	Number of Detects	Detection Frequency	Range of Detection Limits (mg/kg)		Concentration Used for Screening (c)	Screening Level (N/C) (mg/kg) (d)	Known Human Carcinogen?	COPC Flag (Y/N)	Rationale for Selection or Deletion (e)
50-29-3	4,4'-DDT	0.00012 B	0.0068 BJ	S	37	37	100%	9.4E-06	9.4E-06	0.0068	0.012 C	N	N	Maximum Does Not Exceed SL
309-00-2	Aldrin	7.7E-06 J	1.2E-05 J	N	37	5	14%	9.2E-06	9.2E-06	1.2E-05	0.00025 C	N	N	Maximum Does Not Exceed SL
319-84-6	Alpha-BHC	6.4E-06 U	6.9E-05	C	37	36	97%	6.4E-06	6.4E-06	6.9E-05	0.00066 C	N	N	Maximum Does Not Exceed SL
5103-71-9	Alpha-Chlordane	0.00028	0.0060	N	37	36	97%	8.8E-06	8.8E-06	0.0060	0.012 C	N	N	Maximum Does Not Exceed SL
319-85-7	Beta-BHC	0.00001028 JB	0.00027	N	37	37	100%	1.1E-05	1.1E-05	0.00027	0.0023 C	N	N	Maximum Does Not Exceed SL
5103-73-1	cis-Nonachlor	0.003109 D	0.020 DJ	N	37	37	100%	1.3E-05	1.3E-05	0.020	0.012 C	N	Y	Maximum Exceeds SL
319-86-8	Delta-BHC	5.08E-06 U	1.8E-05	S	37	3	8%	5.1E-06	5.1E-06	1.84E-05	0.00066 C	N	N	Maximum Does Not Exceed SL
60-57-1	Dieldrin	0.001495	0.017 D	C	37	36	97%	1.5E-05	1.5E-05	0.017	0.00026 C	N	Y	Maximum Exceeds SL
959-98-8	Endosulfan I	4.2E-05 J	5.7E-05 U	C, N, S	36	1	3%	5.7E-05	5.7E-05	5.74E-05	0.52 N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
1031-07-8	Endosulfan Sulfate	6.2E-05 J	6.3E-05 UJ	N	35	1	3%	6.3E-05	6.3E-05	6.33E-05	0.52 N	N	N	Less than 5% FOD; Maximum Does Not Exceed SL
7421-93-4	Endrin Aldehyde	0.00013 UD	0.00016 J	S	25	3	12%	0.00013	0.00013	0.00016	0.026 N	N	N	Maximum Does Not Exceed SL
58-89-9	Gamma-BHC (Lindane)	5.2E-06 J	3.1E-05	N	37	31	84%	7.7E-06	7.7E-06	3.1E-05	0.0038 C	N	N	Maximum Does Not Exceed SL
76-44-8	Heptachlor	1.9E-05 J	3.3E-05 UD	C, N, S	37	2	5%	3.3E-05	3.3E-05	3.25E-05	0.00092 C	N	N	Maximum Does Not Exceed SL
1024-57-3	Heptachlor Epoxide	0.0024	0.019 D	N	37	37	100%	7.0E-06	7.0E-06	0.019	0.00046 C	N	Y	Maximum Exceeds SL
72-43-5	Methoxychlor	2.4E-05 J	3.9E-05 UDJ	C, N, S	34	2	6%	3.9E-05	3.9E-05	3.89E-05	0.43 N	N	N	Maximum Does Not Exceed SL
2385-85-5	Mirex	0.00012 D	0.00056 J	N	37	37	100%	9.3E-06	9.3E-06	0.00056	0.00023 C	N	Y	Maximum Exceeds SL
39765-80-5	Nonachlor, trans-	0.0030 J	0.042 D	N	37	37	100%	1.0E-05	1.0E-05	0.042	0.012 C	N	Y	Maximum Exceeds SL
27304-13-8	Oxychlordane	0.0097 D	0.061 DJ	N	37	37	100%	1.0E-05	1.0E-05	0.061	0.012 C	N	Y	Maximum Exceeds SL
TOT_AGChlor	Total Alpha + Gamma Chlordane	0.00030 J	0.0064	N	37	37	100%	1.4E-05	1.4E-05	0.0064	0.012 C	N	N	Maximum Does Not Exceed SL
5103-74-2	trans-Chlordane	1.4E-05 UD	0.00077	C	33	30	91%	1.4E-05	1.4E-05	0.00077	0.012 C	N	N	Maximum Does Not Exceed SL
28044-83-9	trans-Heptachlor Epoxide	0.00061	0.0044	N	37	37	100%	1.7E-05	1.7E-05	0.0044	0.00046 C	N	Y	Maximum Exceeds SL
Inorganics														
7429-90-5	Aluminum	5.4 U	48	N	37	17	46%	5.3	5.6	48	87 N	N	N	Maximum Does Not Exceed SL
7440-38-2	Arsenic	1.6	4.8	S	37	37	100%	0.14	0.15	4.8	0.0028 C	Y	Y	Maximum Exceeds SL
7440-39-3	Barium	0.18 U	3.1	C	37	36	97%	0.18	0.18	3.1	17 N	N	N	Maximum Does Not Exceed SL
7440-43-9	Cadmium	0.197	1.3	S	37	36	97%	0.044	0.046	1.3	0.08 N	N	Y	Maximum Exceeds SL
7440-47-3	Chromium (total)	0.097 U	0.43 B	S	37	26	70%	0.095	0.1	0.43	0.0083 C	N	Y	Maximum Exceeds SL
7440-48-4	Cobalt	0.067	0.21	N	37	37	100%	0.019	0.02	0.21	0.026 N	N	Y	Maximum Exceeds SL
7440-50-8	Copper	20	69	S	37	37	100%	0.076	0.08	69	3.5 N	N	Y	Maximum Exceeds SL
7439-89-6	Iron	13	155	N	37	37	100%	4.4	4.6	155	61 N	N	Y	Maximum Exceeds SL
7439-92-1	Lead	0.026 BU	1.4	N	37	36	97%	0.025	0.026	1.4	1.5	N	N	Maximum Does Not Exceeds SL
7439-96-5	Manganese	1.2	25	N	37	36	97%	0.16	0.17	25	12 N	N	Y	Maximum Exceeds SL
7439-97-6	Mercury	0.047	0.19	N	37	37	100%	8.5E-05	0.0021	0.19	0.026 N	N	Y	Maximum Exceeds SL
22967-92-6	Methyl Mercury	0.017	0.22	C	37	37	100%	0.00050	0.002	0.22	0.0083 N	N	Y	Maximum Exceeds SL
7440-02-0	Nickel	0.19 U	0.75	C	37	36	97%	0.18	0.19	0.75	1.7 N	N	N	Maximum Does Not Exceed SL
7782-49-2	Selenium	0.78	1.7	C	37	37	100%	0.095	0.1	1.7	0.43 N	N	Y	Maximum Exceeds SL
7440-22-4	Silver	0.34	2.0	C	37	37	100%	0.019	0.02	2.0	0.43 N	N	Y	Maximum Exceeds SL
7440-32-6	Titanium	0.16 U	1.1	N	37	27	73%	0.16	0.17	1.1	NA	N	Y	No Screening Value
7440-62-2	Vanadium	0.029 U	0.25	N	37	36	97%	0.029	0.03	0.25	0.44 N	N	N	Maximum Does Not Exceed SL
7440-66-6	Zinc	27	61	S	37	37	100%	0.71	0.74	61	26 N	N	Y	Maximum Exceeds SL

Footnotes:
CAS - Chemical Abstracts Service
COPC - Chemical of Potential Concern
FOD - Frequency of Detection
mg/kg - Milograms per kilogram
N - No
NA - Not Available
Y - Yes
SL - screening level

(a) Data Qualifiers:
"J " estimated value
"J-" estimated value, but the result may be biased low
"U" analyzed for but not detected
"T" indicates a summed quantity
"B" the associated analyte was also detected in the method blank for organics; or for inorganics, reported value was obtained from an instrument reading that was less than the project quantitation limit (PQL)
"J+" estimated value, but the result may be biased high
"P" the percent difference between the primary and confirmation column for pesticide/Aroclor analyses is greater than 25%
"D" the organic analyte was quantitated from a diluted analysis
(b) Location of Maximum Concentration: N- northern portion of Bay; C - central portion of Bay; S -southern portion of Bay.
(c) Maximum detected concentration selected for the concentration used for screening.
(d) USEPA Regional Screening Levels Calculator; for Consumption of fish. November 2017. Values based on noncarcinogenic effects are adjusted for a target hazard quotient of 0.1 to account for potential cumulative effects on the same target organ. N - noncarcinogenic; C - carcinogenic. Chemicals for which surrogate values have been identified are presented in Section 5.0, Table 5-1.
(e) See the COPC Selection Process (Section 5.1 of the PAR) for details.

Table 3.1. Exposure Point Concentration Summary - Sediment
Reasonable Maximum Exposure

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	95% UCL (1)	Arithmetic Mean of Detects	Maximum Concentration Detected	Exposure Point Concentration			
						Value	Units	Statistic (3)	Rationale
Sediment	Aluminum	mg/kg	14,444	12,488	23,300	14,444	mg/kg	95% Student's-t	UCL < Max
	Antimony	mg/kg	1.961	1	4.43	1.961	mg/kg	KM H	UCL < Max
	Arsenic	mg/kg	24.45	13.85	55.6	24.45	mg/kg	95% Chebyshev	UCL < Max
	Benzo(a)anthracene	mg/kg	0.165	0.11	0.32	0.165	mg/kg	95% Adj Gamma	UCL < Max
	Benzo(a)pyrene	mg/kg	0.195	0.13	0.39	0.195	mg/kg	95% Adj Gamma	UCL < Max
	Benzo(b)fluoranthene	mg/kg	0.156	0.074	0.31	0.156	mg/kg	95% Adj Gamma	UCL < Max
	Benzo(j,k)fluoranthene	mg/kg	0.154	0.075	0.31	0.154	mg/kg	95% Adj Gamma	UCL < Max
	Chrysene	mg/kg	0.185	0.124	0.35	0.185	mg/kg	95% Adj Gamma	UCL < Max
	Cobalt	mg/kg	11.65	10.12	18.8	11.65	mg/kg	95% Student's-t	UCL < Max
	Copper	mg/kg	186.6	136.9	366	186.6	mg/kg	95% Adj Gamma	UCL < Max
	Chromium (VI)	mg/kg	0.915	1.55	2.00	0.915	mg/kg	95% KM(t)	UCL < Max
	Dibenzo(a,h)anthracene	mg/kg	0.0336	0.0229	0.068	0.0336	mg/kg	95% Adj Gamma	UCL < Max
	Indeno(1,2,3-cd)pyrene	mg/kg	0.128	0.0871	0.26	0.128	mg/kg	95% Adj Gamma	UCL < Max
	Iron	mg/kg	28,875	25,016	47,600	28,875	mg/kg	95% Student's-t	UCL < Max
	Lead	mg/kg	187.4	116	441	187.4	mg/kg	95% Student's-t	UCL < Max
	Manganese	mg/kg	333	260.5	589	333	mg/kg	95% Student's-t	UCL < Max
	Mercury	mg/kg	2.044	1.641	4.48	2.044	mg/kg	95% Adj Gamma	UCL < Max
	Nickel	mg/kg	62.05	46.86	182	62.05	mg/kg	95% Student's-t	UCL < Max
	Phosphorus	mg/kg	868	750.3	1590	868	mg/kg	95% Student's-t	UCL < Max
	Thallium	mg/kg	0.305	0.246	0.717	0.305	mg/kg	95% Student's-t	UCL < Max
	Total PCBs	mg/kg	0.148	0.0494	0.544	0.148	mg/kg	95% Chebyshev	UCL < Max
	PCB TEQ (2)	mg/kg	5.07E-06	1.40E-06	1.98E-05	5.07E-06	mg/kg	95% Chebyshev	UCL < Max
	D/F TEQ (2)	mg/kg	0.000116	8.95E-05	0.000297	0.000116	mg/kg	95% Student's-t	UCL < Max
	Vanadium	mg/kg	39.62	34.31	66.7	39.62	mg/kg	95% Student's-t	UCL < Max

(1) UCLs determined using U.S. EPA's ProUCL ver 5.1; available at http://www.epa.gov/esd/tsc/software.htm; duplicates averaged for UCL determination.
(2) USEPA's online Advanced Kaplan Meier (KM) TEQ Calculator, Version 9.1, issued July 31, 2014 was used to calculate sample-specific concentrations of TCDD-TEQ (D/F) and TCDD-TEQ (PCB).
(3) Where ProUCL suggested a H-UCL, the 95% Chebyshev UCL was substituted.

Table 3.2. Exposure Point Concentration Summary – Surface Water
Reasonable Maximum Exposure

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	Chemical of Potential Concern	Units	95% UCL (1)	Arithmetic Mean of Detects	Maximum Concentration Detected	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Surface Water	Antimomy	ug/L	0.284	0.695	1.35	0.000284	mg/L	95% KM (t)	UCL < Max
	Arsenic	ug/L	1.276	1.22	1.84	0.001276	mg/L	95% KM (t)	UCL < Max
	Chromium	ug/L	1.289	0.89	5.61	0.001289	mg/L	95% KM (t)	UCL < Max
	Iron	ug/L	532.7	375.40	2320	0.5327	mg/L	95% KM (t)	UCL < Max
	Manganese	ug/L	69.11	65.00	117	0.06911	mg/L	95% KM (t)	UCL < Max
	Mercury	ng/L	26.67	20.88	76.3	0.000027	mg/L	95% KM (Chebyshev)	UCL < Max
	Thallium	ug/L	0.009	0.0117	0.48	0.000009	mg/L	95% KM (t)	UCL < Max
	Titanium	ug/L	6.987	6.8280	43.3	0.006987	mg/L	95% KM (gamma)	UCL < Max
	Trichloroethene	ug/L	0.119	0.1250	0.18	0.000119	mg/L	95% KM (t)	UCL < Max
	Benzo(a)anthracene	ng/L	0.0109	0.0088	0.042	1.09E-08	mg/L	95% KM (Chebyshev)	UCL < Max
	Benzo(a)pyrene	ng/L	0.0213	0.0128	0.0574	2.13E-08	mg/L	95% KM (H)	UCL < Max
	Benzo(b)fluoranthene	ng/L	0.0186	0.0178	0.0679	1.86E-08	mg/L	95% KM (H)	UCL < Max
	Benzo(k)fluoranthene	ng/L	0.0081	0.0072	0.0293	8.12E-09	mg/L	95% KM (Chebyshev)	UCL < Max
	Chrysene	ng/L	0.0163	0.0150	0.0639	1.63E-08	mg/L	95% KM (t)	UCL < Max
	Dibenzo(a,h)anthracene	ng/L	0.00283	0.0025	0.0105	2.83E-09	mg/L	95% KM (Chebyshev)	UCL < Max
	Indeno(1,2,3-cd)pyrene	ng/L	0.0851	0.0082	0.0327	8.51E-09	mg/L	95% KM (H)	UCL < Max
	Total PCBs	ng/L	7.52	7.04	15.92	7.52E-06	mg/L	95% ~Gamma	UCL < Max
	Total PCBs	ng/L	7.24	6.78	15.17	7.24E-06	mg/L	95% ~Gamma	UCL < Max
	PCB TEQ (2)	ng/L	0.000111	0.00010	0.00060	1.11E-10	mg/L	95% Student's-t	UCL < Max
	D/F TEQ (2)	pg/L	2.31	1.79	6.818	2.31E-09	mg/L	95% KM (Chebyshev)	UCL < Max

(1) UCLs determined using U.S. EPA's ProUCL ver 5.1; available at http://www.epa.gov/esd/tsc/software.htm; duplicates averaged for UCL determination.
(2) USEPA's online Advanced Kaplan Meier (KM) TEQ Calculator, Version 9.1, issued July 31, 2014 was used to calculate sample-specific concentrations of TCDD-TEQ (D/F) and TCDD-TEQ (PCB).

Table 3.3. Exposure Point Concentration Summary – Fish Tissue (Species Combined)
Reasonable Maximum Exposure

Scenario Timeframe: Current/Future
Medium: Fish Tissue
Exposure Medium: Fish Tissue

Exposure Point	Chemical of Potential Concern	Units	95% UCL (1)	Arithmetic Mean of Detects	Maximum Concentration Detected	Exposure Point Concentration			
						Value	Units	Statistic (3)	Rationale
Fillet	Arsenic	mg/kg	1.083	0.990	3.60	1.083	mg/kg	95% Approximate Gamma	UCL < Max
	Chromium	mg/kg	0.254	0.278	2.42	0.254	mg/kg	95% KM (Chebyshev)	UCL < Max
	Cobalt	mg/kg	0.131	0.439	2.16	0.131	mg/kg	95% Approximate Gamma	UCL < Max
	Lead	mg/kg	0.314	0.248	4.84	0.31	mg/kg	95% KM (Chebyshev)	UCL < Max
	Mercury	ug/kg	285.5	263.6	638	0.2855	mg/kg	95% Approximate Gamma	UCL < Max
	Methyl Mercury	ug/kg	324.7	311.9	764	0.3247	mg/kg	95% KM (t)	UCL < Max
	Selenium	mg/kg	0.530	0.507	0.848	0.530	mg/kg	95% Student's-t	UCL < Max
	Titanium	mg/kg	0.176	0.309	0.338	0.176	mg/kg	95% KM (t)	UCL < Max
	Zinc	mg/kg	0.684	0.669	0.740	0.684	mg/kg	95% Student's-t	UCL < Max
	2,4'-DDD	ng/kg	18,387	8,932	103,000	0.01839	mg/kg	95% Chebyshev	UCL < Max
	2,4'-DDE	ng/kg	5,561	3,070	39,700	0.00556	mg/kg	95% Chebyshev	UCL < Max
	2,4'-DDT	ng/kg	3,231	1350	30,400	0.00323	mg/kg	95% KM (Chebyshev)	UCL < Max
	4,4'-DDD	ng/kg	87,008	50068	418,000	0.08701	mg/kg	95% Chebyshev	UCL < Max
	4,4'-DDE	ng/kg	131862	80,494	679,000	0.131862	mg/kg	95% Chebyshev	UCL < Max
	4,4'-DDT	ng/kg	10590	5,909	68,800	0.01059	mg/kg	95% KM H	UCL < Max
	Alpha-Chlordane	ng/kg	15213	8,910	106,150	0.015213	mg/kg	95% Chebyshev	UCL < Max
	cis-Nonachlor	ng/kg	6499	4,243	28,750	0.006499	mg/kg	95% Chebyshev	UCL < Max
	Dieldrin	ng/kg	7637	4,995	28,000	0.007637	mg/kg	95% Chebyshev	UCL < Max
	Heptachlor Epoxide	ng/kg	1914	1,249	6,340	0.001914	mg/kg	95% Chebyshev	UCL < Max
	Hexachlorobenzene	ng/kg	1841	1,199	6,590	0.001841	mg/kg	95% Chebyshev	UCL < Max
	Mirex	ng/kg	270.6	197.9	942	0.0002706	mg/kg	95% KM H	UCL < Max
	Nonachlor, trans-	ng/kg	15959	10,397	70,750	0.015959	mg/kg	95% Chebyshev	UCL < Max
	Oxychlordane	ng/kg	6107	3,392	28,700	0.006107	mg/kg	95% KM H	UCL < Max
	trans-Chlordane	ng/kg	3314	2,082	18,550	0.003314	mg/kg	95% Chebyshev	UCL < Max
	Total Alpha + Gamma Chlordane	ug/kg	18.4	10.97	122.5	0.0184	mg/kg	95% Chebyshev	UCL < Max
	Total PCBs	ug/kg	375	320.2	1725	0.375	mg/kg	95% Approximate Gamma	UCL < Max
	PCB TEQ (2)	ug/kg	0.00695	0.0033	0.0551	6.95E-06	mg/kg	95% Approximate Gamma	UCL < Max
	D/F TEQ (2)	ug/kg	0.00835	0.00694	0.0337	8.35E-06	mg/kg	95% Approximate Gamma	UCL < Max

(1) UCLs determined using U.S. EPA's ProUCL ver 5.1; available at http://www.epa.gov/esd/tsc/software.htm; duplicates averaged for UCL determination.
(2) USEPA's online Advanced Kaplan Meier (KM) TEQ Calculator, Version 9.1, issued July 31, 2014 was used to calculate sample-specific concentrations of TCDD-TEQ (D/F) and TCDD-TEQ (PCB).
(3) Where ProUCL suggested a H-UCL, the 95% Chebyshev UCL was substituted.

Table 3.4. Exposure Point Concentration Summary – Blue Crab Tissue (muscle+hepatopancreas)
Reasonable Maximum Exposure

Scenario Timeframe: Current/Future
Medium: Blue Crab
Exposure Medium: Blue Crab (muscle+hepatopancreas)

Exposure Point	Chemical of Potential Concern	Units	95% UCL (1)	Arithmetic Mean of Detects	Maximum Concentration Detected	Exposure Point Concentration			
						Value	Units	Statistic (3)	Rationale
Crab (muscle+ hepatopancreas)	4,4'-DDD	mg/kg	0.0547	0.0456	0.179	0.0547	mg/kg	95% Adjusted Gamma	UCL < Max
	4,4'-DDE	mg/kg	0.15	0.132	0.297	0.15	mg/kg	95% Adjusted Gamma	UCL < Max
	Arsenic	mg/kg	2.976	2.787	4.796	2.976	mg/kg	95% Student's-t	UCL < Max
	Benzaldehyde	mg/kg	1.556	1.605	3.158	1.556	mg/kg	95% KM (t)	UCL < Max
	Benzo(a)anthracene	mg/kg	0.00297	0.00324	0.00387	0.00297	mg/kg	95% KM (t)	UCL < Max
	Benzo(a)pyrene	mg/kg	0.00274	0.00331	0.00337	0.00274	mg/kg	95% KM (t)	UCL < Max
	Benzo(b)fluoranthene	mg/kg	0.00264	0.00278	0.0029	0.00264	mg/kg	95% KM (t)	UCL < Max
	Benzo(j,k)fluoranthene	mg/kg	N/A	N/A	0.0031	0.0031	mg/kg	N/A	1 detect; use Max
	Cadmium	mg/kg	0.623	0.532	1.297	0.623	mg/kg	95% KM Adjusted Gamma	UCL < Max
	Chromium	mg/kg	0.174	0.173	0.427	0.174	mg/kg	95% KM (t)	UCL < Max
	Chrysene	mg/kg	0.00371	0.00433	0.00893	0.00371	mg/kg	KM Student's t	UCL < Max
	cis-Nonachlor	mg/kg	0.0088	0.00796	0.0201	0.0088	mg/kg	95% Student's-t	UCL < Max
	Cobalt	mg/kg	0.122	0.113	0.21	0.122	mg/kg	95% Adjusted Gamma	UCL < Max
	Copper	mg/kg	38.19	34.86	68.71	38.19	mg/kg	95% Adjusted Gamma	UCL < Max
	Dibenzo(a,h)anthracene	mg/kg	0.0027	0.00289	0.00344	0.0027	mg/kg	95% KM (t)	UCL < Max
	Dieldrin	mg/kg	0.00967	0.00868	0.017	0.00967	mg/kg	95% KM (t)	UCL < Max
	D/F TEQ (2)	mg/kg	5.12E-05	4.63E-05	8.77E-05	5.12E-05	mg/kg	95% Student's-t	UCL < Max
	Heptachlor Epoxide	mg/kg	0.0061	0.0054	0.0188	0.0061	mg/kg	95% Adjusted Gamma	UCL < Max
	Hexachlorobenzene	mg/kg	0.00176	0.00157	0.00425	0.00176	mg/kg	95% Student's-t	UCL < Max
	Indeno(1,2,3-cd)pyrene	mg/kg	0.0368	0.242	0.257	0.0368	mg/kg	95% KM (t)	UCL < Max
	Iron	mg/kg	55.59	35.92	155.1	55.59	mg/kg	95% Chebyshev	UCL < Max
	Manganese	mg/kg	8.739	7.003	25.32	8.739	mg/kg	KM H	UCL < Max
	Mercury	mg/kg	0.131	0.123	0.186	0.131	mg/kg	95% Student's-t	UCL < Max
	Methyl Mercury	mg/kg	0.135	0.122	0.224	0.135	mg/kg	95% Student's-t	UCL < Max
	Mirex	mg/kg	0.000327	0.000302	0.000558	0.000327	mg/kg	95% Student's-t	UCL < Max
	Nonachlor, trans-	mg/kg	0.0176	0.0152	0.0418	0.0176	mg/kg	95% Adjusted Gamma	UCL < Max
	Oxychlordane	mg/kg	0.0261	0.0234	0.0607	0.0261	mg/kg	95% Adjusted Gamma	UCL < Max
	PCB TEQ (2)	mg/kg	1.95E-05	1.77E-05	3.31E-05	1.95E-05	mg/kg	95% Student's-t	UCL < Max
	Pyridine	mg/kg	0.555	0.586	0.984	0.555	mg/kg	95% KM (t)	UCL < Max
	Selenium	mg/kg	1.32	1.256	1.734	1.32	mg/kg	95% Student's-t	UCL < Max

Table 3.4. Exposure Point Concentration Summary – Blue Crab Tissue (muscle+hepatopancreas) (continued)

Scenario Timeframe: Current/Future
Medium: Blue Crab
Exposure Medium: Blue Crab (muscle+hepatopancreas)

Exposure Point	Chemical of Potential Concern	Units	95% UCL (1)	Arithmetic Mean of Detects	Maximum Concentration Detected	Exposure Point Concentration			
						Value	Units	Statistic (3)	Rationale
	Silver	mg/kg	1.067	0.959	1.993	1.067	mg/kg	95% Adjusted Gamma	UCL < Max
	Titanium	mg/kg	0.28	0.296	1.065	0.28	mg/kg	KM Student's	UCL < Max
	Total PCBs	mg/kg	0.652	0.6	1.03	0.652	mg/kg	95% Student's-t	UCL < Max
	trans-Heptachlor Epoxide	mg/kg	0.00183	0.00165	0.00436	0.00183	mg/kg	95% Student's-t	UCL < Max
	Zinc	mg/kg	46.23	43.56	60.8	46.23	mg/kg	95% Student's-t	UCL < Max

(1) UCLs determined using U.S. EPA's ProUCL ver 5.1; available at http://www.epa.gov/esd/tsc/software.htm; duplicates averaged for UCL determination.
(2) USEPA's online Advanced Kaplan Meier (KM) TEQ Calculator, Version 9.1, issued July 31, 2014 was used to calculate sample-specific concentrations of TCDD-TEQ (D/F) and TCDD-TEQ (PCB).
(3) Where ProUCL suggested a H-UCL, the 95% Chebyshev UCL was substituted.

Table 4.1. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Angler/ Sportsman	Adult	Fish/Crab	Ct	Exposure Point Concentration - Tissue	mg/kg wet weight	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				IRF	Ingestion rate of fish	g/d	34.6	USEPA 2012a	3.9	USEPA 2012a	Intake (mg/kg-day) =
				IRC	Ingestion rate of crab	g/d	20.9	USEPA 2012a	3.0	USEPA 2012a	
				FI	Fraction from source	unitless	1	Assumed 100% of fish/crab consumed is from NBSA	1	Assumed 100% of fish/crab consumed is from NBSA	Ct x EF x ED x IR x (1-Loss) x FI x CF1 / AT x BW
				EF	Exposure frequency	d/yr	365	Fish ingestion rate already averaged over one year	365	Fish ingestion rate already averaged over one year	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				Loss	Cooking loss for fish	g/g	0	Assumed 100% of chemical remains in fish	Chemical-specific	USEPA 2000a,b in addition to more recent publications if any	
				Loss	Cooking loss for crab	g/g	0	Assumed 100% of chemical remains in crab	Chemical-specific	Zabik et al. 1992 in addition to more recent publications if any	
				CF1	Conversion factor	kg/g	1E-03	--	1E-03	--	
				BW	Body weight	kg	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
Incidental Ingestion	Angler/ Sportsman	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	Cs x EF x ED x RBA x IRsed x FI x CF2 / AT x BW
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 2014)	25	Assumed to be one-half RME	Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Angler/ Sportsman	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	Cs x EF x ED x SA x AF x ABS x FI x CF2 / AT x BW
				SA	Skin surface area	cm^2/d	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	

Table 4.1. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
				AF	Adherence factor	mg/cm^2	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	Assumes 1 dermal event per exposure day
				ABS	Dermal absorption factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Inhalation	Angler/ Sportsman	Adult	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	$\frac{\text{Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4}}{\text{AT}}$
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	*Note: CF4 applies to the cancer equation only
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
Incidental Ingestion	Angler/ Sportsman	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	$\frac{\text{Cwat x EF x ED x IRwat x ET x FI}}{\text{AT x BW x CF4}}$
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				IRwat	Ingestion rate of surface water	L/hr	0.011	50% of the mean swimming rate for adults (USEPA 2011)	0.011	50% of the mean swimming rate for adults (USEPA 2011)	
				ET	Exposure Time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Angler/ Sportsman	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	For Inorganics: Intake (mg/kg-day) =
				DAevent	Absorbed dose per event	mg/cm2-event	Calculated value	--	Calculated value	--	$\frac{\text{Cwat x Kp x ET}}{\text{DAevent (int) x CF4}}$
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	For Organics:

Table 4.1. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	If ET ≤ t*, Intake (mg/kg-day) =
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	Cwat x 2 x FA x Kp x SQRT(6 x tau_event x ET/¶)
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	DAevent x CF4
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	If ET > t*, Intake (mg/kg-day) =
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	Cwat x FA x Kp x (ET/1+B + 2 x tau_event x [1+3B+3B2/(1+B)2])
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	DAevent x CF4
				EV	Event frequency	event/d	1	Professional judgment	1	Professional judgment	Where:
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	DAevent =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	AT x BW x CF4 EV x ED x EF x SA x FI
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				SA	Skin surface area	cm2	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Inhalation	Angler/ Sportsman	Adult	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Cwat x EF x ED x ET x CF3 x FI x VF AT x CF4
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	*Note: CF4 applies to the noncancer equation only
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, g/d - gram per day, g/g - gram per gram, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m3 - liter per cubic meter, mg/cm2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, µg/cm2 - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.1. Values Used for Daily Intake Calculations (continued)

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Table 4.2. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/Model Name
Ingestion	Angler/ Sportsman	Adolescent	Fish/Crab	Ct	Exposure Point Concentration - Tissue	mg/kg wet weight	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				IRF	Ingestion rate of fish	g/d	23.1	Assumed to be 2/3 of adult ingestion (USEPA 2012a)	2.6	Assumed to be 2/3 of adult ingestion (USEPA default)	Intake (mg/kg-day) =
				IRC	Ingestion rate of crab	g/d	13.9	Assumed to be 2/3 of adult ingestion (USEPA 2012a)	2.0	Assumed to be 2/3 of adult ingestion (USEPA default)	
				FI	Fraction from source	unitless	1	Assumed 100% of fish/crab consumed is from NBSA	1	Assumed 100% of fish/crab consumed is from NBSA	Ct x EF x ED x IR x (1-Loss) x FI x CF1
				EF	Exposure frequency	d/yr	365	Fish ingestion rate already averaged over one year	365	Fish ingestion rate already averaged over one year	AT x BW
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				Loss	Cooking loss for fish	g/g	0	Assumed 100% of chemical remains in fish	Chemical-specific	USEPA 2000a,b in addition to more recent publications if any	
				Loss	Cooking loss for crab	g/g	0	Assumed 100% of chemical remains in crab	Chemical-specific	Zabik et al. 1992 in addition to more recent publications if any	
				CF1	Conversion factor	kg/g	1E-03	--	1E-03	--	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
Incidental Ingestion	Angler/ Sportsman	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	Cs x EF x ED x RBA x IRsed x FI x CF2
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	AT x BW
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 2014)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Dermal Contact	Angler/ Sportsman	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	Cs x EF x ED x SA x AF x ABS x FI x CF2
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	AT x BW
				SA	Skin surface area	cm^2/d	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	Assumes 1 dermal event per exposure day
				ABS	Dermal absorption factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	

Table 4.2. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/Model Name
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Inhalation	Angler/ Sportsman	Adolescent	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4 / AT
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	*Note: CF4 applies to the cancer equation only
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	USEPA 2014	0.04	USEPA 2014	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
Incidental Ingestion	Angler/ Sportsman	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Intake (mg/kg-day) =
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	Cwat x EF x ED x IRwat x ET x FI / AT x BW x CF4
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	
				IRwat	Ingestion rate of surface water	L/hr	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Dermal Contact	Angler/ Sportsman	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	For Inorganics: Intake (mg/kg-day) =
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	Cwat x Kp x ET / DAevent x CF4
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	For Organics:
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	If ET ≤ t*, Intake (mg/kg-day) =
				tau_event	Lag time per event	hr/evnt	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	Cwat x 2 x FA x Kp x SQRT(6 x tau_event x ET/¶) / DAevent x CF4
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	

Table 4.2. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/Model Name
					coefficient across the viable epidermis						
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	If ET > t*, Intake (mg/kg-day) =
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	Cwat x FA x Kp x (ET/1+B + 2 x tau_event x [1+3B+3B2/(1+B)2])
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	DAevent (int) x CF4
				EV	Event frequency	event/d	1	Assumes receptor goes fishing once per day	1	Assumes receptor goes fishing once per day	Where:
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	DAevent =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	AT x BW x CF4
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	EV x ED x EF x SA x FI
				SA	Skin surface area	cm^2	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Inhalation	Angler/ Sportsman	Adolescent	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EFF	Exposure frequency fishing	d/yr	48	Assumed fishing 2x per week for ~5.5 months per year of fishing per Burger 2002	24	Assumed to be one-half RME	Cwat x EF x ED x ET x CF3 x FI x VF
				EFC	Exposure frequency crabbing	d/yr	30	Assumed crabbing 2x per week for ~3.5 months per year of crabbing per Burger 2002	15	Assumed to be one-half RME	AT x CF4
				ED	Exposure duration	yr	12	USEPA 2000b	6	Assumed to be one-half RME	*Note: CF4 applies to the noncancer equation only
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	USEPA 2014	0.04	USEPA 2014	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, g/d - gram per day, g/g - gram per gram, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, µg/cm2 - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.3. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment, Surface Water
Exposure Medium: Fish/Crab, Sediment, Surface Water, Ambient Air
Receptor Population: Angler/Sportsman - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/Model Name
Ingestion	Angler/ Sportsman	Child	Fish/Crab	Ct	Exposure Point Concentration - Tissue	mg/kg wet weight	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				IRF	Ingestion rate of fish	g/d	11.5	Assumed to be 1/3 of adult ingestion (USEPA 2012)	1.3	Assumed to be 1/3 of adult ingestion (USEPA 2012)	Intake (mg/kg-day) =
				IRC	Ingestion rate of crab	g/d	7.0	Assumed to be 1/3 of adult ingestion (USEPA 2012)	1.0	Assumed to be 1/3 of adult ingestion (USEPA 2012)	
				FI	Fraction from source	unitless	1	Assumed 100% of fish/crab consumed is from NBSA	1	Assumed 100% of fish/crab consumed is from NBSA	$\frac{\text{Ct x EF x ED x IR x (1-Loss) x FI x CF1}}{\text{AT x BW}}$
				EF	Exposure frequency	d/yr	365	Fish ingestion rate already averaged over one year	365	Fish ingestion rate already averaged over one year	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				Loss	Cooking loss for fish	g/g	0	Assumed 100% of chemical remains in fish	Chemical-specific	USEPA 2000a,b in addition to more recent publications if any	
				Loss	Cooking loss for crab	g/g	0	Assumed 100% of chemical remains in crab	Chemical-specific	Zabik et al. 1992 in addition to more recent publications if any	
				CF1	Conversion factor	kg/g	1E-03	--	1E-03	--	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	

Definitions

CTE - central tendency exposure, d - day, d/yr day per year, g/d - gram per day, g/g - gram per gram, kg - kilogram, kg/g - kilogram per gram, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, yr - year

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Table 4.4. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Receptor Population: Worker - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/Model Name
Incidental Ingestion	Worker	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	50	1 day/week, 50 weeks/year	25	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	25	USEPA 2014	7	USEPA 2011	<u>Cs x EF x ED x RBA x IRsed x FI x CF2</u>
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012, USEPA 2017	Chemical-specific	USEPA 2012, USEPA 2017	AT x BW
				IRsed	Ingestion rate of sediment	mg/d	50	USEPA 1991	25	Assumed to be one-half RME	Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	9,125	ED x 365 d/yr	2,555	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	
Dermal Contact	Worker	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	50	1 day/week, 50 weeks/year	25	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	25	USEPA 2014	7	USEPA 2011	<u>Cs x EF x ED x SA x AF x ABS x FI x CF2</u> AT x BW
				SA	Skin surface area	cm^2/d	3,527	Mean default value for workers: head, hands, forearms (USEPA 2014)	3,527	Mean default value for workers: head, hands, forearms (USEPA 2014)	
				AF	Adherence factor	mg/cm^2	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	Assumes 1 dermal event per exposure day
				ABSd	Dermal absorption factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	9,125	ED x 365 d/yr	2,555	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Inhalation	Recreational User	Adult	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EF	Exposure frequency	d/yr	50	1 day/week, 50 weeks/year	25	Assumed to be one-half RME	<u>Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4</u>
				ED	Exposure duration	yr	25	USEPA 2014	7	USEPA 2011	AT
				ET	Exposure time	hr/d	8	Professional judgment for a normal work day	4	Assumed to be one-half RME	*Note: CF4 applies to the cancer equation only
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	9,125	ED x 365 d/yr	2,555	ED x 365 d/yr	

Table 4.4. Values Used for Daily Intake Calculations (continued)

Definitions

cm2/d - square centimeter per day, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, ehr - hour, hr/d - hour per day, kg - kilogram, kg/mg - kilogram per milligram, mg/cm2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, µg/mg - microgram per milligram, yr - year

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Table 4.5. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	Cs x EF x ED x RBA x IRsed x FI x CF2
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	AT x BW
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	
Incidental Ingestion	Swimmer	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Incidental Ingestion	Boater	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	9	1 day/month, 8.5 months/year	4	Approx one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	U.S. EPA 1989	
				RBA	Relative bioavailability factor for soil (used for sediment)	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Wader	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	Cs x EF x ED x SA x AF x ABS x FI x CF2
				SA	Skin surface area	cm^2/d	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	AT x BW
				AF	Adherence factor	mg/cm^2	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	Assumes 1 dermal event per exposure day
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	

Table 4.5. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Swimmer	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				SA	Skin surface area	cm^2/d	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	2,692	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Boater	Adult	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	9	1 day/month, 8.5 months/year	4	Approx one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				SA	Skin surface area	cm^2/d	2,692	Mean value for adults: face, hands, forearms (USEPA 2011)	2,692	Mean value for adults: face, hands, forearms (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	0.3	50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Inhalation	Wader	Adult	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	AT
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	*Note: CF4 applies to the cancer equation only
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
Inhalation	Swimmer	Adult	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	

Table 4.5. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, µg/cm2 - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.6. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	Cwat x ET x EF x ED X IRwat x FI
				IRwat	Ingestion rate of surface water	L/hr	0.011	50% of the mean swimming rate for adults (USEPA 2011)	0.011	50% of the mean swimming rate for adults (USEPA 2011)	AT x BW x CF4
				ET	Exposure Time	hr/day	1	Best professional judgment	0.5	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	80	USEPA 2014; USEPA 2011, weighted mean values for adults 21–78 yrs	
Incidental Ingestion	Swimmer	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				IRwat	Ingestion rate of surface water	L/hr	0.021	mean swimming rate for adults (USEPA 2011)	0.021	mean swimming rate for adults (USEPA 2011)	
				ET	Exposure Time	hr/d	2.6	National average for swimming (U.S. EPA 1989)	2.6	National average for swimming (U.S. EPA 1989)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Incidental Ingestion	Boater	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	259	7 days/week for 37 weeks	111	3 days/week for 37 weeks	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				IRwat	Ingestion rate of surface water	L/hr	0.011	50% of the mean swimming rate for adults (USEPA 2011)	0.011	50% of the mean swimming rate for adults (USEPA 2011)	
				ET	Exposure time	hr/day	2	Based on assumption in Lower Passaic River Baseline Human Health Risk Assessment	1.5	Based on assumption in Lower Passaic River Baseline Human Health Risk Assessment	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
Dermal Contact	Wader	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	For Inorganics: Intake (mg/kg-day) =
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	Cwat x Kp x ET
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	DAevent x CF4
				ET	Exposure time	hr/d	1	Best professional judgment	0.5	Best professional judgment	

Table 4.6. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	For Organics:
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	If ET ≤ t*, Intake (mg/kg-day) =
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	Cwat x 2 x FA x Kp x SQRT(6 x tau_event x ET/¶) DAevent x CF4
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	If ET > t*, Intake (mg/kg-day) =
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	Cwat x FA x Kp x (ET/1+B + 2 x tau_event x [1+3B+3B2/(1+B)2])
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	DAevent x CF4
				EV	Event frequency	event/d	1	USEPA 2004	1	USEPA 2004	Where:
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	DAevent =
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	AT x BW x CF4
				SA	Skin surface area	cm^2	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	6,492	Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)	EV x ED x EF x SA x FI
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Dermal Contact	Swimmer	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
				EV	Event frequency	event/d	1	USEPA 2004	1	USEPA 2004	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				SA	Skin surface area	cm^2	20,900	Resident default whole body (USEPA 2014)	20,900	Resident default whole body (USEPA 2014)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed to be one-half RME	
Dermal Contact	Boater	Adult	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	

Table 4.6. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	2.0	Best professional judgment	1.5	Best professional judgment	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
				BW	Body weight	kg	80	USEPA 2014	80	USEPA 2014	
				EV	Event frequency	event/d	1	USEPA 2004	1	USEPA 2004	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				EF	Exposure frequency	d/yr	259	7 days/week for 37 weeks	111	3 days/week for 37 weeks	
				SA	Skin surface area	cm^2	2,692	Mean value for adults: face, hands, forearms (USEPA 2011)	2,692	Mean value for adults: face, hands, forearms (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Inhalation	Wader	Adult	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) = Cwat x EF x ED x ET x CF3 x FI x VF / AT x CF4 *Note: CF4 applies to the noncancer equation only
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	
Inhalation	Swimmer	Adult	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	-
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	20	USEPA 2014	9	USEPA 1989	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	

Table 4.6. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adult
Receptor Age: >18 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	7,300	ED x 365 d/yr	3,285	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, $\mu g/cm^2$ - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.7. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Intake (mg/kg-day) = Cs x EF x ED x RBA x IRsed x FI x CF2 / AT x BW Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Incidental Ingestion	Swimmer	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Incidental Ingestion	Boater	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Approx one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				RBA	Relative bioavailability factor for soil (used for sediment)	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	50	50% of the default residential adult soil IR (USEPA 1991)	25	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	-
Dermal Contact	Wader	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Intake (mg/kg-day) = Cs x EF x ED x SA x AF x ABS x FI x CF2 / AT x BW Assumes 1 dermal event per exposure day
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				SA	Skin surface area	cm^2/d	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	-

Table 4.7. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Dermal Contact	Swimmer	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				SA	Skin surface area	cm^2/d	4,436	Mean value for male/female 7 - 18 years: hands, lower legs, forearms, feet, and face (USEPA 2011)	4,436	Mean value for male/female 7 - 18 years: hands, lower legs, forearms, feet, and face (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Dermal Contact	Boater	Adolescent	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Approx one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				SA	Skin surface area	cm^2/d	4,436	Mean value for male/female 7 - 18 years: hands, lower legs, forearms, feet, and face (USEPA 2011)	4,436	Mean value for male/female 7 - 18 years: hands, lower legs, forearms, feet, and face (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Inhalation	Wader	Adolescent	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) = Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4 / AT *Note: CF4 applies to the cancer equation only
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
Inhalation	Swimmer	Adolescent	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months year	20	Assumed to be one-half RME	

Table 4.7. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, $\mu g/cm^2$ - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.8. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	Cwat x ET x EF x ED x IRwat x FI
				IRwat	Ingestion rate of surface water	L/hr	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	AT x BW x CF4
				ET	Exposure Time	hr/day	1	Best professional judgment	0.5	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Incidental Ingestion	Swimmer	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				IRwat	Ingestion rate of surface water	L/hr	0.05	USEPA 2011	0.05	USEPA 2011	
				ET	Exposure Time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Incidental Ingestion	Boater	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	98	7 days/week for 14 weeks	70	5 days/wk for 14 weeks	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				IRwat	Ingestion rate of surface water	L/hr	0.025	USEPA 2011	0.025	USEPA 2011	
				ET	Exposure time	hr/day	2	Best professional judgment	1.5	Best professional judgment	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
Dermal Contact	Wader	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	For Inorganics: Intake (mg/kg-day) =
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	Cwat x Kp x ET
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	DAevent x CF4
				ET	Exposure time	hr/d	1	Best professional judgment	0.5	Best professional judgment	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	For Organics:
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	If ET ≤ t*, Intake (mg/kg-day) =
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	Cwat x 2 x FA x Kp x SQRT(6 x tau_event x ET/¶)
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	DAevent (int) x CF4

Table 4.8. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	If ET > t*, Intake (mg/kg-day) =
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	Cwat x FA x Kp x (ET/1+B + 2 x tau_event x [1+3B+3B2/(1+B)2])
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	DAevent x CF4
				EV	Event frequency	event/d	1	Best professional judgment	1	Best professional judgment	Where:
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	DAevent =
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	AT x BW x CF4
				SA	Skin surface area	cm^2	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	EV x ED x EF x SA x FI
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Dermal Contact	Swimmer	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
				EV	Event frequency	event/d	1	Best professional judgment	1	Best professional judgment	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	
				SA	Skin surface area	cm^2	14,825	Mean value for 7 to <19 years: whole body (USEPA 2011)	14,825	Resident default whole body (USEPA 2014)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed to be one-half RME	
Dermal Contact	Boater	Adolescent	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	2.0	Best professional judgment	1.5	Best professional judgment	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	

Table 4.8. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer, Boater - Adolescent
Receptor Age: 7-<19 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
				BW	Body weight	kg	52	USEPA 2011	52	USEPA 2011	
				EV	Event frequency	event/d	1	Best professional judgment	1	Best professional judgment	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				EF	Exposure frequency	d/yr	98	7 days/week for 14 weeks	70	5 days/wk for 14 weeks	
				SA	Skin surface area	cm^2	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	4,436	Mean value for 7 to <19 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Inhalation	Wader	Adolescent	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) = Cwat x EF x ED x ET x CF3 x FI x VF AT x CF4 *Note: CF4 applies to the noncancer equation only
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	
				ED	Exposure duration	yr	12	USEPA 2000	6	Assumed to be one-half RME	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	
Inhalation	Swimmer	Adolescent	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	39	3 days/week, 3 months/year	20	Assumed to be one-half RME	-
				ED	Exposure duration	yr	12	USEPA 2014	6	Assumed to be one-half RME	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	4,380	ED x 365 d/yr	2,190	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, $\mu g/cm^2$ - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.9. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Child	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	Cs x EF x ED x RBA x IRsed x FI x CF2
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	AT x BW
				IRsed	Ingestion rate of sediment	mg/d	100	50% of the default residential child soil IR (USEPA 2014)	50	Assumed to be one-half RME	Arsenic RBA is 0.6; RBA for other chemicals is 1 (USEPA 2012b, USEPA 2017)
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Incidental Ingestion	Swimmer	Child	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				RBA	Relative bioavailability factor	unitless	Chemical-specific	USEPA 2012b, USEPA 2017	Chemical-specific	USEPA 2012b, USEPA 2017	
				IRsed	Ingestion rate of sediment	mg/d	100	50% of the default residential child soil IR (USEPA 2014)	50	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Dermal Contact	Wader	Child	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	Intake (mg/kg-day) =
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	Cs x EF x ED x SA x AF x ABS x FI x CF2
				SA	Skin surface area	cm^2/d	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	AT x BW
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	Assumes 1 dermal event per exposure day
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Dermal Contact	Swimmer	Child	Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				SA	Skin surface area	cm^2/d	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				AF	Adherence factor	mg/cm^2	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	0.2	50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004)	
				ABSd	Dermal Absorption Factor	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	

Table 4.9. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment, Ambient Air
Receptor Population: Wader, Swimmer - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				CF2	Conversion factor	kg/mg	1E-06	--	1E-06	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Inhalation	Wader	Child	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	Cs x EF x ED x ET x CF3 x (1/VF) x FI x CF4
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	AT
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	*Note: CF4 applies to the cancer equation only
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated	Chemical-specific	Calculated	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
Inhalation	Swimmer	Child	VOCs, SVOCs in Sediment	Cs	Exposure Point Concentration - Sediment	mg/kg	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	-
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				ET	Exposure time	hr/d	2.6	National average for swimming (USEPA 1989)	2.6	National average for swimming (USEPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				VF	Volatilization factor	m^3/kg	Chemical-specific	Calculated, See Table X	Chemical-specific	Calculated, See Table X	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, µg/cm^2 - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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Table 4.10. Values Used for Daily Intake Calculations
Reasonable Maximum Exposure/Central Tendency Exposure

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Incidental Ingestion	Wader	Child	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Intake (mg/kg-day) = Cwat x ET x EF x ED X IRwat x FI AT x BW x CF4
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				IRwat	Ingestion rate of surface water	L/hr	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	0.025	50% of the mean swimming rate for children age 6-15 (USEPA 2011)	
				ET	Exposure Time	hr/day	1	Best professional judgment	0.5	Assumed to be one-half RME	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	25,550	70-yr lifetime x 365 d/yr (USEPA, 1989)	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Incidental Ingestion	Swimmer	Child	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day/week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				IRwat	Ingestion rate of surface water	L/hr	0.05	Mean swimming rate for children 6-15 yrs (USEPA 2011)	0.05	Mean swimming rate for children 6-15 yrs (USEPA 2011)	
				ET	Exposure Time	hr/d	2.6	National average for swimming (U.S. EPA 1989)	2.6	National average for swimming (U.S. EPA 1989)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
Dermal Contact	Wader	Child	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	For Inorganics: Intake (mg/kg-day) = Cwat x Kp x ET DAevent x CF4
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	1	Best professional judgment	0.5	Best professional judgment	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	For Organics:
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	If ET ≤ t*, Intake (mg/kg-day) =
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	Cwat x 2 x FA x Kp x SQRT(6 x tau_event x ET/¶) DAevent x CF4
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	If ET > t*, Intake (mg/kg-day) =
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	Cwat x FA x Kp x (ET/1+B + 2 x tau_event x [1+3B+3B2/(1+B)2])

Table 4.10. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	DAevent x CF4
				EV	Event frequency	event/d	1	USEPA 2004	1	USEPA 2004	Where:
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	DAevent =
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	$\frac{AT \times BW \times CF4}{EV \times ED \times EF \times SA \times FI}$
				SA	Skin surface area	cm^2	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	2,272	Mean value for 1 to <7 years: face, hands, forearms, lower legs, feet (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Dermal Contact	Swimmer	Child	Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				DAevent	Absorbed dose per event	mg/cm^2-event	Calculated value	--	Calculated value	--	
				Kp	Dermal permeability constant	cm/hr	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				ET	Exposure time	hr/d	2.6	National average for swimming (U.S. EPA 1989)	2.6	National average for swimming (U.S. EPA 1989)	
				CF4	Conversion Factor	µg/mg, cm^3/L	1E+03	--	1E+03	--	
				FA	Fraction absorbed water	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				tau_event	Lag time per event	hr/event	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	Chemical-specific	USEPA 2004	Chemical-specific	USEPA 2004	
				t*	Time to reach steady-state	hr	Chemical-specific (2.4 x tau_event)	USEPA 2004	Chemical-specific (2.4 x tau_event)	USEPA 2004	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	
				BW	Body weight	kg	17	USEPA 2011 (mean, ages 1 to <7)	17	USEPA 2011 (mean, ages 1 to <7)	
				EV	Event frequency	event/d	1	USEPA 2004	1	USEPA 2004	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	
				SA	Skin surface area	cm^2	7,500	Mean value for 1 to <7 years: whole body (USEPA 2011)	7,500	Mean value for 1 to <7 years: whole body (USEPA 2011)	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
Inhalation	Wader	Child	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	Exposure Concentration (mg/m3 [noncancer]; µg/m3 [cancer]) =
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	$\frac{Cwat \times EF \times ED \times ET \times CF3 \times FI \times VF}{AT \times CF4}$
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				ET	Exposure time	hr/d	1	Professional judgment	0.5	Assumed to be one-half RME	*Note: CF4 applies to the noncancer equation only
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	-
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	

Table 4.10. Values Used for Daily Intake Calculations (continued)

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water, Ambient Air
Receptor Population: Wader, Swimmer - Child
Receptor Age: 1-<7 Years

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Inhalation	Swimmer	Child	VOCs, SVOCs in Surface Water	Cwat	Exposure Point Concentration - Surface Water	ug/L	Site-specific	See Table 3 Series	Site-specific	See Table 3 Series	
				EF	Exposure frequency	d/yr	13	1 day per week, 3 months/year	7	Assumed to be one-half RME	
				ED	Exposure duration	yr	6	USEPA 2014	3	Assumed to be one-half RME	
				ET	Exposure time	hr/d	2.6	National average for swimming (U.S. EPA 1989)	2.6	National average for swimming (U.S. EPA 1989)	
				CF3	Conversion factor	d/hr	0.04	--	0.04	--	
				FI	Fraction from source	unitless	1	Assumed 100% exposure is from NBSA	1	Assumed 100% exposure is from NBSA	
				VF	Volatilization factor	L/m^3	Chemical-specific	Calculated	Chemical-specific	Calculated	
				CF4	Conversion factor	µg/mg	1E+03	--	1E+03	--	
				ATc	Averaging time (cancer)	d	25,550	70-yr lifetime x 365 d/yr	25,550	70-yr lifetime x 365 d/yr	
				ATnc	Averaging time (noncancer)	d	2,190	ED x 365 d/yr	1,095	ED x 365 d/yr	

Definitions

cm^2/d - square centimeter per day, cm/hr - centimeter per hour, cm^3/L - cubic centimeter per liter, CTE - central tendency exposure, d - day, d/hr - day per hour, d/yr day per year, event/d - event per day, hr - hour, hr/d - hour per day, hr/event - hour per event, kg - kilogram, kg/g - kilogram per gram, kg/mg - kilogram per milligram, L/d - liter per day, L/m^3 - liter per cubic meter, mg/cm^2 - milligram per square centimeter, mg/d - milligram per day, mg/kg - milligram per kilogram, RME - reasonable maximum exposure, $\mu g/cm^2$ - event - microgram per square centimeter per event, µg/mg - microgram per milligram, ug/L - micrgram per liter, yr - year

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USEPA 2004. Updated 2007. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005, OSWER 9285.7-02EP, PB99-963312. Office of Superfund Remediation and Technology Innovation U.S. Environmental Protection Agency Washington, DC. July.
USEPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

Table 5.1. Noncancer Toxicity Data – Oral/Dermal

Chemical of Potential Concern	CAS Number	Chronic Oral Reference Dose (mg/kg-day)	GI ABS Efficiency for Dermal (a)	Absorbed Chronic Dermal RfD (mg/kg-day) (b)	Primary Target Organ/ System	Combined Uncertainty/ Modifying Factors	Source	Date
PCDDs/PCDFs								
TCDD-TEQ	--	7.00E-10	--	7.00E-10	Reproductive	30	IRIS	1/2018
PCBs								
PCBs, total PCBs (non-DLC)	1336-36-3	7.00E-05 (c)	--	7.00E-05	Developmental	100	IRIS	1/2018
		2.00E-05 (c)	--	2.00E-05	Eye, Dermal, Immune	300	IRIS	1/2018
PCB-TEQ	--	7.00E-10 (i)	--	7.00E-10	Reproductive	30	IRIS	1/2018
Inorganics								
Aluminum	7429-90-5	1.00E+00	--	1.00E+00	Neurological	100	PPRTV	10/2006
Antimony	7440-36-0	4.00E-04	0.15	6.00E-05	Blood, Other	1,000	IRIS	1/2018
Arsenic, inorganic	7440-38-2	3.00E-04	--	3.00E-04	Skin, Cardiovascular	3	IRIS	1/2018
Cadmium, diet	7440-43-9	1.00E-03 (k)	0.025	2.50E-05	Kidney	10	IRIS	1/2018
Cadmium, water	7440-43-9	5.00E-04 (k)	0.05	2.50E-05	Kidney	10	IRIS	1/2018
Chromium (III)	16065-83-1	1.50E+00	0.013	1.95E-02	No effects observed	1,000	IRIS	1/2018
Chromium (VI)	18540-29-9	3.00E-03	0.025	7.50E-05	None reported	900	IRIS	1/2018
Cobalt	7440-48-4	3.00E-04	--	3.00E-04	Thyroid	3,000	PPRTV	8/2008
Copper	7440-50-8	4.00E-02	--	4.00E-02	Gastrointestinal	NA	HEAST	1997
Lead	7439-92-1	NA (g)	--	NA	NA	NA	NA	NA
Manganese, diet	7439-96-5	1.40E-01 (l)	NA	NA	Neurological	1	IRIS	1/2018
Manganese, non-diet	7439-96-5	2.40E-02 (j)	0.04	9.60E-04	Neurological	3	IRIS	1/2018
Mercury, inorganic	7487-94-7	3.00E-4 (m)	0.07	2.10E-05	Immune	1,000	IRIS	1/2018

Table 5.1. Noncancer Toxicity Data – Oral/Dermal (continued)

Chemical of Potential Concern	CAS Number	Chronic Oral Reference Dose (mg/kg-day)	GI ABS Efficiency for Dermal (a)	Absorbed Chronic Dermal RfD (mg/kg-day) (b)	Primary Target Organ/ System	Combined Uncertainty/ Modifying Factors	Source	Date
Methyl Mercury	22967-92-6	1.00E-04	--	1.00E-04	Neurological	10	IRIS	1/2018
Selenium	7782-49-2	5.00E-03	--	5.00E-03	Neurological, Blood, Dermal Behavioral	3	IRIS	1/2018
Silver	7440-22-4	5.00E-03	0.04	2.00E-04	Skin	3	IRIS	1/2018
Thallium	7440-28-0	1.00E-05 (h)	--	1.00E-05	Hair	3,000	PPRTVscreening value (h)	10/2012
Titanium	7440-32-6	NA		NA			IRIS	1/2018
Vanadium	7440-62-2	5.04E-03 (i)	0.026	1.31E-04	Dermal	100	IRIS	1/2018
Zinc	7440-66-6	3.00E-01	--	3.00E-01	Immune, Blood	3	IRIS	1/2018
Pesticides								
4,4'-DDD	72-54-8	5.00E-04 (d)	--	5.00E-04	(d)	(d)	(d)	
4,4'-DDE	72-55-9	5.00E-04 (d)	--	5.00E-04	(d)	(d)	(d)	
4,4'-DDT	50-29-3	5.00E-04	--	5.00E-04	Liver	100	IRIS	1/2018
cis-Nonachlor	5103-73-1	1.04E-04 (e,n)	--	1.04E-04	(e,n)	(e,n)	(e,n)	
Dieldrin	60-57-1	5.00E-05	--	5.00E-05	Liver	100	IRIS	1/2018
alpha-Chlordane	5103-71-9	see Chlordane						
gamma-Chlordane	5566-34-7	see Chlordane						
trans-Chlordane	5103-74-2	see Chlordane						
Chlordane	12789-03-6	5.00E-4 (e)	--	5.00E-04	Liver	300	IRIS	1/2018
Heptachlor Epoxide	1024-57-3	1.30E-05	--	1.30E-05	Liver	1,000	IRIS	1/2018
trans-Heptachlor Epoxide	28044-83-9	see Heptachlor Epoxide						
Hexachlorobenzene	118-74-1	8.00E-04	--	8.00E-04	Liver	100	IRIS	1/2018
Mirex	2385-85-5	2.00E-04	--	2.00E-04	Endocrine/ Hepatic	300	IRIS	1/2018
Oxychlordane	27304-13-8	8.00E-04 (e,n)	--	8.00E-04	(e,n)	(e,n)	(e,n)	
trans-Nonachlor	39765-80-5	1.55E-05 (e,n)	--	1.55E-05	(e,n)	(e,n)	(e,n)	

Table 5.1. Noncancer Toxicity Data – Oral/Dermal (continued)

Chemical of Potential Concern	CAS Number	Chronic Oral Reference Dose (mg/kg-day)	GI ABS Efficiency for Dermal (a)	Absorbed Chronic Dermal RfD (mg/kg-day) (b)	Primary Target Organ/ System	Combined Uncertainty/ Modifying Factors	Source	Date
PAHs								
Benzo(a)anthracene	56-55-3	NA	--	NA	NA	NA	NA	NA
Benzo(a)pyrene	50-32-8	3.00E-04	--	3.00E-04	Developmental	300	IRIS	1/2018
Benzo(b)fluoranthene	205-99-2	NA	--	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	207-08-9	NA	--	NA	NA	NA	NA	NA
Benzo(j,k)fluoranthene								
Chrysene	218-01-9	NA	--	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	53-70-3	NA	--	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	193-39-5	NA	--	NA	NA	NA	NA	NA
VOCs								
Trichloroethene	79-01-6	5.00E-04	--	5.00E-04	Immune Immune Cardiovascular	100 1,000 10	IRIS	1/2018

Notes:
"--" - No adjustment necessary
GI ABS - Fraction of contaminant absorbed in gastrointestinal tract (dimensionless)
CAS - Chemical Abstracts Service
CNS - Central Nervous System
DLC - Dioxin-like congener
HEAST - Health Effects Assessment Summary Tables (USEPA, 1997)
mg/kg-day - milligrams per kilogram per day
NA - Not available
PAH - Polycyclic Aromatic Hydrocarbons
PCB - Polychlorinated Biphenyls
PPRTV - Provisional Peer Reviewed Toxicity Value
RfD - Reference Dose
SVOC - Semi-Volatile Organic Compounds.
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
IRIS - Integrated Risk Information System
VOC - Volatile Organic Compound
PCDD - Polychlorinated dibenzodioxins
PCDF - Polychlorinated dibenzofurans

(a) USEPA 2004b. Risk Assessment Guidance for Superfund. Volume 1, Part E, Supplemental Guidance for Dermal Risk Assessment. Exhibit 4-1. Where USEPA 2004b does not recommend adjustments, no value is listed.
(b) Oral RfD multiplied by ABSGI. Where no adjustment is recommended, Dermal RfD = Oral RfD.
(c) Value for Aroclor 1254 (2E-05 mg/kg-day) or Aroclor 1016 (7E-05 mg/kg-day) may be used to evaluate the noncarcinogenic hazards of total PCBs, and the Aroclor selected depends on the chlorine content of the PCB congeners in the medium of interest. The RfD for Aroclor 1254 is used to evaluate noncarcinogenic effects of total PCBs and non-dioxin-like PCBs (PCBs (non-DLC)).

Table 5.1. Noncancer Toxicity Data – Oral/Dermal (continued)

(d) The value for 4,4'-DDT is used as a surrogate based on structural similarity (USEPA, 2015a).
(e) Value for chlordane is used as a surrogate based on structural similarity. Relative potency factors have been applied based on a letter from Superfund Technical Support Center to Marian Olsen dated August 5, 2015 (USEPA, 2015b). The relative potency factors applied are: 4.8 (cis-nonachlor), 32.2 (trans-nonachlor, and 5.6 (oxychlordane).
(f) The reference dose for 2,3,7,8-TCDD is used to evaluate the noncarcinogenic effects of potentially dioxin-like PCBs (PCB-TEQ).
(g) Lead is evaluated using available lead modeling tools.
(h) No PPRTVs were developed for thallium in the PPRTV document (USEPA, 2012) due to database deficiencies. According to USEPA (2012) an RfD for thallium was not derived because the available toxicity database contains studies that are generally of poor quality. Appendix A of the PPRTV document indicates that it is inappropriate to derive provisional chronic or subchronic RfDs for thallium, but that information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors as a screening value. The use of this provisional value is highly uncertain but is the value used in the USEPA Regional Screening Tables (USEPA, 2017a).
(i) The oral RfD for vanadium is derived from the IRIS oral RfD for Vanadium Pentoxide by factoring out the molecular weight (MW) of the oxide ion. Vanadium Pentoxide (V205) has a molecular weight of 181.88. The two atoms of Vanadium contribute 56% of the MW. Vanadium Pentoxide's oral RfD of 9E-03 mg/kg-day multiplied by 56% gives a Vanadium oral RfD of 5.04E-03 mg/kg-day.
(j) When assessing exposure to manganese for non-dietary pathways, IRIS recommends applying a modifying factor of 3 to the oral RfD of 0.14 mg/kg-day. The USEPA Regional Screening Level User's Guide also indicates that the average dietary manganese content of the US diet (5 mg/day) be subtracted from the critical dose of 10 mg/day when assessing exposure to non-dietary manganese. Therefore, the RfD is (10 mg/day - 5 mg/day)/Modifying Factor (3) = 1.67 mg/day / 70 kg = 0.024 mg/kg-day. The unadjusted value of 0.14 mg/kg-day is used to assess dietary exposure to fish and crab tissue.
(k) The RfD for cadmium in food is used to evaluate dietary cadmium as well as oral and dermal contact with cadmium in sediment. The RfD for cadmium in water is used to evaluate oral and dermal contact with cadmium in surface water.
(l) The value for manganese, non-diet is used to assess dermal exposures.
(m) The value for mercury, inorganic is used to assess dermal exposures.
(n) Letter from Superfund Technical Support Center to Marian Olsen dated April 9, 2015 (USEPA, 2015b). Approval of Surrogates for Multiple Chemicals. Cis- and trans-nonachlor and oxychlordane.

Table 6.1. Cancer Toxicity Data – Oral/Dermal

Chemical of Potential Concern	CAS No.	Oral Cancer Slope Factor (mg/kg-day)$^{-1}$	GI ABS Efficiency for Dermal (a)	Absorbed Dermal Cancer Slope Factor (mg/kg-day)$^{-1}$ (b)	Weight of Evidence/ Cancer Guideline Description (c)	Classification System	Oral CSF/WOE Source (s)	Oral CSF/WOE Date
PCDDs/PCDFs								
TCDD-TEQ	TCDD-TEQ	1.50E+05 (d)	--	1.50E+05 (d)	(k)	(k)	HEAST	1997
PCBs								
PCBs, total PCBs (non-DLC)	1336-36-3							
high risk & persistence/upper bound		2.00E+00 (e)	--	2.00E+00	B2	1986	IRIS	1/2018
high risk & persistence/central estimate		1.00E+00 (e)	--	1.00E+00				
low risk & persistence/upper bound		4.00E-01 (e)	--	4.00E-01				
low risk & persistence/central estimate		3.00E-01 (e)	--	3.00E-01				
lowest risk & persistence/upper bound		7.00E-02 (e)	--	7.00E-02				
lowest risk & persistence/central estimate		4.00E-02 (e)	--	4.00E-02				
PCB-TEQ	PCB-TEQ	1.50E+05 (d)	--	1.50E+05 (d)	(k)	(k)	HEAST	1997
Inorganics								
Aluminum	7429-90-5	NA	--	NA	Inadequate Information	2005	PPRTV	2/2007
Antimony	7440-36-0	NA	0.15	NA	NA	NA	NA	NA
Arsenic, inorganic	7440-38-2	1.50E+00	--	1.50E+00	A	1986	IRIS	1/2018
Cadmium, diet	7440-43-9	NA	0.025	NA	B1	1986	IRIS	1/2018
Cadmium, water	7440-43-9	NA	0.05	NA	B1	1986	IRIS	1/2018
Chromium (III)	16065-83-1	NA	0.013	NA	D	1986	IRIS	1/2018
Chromium (VI)	18540-29-9	5.00E-01 (j,i)	0.025	2.00E+01 (j,i)	D [oral (l)]; A[inhalation]	1986	NJDEP	4/2009
Cobalt	7440-48-4	NA	--	NA	Likely Carcinogenic (inhalation)	2005	PPRTV	8/2008
Copper	7440-50-8	NA	--	NA	NA	NA	NA	NA
Lead	7439-92-1	NA	--	NA	B2	1986	IRIS	1/2018
Manganese, diet	7439-96-5	NA	1	NA	D	1986	IRIS	1/2018
Manganese, non-diet	7439-96-5	NA	0.04	NA	D	1986	IRIS	1/2018
Mercury, inorganic	7487-94-7	NA	0.07	NA	C	1986	IRIS	1/2018

Table 6.1. Cancer Toxicity Data – Oral/Dermal (continued)

Chemical of Potential Concern	CAS No.	Oral Cancer Slope Factor (mg/kg-day)-1	GI ABS Efficiency for Dermal (a)	Absorbed Dermal Cancer Slope Factor (mg/kg-day)-1 (b)	Weight of Evidence/ Cancer Guideline Description (c)	Classification System	Oral CSF/WOE Source (s)	Oral CSF/WOE Date
Methyl Mercury	22967-92-6	NA	NA	NA	C	1986	IRIS	1/2018
Selenium	7782-49-2	NA	--	NA	D	1986	IRIS	1/2018
Silver	7440-22-4	NA	0.04	NA	D	1986	IRIS	1/2018
Thallium	7440-28-0	NA	--	NA	Inadequate Information	2005	PPRTV	10/2012
Titanium	7440-32-6	NA						
Vanadium	7440-62-2	NA	0.026	NA	NA	NA	NA	NA
Zinc	7440-66-6	NA	--	NA	Inadequate Information	2005	IRIS	1/2018
Pesticides								
4,4'-DDD	72-54-8	2.40E-01	--	2.40E-01	B2	1986	IRIS	1/2018
4,4'-DDE	72-55-9	3.40E-01	--	3.40E-01	B2	1986	IRIS	1/2018
4,4'-DDT	50-29-3	3.40E-01	--	3.40E-01	B2	1986	IRIS	1/2018
cis-Nonachlor	5103-73-1	3.50E-01 (f,g)	--	3.50E-01 (f,g)	(f,g)	(f,g)	(f,g)	
alpha-Chlordane	5103-71-9	see Chlordane						
gamma-Chlordane	5566-34-7	see Chlordane						
trans-Chlordane	5103-74-2	see Chlordane						
Chlordane	12789-03-6	3.50E-01	--	3.50E-01	B2	1986	IRIS	1/2018
Dieldrin	60-57-1	1.60E+01	--	1.60E+01	B2	1986	IRIS	1/2018
Heptachlor Epoxide	1024-57-3	9.10E+00	--	9.10E+00	B2	1986	IRIS	1/2018
trans-Heptachlor Epoxide	28044-83-9	see Heptachlor Epoxide						
Hexachlorobenzene	118-74-1	1.60E+00	--	1.60E+00	B2	1986	IRIS	1/2018
Mirex	2385-85-5	1.80E+01		1.80E+01	Not assessed under IRIS		Cal/EPA	1/2018
Oxychlordane	27304-13-8	3.50E-01 (f,g)	--	3.50E-01 (f,g)	(f,g)	(f,g)	(f,g)	
trans-Nonachlor	39765-80-5	3.50E-01 (f,g)	--	3.50E-01 (f,g)	(f,g)	(f,g)	(f,g)	
PAHs								
Benzo(a)anthracene	56-55-3	1.00E-01 (h,i)	--	1.00E-01 (h,i)	Carcinogenic to humans	2005	IRIS	1/2018

Table 6.1. Cancer Toxicity Data – Oral/Dermal (continued)

Chemical of Potential Concern	CAS No.	Oral Cancer Slope Factor (mg/kg-day)$^{-1}$	GI ABS Efficiency for Dermal (a)	Absorbed Dermal Cancer Slope Factor (mg/kg-day)$^{-1}$ (b)	Weight of Evidence/ Cancer Guideline Description (c)	Classification System	Oral CSF/WOE Source (s)	Oral CSF/WOE Date
Benzo(a)pyrene	50-32-8	1.00E+00 (i)	--	1.00E+00 (i)	B2	1986	IRIS	1/2018
Benzo(b)fluoranthene	205-99-2	1.00E-01 (h,i)	--	1.00E-01 (h,i)	B2	1986	IRIS	1/2018
Benzo(j)fluoranthene	205-82-3	1.20E+00	--	1.20E+00				
Benzo(j,k)fluoranthene	207-08-9-JK	see Benzo(j)fluoranthene						
Benzo(k)fluoranthene	207-08-9	1.00E-02 (h,i)	--	1.00E-02 (h,i)	B2	1986	IRIS	1/2018
Chrysene	218-01-9	1.00E-03 (h,i)	--	1.00E-03 (h,i)	B2	1986	IRIS	1/2018
Dibenz(a,h)anthracene	53-70-3	1.00E+00 (h,i)	--	1.00E+00 (h,i)	B2	1986	IRIS	1/2018
Indeno(1,2,3-cd)pyrene	193-39-5	1.00E-01 (h,i)	--	1.00E-01 (h,i)	B2	1986	IRIS	1/2018
VOCs								
Trichloroethene	79-01-6	4.60E-02 (i)	--	4.60E-02 (i)	Carcinogenic to humans	2005	IRIS	1/2018

Notes:

"--" - No adjustment necessary
GI ABS - Fraction of contaminant absorbed in gastrointestinal tract (dimensionless)
CalEPA - California EPA, www.oehha.ca.gov/risk/ChemicalDB/index.asp
CAS - Chemical Abstracts Service
DLC - Dioxin-like congener
CSF - Cancer Slope Factor
HEAST - Health Effects Assessment Summary Tables (USEPA. 1997)
IRIS - Integrated Risk Information System
mg/kg-day - milligrams per kilogram per day
NA - Not available
NJDEP - New Jersey Department of Environmental Protection
NTP - National Toxicology Program
PAH - Polycyclic Aromatic Hydrocarbons
PCB - Polychlorinated Biphenyls
PCDD - Polychlorinated dibenzodioxins
PCDF - Polychlorinated dibenzofurans
PPRTV - Provisional Peer Reviewed Toxicity Value
RPF - Relative Potency Factor
SVOC - Semi-Volatile Organic Compounds
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - Toxicity Equivalence
VOC - Volatile Organic Compounds
WOE - Weight-of-Evidence

(a) USEPA 2004b. Risk Assessment Guidance for Superfund. Volume 1, Part E, Supplemental Guidance for Dermal Risk Assessment. Exhibit 4-1. Where USEPA 2004b does not recommend adjustments, no value is listed.

Table 6.1. Cancer Toxicity Data – Oral/Dermal (continued)

(b) Oral CSF divided by ABSGI. Where no adjustment is recommended, Dermal CSF = Oral CSF.
(c) Some chemicals are classified under the 1986 system, while others have been classified under the 2005 system:

1986 Classifications	2005 Classifications
Group A Carcinogenic to Humans	Carcinogenic - Carcinogenic to Humans
Group B Probably Carcinogenic to Humans	Likely Carcinogenic - Likely to be Carcinogenic to Humans
B1 Based on limited human evidence	Suggestive Evidence - Suggestive Evidence of Carcinogenic Potential
B2 Based on animal evidence	Inadequate Information - Inadequate Information to Assess Carcinogenic Potential
Group C Possibly Carcinogenic to Humans	Not Likely Carcinogenic - Not Likely to be Carcinogenic to Humans
Group D Not Classifiable as to Human Carcinogenicity	
Group E Evidence of Noncarcinogenicity for Humans	

(d) The HEAST (USEPA, 1997) cancer slope factor for 2,3,7,8-TCDD is used to evaluate carcinogenic effects of TCDD-TEQ and the potentially dioxin-like PCBs (PCB-TEQ).
(e) The range of PCB CSFs is used to evaluate carcinogenic effects of total PCBs and non-dioxin-like PCBs (PCBs [non-DLC]).
(f) Letter from Superfund Technical Support Center to Marian Olsen dated April 9, 2015 (USEPA, 2015b). Approval of Surrogates for Multiple Chemicals. Cis- and trans-nonachlor and oxychlordane.
(g) Value for chlordane is used as a surrogate based on structural similarity, and without the use of relative potency factors, per letters from Superfund Technical Support Center to Marian Olsen, USEPA Region 2, dated August 5, 2015 and November 24, 2015 (USEPA, 2015a,b).
(h) Calculated using RPFs as per USEPA Guidance for Quantitative Risk Assessment of PAHs (USEPA, 1993) and USEPA's Toxicological Review of Benzo(a)pyrene (USEPA, 2017b).
(i) Assumed to act via a mutagenic mode of carcinogenic action; therefore, age-dependent adjustment factors are applied to the risk estimates.
(j) IRIS indicates that there is no evidence that chromium VI is carcinogenic via the oral route and does not provide a CSF. However, because USEPA has used the NJDEP CSF in its RSL tables, the NJDEP value is used here (Derivation of Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Chromium (NJDEP, 2009).
(k) The cancer assessment for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is currently deferred, as indicated in the IRIS Program Multi-Year Agenda, December 2015 (USEPA, 2015a).
(l) The cancer assessment for oral exposure to chromium VI is currently in draft development, as indicated in the IRIS Program Multi-Year Agenda, December 2015 (USEPA, 2015d).