Control of Toxic Chemicals in Puget Sound

Phase 1: Initial Estimate of Loadings

WASHINGTON STATE DEPARTMENT OF ECOLOGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUGET SOUND PARTNERSHIP
STATE OF WASHINGTON

HARTCROWSER

Phase 1: Initial Estimate of Toxic Chemical Loadings to Puget Sound

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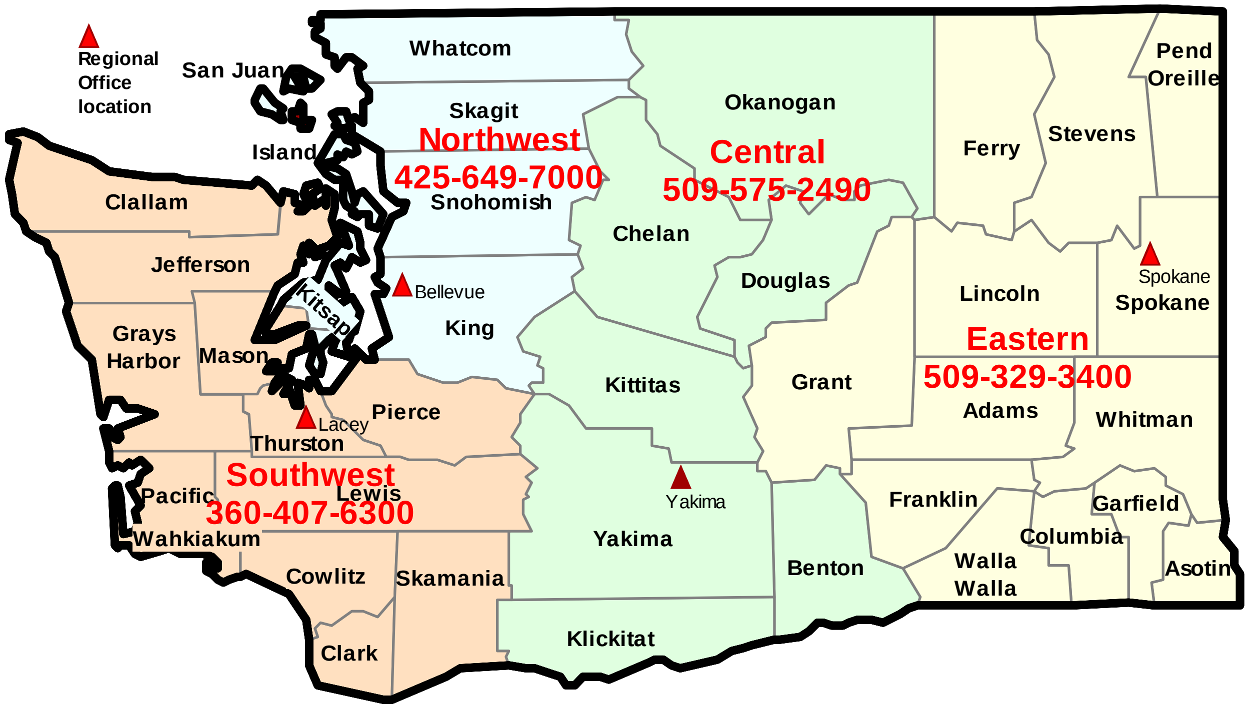

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Context and Overview

Purpose and Background

Following a recommendation in December 2006 by the original Puget Sound Partnership, Washington State statute declared that one of the objectives for ensuring the recovery of Puget Sound is ***significantly reducing toxics entering Puget Sound fresh and marine waters***. A team of toxic contamination experts from various governmental entities around Puget Sound has initiated an effort to assess toxic contaminant loading to Puget Sound so that the Puget Sound Partnership, Department of Ecology (Ecology), and other agencies can select how and where to target toxics reduction efforts to provide the most benefit for Puget Sound. This interagency toxics study team has initiated a multiple phase project to:

- Analyze toxic contaminant loading to identify areas of greatest uncertainty.
- Provide interim results to inform subsequent analytical steps.
- Guide the development of the 2020 Action Agenda (to be developed by the Puget Sound Partnership by September 2008) and other initiatives to improve the management of toxic contaminants in the Puget Sound region.

Ecology led the first phase of this long-term project with assistance from the interagency toxics study team and using its own and U.S. Environmental Protection Agency funding. Subject area experts beyond the study team provided technical input during project scoping/design and as reviewers of the draft report. This Phase 1 project was an initial reconnaissance to support characterization of toxic contaminant loadings from several main pathways. The study team acknowledged that the effort would investigate and describe pathways by which contaminants were conveyed to Puget Sound but would not characterize the sources that introduced contaminants to the environment. Furthermore, the study team understood that the initial phase, which relied on existing data, would not be able to characterize all pathways by which toxics were introduced to Puget Sound. Despite these limitations, project participants hoped that the Phase 1 project would provide insights about the relative importance of various pathways and thereby be useful for identifying potential management program innovations and directions for future studies. This document reports on the first phase of this project, representing work done in the first nine months of 2007.

During the course of this Phase 1 project, the toxics study team designed and initiated a series of Phase 2 projects that build upon the Phase 1 project and provide advice for developing the 2020 Action Agenda. Phase 2 analyses will:

- Refine the understanding of pathways and sources, especially roadway runoff and industrial and municipal wastewater discharges.
- Begin to characterize the movement of toxics in the Puget Sound ecosystem, especially movement to and from marine sediments, to and from marine biota, and to and from the Pacific Ocean and the inland marine waters of British Columbia.

- Update and improve a conceptual model and a simple numerical model to frame a collective understanding of toxics in the Puget Sound ecosystem.
- Develop plans for improved surveys of toxic contaminants and their effects, including effects on human health and the biological organisms of the Puget Sound ecosystem.

The study team expects the results of its Phase 1 and 2 technical studies to support a policy analysis that will be completed no later than mid-2008. This analysis will help describe innovations for reducing the use and generation of toxics and for reducing the discharge and emission of toxics to the Puget Sound environment. The timing of these tasks is important if the toxics studies conducted through Phases 1 and 2 are to inform the 2020 Action Agenda.

In future years, the toxics study team anticipates that analyses will include studies to fill gaps in existing data and to characterize and compare contaminant sources affecting toxic contaminant loadings in each loading pathway. Additional analyses will inform policy and management actions that can best accomplish the Puget Sound Partnership's goals of water and sediment quality that do not harm the Puget Sound ecosystem or human uses of the ecosystem. Ecology has proposed to continue Phase 3 through a budget request in the FY08 legislative session. The study team anticipates that further toxics study will be integrated into the Puget Sound Partnership's strategic science program, which should take form by mid-2008.

Results and Limitations

This Phase 1 study provided estimates of loadings for 17 chemicals of concern to the Puget Sound ecosystem from surface runoff, atmospheric deposition to the marine area of the watershed, a limited number of permitted wastewater dischargers (point sources), and direct spills to the surface waters of the watershed. This study did not characterize other pathways, such as leaching from sediment deposits into the water column, migration via biota, and exchange with oceanic waters. The summary table at the end of this section provides the Phase 1 best estimate of the loadings of toxic chemicals to Puget Sound along with their uncertainties. Future work should include assessments of other toxic substances beyond those considered in this study.

Surface Runoff: The bulk of the toxic chemicals that enter Puget Sound marine waters have done so through runoff from the land surface. Lands developed for commercial, industrial, and residential uses have generated higher rates of runoff and more highly contaminated runoff. Developed lands contributed the majority of several toxic chemicals to Puget Sound (i.e., cadmium, lead, zinc, nonylphenol, and oil and petroleum products). However, the large area of undeveloped lands in the Puget Sound Basin (forest & fields and agricultural lands), covering approximately 89 percent of the basin, has yielded a much greater quantity of runoff. Therefore, based on the relative amounts of undeveloped lands and the limited available concentration data, undeveloped lands have delivered to Puget Sound the bulk of the surface runoff load for several of the contaminants of concern (i.e., arsenic, polybrominated diphenyl ethers (PBDEs), dichlorodiphenyltrichloroethane (DDT), and triclopyr). As defined in this Phase 1 study, surface runoff consists of stormwater, non-point overland flow, and groundwater discharge to surface waters that flow to Puget Sound. This study did not characterize separately stormwater from urban lands and surface runoff from non-urban lands.

Atmospheric Deposition: Atmospheric deposition directly to Puget Sound appeared to be an important source of loading for some chemicals of concern. For several of them (i.e., for polyaromatic hydrocarbons (PAHs) and PBDEs), atmospheric loading directly to the marine waters and tidelands was greater than or comparable to the loading from surface runoff. Atmospheric deposition information used in the Phase 1 project came predominantly from observations in urban areas. The limited characterization of deposition in rural areas introduced significant uncertainty into these estimates.

Industrial and Municipal Wastewater: The characterization of toxics loadings from industrial and municipal wastewater incompletely accounted for loadings from permitted point source dischargers. Since the analytical approach for the Phase 1 project relied solely on matched pairs of concentration and flow data from individual facilities, the study did not provide an estimate of the total loading from the entire list of 200 Puget Sound Basin facilities with individual wastewater discharge permits.

Combined Sewer Overflows: Episodic discharge of untreated and partially treated wastewaters from combined sewer overflow (CSO) outfalls contributed relatively little to the total loading of toxic chemicals to Puget Sound. The estimated loadings from CSO systems in the Puget Sound Basin represented much less than one percent of that from surface runoff.

Direct Spills: The available data did not support estimation of loadings from direct spills for the individual chemicals of concern. However, the total amount of reported oil and petroleum products spilled directly into the surface waters of the Puget Sound Basin was only about four percent of the amount estimated to enter via surface runoff.

Conclusions and Recommendations

The results of this study suggested that runoff from the land surface and deposition from the air (directly to marine waters) have imposed considerable loads of contaminants to Puget Sound. The toxics study team concluded that actions to reduce the contamination of the land surface and air (e.g., best management practices to prevent or minimize toxics releases) and actions to remove toxic contaminants from surface runoff (e.g., stormwater source control or treatment) may offer the best opportunities to reduce toxics loading.

Overflows from combined sanitary and storm sewers (CSOs) represented a small percentage of the loading from runoff because overflow volumes were much smaller than surface runoff volumes. Across the entire basin, it appeared that CSOs do not present a significant opportunity to reduce the toxic contaminant loadings to Puget Sound. However, in the vicinity of CSO outfalls, overflow events may be a significant contributor to localized toxics problems. Additional controls of CSO discharges may provide toxic reduction benefits for specific contaminated sites, possibly at the scale of the urban bay.

The Phase 1 project did not sufficiently characterize loadings from the discharge of industrial and municipal wastewater or from spills directly to surface waters to support conclusions about the benefits of additional controls on these pathways. The study team recommended further investigation of these pathways.

The toxics study team recommended additional review of existing data and collection of new data to improve toxics loading estimates. Section 5 of this report provides specific recommendations. Highlights of these recommendations include the following:

- Search for and acquire wastewater concentration and flow information not obtained during the Phase 1 project (e.g., permittee monitoring reports not stored electronically).
- Collect and analyze environmental samples to quantify the amounts of specific toxic chemicals released to Puget Sound. Distinguish temporal variations in loading, and establish linkages between pollutant sources and pathways.
- Use a quantitative mass balance model to:
    - Determine whether the current loading estimates are consistent and realistic.
    - Develop a better idea of the fate of contaminants in Puget Sound and its sub-watersheds.
    - Establish a consistent approach for identifying key data gaps and uncertainties.
    - Improve management tools for predicting results from load reductions.
- Conduct analyses to improve the understanding of how land use and stormwater management practices in highly developed areas affect loadings from surface runoff.
- Improve estimates of the contributions of specific toxic chemicals in permitted discharges of wastewater from industrial and municipal treatment facilities.
- Develop estimates of toxic chemical loadings from specific potential sources, such as stormwater runoff from roadways.
- Apply regional air pollutant transport models to estimate relative differences in deposition rates at different locations in the Puget Sound watershed.
- Confirm the estimated atmospheric deposition rates through monitoring at mid-water locations of Puget Sound and at selected locations on land. Adjust the expected surface runoff concentrations from the various land uses to account for geographical differences in air deposition rates.
- Verify and recalculate if necessary the estimated loading values for arsenic, total PBDEs, DDT, and triclopyr through collection and analyses of surface runoff from areas of agricultural, residential, and forest & field land use located throughout the Puget Sound Basin.
- Improve the understanding of seasonal variations in loading rates.
- Evaluate the relationship between stream flow rates and toxic chemical concentrations.

Summary of Toxic Chemical Loadings to the Puget Sound Basin (metric tons per year)

(Page 1 of 2)

Chemical	Runoff (a)	Atmospheric Deposition (b)	Wastewater (c)		CSOs (e)
			POTWs (d)	Industries	
Arsenic	**62** *(32 to 118)*	**3.1** *(0.3 to 16)*	**0.0005** *(0.0000 to 0.0010)*	**7.4** *(0.20 to 14.6)*	**0.014**
Cadmium	**5.2** *(2.3 to 13)*	**1.6** *(0.31 to 6.2)*	**0.0023** *(0.00083 to 0.0037)*	**0.45** *(0.019 to 0.88)*	**0.0046**
Copper	**102** *(49 to 198)*	**31** *(3.1 to 150)*	**1.2** *(1.2 to 1.2)*	**6.0** *(6.0 to 6.0)*	**0.23**
Lead	**89** *(34 to 238)*	**31** *(3.1 to 150)*	**0.11** *(0.10 to 0.12)*	**4.6** *(0.28 to 9.0)*	**0.14**
Zinc	**344** *(173 to 637)*	**60** *(6 to 310)*	**2.6** *(2.6 to 2.6)*	**15.5** *(15.5 to 15.5)*	**0.59**
Mercury	**0.52** *(0.19-1.4)*	**0.031** *(0.0062-0.16)*		**0.015** *(0.0000-0.029)*	**0.00069**
Total PCBs (f)	**0.17** *(0.040 to 0.72)*	**0.0062** *(0.0016 to 0.062)*			
Total PBDEs (g)	**6.0E-04** *(1.7E-04 to 2.2E-03)*	**0.0062** *(0.0016 to 0.019)*			
Carcinogenic PAHs (h)	**2.3** *(0.81 to 6.6)*	**3.1** *(0.31 to 16)*		**0.024** *(0.00018 to 0.048)*	**0.00093**
Other High Molecular Weight PAHs	**1.7** *(0.61 to 5.0)*	**1.6** *(0.31 to 6.2)*		**0.0070** *(0.00079 to 0.013)*	**0.0017**
Low Molecular Weight PAHs	**5.9** *(2.1 to 17)*	**1.6** *(0.31 to 6.2)*		**0.014** *(0.00099 to 0.026)*	**0.0021**
bis(2-Ethyl-hexyl)-phthalate	**74** *(19 to 289)*	**3.1** *(0.31 to 16)*		**0.082** *(0.082 to 0.082)*	**0.047**
Total Dioxin TEQs (i)	**4.5E-05** *(1.1E-05to 1.8E-04)*	**3.1E-06** *(3.1E-07 to 3.1E-05)*			**2.3E-08**
Total DDT (j)	**0.16** *(0.042 to 0.63)*	**0.0062** *(0.0012 to 0.031)*			

Summary of Toxic Chemical Loadings to the Puget Sound Basin (metric tons per year)

(Page 2 of 2)

Chemical	Runoff (a)	Atmospheric Deposition (b)	Wastewater (c)		CSOs (e)
			POTWs (d)	Industries	
Triclopyr	**0.49** *(0.12 to 1.9)*				
Nonylphenol	**7.8** *(1.9 to 32)*				**0.041**
Oil or Petroleum Product (k)	**22,580** *(9,580 to 55,750)*		**6.1** *(6.1 to 6.1)*	**51.3** *(38.6 to 66.7)*	**36**

(a) = Best estimate; (75% to 25% probability of exceedance).
(b) = Best estimate; (High to Low probability of exceedance).
(c) = Loadings are based on the assumption that non-detects (NDs) = ½ of the analytical detection limit.
(For High and Low probabilities of exceedance: Assume ND = 0 and ND = detection limit.)
Loadings are based on limited data and were not scaled up to account for the absent concentration and flow pairs.
(d) = Publicly-Owned Treatment Works.
(e) = Combined Sewer Outfall.
(f) = PCB = Polychlorinated biphenyls.
(g) = PBDE = Polybrominated diphenyl ethers.
(h) = PAH = Polyaromatic hydrocarbons.
(i) = TEQ = Toxicity equivalents relative to 2,3,7,8-dioxin.
(j) = DDT = Dichlorodiphenyltrichloroethane and metabolites.
(k) = Data from the Emergency Response Tracking System for the years 2000 through 2006 showed that an average of only approximately 960 metric tons/year of oil and petroleum products were spilled directly to the marine or surface waters in the Puget Sound watershed.

1.0 Background and Objectives

The Washington State Department of Ecology (Ecology), United States Environmental Protection Agency (EPA), Puget Sound Partnership, King County, and other interested parties are collaborating to advance toxic chemical controls as part of a multi-year effort to protect and restore the overall health of the Puget Sound ecosystem by 2020. Following a recommendation made by the original Puget Sound Partnership in December 2006, Ecology and its partners initiated a multi-year, multi-phase project to improve understanding of and controls on the sources of toxic chemical contamination to the Puget Sound ecosystem. Some of the objectives of the overall project include:

- Identify the toxic chemicals of greatest ecological and human health concern for the Puget Sound ecosystem.
- Estimate the loading rates of key contaminants from major pathways to all or selected portions of the Puget Sound ecosystem.
- If necessary, collect and analyze samples to fill high-priority data gaps.
- Develop a mass budget for each of the toxic chemicals in the Puget Sound ecosystem, including characterizing toxic chemical loadings, accumulation, and loss.
- Identify and understand the degree and sources of uncertainty for each phase of the project.
- Evaluate the potential for reductions in toxic chemical loadings for major pathways.
- Develop recommendations in each phase of the project for the appropriate uses of the results and suggestions for data presentation to assure clear communication of the uncertainties.
- Prepare a strategy in collaboration with stakeholders that identifies the actions, practices, and policies that will reduce loads of toxic chemicals to Puget Sound to protect and restore the overall health of the ecosystem.

1.1 Report Organization

This summary report presents the results of the Phase 1 assessment of toxic chemical loadings to Puget Sound. Following this Background and Objectives section, the report includes the following sections:

- 2.0 Scope of Services
- 3.0 Chemicals of Concern and Mass Loading Pathways
- 4.0 Toxics Loadings Calculations and Results
- 5.0 Conclusions and Recommendations
- 6.0 References

Tables and figures follow the main text. Appendices A and C summarize surface runoff water quality and atmospheric deposition flux data, respectively, obtained from various studies. Appendix B presents estimated surface runoff loadings for watersheds defined by Ecology for its Puget Sound circulation and transport box model. Appendix D presents detailed calculations for the wastewater point source loading rates.

1.2 Puget Sound Characteristics

Puget Sound, located in Washington State (Figure 1), is the largest fjord-like estuary in the continental United States. Nestled between the Cascade and Olympic mountain ranges, the Puget Sound Basin covers more than 43,400 square kilometers (16,800 square miles) of land and water. It consists of a series of interconnected deep (average depth of 140 meters or 460 feet) underwater basins separated by ridges called sills. These basins include the deep Main Basin (up to 280 meters [920 feet] deep) and the shallower South Sound, Hood Canal, and Whidbey Basins. Admiralty Inlet connects Puget Sound to the Pacific Ocean through the Strait of Juan de Fuca. For the purposes of this project, the term "Puget Sound" includes all of Puget Sound, Hood Canal, and the Straits of Georgia and Juan de Fuca within the state of Washington.

Approximately 4,000 kilometers (2,500 miles) of shoreline including a mix of beaches, bluffs, deltas, mudflats, and wetlands surround Puget Sound. More than 10,000 streams and rivers drain into Puget Sound and mix with Pacific Ocean-derived salt water. Almost 85 percent of the annual surface water runoff from the basin discharges from the following ten rivers:

- Cedar/Sammamish
- Elwha
- Green/Duwamish
- Nisqually
- Nooksack
- Puyallup
- Skagit
- Skokomish
- Snohomish
- Stillaguamish

Recent growth and development in the region are stressing the Puget Sound ecosystem. Puget Sound has significant challenges, from water pollution and sediments laden with toxic pollutants to sharp declines of salmon, orcas, marine birds, and rockfish. A steady loss of habitat, declines in some fish and wildlife populations, recontamination of sediment cleanup sites, and closures of shellfish beds signal that the health of Puget Sound is threatened.

1.3 Contaminant Sources and Pathways

The toxic contaminants that harm and threaten Puget Sound include:

- Chemicals purposefully synthesized for use in industry and commerce or by individuals.
- Byproducts of manufacturing or the combustion of fuel.

- Elements and compounds that occur naturally but may become concentrated in the environment due to human uses or other activities.

Releases of toxic contaminants to the environment can occur through designed and controlled human actions (e.g., application of pesticides or discharge of wastes through outfall pipes and smokestacks) or as unintended consequences of human activities (e.g., spills; leaching from landfills; or deterioration and wear of roof, pavement, and tire materials).

Toxic chemicals make their way from their original sources into Puget Sound through a variety of pathways. The sources associated with major pathways are described below.

1.3.1 Surface Runoff

The surface runoff pathway includes contaminants transported by rainwater or urban activities into water bodies that flow to Puget Sound (e.g., by irrigation overflow). For the purposes of this Phase 1 study, toxic chemicals discharged in overland flow (also called a non-point source), stormwater that discharges through pipes, and groundwater discharge to water bodies are considered to be “surface runoff.” Surface runoff can include toxic chemicals dissolved in water or adsorbed to solid particles (e.g., eroded soil particles). Excluding direct groundwater discharge to Puget Sound, nearly 85 percent of the surface runoff that enters Puget Sound flows into the ten large Puget Sound rivers listed above (Puget Sound Action Team 2007). In addition, thousands of small creeks and stormdrains, and many acres of overland sheet flow contribute freshwater surface runoff directly to Puget Sound.

Sources of toxic chemicals that surface runoff transports to Puget Sound include motor vehicle operations, galvanized structures, illegal dumping, aerial deposition of air pollutants onto the land, pesticide and fertilizer applications, construction materials, and stockpiled materials. For the purpose of this study, the surface runoff pathway also includes spills onto the land surface that become commingled with stormwater runoff and groundwater that may discharge to surface water.

Most urban development in the region occurs along the edge of Puget Sound and in the flatlands of the major estuaries (Figure 2). Urban lands (areas with a large number and high density of human residents) cover 11 percent of the Puget Sound Basin. Development in these areas has replaced trees and soil that had previously captured and filtered toxic chemicals in runoff and provided protection to Puget Sound.

Human development of the Puget Sound Basin has converted much of the natural landscape of forests and fields to impermeable surfaces that hasten runoff and facilitate the runoff of fine particulates to which contaminants have adsorbed. In developed urban areas, runoff (principally urban stormwater) typically flows through storm sewer systems where it may bypass the soils, trees, and vegetation that would have captured and filtered toxic chemicals as occurs in undeveloped areas.

The National Pollutant Discharge Elimination System (NPDES) program of the federal Clean Water Act regulates stormwater discharges from some developed areas. Ecology has issued more than 3,000 stormwater NPDES permits, including 120 municipal separate storm sewer system Phase I and II permits, 1,100 industrial stormwater permits, and more than 2,000 construction stormwater permits. Not all stormwater permits require monitoring for toxic substances. For the most part they are general (as opposed to individual) technology-based permits (LaLiberte and Ewing 2006).

Agricultural, managed forest, and pasture land also contribute toxic chemicals to surface runoff, although usually with a different mix of chemicals. Ongoing studies provide examples of these differences by comparing levels of pesticides found in runoff from two major Puget Sound river systems: Cedar-Sammamish (an urban sub-basin) and Lower Skagit-Samish (an agricultural sub-basin). The following table shows the most frequently detected pesticides (>20 percent of samples) in the stream data from the typical pesticide-use season (March through October) in 2006 (Ecology 2007a).

Pesticide	Type	Detection Frequency (percent)	Maximum Concentration (ug/L)
Thornton Creek in Cedar-Sammamish Watershed			
Dichlobenil	H	58	0.031
2,4-D	H	22	0.12
Triclopyr	H	22	0.097
Sub-Basins in Lower Skagit-Samish Watershed			
Diphenamid	H	75	0.024
2,4-D	H	45	0.43
Dichlobenil	H	45	0.13
Metalaxyl	F	39	0.13
EPTC	H	36	1.8
Simazine	H	36	1.6
Bentazon	H	32	0.28
Tebuthiuron	H	32	0.31
Triclopyr	H	32	0.73
Metolachlor	H	29	0.11
Atrazine	H	21	0.15
MCPA	H	21	0.18
MCPP	H	21	0.046
Pentachlorophenol	WP	21	0.022

Pesticide Types:
F = Fungicide
H = Herbicide
WP = Wood Preservative

1.3.2 Aerial Deposition

Air pollution in the Puget Sound Basin originates from sources in the region and areas upwind of Puget Sound, including elsewhere in the Pacific Northwest and across the Pacific Ocean. Emitted constituents from local sources may move into upper air strata and out of the Puget Sound region, or they may deposit onto either water or land surfaces. Contaminants deposited onto the land may then flow into Puget Sound via stormwater runoff. (For this study, contaminants carried in stormwater runoff are included in surface runoff calculations.) Airborne emissions from industrial, commercial, and transportation sources located in this region or beyond contribute contaminants by deposition to the surface runoff pathway or directly to surface waters. Local sources include emissions from marine traffic, point sources (such as factories), commercial enterprises (e.g., dry cleaners, auto body paint facilities), and diffuse activities such as car, truck, rail, and air traffic, and wood burning.

The Puget Sound Clean Air Agency (PSCAA) and other local air pollution control agencies inventory sources of air emissions in the Puget Sound area. These efforts primarily assess emissions of conventional pollutants in the region, such as particulates and sulfur dioxide. PSCAA has demonstrated that nearly 70 percent of the air pollution comes from motor vehicle emissions. To show the relative proportion of toxic chemical emissions from various sources, the following table highlights volatile organic compounds (VOCs) and fine particulate matter (PM2.5) (PSCAA 2006).

	2004 Emissions (thousands of tons/year)	
Category	**VOCs**	**PM2.5**
Large facility point sources	4	1
On-road mobile sources		
On-road gasoline vehicles	78	1
On-road diesel vehicles	2	1
Non-road mobile sources		
Marine vessels and watercraft	6	2
Off-road vehicles and equipment	17	2
Aircraft and airport equipment	2	0.2
Stationary area sources		
Outdoor burning	4	10
Indoor wood burning	13	4
Other sources (such as evaporation from paints, solvents, and fuels)	57	9
Biogenic sources	71	0

The Puget Sound 2005 Maritime Air Emissions Inventory provided the following summary of the numbers of maritime-related vessels, and the relative volumes of VOCs and PM2.5 from these sources (Puget Sound Maritime Air Forum 2007).

	Emissions (tons/year)		
Source	**VOCs**	**PM2.5**	**Number**
Ocean-going vessels			2,937 inbound calls
Hoteling	74	209	
Maneuvering	24	17	
Transiting	399	566	
Harbor vessels	3,363	456	678 vessels
Rail			>7,000 trains
Rail, off-terminal	57	32	
Rail, on-terminal	67	32	
Cargo handling equipment	103	72	1,145 units
Heavy-duty vehicles, off-terminal	58	39	
Heavy-duty vehicles, on-terminal	18	4	
Fleet vehicles	5	0	

Finally, the 2005 National Toxic Release Inventory gave a rough estimate for air releases of toxic chemicals from point sources. These numbers likely underestimate the releases because facilities self report and because the law requires reporting releases only above threshold amounts. Facilities located in the 12 counties adjacent to Puget Sound reported the following air releases in 2005 for chemicals of interest (http://www.epa.gov/tri).

Constituent	**Release (pounds/year)**	**Number of Facilities**
Copper and copper compounds	15,872	12
Dioxin and dioxin-like compounds	3.8 grams/yr	10
Lead and lead compounds	3,204	43
Mercury compounds	219	13
Polycyclic aromatic hydrocarbons (PAHs)	30,991	24
Phenols	47,480	13
Phthalates	4,522	4
Zinc compounds	10,437	8

1.3.3 Discharges of Industrial and Municipal Wastewater

This pathway includes point source effluent discharges from industrial facilities and sewage treatment plants that flow through discrete pipes into rivers, lakes, and Puget Sound. The state has regulated point sources under the federal Clean Water Act through NPDES permits since the

1970s. This pathway also includes sources that are regulated in Washington under general permits in broad categories such as sand and gravel operators, dairy facilities, and aquatic pesticide applicators. This pathway does not include discharges from facilities to land surfaces that do not overflow to surface waters (i.e., irrigation fields, infiltration beds).

Ecology regulates approximately 200 individual permitted effluent dischargers to surface waters in the Puget Sound Basin. Only about 16 percent of these regulated facilities have permits that limit toxic pollutants in their treated wastewater (Maroncelli 2007). Approximately 103 sewage treatment plants discharge to surface waters in the Puget Sound Basin. Ecology regulates 95 of them, while the EPA regulates 8. The permitted design flow from these facilities totals over 700 million gallons per day. Actual flow is less, though, because these facilities operate at levels below their permitted design flow. Toxic contaminants in industrial and municipal point source wastewaters include chemical byproducts and wastes from industrial processes and chemicals from industrial, commercial, and consumer products such as cleaning products and pharmaceuticals.

1.3.4 Discharges from Combined Sewer Overflows

Combined sanitary-stormwater sewer systems represent another pathway that conveys toxic chemicals to Puget Sound. Combined sewer overflows (CSOs) exist in the older parts of some cities in the Puget Sound region. For most of the year, these combined flows enter sewage treatment plants and discharge only after treatment. The systems, however, do overflow (as designed) at designated outfalls when large rainstorms overwhelm the wastewater treatment plants (WWTPs).

The ten sanitary systems in Puget Sound with CSO components include:

- City of Anacortes
- City of Bellingham
- Bremerton
- City of Everett
- City of Mount Vernon
- Metropolitan King County (West Point)
- Snohomish
- City of Olympia
- City of Port Angeles
- City of Seattle

During large rain events, toxic chemicals from these untreated effluents sometimes flow into Puget Sound at CSO outfalls. Some of these discharges include effluents from industrial facilities that ordinarily flow to sewage treatment plants. These CSOs had reported flow rates in the past few years ranging from a low of 495 million gallons in 2001 to a high of 1.7 billion gallons in 2004. Several contaminated sediment sites in Puget Sound are located at or near CSO outfalls.

1.3.5 Direct Spills to Aquatic Systems

Sources of spills directly to aquatic systems include small to catastrophic releases from the transfer or transportation of hazardous chemicals, oil and petroleum products from refining activities, tanker ship loading and unloading, transportation of oil via land-based pipelines, and leaking of derelict vessels. This Phase 1 study incorporates spills onto land surfaces into its calculations for loadings from surface runoff.

Over 20 billion gallons of oil and hazardous chemicals are transported through Washington State each year, by ship, barge, pipeline, rail, and road (Ecology 2007b). Analysis of spills from 1980 to 1989 shows that the majority of spills occur during fuel transfers and result in small releases of several hundred gallons (US Coast Guard 2007).

Chemicals of concern from spills include polycyclic aromatic hydrocarbons (PAHs) and other petroleum-based chemicals related to fuel. Catastrophic spills may include toxic chemicals released during transport (such as train derailments).

1.3.6 Groundwater Discharge to Surface Waters

This Phase 1 study has incorporated groundwater discharges to surface waters in upper watersheds into the baseflow calculations in the surface runoff pathway. A significant amount of groundwater, however, flows directly into Puget Sound. For example, modeling results for the Duwamish River Basin showed a total groundwater discharge rate of 0.85 cubic meters per second (220 gallons per second) to the Duwamish River, Elliott Bay, or Lake Washington (Fabritz et al. 1998).

Sources of toxic chemical contamination of groundwater include contact with contaminated soil sites, leaking underground storage tanks, landfill leachate, and other releases from industrial sites. The sites of most concern for groundwater contamination are located within a kilometer of the edge of Puget Sound or its drainages. As of June 2006, there were 1,014 listed contaminated sites within 0.8 kilometers (0.5 miles) of Puget Sound, although 34 percent of these had been cleaned up (Washington GMAP 2006). Tidally-induced movement of groundwater can increase the transport rate of contaminants at sites located within 180 meters (600 feet) of the shore.

This Phase 1 study did not evaluate groundwater discharges directly to Puget Sound. However, this study did include groundwater discharges to streams and rivers as part of surface runoff discharge.

1.3.7 Flow of Marine Waters from the Pacific Ocean

The exchange of waters with the Pacific Ocean and Canada influences the chemistry of Puget Sound. For example, surface particles in the North Puget Sound, Central Puget Sound, and Whidbey Basins can move out of the Sound in 1 to 2 weeks. In the South Sound, surface particles reside in the basin for up to 3 weeks before they flush out through Admiralty Inlet or mix deeper into the water column due to the strong tidal currents in the Tacoma Narrows. At various places, relatively shallow sills coupled with large tidal volumes result in active surface-to-bottom mixing. Thus, some of what leaves a basin is re-entrained and returns. This re-entrainment occurs in the Tacoma Narrows and Admiralty Inlet. Nevertheless, net exchanges occur between basins and Pacific Ocean waters.

Pacific Ocean water exchanges with Puget Sound and Canadian waters through the Strait of Juan de Fuca by an incoming deep ocean layer flowing below an outgoing surface fresh water layer. Ocean conditions strongly influence the delivery of deep ocean water into the Strait of Juan de Fuca and the rest of Puget Sound. River conditions strongly influence the outgoing surface layer. Flow rates in the major freshwater rivers in Puget Sound peak in January and June to levels as high as 850 cubic meters per second (225,000 gallons per second) (Snover et al. 2005). During the 2000-2001 drought, University of Washington researchers documented a four-fold decrease in geostatic exchange velocity in the Strait of Juan de Fuca with implications for exchange of nutrients as well as toxic chemicals (Newton et al. 2003).

Sources of contaminants in incoming ocean water include aerial deposition from global sources and earth crust and ocean processes that lead to concentration of some chemicals (e.g., metals) in ocean waters.

This Phase 1 study did not evaluate loading of toxic chemicals from the Pacific Ocean and Canadian waters.

1.3.8 Leaching or Biotic Activation from Contaminated Sediments

Toxic chemicals in Puget Sound bottom sediments, especially in the top 10 centimeters (4 inches) of the sediment, have the potential to leach into surface waters or become incorporated into the food web by bottom dwelling organisms that are in turn consumed by higher trophic-level aquatic species. Contaminated sediments serve as a long-term source of contamination to Puget Sound when they remain in place. Contaminated sediments may also serve as short term bursts of sources when dredged for maintenance or cleanup purposes.

Based on data collected from 1997 to 2003 (PSAMP 2007), Puget Sound contains approximately 18 square kilometers (6.9 square miles) of degraded sediments and more than 820 square kilometers (320 square miles) of sediments of intermediate quality. Identified contaminated sediment sites in the Puget Sound Basin include 49 federal Superfund sites (Washington GMAP 2006). Ecology’s most recent sediment cleanup status report in 2005 catalogued the following Puget Sound sites (Ecology 2005a).

Location*	Underway	Cleaned up/ Monitoring
Bellingham Bay	10	2
Commencement Bay	4	9
Duwamish River	10	2
Elliott Bay/Harbor Island	13	11
Everett and Port Gardner	6	5
Fidalgo Bay	7	1
Kitsap Peninsula/Sinclair Inlet	4	12
Lake Union	6	1
Lake Washington	3	3

*Includes sites under federal oversight

Toxic chemicals enter water bodies and accumulate in bottom sediment from shipping and boating activities (such as paint flaking off ships or from boatyard activities), stormwater discharge, wastewater effluent, CSO outfalls, spills, and aerial deposition.

This Phase 1 study did not evaluate toxic chemical loading from sediment flux.

1.3.9 Migration of Biota into Puget Sound

Migrating biota can carry accumulated contaminants from urban/industrial areas and from globally distributed contaminants in the north Pacific Ocean into the Puget Sound Basin. For example, Krummel et al. (2006) showed this chemical transfer process from sockeye salmon to otherwise pristine lakes and creeks in Alaska.

This Phase 1 study did not evaluate the impact of migrating biota on the loading of toxic chemicals into Puget Sound.

2.0 Scope of Services

Ecology and its partners plan to perform the overall toxic chemical loadings project in phases. The objective of the Phase 1 work is to develop a preliminary assessment of loadings of toxic chemicals to the Puget Sound ecosystem. Specific Phase 1 tasks identified by Ecology and the interagency project steering committee include the following:

- Identify and prioritize a list of toxic chemicals of concern that enter the Puget Sound ecosystem.
- Identify simple models that can be used to evaluate toxic chemical loadings to the Puget Sound ecosystem.
- Obtain and review available data to characterize and evaluate the loading of the toxic chemicals of concern to the Puget Sound ecosystem.
- Characterize sources and pathways of toxic chemicals of concern.
- Prepare this summary report to present results of Phase 1 activities and identify uncertainties and data gaps.

Ecology and the project steering committee selected Hart Crowser to assist with completing the Phase 1 project. Ecology also formed several work groups to accomplish specific technical tasks, such as selecting chemicals of concern and obtaining pathway-specific loading data. The project steering committee selected the members of the work groups from their own agencies, other stakeholders with particular knowledge or skills, and the general scientific community.

The following sections describe the scope of Phase 1 tasks in greater detail.

2.1 Identify Toxic Chemicals of Concern

Hart Crowser and the chemicals of concern work group identified a list of toxic chemicals of concern and appropriate indicator parameters that enter the Puget Sound ecosystem and pose significant threats to ecological and/or human health. The work group prioritized the list of toxic chemicals based on the relative magnitude of their threat as discussed in Section 3.1.

2.2 Identify Simple Toxics Loading Models

Hart Crowser and the modeling work group identified simple models that could be used to evaluate toxic chemical loadings in the Puget Sound ecosystem, including watershed hydrology and loading tools. Ecology's Environmental Assessment Program provided guidance to ensure that the selected hydrologic model would be consistent with and be able to "feed" the Puget Sound circulation model (box model) currently under development. Modeling of other pathways was straightforward (e.g., atmospheric deposition) or was not attempted by Hart Crowser (e.g., municipal and industrial wastewater point sources).

2.3 Obtain Toxic Chemicals Loading Data

Hart Crowser and the data work group identified available data to characterize and evaluate the loading of the toxic chemicals of concern to the Puget Sound ecosystem via the various pathways. The sources of data included peer-reviewed, trade, and unpublished literature; databases maintained and provided by various agencies and non-governmental organizations; and other information identified by the Ecology project steering committee and project work groups. Table 10 lists data sources and the types of information provided. Hart Crowser compiled pertinent data into a GIS-linked database.

Ecology and the project steering committee determined that the loading of toxic chemicals of concern associated with sediment transport and biota would be addressed in later phases of the project.

2.4 Characterize Sources and Pathways of Toxic Chemicals of Concern

Hart Crowser used ArcMap 9.2 with Spatial Analyst (ESRI 2006) to assemble the geographic data and organize it into study units. Sources of shapefiles and geo-referenced data included Ecology, the United States Geological Survey, Washington Department of Natural Resources, United States Department of Agriculture, and King County. Hart Crowser clipped or extracted existing shape files to the extent of the project area. Hart Crowser compiled a 90-meter digital elevation map of the Puget Sound area from county-wide coverage produced by the Washington Department of Natural Resources. Hart Crowser queried land use and land cover information using Spatial Analyst for ArcGIS 9.2 from the MRLC Consortium's Washington grid data. Table 11 lists the GIS data sources that were used.

Hart Crowser used the toxic chemical data to develop spreadsheet summaries of regional or Puget Sound-wide loading estimates by pathway and major groups of the chemicals of concern (e.g., metals, PAHs, pesticides). Hart Crowser used these tables to assess the relative contributions of toxic chemicals to the Puget Sound ecosystem for the identified pathways.

Due to the lack of readily available data, loading estimates were not developed for the following pathways:

- Groundwater discharge to surface waters
- Flow of marine waters from the Pacific Ocean
- Transfer from contaminated sediments
- Migration of biota into Puget Sound

2.5 Prepare Summary Report

This report summarizes the results of the Phase 1 activities completed, including:

- Rationale for selection of the toxic chemicals of concern.
- Description and listing of data source references reviewed as part of research on loading of toxic chemicals of concern to the Puget Sound ecosystem.
- Rationale used to develop Puget Sound regions and chemical groupings for calculating loading estimates.
- Spreadsheet summaries of Puget Sound loading data estimates by pathway and toxic chemicals of concern groupings.
- Discussion of data gaps and uncertainties.
- Suggested future Phase 2 scope items.

3.0 Chemicals of Concern and Mass Loading Pathways

3.1 Identify Chemicals of Concern

Ecology and its partners intend to use the loading information from this Phase 1 project and future estimates to reduce the releases of toxic chemicals to Puget Sound. Both Phase 1 and future studies will develop increasingly accurate information about the relative contributions of the various sources of toxic chemical loadings to the Puget Sound ecosystem. In later phases of the project, Ecology and its partners will use this information to help guide decisions about how to most effectively direct resources to address toxic contamination problems (e.g., which sources or pathways should receive priority attention; how much toxic reduction can be accomplished by sediment cleanup, by stormwater management, etc.). Therefore, the chemicals addressed in the Phase 1 study include those that harm or threaten to harm the Puget Sound ecosystem and those that represent, or serve as an indicator for, a particular class of chemicals. For all of the toxics included in Phase 1, uncertainty exists in quantifying the sources and pathways by which chemicals enter the Puget Sound ecosystem.

Over the past 150 years, human activities have released numerous toxic chemicals into Puget Sound. The Puget Sound Action Team (PSAT) review of "Toxics in Puget Sound" dated April 2006 provides a list of toxic contaminants that harm or threaten to harm the Puget Sound ecosystem and human uses of the ecosystem. The PSAT list of toxic contaminants included six metals (arsenic, cadmium, copper, lead, mercury, and tributyl tin) and seven classes of organic compounds (polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides, dioxins and furans, phthalate esters, polybrominated diphenyl ethers (PBDEs), and hormone disrupting chemicals). Ecology, Hart Crowser, and the chemicals of concern work group used PSAT's list as a starting point in its deliberations about which chemicals to address in this Phase 1 project.

The work group recommended to eliminate tributyl tin, one of the chemicals identified in the PSAT review, from evaluation in this Phase 1 study because the harm and threats that it poses in Puget Sound relate to its use as an anti-fouling agent in marine environments. Hart Crowser did not address this as a chemical of concern for this Phase 1 study because the sources and pathways by which tributyl tin is introduced to the Puget Sound ecosystem are already well understood.

The work group recommended that Hart Crowser should include oil and petroleum products on the list of Phase 1 chemicals of concern. The PSAT review discussed threats from oil spills in the Puget Sound region but did not include oil or petroleum products in its list of contaminants of concern. The work group and Hart Crowser also included zinc. Although zinc was not discussed in the PSAT review, it appears to be an emerging issue for aquatic resources as evidenced by tentative findings of increasing sediment concentrations.

Table 1 presents the specific parameter list and rationale for the selection of the 17 chemicals/groups studied in Phase 1. Work group members suggested a number of other chemicals or groups (e.g., chromium, chlordane, diazinon, and a general category labeled "poisons") for consideration in the project. The work group did not reach consensus on these other parameters and, therefore, Hart Crowser did not address them in this Phase 1 project. The project steering committee will continue discussions about a larger list of contaminants to identify any chemicals that should be addressed in later phases of the loading studies.

3.2 Description of Mass Loading Pathways Addressed in the Study

Figure 3 graphically illustrates the pathways by which contaminants can be transported to Puget Sound. The Phase 1 study addressed only the following pathways: runoff from urban lands and non-urban areas, atmospheric deposition to marine waters, point source discharges of industrial and municipal wastewater, CSO outfalls, and direct spills to marine waters and tidelands.

The availability of resources and sufficiency of compiled data did not allow estimates for all pathways by which toxic chemicals of concern enter Puget Sound. Pathways not addressed by this Phase 1 study included: direct groundwater discharge, ocean inputs, sediment flux, and biota migrations. Excluding these pathways from the Phase 1 analysis may leave significant gaps in overall loading estimates since some of these pathways may contribute sizable loads of some contaminants (e.g., arsenic from tidal exchange with the ocean).

Chemical transport in water derived from precipitation occurs as both overland flow of water and groundwater recharge. This Phase 1 study addresses chemical loadings via groundwater that discharges to surface waters other than Puget Sound (i.e., streams and rivers) as the baseflow component of the surface runoff pathway. Groundwater that flows directly into Puget Sound was not addressed separately in this study. Hart Crowser characterizes in this report contaminant loads in overland flow and groundwater recharge from commercial/industrial, residential, agricultural, and forest and field land and from urban and non-urban areas as surface runoff.

As shown on Figure 3, chemicals of concern can transfer from the atmosphere to land and water surfaces. Deposition of chemicals from the atmosphere to land surfaces represents one of the sources of contamination in urban stormwater and other runoff. This Phase 1 project does not, however, distinguish this or other sources of toxics in runoff. Three mechanisms transfer chemicals of concern from the air to water: wet deposition (rain or snow), dry deposition (falling particles), and gas absorption (gas-phase transfer from air to water). Section 4.2 provides more discussion of the atmospheric loading mechanisms.

This Phase 1 project estimates toxic contaminant loads in discharges of treated wastewater from industrial facilities and publicly owned treatment works (POTWs). This project also characterizes discharges of minimally-treated effluent from CSO events. As discussed in Section 1.3.4, in ten Puget Sound jurisdictions stormwater is mingled with municipal wastewater in combined sewer systems. Overflows from these CSOs are episodic, but typically receive lower levels of treatment than municipal wastewater.

4.0 Toxics Loadings Calculations and Results

4.1 Runoff Pathway

To address the uncertainty involved with chemical concentrations in runoff, Hart Crowser developed a probabilistic approach to estimating chemical mass loadings to Puget Sound. This Phase 1 study did not assess or present the uncertainties involved in characterizing runoff quantity or land use, two other key determinants of runoff pathway loadings.

Rather than computing one "best estimate" and making arbitrary estimates of "high" and "low" mass loading rates, Hart Crowser used the results of statistical analyses of chemical concentrations in runoff to quantify the probabilities of a range of mass loading rates from the study units. For example, statistical evaluations of chemical concentrations in runoff, as documented in the comprehensive National Stormwater Quality Database (NSQD; Maestre and Pitt 2005), have shown that the concentrations for most constituents follow lognormal probability distributions. The NSQD contains water quality information from the EPA's NPDES stormwater permits during the period 1992 to 2002. The database contains data for about 3,765 storm events from 360 cities throughout the United States.

Evans et al. (1993) describe the mathematical formulation of the lognormal probability distribution for a variable, such as chemical concentration (c) in runoff. Two parameters define the lognormal distribution: the median (m) and the standard deviation (σ) of $ln(c)$ (the natural logarithm of the concentration). Larger values of σ indicate greater uncertainty in the concentration estimates for a particular runoff chemical. Figure 6 shows (a) the lognormal probability density function (PDF) and (b) the cumulative probability function (CPF) for $m = 1.0$ and $\sigma = 0.6$ and 1.0. The horizontal scale of both the PDF and CPF represents uncertainty.

The CPF can be used to estimate the probability of exceedance of a specific value of a variable (e.g., concentration or mass loading). CPF can also be used to evaluate the likelihood that a concentration or loading lies within a certain range of values. For example, in Figure 6b, the probability that X (e.g., concentration or loading) is less than or equal to 1.0 is about 50 percent. Similarly, the probability that X is less than or equal to 0.5 is approximately 10 percent for σ = 0.6, and 20 percent for σ = 1.0. By reversing the logic, the CPF shows that the probability that X is greater than 0.5 is approximately 90 percent (i.e., 100 minus 10) for σ = 0.6, and 80 percent for σ = 1.0.

Finally, the difference between two cumulative probabilities on the vertical axis can be used to estimate the likelihood that a specific value of X lies within a certain range. For example, using the preceding example, the likelihood that X lies between 0.5 and 1.0. is 40 percent (50 minus 10) for σ = 0.6 or 30 percent (50 minus 20) for σ = 1.0.

Thus, this Phase 1 report expresses loading estimates in terms of best estimates of the median and "probabilities of exceedance" (POEs). For example, the values shown below have the following meanings:

Toxic Chemical	Probability of Exceedance (percent)	Loading (metric tons/year)
Arsenic	95	3.6
	75	8.8
	50	16.
	25	31.
	5	77.

- The best estimate of the median (50th percentile) for the total loading of arsenic is 16 metric tons/year.
- A 25 percent probability exists that the actual loading of arsenic is greater than 31 metric tons/year.
- We are 95 percent certain than the actual loading of arsenic is not less than 3.6 metric tons/year.

4.1.1 Hydrologic Study Units and Land Use Delineation

Hart Crowser delineated six hydrologic study units (Figure 4) based on topography, land use, and available hydrologic information. These include the following basins: Bellingham, Whidbey, Main, South Sound, Hood Canal, and Olympic Peninsula. Hart Crowser based topographic analyses on 90-meter digital elevation maps of the Puget Sound area compiled from county-wide coverage areas produced by the Washington State Department of Natural Resources (DNR). Hart Crowser determined hydrologic boundaries by evaluating existing Water Resource Inventory Areas (WRIA) and the discharge regions defined by Lincoln (1977).

Figure 5 shows land use variations in the study area, which were estimated from the Multi-Resolution Land Characteristics (MRLC) Consortium's Washington grid data. As part of a cooperative project between the United States Geological Survey (USGS) and the EPA, the MRLC grid offers a consistent land cover data layer for the contiguous United States based on 30-meter Landsat data.

Table 2 summarizes the land use distributions in the six study areas based on four groups or categories: *commercial/industrial* (includes transportation), *residential* (high and low intensity), *agricultural*, and *forest and field*, and a division of each basin into urban and non-urban areas. Most of the Puget Sound drainage area consists of open area, mostly made up of *forest and field* land use (about 80 percent or more) (Figure 5). The Bellingham study area contains the largest percentage of agricultural use (about 15 percent). The highest degree of development occurs in the Main Basin area (about 10 percent *residential* and 3 percent *commercial/industrial)* and the South Sound area (about 6 percent *residential* and 2 percent *commercial/ industrial).*

Based on the U.S. census definition of urbanized areas, 11 percent of the Puget Sound watershed is urban. The urban portion of the watershed covers about 385,000 hectares (1,490 square miles) and encompasses 79 percent of the watershed's *residential* lands and 71 percent of the *commercial/industrial* lands, but only 13 percent of the *agricultural* lands and 7 percent of the *forests and fields*.

4.1.2 Surface Runoff Rates

Hart Crowser computed surface runoff rates for the hydrologic study units using long-term stream discharge measurements from several gauging stations located throughout the Puget Sound drainage basin. Hart Crowser followed the methodology of Lincoln (1977) with two exceptions: (1) they modified the calculations to account for the hydrologic study areas described in Section 4.1.1 and (2) they used the most recent 10-year period of gauging station data. For most rivers and streams, the averages (means) of the last 10 years of discharge data very closely approximated the magnitude of the averages for the entire period of record.

The Lincoln method is a traditional hydrologic technique that uses long-term annual and monthly averages of stream discharge measurements to characterize the rate of runoff from the watershed area that drains into the river/stream upstream from the gauging station. This method characterizes runoff from a watershed in units of discharge per unit area (e.g., cubic meters per year per acre [m^3/yr/acre]). Runoff rates depend on the local precipitation and evapotranspiration rates, the drainage properties of surficial soils, topography, etc. In order to account for runoff from ungauged watersheds, Hart Crowser assessed the hydrologic characteristics in nearby gauged watersheds, compared them with those in the ungauged watersheds, and then applied normalized discharge rates to the ungauged watersheds.

Table 3 summarizes the computed monthly and annual average total runoff rates for the six study areas. The total runoff rate for the six areas is 1,717 m^3/sec (454,000 gallons/sec). The combined annual mean runoff from the Main Basin, Whidbey Basin, Hood Canal, and South Sound units is 1,420 m^3/sec, which is very close to the value of 1,400 m^3/sec (371,000 gallons/sec) estimated by Lincoln (1977). The largest average annual runoff per study area (0.00024 m^3/sec/acre) occurs in the Whidbey Basin area, whereas the smallest normalized annual runoff (0.00013 m^3/sec/acre) occurs in the South Sound area. The mean runoff for the six areas is 0.00020 m^3/sec/acre.

4.1.3 Surface Runoff Water Quality Data

As part of this Phase 1 study, Hart Crowser performed an extensive literature survey to obtain runoff water quality data that they could use for the loading calculations. Appendix A summarizes the results of this literature review. Section 4.1.4.2 presents the land use-based concentrations for each toxic chemical used in the mass loading calculations for the surface runoff pathway.

4.1.4 Mass Loadings for Runoff Pathway

4.1.4.1 Runoff as a Function of Land Use

The study area discharge rates presented in Section 4.1.2 represent spatial averages of runoff from all land uses in the respective drainage areas. To calculate runoff loadings as a function of land use, Hart Crowser distributed the total runoff volumes across different land uses based on the runoff coefficient technique (Chow 1964) using the following equation:

$$q_i = r_i f_i Q$$

where:

q_i = total study area discharge rate (volume/time) from land use i
f_i = fraction of total study area represented by land use i (Table 2)
Q = study area discharge rate (Table 3)
r_i = relative runoff rate (dimensionless) for land use i

Hart Crowser computed the values of r_i for the four land use types using the following four equations:

$$r_1 f_1 + r_2 f_2 + r_3 f_3 + r_4 f_4 = 1.0$$

$$r_1 / r_2 = (Rc)_1 / (Rc)_2$$

$$r_1 / r_3 = (Rc)_1 / (Rc)_3$$

$$r_1 / r_4 = (Rc)_1 / (Rc)_4$$

where:

$(Rc)_i$ = runoff coefficients (fraction between 0 and 1) for land use i

The following equation shows the approach used to compute runoff chemical loading rates to Puget Sound, m_i (mass/time), for each land use i :

$$m_i = q_i c_i$$

where:

c_i = best estimate of the representative chemical concentration in the runoff from a specific land use

Hart Crowser used the following runoff coefficient values to estimate the study area loading rates for each chemical of concern:

$(Rc)_{commercial/industrial} = 0.85$

$(Rc)_{residential} = 0.70$

$(Rc)_{agricultural} = 0.60$

$(Rc)_{forest\ \&\ field} = 0.50$

To determine these values of $(Rc)_i$, Hart Crowser reviewed various published data for the Puget Sound Region assembled by the U.S. Geological Survey, King County, and others. These data included runoff coefficient values, flow data from monitored gauging stations, and land use coverages (e.g., for Skagit River in the Whidbey Basin and Green River in the Main Basin). Hart Crowser employed the selected runoff coefficients (listed above) in the loading calculations for all of the study areas in the Puget Sound watershed.

4.1.4.2 Selection of Concentrations for Loading Calculations

Based on the data presented in Appendix A and discussions with Ecology and the project work groups, Hart Crowser selected representative concentrations of the toxic chemicals of concern in runoff as a function of the four types of land use. Table 4 summarizes these available data, along with the predominant land use associated with each measurement, and lists the selected concentrations for the runoff loading calculations.

Since the concentrations were derived from measurements at various geographic locations with differing climatologic conditions, Hart Crowser gave the highest priority to monitoring data from water bodies and drainage areas within the Puget Sound watershed. Hart Crowser assigned second priority to monitoring data from water bodies in the United States and elsewhere with climatologic conditions similar to the Puget Sound region (e.g., British Columbia, United Kingdom). Monitoring data from water bodies in the United States with climatologic conditions dissimilar to the Puget Sound region (e.g., California, eastern Washington) had third highest priority. However, analyses of data in the NSQD (Maestre and Pitt 2005) demonstrated that chemical concentrations in runoff do not show a strong dependence on geography or climate, but rather on land use.

4.1.4.3 Results of Runoff Loading Calculations

Figures 7 and 8 depict the estimated ranges of Puget Sound surface runoff loading rates (total and by study area, respectively). Table 5 summarizes estimated runoff loading rates (M_R) to Puget Sound based on five probabilities of exceedance (POE): 95, 75, 50, 25, and 5 percent. Hart Crowser estimated the runoff concentrations, c, for each POE based on the water quality information in Table 4 [median concentration (m) and standard deviation (σ)] and the mathematical form of the lognormal probability distribution. The values of the loading rates (M_R) increase with decreasing probability of exceedance. The median M_R corresponds to the 50 percent probability of exceedance. Using copper as an example, the estimated median total M_R is approximately 102 metric tons per year (mt/yr). Similarly, the expected probability that $(M_R)_{copper}$ is greater than about 198 mt/yr is 25 percent (75 percent likelihood that $(M_R)_{copper} < 198$ mt/yr).

In addition, we can analyze the ranges of probability of exceedance (POE) to determine the probability that a particular loading rate lies within a specific range. For example, there is a 50 percent likelihood that $(M_R)_{copper}$ is between approximately 49 (75 percent POE) and 198 (25 percent POE) mt/yr. Similarly, there is an expected 90 percent chance that $(M_R)_{copper}$ lies in the range of approximately 17 (95 percent POE) to 621 (5 percent POE) mt/yr.

4.1.4.4 Discussion of Runoff Loading Results

Land use was the key determinant of the toxic chemical loading in surface runoff. Compared to undeveloped forests and fields:

- Lands developed for industrial/commercial, residential, and agricultural use generated more runoff per unit area.
- This runoff from developed areas carried greater concentrations of toxic chemicals.

The runoff coefficients developed for this study were consistent with the results of other models and our understanding that developed lands produce greater rates of runoff than do undeveloped lands. The coefficients suggested that a given area of *commercial/industrial* land typically produces 70 percent more runoff than would have come from that land in the forested condition. Similarly, runoff rates from *residential* lands and *agricultural* lands were 40 percent and 20 percent greater, respectively, than the runoff rates from *forests and fields* lands.

Runoff from *industrial/commercial* lands generally had the poorest quality, with concentrations of many chemicals 20 to 200 times greater than the concentrations in *forest and field* runoff. Runoff from *residential* and *agricultural* lands was of intermediate quality for most chemicals, with concentrations 2 to 100 times those in *forest and fields* runoff. Since mass loading of toxic chemicals combined the effects of both greater flows and greater concentrations, the loading per unit area of developed lands was considerably greater than that from *forests and fields*. However since *forests and fields* cover almost 90 percent of the Puget Sound Basin, the total loading from these undeveloped lands is still considerable for some chemicals.

Table 6 presents study area runoff loading rates (median values) expressed as (1) a percentage of the total Puget Sound runoff loading, and (2) runoff mass loading per unit of drainage area (mt/yr/ha). For all the toxics evaluated except the pesticides, runoff from the highly urbanized Main Basin contributed most to the total loading to Puget Sound. The Main Basin contributed the highest relative percentage (38 to 43 percent) of cadmium, lead, zinc, and mercury, and about twice as much as the Whidbey Basin and South Sound Basin. The Main Basin and Whidbey Basin yielded the greatest arsenic and copper loadings (27 to 34 percent), contributing about two times more than those for the South Sound. Almost one-half of the total loading of PCBs, PAHs, petroleum products, and nonylphenol appeared to originate in the Main Basin (about two times greater than the corresponding loading rates for the Whidbey and South Sound Basins). Most of the PBDEs, bis(2-ethylhexyl)phthalate (BEHP), and dioxin loadings originated in the Main Basin (29 to 39 percent) and the Whidbey Basin (22 to 31 percent). About 37 percent of the estimated DDT loading originated in the Whidbey Basin, which was almost twice the loading rate for the Main Basin. Most of the estimated total triclopyr loading originated in the Whidbey Basin (30 percent) and Main Basin (28 percent).

Evaluation of loading from runoff on a per study area basis demonstrated differences between the highly urbanized Main Basin and the other basins. The mercury, zinc, lead, copper, and cadmium runoff loading rates per study area showed similar magnitudes in the South Sound, Hood Canal, Whidbey Basin, Bellingham, and Olympic Peninsula areas. These estimated metals loading rates per study area for these five study areas were two to three times smaller than those for the highly urbanized Main Basin. The arsenic runoff loading rate per study area was similar in magnitude for all study areas.

The PCBs, PAHs, petroleum products, and nonylphenol runoff loadings per study area showed similar magnitudes in the South Sound, Hood Canal, Whidbey, and Bellingham Basins. The runoff loading rates per unit area for these four chemical groups in the four study areas were about two to four times smaller than those for the Main Basin and generally 1.5 to 2 times greater than those for the Olympic Peninsula. The PBDEs, BEHP, and dioxin loading rates per study area in the South Sound, Hood Canal, Whidbey Basin, and Olympic Peninsula areas showed a similar pattern (up to a factor of three less than those for the Main Basin and Bellingham Basin). The largest DDT and triclopyr loading rates per area originated in the Whidbey Basin and Bellingham areas. However, these were similar in magnitude to those in the Main Basin, Hood Canal, and Olympic Peninsula areas. DDT and triclopyr runoff from the South Sound area was less than the loadings from the other study areas on a unit-area basis.

The results for bis(2-ethylhexyl)phthalate were consistent with the Sediment Phthalates Work Group determination (2007) that the primary source of phthalates is off-gassing from plastic products. Apparently, after volatilizing from populated areas, phthalates fall to the ground nearby either directly or by attaching to particulates that then settle to the ground. These phthalates then migrate to Puget Sound via the surface runoff pathway (e.g., stormwater flushing).

From an evaluation of loadings as a function of land use, a different pattern emerged. The last columns of Table 6 summarize runoff loading percentages as a function of land use. The loading calculations indicated that undeveloped areas (*forest/field* and *agricultural* land uses) contributed most (about 60 to 70 percent or more of the median loading) of the arsenic, copper, PBDEs, DDT, and triclopyr loadings by surface runoff to Puget Sound. Mercury, lead, PCBs, BEHP, and dioxins loadings showed a relatively even distribution between developed and undeveloped areas. Total Puget Sound loadings for cadmium, zinc, nonylphenol, PAHs, and oil/petroleum product most strongly correlated with high-development land uses (about two-thirds of the total median loadings).

Monthly estimates of runoff loading rates (metric tons per month) equal the product of the annual mass loadings (Table 5) and the relative monthly runoff coefficients (Table 7). The monthly runoff coefficients represent the total monthly runoff volume divided by the annual volume (Table 3). This approach to monthly loading estimation assumes that runoff quality does not exhibit a strong seasonal correlation. This assumption needs further evaluation. Analyses of data in the NSQD show that seasonal variations of runoff concentrations are not as obvious as the land use or geographical variations, except for bacteria. Bacteria appear to be lowest during the winter season and highest during the summer and fall (Maestre and Pitt 2005). Evaluations of historical data collected as part of the Nationwide Urban Runoff Program (USEPA 1983) provided similar conclusions. For example, a recent water quality analysis of the Green-Duwamish drainage system (King County 2007) indicated the concentrations of several chemicals during peak-flow periods were as much as 2 to 3 times higher than concentrations during lower baseflow conditions.

4.1.4.5 Loading Results to Feed the Ecology Box Model

The fate and transport box model of Puget Sound that Ecology has been developing employs loading inputs that differ from the loading outputs that Hart Crowser could provide based upon its study areas. Therefore, Hart Crowser determined loading rates for an additional set of 14 study areas that corresponded to the loading inputs of the box model. Table B-1 in Appendix B shows the total average annual surface runoff rates for the box model study areas, which corresponds to the total average annual surface runoff rates shown in Table 3 for the Hart Crowser study areas. The total flows differed between these two differing sub-divisions of the Puget Sound watershed. The Hart Crowser study areas yielded 1,717 m^3/sec, and the box model study areas yielded 1,785 m^3/sec. This small 4 percent difference was the expected result of computations based upon different sub-watershed groupings in each of the study areas.

The estimated loading rates for surface runoff for the box model study areas are presented in Table B-2 in Appendix B. Similarly, the total loading to Puget Sound for each chemical of concern differs from that based upon the Hart Crowser study areas. The differences between the two sets of calculations were small relative to the uncertainties of the estimates themselves.

4.2 Atmospheric Deposition Pathway

Three mechanisms transfer pollutants from air to water (Figure 3): wet deposition (rain or snow), dry deposition (falling particles), and gas absorption (gas phase transfer from air to water). Wet deposition is the product of the volume-weighted mean precipitation concentration, the rate of precipitation, and the water body surface area. Dry deposition rates reflect the amount of contaminant transferred to the surface via the settling of particles (the product of particle velocity and the concentration on the solid phase).

Contaminant mass may also leave the water body by volatilization (water to air transfer). Together, gas absorption and volatilization are called gas exchange (IADN 2000). The gas exchange rate may be positive (absorption greater than volatilization) or negative. Gas exchange represents the dominant atmospheric deposition process for many semivolatile toxic chemicals such as LPAHs (low molecular weight PAHs). For example, gas absorption represents the dominant atmospheric mechanism for LPAHs loading to the Great Lakes (IADN 2000). However, wet and dry deposition served as the main atmospheric pathways for the HPAHs (other high molecular weight PAHs).

4.2.1 Atmospheric Deposition Flux Measurements from Various Studies

As part of this Phase 1 study, Hart Crowser performed an extensive literature survey to obtain atmospheric deposition flux measurements that could be used for the loading calculations. Appendix C summarizes the results of this literature review.

4.2.2 Atmospheric Loadings

4.2.2.1 Selection of Atmospheric Deposition Rates

Based on the data presented in Appendix C and the results of discussions with Ecology, Hart Crowser selected representative atmospheric deposition rates for the Puget Sound water surface for each of the chemicals of concern. Table 8 summarizes these available data and lists the selected fluxes for the atmospheric loading calculations. Comments in the table explain the rationale for flux selection.

Many of the flux measurements from the literature review were taken in urban or otherwise developed areas that are not representative of the Puget Sound water surface as a whole. Therefore, Hart Crowser selected the estimated fluxes in Table 8 to represent areas of less development [e.g., the "rural" and "marine" sites in the Crecelius (1991) study] so that the corresponding atmospheric loadings estimates would not be overly biased by urban/industrial centers. Hart Crowser selected the upper- and lower-bound fluxes (i.e., low and high probabilities of exceedance, respectively) to mirror the variability (i.e., potential range) of the measurements reported in the literature.

4.2.2.2 Results of Atmospheric Loading Calculations

Figure 7 shows the estimated range of atmospheric loading rates to Puget Sound for each of the chemicals of concern. Table 9 summarizes the estimated average annual atmospheric loading rates, M_A (mt/yr), for the chemicals of concern. Hart Crowser computed M_A as the product of the mean atmospheric deposition flux, F (Tables 8 and 9), and the Puget Sound water surface area, A_{PS} , using the following equation:

$$M_A = F \ A_{PS}$$

A_{PS} , which also includes the portions of the Strait of Juan de Fuca and Strait of Georgia located within the United States border (Figure 1), represents approximately 8,530 square kilometers (3,290 square miles).

4.2.2.3 Discussion

As summarized in Table 9, the atmospheric loading for most chemicals of concern represented a fraction of the surface runoff loading. The estimated medium POE atmospheric loading rates for the metals varied from 5 to 35 percent of the total median surface runoff loading rates for Puget Sound. Atmospheric loading rates for PCBs, dioxin, DDT, and BEHP represented about 4 to 7 percent of the runoff pathway. Total estimated air-to-water transfer rates of cPAHs (carcinogenic PAHs) and HPAHs showed similarities in magnitude to the corresponding median runoff loading rates. Unlike the other chemicals of concern, the estimated atmospheric loading rate of PBDEs was ten times greater than the total runoff loading. However, both pathways had few available PBDE measurements.

Hart Crowser considers the atmospheric deposition fluxes to have a greater degree of uncertainty than the surface runoff loading rates based on the limited number of measurements in the Puget Sound area. For example, as discussed earlier, most of the available atmospheric flux data were land-based or shoreline measurements taken in areas that did not directly reflect the air quality and atmospheric physics (i.e., chemical deposition and air-water exchange) of offshore regions (i.e., over-water areas) of Puget Sound. In addition, no direct measurements of gas exchange (absorption and volatilization) rates for semivolatile chemicals of concern were available. Gas exchange served as the dominant atmospheric deposition process for many semivolatile toxic chemicals such as LPAHs.

4.3 Wastewater Loading Pathway

4.3.1 Data Sources

Ecology provided more than one million data points for the wastewater loading calculations. In most cases, the wastewater data consisted of either a flow rate or a chemical concentration, but rarely both. Approximately 55,000 of these measurements consisted of matched flow rate and wastewater concentration data, which are required to directly compute the mass loading rate. Of these, 7,146 measurements were for Phase 1 chemicals of concern. Separating wastewater data from CSO and surface water (rivers and streams) data left 5,770 matched pairs of flow rate and concentration measurements that could be used to compute wastewater loadings for the chemicals of concern.

4.3.2 Wastewater Loading Rates

Appendix D presents information on the calculated wastewater loadings for chemicals and facilities at which paired flow and concentration data were available. This appendix also includes details about the time period of sampling, number of data points, and number of sampling locations.

Hart Crowser computed the wastewater chemical loading rate, M_{WW} , for each facility for which paired concentration and flow data were available as the product of the mean discharge rate, Q_{WW}, and average chemical concentration in the wastewater effluent, C_{WW}, for the monitoring period using the formula:

$$M_{WW} = Q_{WW} \; C_{WW}$$

This approach to characterizing toxic chemical loadings from municipal and industrial wastewater provided an incomplete accounting of loadings from this pathway. Paired data on concentration and flow existed for relatively few of the approximately 200 facilities in the Puget Sound Basin with individual wastewater discharge permits, municipal or industrial. Table 12 summarizes the estimated annual average wastewater loading rates for Puget Sound based on this partial data set. Figure 7 depicts the estimated total wastewater loading rates for each chemical of concern. The actual loading rates from municipal and industrial point sources may be significantly greater.

4.4 CSO Loading Pathway

4.4.1 CSO Loading Calculations

Combined sewer overflows (CSOs) were another pathway for conveyance of toxic chemicals to Puget Sound. On an average annual basis for the period 2001 through 2005 these reported overflows equaled 0.15 m^3/sec (5.12 ft^3/sec or 40 gallons/sec).

A City of Seattle CSO characterization project (Seattle Public Utilities, 2000) measured average chemical concentrations in CSO effluent. Hart Crowser used these water quality data and the reported overflow rates for the Puget Sound outfalls to estimate average annual mass loading rates for the CSO pathway. Hart Crowser assumed that the Seattle CSO effluent concentrations (Table 13) represent other CSO outfalls.

4.4.2 Discussion

CSO concentrations were similar in magnitude to the best estimate of the median values selected for the *commercial/industrial* and *residential* land uses in the surface runoff loading calculations (Table 4). For example, the measured concentrations of arsenic, cadmium, mercury, PAHs, BEHP, and dioxin from CSOs lay in the middle of the ranges defined for *commercial/industrial* and *residential* runoff concentrations. The CSO concentrations for lead, copper, zinc, nonylphenol, and oil/petroleum were similar in magnitude (but higher) than the respective *commercial/industrial* runoff concentrations. However, similar concentrations do not equate to similar loadings.

Table 13 summarizes the results of the CSO loading calculations for chemicals of concern that were included in the City of Seattle study. Figure 7 shows the estimated Puget Sound CSO loading rates for each chemical of concern. For corresponding chemicals of concern, the CSO loading rates approximated 0.1 to 0.5 percent of the combined *commercial/industrial* plus *residential* (i.e., urban) runoff loading rates for Puget Sound (Table 5). This difference reflected primarily the significantly lower reported total CSO flow rate (about 0.15 m^3/sec or 40 gallons/sec) compared to the total estimated urban runoff from the Puget Sound Watershed (about 125 m^3/sec or 33,000 gallons/sec).

4.5 Direct Spill Pathway

The readily-available information quantifying the amounts of the chemicals of concern spilled directly to Puget Sound and the associated tidelands was limited. The Emergency Response Tracking System (ERTS) database did contain historical information regarding releases of oils and petroleum products to Puget Sound and surface waters in the Puget Sound Basin. The average amount of oils and petroleum products spilled each year from 2000 through 2006 was 960 metric tons. The actual amount that reached the marine waters (i.e., that which did not degrade or volatilize between where it was spilled and where it may have been flushed to the Sound) was not estimated in this Phase 1 study.

4.6 Previous Loading Studies

Table 14 compares the mass loading estimates from two previous Puget Sound studies (Strayer and Pavlou 1987, National Oceanic and Atmospheric Administration (NOAA) 1988) with the results of the present study.

4.6.1 Runoff

In general, the computed runoff loading rates of metals, PCBs, PAHs, and oil/petroleum product to Puget Sound from Strayer and Pavlou (1987) and NOAA (1988) were within or close to the 50 percent probability range of loading estimates from this study (i.e., between the high (75 percent) and low (25 percent) POE loading values). The arsenic, cadmium, and oil/petroleum loading values from NOAA (1988) showed only moderately similar results to the present study (close to the 95 to 75 percent POE range). The mercury loading estimate by Strayer and Pavlou showed greater similarity with the present study (in the 5 to 25 percent POE range).

4.6.2 Wastewater

The Strayer and Pavlou and NOAA studies also characterized municipal and industrial discharges. For comparison purposes, Hart Crowser assumed that the “high,” “medium,” and “low” POE effluent loadings from the present study correspond to the manner in which effluent concentrations lower than the detection limit (DL) were handled. Specifically, “high” POE corresponds to the assumption that the concentrations of non-detects (ND) are equal to zero (ND=0). “Medium” and “low” POEs are the effluent loadings for the assumptions of ND=½DL and ND=DL, respectively.

Overall, the Strayer and Pavlou and NOAA effluent loading estimates are 4 to 20 times higher compared with the “medium” loading values presented in Appendix D. The NOAA oil/petroleum effluent loading rate is a factor of 160 greater. The present study’s failure to extrapolate from the small number of the facilities with paired flow and concentration data to the larger population of all permitted wastewater dischargers is one possible reason for the large differences.

4.6.3 Atmospheric Deposition

The atmospheric loading rates from the Strayer and Pavlou (1987) study are located within the “high” to “low” POE range of loading estimates from the present study. However, as discussed earlier, only a limited amount of data are available to characterize the atmospheric transfer of chemicals of concern to Puget Sound.

4.7 Data Uncertainty

Table 15 outlines a preliminary assessment of the degree of certainty (DoC) associated with the mass loading estimates developed in this study. For these purposes, DoC refers to the adequacy of the database that exists for calculating chemical loadings to Puget Sound for the surface runoff, wastewater discharge, and atmospheric deposition pathways. Hart Crowser assigned four confidence levels: *high*, *medium*, *low*, and *incomplete* (no data available).

For the surface runoff pathway, Hart Crowser found that all the toxic chemicals of concern had less than a high DoC. Metals, oil/petroleum, and DDT loading estimates had a higher DoC *(medium)* than the other chemicals of concern *(low)* for all land uses. Several studies have monitored DDT levels in runoff from undeveloped areas and have shown significant concentration decreases during the past decade in Puget Sound watersheds. Therefore, DDT may not require further assessment. The data characterizing PAH concentrations in surface runoff from high-development areas (which includes *commercial/industrial/transportation* and *residential/urban* land uses) had a generally higher DoC (medium) than the available data for PCBs, dioxins, PBDEs, triclopyr, and hormone-disrupting compounds (nonylphenol and BEHP) for all land uses (*low* DoC).

Metals and oil/petroleum concentrations in wastewater discharges showed better characterization *(medium/low)* than the concentrations of the other chemicals of concern. The DoCs based on the available wastewater effluent data are lower for mercury, arsenic, cadmium, and lead because many of the effluent concentrations were less than analytical method detection limits. Ecology should identify and require use of analytical methods with lower detection limits for these four metals. A very limited number of data were available to quantify mercury, PAHs, and BEHP effluent loading rates (low DoC). Ecology should require all wastewater dischargers to monitor for these toxins as part of priority pollutant scans. The DoCs for the other chemicals of concern are *incomplete* due to an absence of effluent quality data. To better calculate loadings, Ecology should also include these toxics in required priority pollutant scans.

Atmospheric loading estimates for metals showed more accuracy (*medium/low* DoC) than the other chemicals of concern (*low* DoC for PBDEs, PAHs, PCBs, BEHP, DDT, and dioxins). The DoCs for nonylphenol, triclopyr, and oils were *incomplete*.

5.0 Conclusions and Recommendations

1. Estimated Chemical Loadings
   This Phase 1 study provided estimates of loadings of chemicals of concern to the Puget Sound ecosystem from surface runoff, atmospheric deposition to the marine area of the watershed, a limited number of wastewater dischargers, and direct spills to the surface waters of the watershed. This study did not characterize other pathways, such as leaching from sediment deposits, migration via biota, and exchange with oceanic waters. The summary table at the end of the Context and Overview section provides the present best estimate of the loadings of toxic chemicals to the Puget Sound Basin along with their uncertainties.

   (a) Surface Runoff: The bulk of the toxic chemicals that enter Puget Sound marine waters enter through runoff from the land surface. As defined in this Phase 1 study, surface runoff consists of stormwater, non-point overland flow, and groundwater discharge to surface waters that flow to Puget Sound. For most of the chemicals of concern, estimates of loading from the surface runoff pathway were much greater than estimates of loading from the other pathways (Figure 7).

   (b) Atmospheric Deposition: Atmospheric deposition directly to Puget Sound appeared to be an important source of toxics loading for some chemicals. For several of the chemicals of concern (i.e., for PAHs and PBDEs), atmospheric loading directly to the marine waters and tidelands was greater than or comparable to the loading from surface runoff.

   (c) Wastewater: The characterization of toxics loadings from industrial and municipal wastewater incompletely accounted for loadings from permitted point source dischargers. Since the analytical approach for the Phase 1 project relied solely on matched pairs of concentration and flow data from individual facilities, the study did not provide an estimate of the total loading from the entire list of 200 Puget Sound Basin facilities with individual wastewater discharge permits.

   (d) Combined Sewer Overflows: Episodic discharge of untreated and partially treated wastewaters from CSO outfalls contributed relatively little to the total loading of toxic chemicals to Puget Sound. The estimated loadings from CSO systems in the Puget Sound Basin represented much less than 1 percent of that from surface runoff. However, in the vicinity of CSO outfalls, overflow events may be a significant contributor to localized toxics problems. Additional controls of CSO discharges may provide toxic reduction benefits for specific contaminated sites, possibly at the scale of the urban bay.

   (e) Direct Spills: Although the available data did not support estimation of loadings from direct spills for the individual chemicals of concern, the total reported oil and petroleum products spilled directly into the surface waters of the Puget Sound Basin was only approximately 4 percent of the amount estimated to enter via surface runoff.

The findings show that Ecology and the other agencies in the toxics study team must collect or develop certain additional information to enable selection of appropriate control actions.

2. Collection of Additional Data
Limited time and budget for this Phase 1 study constrained the literature search and estimation approaches. Table 15 highlights significant gaps in the current understanding of the sources and quantities of toxic chemicals. Additional monitoring results and other scientific data likely exist that will improve the loading estimates determined in this study.

The toxics study team should conduct focused searches of the literature and existing data that they can use to improve key loading estimates. Data collection should focus on:

- Seasonal and geographic variations in loading rates
- Data for specific chemicals, sources, and pathways

The agencies should prioritize data collection that will promote the selection of more effective control actions. Based on the results of this Phase 1 study, the particular toxic chemicals for which the toxics study team should obtain more information include:

bis(2-Ethylhexyl)phthalate	Polybrominated diphenyl ethers (PBDEs)
Nonylphenol	Polyaromatic hydrocarbons (PAHs)
Polychlorinated biphenyls (PCBs)	Triclopyr

The particular sources and pathways of these chemical for which the toxics study team agencies should obtain more information are:

Industrial wastewater	Marine sediment
Municipal wastewater	Exchange of ocean waters
Combined sewer overflows	Biotic transport
Stormwater from various land uses	Groundwater discharge
Atmospheric deposition	

Bis(2-ethylhexyl)phthalate, nonylphenol, and triclopyr represent specific classes of chemicals of concern, i.e., phthalates, hormone disruptors, and current-use pesticides, respectively. Future data collection to fill gaps should ensure that any indicator chemicals adequately represent their chemical class.

To minimize delays and maximize efficiencies, the toxics study team should prioritize their efforts to incorporate additional data as follows:

(a) Search for and obtain existing data. Study team agencies should search

(i) Their own files for relevant concentration and flow information (e.g., permittee monitoring reports not stored electronically).

(ii) Additional published and unpublished literature to obtain existing data focused on the Puget Sound Region and on other locations with similar characteristics.

(b) Extrapolate from selected data. Employ secondary data along with scientifically-grounded assumptions to improve loading estimates. For example, Ecology may estimate municipal wastewater loadings by extrapolating discharge concentrations from similar facilities with data to those without data by using the average concentrations for comparable small, medium, and large facilities. Ecology could also apply the actual measured concentrations of pollutants in stormwater from one watershed to unmonitored drainage areas that contain similar distributions of land uses.

(c) Collect and analyze new environmental samples. Specific goals may include quantifying the amounts of specific toxic chemicals released to Puget Sound, distinguishing temporal variations in loading, and establishing linkages between pollutant sources and pathways. For example, Ecology should require all individual NPDES permit holders to analyze their wastewater discharges for priority pollutants, including the chemicals of concern identified in this study. Ecology should also specify that each discharger should sample and analyze at least one wet weather sample and one dry weather sample and use particular sampling and analytical methodologies to achieve adequate detection/quantitation levels for each analyte.

3. Improvement of Loading Estimates
The toxics loadings estimates developed in this Phase 1 study have a high degree of uncertainty. Some of this uncertainty relates to the quantity of available data (as addressed in Table 15), and some relates to the approaches used for estimating loadings for this study. Apart from the data uncertainties, using the results from this study to quantify relative contributions of toxic chemicals is difficult because:

(a) The method used to characterize loadings from permitted industrial and municipal wastewater dischargers was limited and resulted in loading estimates for only a fraction of the total number of those dischargers in the Puget Sound Basin.

(b) The pathways not quantified in this study may contribute substantial loads of some chemicals (e.g., PAHs from direct spills, PBDE deposition downwind of major sources onto the land surface, and metals imported from the ocean).

(c) The loading calculation approach included an assumption of mass balance that did not account for the likely biological, chemical, and physical degradation or transformation of toxic chemicals.

Hart Crowser necessarily employed numerous assumptions to estimate loadings for this Phase 1 study. For example, they assumed that land use was a greater determinant than geographic location of surface runoff concentrations. Thus, they used surface runoff concentrations based on data from areas far removed from the Puget Sound region, e.g., the National Stormwater Quality Database and various published assessments of locations in

Europe and Asia. These assumptions created large uncertainties in the various loading estimates.

In the face of the Phase 1 study uncertainties, the toxics study team should establish methods to improve loading estimates for each toxic substance, source, and pathway. The steps necessary to manage improvements in loading estimates include:

(a) Update the conceptual mass balance model of toxic contaminants in Puget Sound.

(b) Create a framework for tracking the sources of toxic chemicals based on Ecology's "box model" and the conceptual model approach of the Puget Sound Assessment and Monitoring Program.

(c) Use a quantitative mass balance model (e.g., the Ecology "box model") to evaluate and refine estimates of toxic chemical loadings to Puget Sound. Improving the estimates will entail prioritizing efforts to reduce the uncertainties of those estimates among the various toxic substances, sources, and pathways, and ensuring that the loading rate of each toxic substance entering Puget Sound (less the amount stored, transformed, or degraded) equals the rate of the substance leaving the Sound. This mass balance approach should:

    (i) Assess whether the loading estimates are consistent and realistic.

    (ii) Evaluate the fate of contaminants in Puget Sound and its sub-watersheds.

    (iii) Develop a consistent approach for identifying key data gaps and uncertainties.

    (iv) Develop or establish a management tool for predicting results from load reductions.

(d) Revisit the assumptions upon which loading estimates have been made. Verify loading estimates by collecting environmental data from the Puget Sound Basin to determine the validity of the assumptions for representing the actual conditions in the watershed and to refine the loading estimates with additional hard data.

(e) Periodically update the conceptual model and modify the mass balance pathways as Ecology and others acquire a greater understanding of the transport and fate of toxic substances within Puget Sound.

(f) Use each iteration of the model to adaptively control the sources of toxics to the Puget Sound Basin.

4. <u>Surface Runoff Pathway</u>

(a) <u>Highly Developed Urban Lands</u>
Extrapolating from the demonstrated relationships between land use and toxic chemical discharges from stormwater runoff is a powerful method for estimating toxic loadings. However, the literature estimates of these relationships vary considerably. The only

comprehensive determination of these relationships locally (by Cullinan, et al. (2006) for the ENVVEST project) did not address heavily urbanized land uses, such as in Seattle and Tacoma. Thus, our understanding of the relationships between land use and toxic chemical loadings is incomplete for highly urbanized areas.

The toxics study team should improve their understanding of how land use and stormwater management practices in highly developed areas affect loadings from surface runoff. For example, the team should develop estimates of toxic chemical loadings from specific potential sources, such as stormwater runoff from roadways. Agencies should also develop mass loading data from locations in major rivers where urban runoff has a greater influence to improve the accuracy of loading estimates.

(b) Undeveloped and Agricultural Lands

This Phase 1 project found that the primary source of DDT and triclopyr was surface runoff from undeveloped (forests and fields) and agricultural lands. The total loadings of arsenic, total PBDEs, DDT, and triclopyr from the Whidbey Basin (a relatively undeveloped and agricultural area) were larger relative to the Main Basin than they were from the other areas around Puget Sound. However, limited concentration data were available, particularly for runoff from agricultural areas. Therefore, the relative contribution from the Whidbey Basin to the total loading of these four chemicals may have been overstated.

Ecology should verify and recalculate if necessary the loading values for arsenic, total PBDEs, DDT, and triclopyr through collection and analyses of samples of surface runoff from areas of undeveloped and agricultural land uses located throughout the Puget Sound Basin.

(c) Seasonal Variations

Seasonal variations in toxic chemical loading rates may justify significantly different control actions at different times of the year. Some of the data reviewed for this study indicated that chemical concentrations in stormwater varied as a function of stream discharge rates. A better understanding of the relationships between stream discharge rates and chemical concentrations in stormwater will likely improve the accuracy of loading estimates.

Ecology should improve its understanding of seasonal variations in toxic chemical loading to Puget Sound and the correspondence between stream flow rates and toxic chemical concentration.

5. Atmospheric Deposition Pathway

Based upon a review of the literature (e.g., a study in the Great Lakes), gas exchange (absorption and volatilization) was the dominant atmospheric deposition process for many semivolatile persistent bioaccumulative toxic pollutants. In this Phase 1 study, the limited data may have biased estimates of atmospheric loading directly to Puget Sound toward near-shore conditions rather than mid-water. Proximity to local sources is likely to create differences in the expected concentrations in surface runoff.

Ecology should account for the effects of geography on its estimates of loadings by implementing the following actions:

(a) Apply regional air pollutant transport models to estimate relative differences in deposition rates at different locations in the Puget Sound watershed.

(b) Confirm the actual atmospheric deposition rates through monitoring at mid-water locations of Puget Sound and at selected locations on land.

(c) Recalculate the loading estimates for direct atmospheric deposition to the water and tidelands of Puget Sound.

(d) Adjust the expected surface runoff concentrations from the various land uses to account for geographical differences in air deposition rates, and then recalculate the estimates of loadings from surface runoff.

6. Wastewater
   This Phase 1 study did not provide accurate estimates of the total toxic chemical loadings from the permitted discharge of wastewater.

   The toxics study team should improve estimates of the contributions of specific toxic chemicals in permitted discharges of wastewater from industrial and municipal treatment facilities.

7. Sediment and Biota Pathways
   The contaminated sediment on the bottom of Puget Sound may serve as a source of toxic chemicals to the overlying water. This study did not quantify the mass transfer of toxic chemicals between the sediments, aquatic life, and the Puget Sound water column.

   The toxics study team should develop estimates of mass transfer of toxic chemicals between the Puget Sound water column, sediments, benthic organisms, and other aquatic life. Ecology could use the information in its Puget Sound circulation and chemical transport "box model" to evaluate the water quality impacts of sediment contamination.

8. Groundwater Pathway
   The Phase 1 study incorporated groundwater inflow only through surface runoff. Chemical loadings through direct discharge of groundwater along the Puget Sound shoreline were not estimated separately. If direct discharge of groundwater significantly contributes toxic chemicals, control actions designed to reduce contaminants in stormwater runoff may not prevent loading to Puget Sound via the groundwater.

   The toxics study team should evaluate loadings associated with direct groundwater discharge to Puget Sound to assess the importance of this pathway relative to the others, particularly with regard to localized impacts.

9. Analytical Detection Limits
   Inadequate detection limits and sporadic monitoring efforts in the past have rendered much data unusable for estimating loading. In this Phase 1 study, the wastewater loading estimates for arsenic, cadmium, lead, mercury, and PAHs were strongly influenced by analytical method detection limits that were not low enough.

   Ecology should ensure that analytical detection limits are as low as feasible whenever the agency requires sampling and analyses.

10. Probabilistic Analyses
    Limited data, time, and budget for this Phase 1 study precluded the use of a probabilistic approach to estimate chemical loadings (such as a Monte Carlo simulation). If sufficient data were available, a probabilistic approach would improve the credibility of the total loading estimates and may identify more explicitly the parameters that drive the loading estimates for the various sources and pathways, e.g., surface runoff and wastewater flows derived for the different study areas.

    Ecology should employ probabilistic methods in future refinements of loading estimates. This approach may also be useful for predicting the likely outcomes from proposed control actions. Ecology should consider using the AquaTox ecological risk assessment simulation (Park and Clough 2004) to estimate pollutant concentrations in surface water bodies. This method determines the variables that have the greatest impact on the loading results. After gathering more accurate data for the most important variables, Ecology should then calculate more accurate loading estimates.

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Tables

Table 1 - Chemicals of Concern

Chemical of Concern	Category Addressed	Harm or threat
Arsenic	Arsenic	Associated with sediment toxicity and benthic community impairment
Cadmium	Cadmium	Accumulation in shellfish
Copper	Copper	Associated with sediment toxicity and benthic community impairment; affects salmonids and stream health
Lead	Lead	Associated with sediment toxicity and benthic community impairment
Mercury	Mercury	Target of fish consumption advice; Associated with sediment toxicity and benthic community impairment
Total PCBs (a)	PCBs	Target of fish consumption advice; accumulation in fish, birds, mammals; associated with sediment toxicity and benthic community impairment
Low molecular weight PAHs (b)	PAHs	Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment
Carcinogenic PAHs (c)	PAHs	Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment
Other high molecular weight PAHs (d)	PAHs	Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment
Sum of DDT and metabolites (e)	Pesticides	Accumulation in fish, birds, and mammals; associated with sediment toxicity and benthic community impairment
Triclopyr (f)	Pesticides	Category thought to affect salmonids and stream health
Total dioxin TEQs from dioxins & furans (g)	Dioxins and furans	Accumulation in birds and mammals; furans associated with sediment toxicity and benthic community impairment
bis(2-Ethylhexyl)phthalate	Phthalate esters	Category shown to accumulate in fish, invertebrates, and sediment of urban waterways at levels triggering sediment clean up activities
Total PBDEs (h)	PBDEs	Accumulation in sediments, fish, and harbor seals
Nonylphenol	Hormone disrupting chemicals	Category thought to cause reproductive impairment observed in fish from urban bays
Oil or petroleum product (i)		Kills and reduces fitness of marine organisms
Zinc		Increasing concentrations may threaten aquatic resources

(a) Sum of polychlorinated biphenyl congeners.

(b) Polyaromatic hydrocarbons: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene (per WAC 173-204-320).

(c) Polyaromatic hydrocarbons: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene (per USEPA).

(d) Polyaromatic hydrocarbons: benzo(g,h,i)perylene, fluoranthene, and pyrene (WAC 173-204-320 high molecular weight PAHs not on U.S. EPA list of carcinogenic PAHs).

(e) DDT = Dichlorodiphenyltrichloroethane.

(f) Input from the project team did not reflect consensus to include this compound as currently used pesticide. Other candidates suggested by project team members included diazinon and dichlorbenil.

(g) TEQ = Toxicity equivalent.

(h) PBDEs = Polybrominated diphenyl ethers. Sum of congeners have been normalized.

(i) Specified as crude oil, specific refined product (e.g., diesel, gasoline, heavy fuel oil), or analytical result as TPH-D or TRPH.

Table 2 - Land Use Distribution by Study Units

Study Unit	Drainage Area		Land Use in Percent			
	Square Miles	Hectares	Commercial / Industrial	Residential	Open	
					Agricultural	Forest and Field
Main Basin	3,172	821,500	3.07	9.47	3.52	83.94
South Sound	2,852	738,600	2.08	6.15	3.64	88.13
Hood Canal	1,369	354,500	0.75	1.58	2.15	95.52
Whidbey Basin	3,923	1,016,000	0.42	0.95	4.74	93.89
Bellingham	1,113	288,200	0.74	1.90	14.59	82.77
Olympic Peninsula	1,055	273,200	0.30	0.66	2.74	96.30
Urban	1,486	384,809	9.36	29.96	5.44	55.24
Nonurban	11,998	3,107,531	0.46	0.98	4.51	94.04
TOTAL	**13,484**	**3,492,000**	**1.45**	**4.17**	**4.61**	**89.77**

Table 3 - Study Unit Runoff Rates

Study Unit	Mean Runoff Rate (cubic meters per second)					
	January	February	March	April	May	June
Main Basin	743	442	343	323	480	595
South Sound	458	327	292	226	204	197
Hood Canal	343	198	199	148	163	151
Whidbey Basin	836	625	599	598	691	733
Bellingham	198	170	148	150	181	192
Olympic Peninsula	202	171	136	123	166	190
TOTAL	**2,780**	**1,934**	**1,717**	**1,567**	**1,885**	**2,058**

Study Unit	Mean Runoff Rate (cubic meters per second)						
	July	August	September	October	November	December	Average Annual
Main Basin	368	128	119	195	571	550	**405**
South Sound	137	98	89	137	269	372	**234**
Hood Canal	91	51	43	119	251	306	**172**
Whidbey Basin	574	357	314	472	736	777	**609**
Bellingham	138	83	74	111	200	206	**154**
Olympic Peninsula	130	71	52	93	175	211	**143**
TOTAL	**1,437**	**789**	**690**	**1,128**	**2,202**	**2,423**	**1,717**

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
	Measured Concentrations in Runoff (ug/L)								**Selected Value for Loading Calculations (ug/L)**			
Arsenic (Total)	Stillaguamish River, WA	Ecology (2004a)	Forest & Field	In-Stream	0.19 to 0.6	1.1 to 4.1						
	Lower Similkameen River, WA	Ecology (2004b)		In-Stream	1.0	1.5 to 2.5						
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			0.9 to 1.5		**Forest & Field**	**1**	**1.0**	1
			Industrial	Runoff			6 to 9		**Agricultural**	**1.5**	**0.8**	2
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream	2.2	4.2			**Residential**	**2**	**0.85**	1
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			3.0 to 4.0		**Commercial/Industrial**	**4**	**0.8**	1
			Residential	Runoff			3.0	0.85				
			Commercial/Industrial	Runoff			2.0 to 4.0	0.66 to 0.95				
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	0.3	2.0						
		King County (2006)	Commercial/Industrial	Runoff	1.4	2.75	2.4					
Cadmium (Total)	Green River, WA	Ecology (1994)	Forest & Field	In-Stream	0.002	0.051	0.006					
	Duwamish River, WA			In-Stream	0.005	0.041	0.012					
	Puyallup River, WA			In-Stream	0.005	0.091	0.026					
	Snohomish River, WA		Forest & Field	In-Stream			0.014					
	Yakima River, WA			In-Stream	0.010	0.045	0.015					
	Upper Columbia River, WA			In-Stream			0.17					
	Lower Columbia River, WA			In-Stream			0.029					
	Spokane River, WA			In-Stream			0.28					
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			0.2					
			Industrial	Runoff			0.6		**Forest & Field**	**0.013**	**2.6**	3
	Loadings to San Francisco Bay, CA	Davis et al. (2000)	Open	Runoff			0.4		**Agricultural**	**0.5**	**1.1**	4
			Residential	Runoff			1.7		**Residential**	**0.5**	**1.2**	1
			Commercial/Industrial	Runoff			1.9 to 3.1		**Commercial/Industrial**	**1.5**	**1.1**	1
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			0.09					
			Agriculture	Runoff			4.3					
			Residential	Runoff			0.20					
			Commercial/Industrial	Runoff			0.26 to 0.46					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			0.4	2.6				
			Residential	Runoff			0.5 to 0.9	1.2				
			Commercial/Industrial	Runoff			0.9 to 2.0	0.8 to 1.3				
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream			0.48 to 0.69					
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	0.2	0.5						
		King County (2006)	Commercial/Industrial	Runoff	0.54	2.24	1.0					

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
Copper (Total)	Green River, WA	Ecology (1994)	Forest & Field	In-Stream	0.26	17	0.41					
	Duwamish River, WA		Mixed Forest & Urban	In-Stream	0.69	3.8	0.96					
	Puyallup River, WA			In-Stream	1.1	41	17					
	Snohomish River, WA		Forest & Field	In-Stream			1.3					
	Yakima River, WA			In-Stream	1.0	2.9	2.2					
	Upper Columbia River, WA			In-Stream			1.7					
	Lower Columbia River, WA			In-Stream			1.7					
	Spokane River, WA			In-Stream			0.74					
	Green River, WA	King County (2007)	Forest & Field	In-Stream			0.4 to 0.7 (B)					
				In-Stream			0.87 to 1.4 (S)					
	Major Streams: Green-Duwamish Watershed		Mixed Forest & Urban	In-Stream			0.48 to 1.6 (B)					
				In-Stream			1.3 to 5.0 (S)					
	Green-Duwamish Watershed		Forest	In-Stream			0.20 to 0.63 (B)					
				In-Stream			0.52 to 2.0 (S)					
			Agriculture	In-Stream			1.6 to 4.9 (B)					
				In-Stream			4.7 to 7.2 (S)					
			Low/Medium Development	In-Stream			0.67 to 1.2 (B)					
				In-Stream			2.1 to 4.6 (S)					
			High Development	In-Stream			1.6 to 3.2 (B)					
				In-Stream			3.7 to 5.0 (S)					
	Snohomish River near Monroe, WA	Ecology and Other Agencies		In-Stream			0.51					
	Quilceda Creek, WA			In-Stream			2.0					
	May Creek, WA			In-Stream			1.3		**Forest & Field**	**1**	**1.2**	1
	Allen Creek, WA			In-Stream			3.0		**Agricultural**	**5**	**1.2**	1
									Residential	**4**	**1.0**	1
	Sinclair/Dyes Inlets Streams, WA	Crecelius et al. 2003		Runoff	1.5 (W)	16 (W)			**Commercial/Industrial**	**25**	**0.9**	1
				Runoff	0.26 (D)	1.1 (D)						
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			6 to 15					
			Industrial	Runoff			25 to 75					
			Low Development	Runoff			1 to 4					
			Moderate Development	Runoff			2.5 to 4.5					
			High Development	Runoff			4 to 9					
	Loadings to San Francisco Bay, CA	Davis et al. (2000)	Open	Runoff			11					
			Residential	Runoff			51					
			Commercial/Industrial	Runoff			51 to 53					
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			5					
			Agriculture	Runoff			150					
			Residential	Runoff			16					
			Commercial/Industrial	Runoff			21 to 28					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			10	1.2				
			Residential	Runoff			12 to 16					
			Commercial/Industrial	Runoff			17 to 23	0.8 to 1.0				
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream			9 to 55					
	Industrial-Area Creek, WA	Ecology (2006a)	Commercial/Industrial	In-Stream	0.94	13.6						
				In-Stream	0.89	14						
				In-Stream	1.2	6.0						
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	34	59						
		King County (2006)	Commercial/Industrial	Runoff	36	77	53					

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Chemical of Concern	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
	Measured Concentrations in Runoff (ug/L)								**Selected Value for Loading Calculations (ug/L)**			
Lead (Total)	Green River, WA	Ecology (1994)	Forest & Field	In-Stream	0.035	2.0	0.099					
	Duwamish River, WA		Mixed Forest & Urban	In-Stream	0.13	2.0	0.26					
	Puyallup River, WA			In-Stream	0.19	4.5	1.5					
	Snohomish River, WA		Forest & Field	In-Stream			0.17					
	Yakima River, WA			In-Stream	0.2	1.0	0.64					
	Upper Columbia River, WA			In-Stream			3.2					
	Lower Columbia River, WA			In-Stream			0.35					
	Spokane River, WA			In-Stream			1.1					
	Snohomish River near Monroe, WA	Ecology and Other Agencies	Forest & Field	In-Stream			0.0074					
	Quilceda Creek, WA			In-Stream			0.39 to 0.83					
	May Creek, WA			In-Stream			0.13					
	Allen Creek, WA			In-Stream			0.29					
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			9 to 10		**Forest & Field**	**0.5**	**1.9**	1
			Industrial	Runoff			10 to 14		**Agricultural**	**5**	**1.15**	2
			Low Development	Runoff			0.3 to 1.4		**Residential**	**10**	**1.5**	1
			Moderate Development	Runoff			1.3 to 2.4		**Commercial/Industrial**	**20**	**1.15**	1
			High Development	Runoff			3 to 11					
	Loadings to San Francisco Bay, CA	Davis et al. (2000)	Open	Runoff			7					
			Residential	Runoff			52					
			Commercial/Industrial	Runoff			143 to 151					
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			0.7					
			Agriculture	Runoff			43					
			Residential	Runoff			4.0					
			Commercial/Industrial	Runoff			3.7 to 5.9					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			10	1.9				
			Residential	Runoff			12 to 16					
			Commercial/Industrial	Runoff			17 to 25	1.0 to 1.3				
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream			19 to 34					
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	6	18						
		King County (2006)	Commercial/Industrial	Runoff	11	47	16					

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
	Green River, WA	Ecology (1994)	Forest & Field	In-Stream	0.38	7.5	1.3					
	Duwamish River, WA		Mixed Forest & Urban	In-Stream	0.88	9.5	2.2					
	Puyallup River, WA			In-Stream	1.4	44	17					
	Snohomish River, WA		Forest & Field	In-Stream			3.1					
	Yakima River, WA			In-Stream	1.3	5.7	3.0					
	Upper Columbia River, WA			In-Stream			2.1					
	Lower Columbia River, WA			In-Stream			1.4					
	Spokane River, WA			In-Stream			109					
	Green River, WA	King County (2007)	Forest & Field	In-Stream			0.59 to 1.0 (B)					
				In-Stream			1.7 to 3.6 (S)					
	Major Streams: Green-Duwamish Watershed		Mixed Forest & Urban	In-Stream			0.67 to 10 (B)					
				In-Stream			1.8 to 30 (S)					
	Green-Duwamish Watershed		Forest	In-Stream			0.38 to 0.60 (B)					
				In-Stream			0.95 to 2.5 (S)					
			Agriculture	In-Stream			2.4 to 6.6 (B)					
				In-Stream			6.6 to 20 (S)					
			Low/Medium Development	In-Stream			0.94 to 4.0 (B)					
				In-Stream			3.0 to 10 (S)					
			High Development	In-Stream			10 to 24 (B)					
				In-Stream			20 to 40 (S)					
	Snohomish River near Monroe, WA	Ecology and Other Agencies	Forest & Field	In-Stream			0.44		**Forest & Field**	**2**	**1.2**	1
	Quilceda Creek, WA			In-Stream			4.5 to 6.4		**Agricultural**	**10**	**1.2**	1
Zinc (Total)	May Creek, WA			In-Stream			3.4		**Residential**	**30**	**1.0**	1
	Allen Creek, WA			In-Stream			6.0		**Commercial/Industrial**	**120**	**0.9**	1
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			50 to 65					
			Industrial	Runoff			80 to 130					
			Low Development	Runoff			4 to 9					
			Moderate Development	Runoff			13 to 18					
			High Development	Runoff			14 to 35					
	Loadings to San Francisco Bay, CA	Davis et al. (2000)	Open	Runoff			34					
			Residential	Runoff			188					
			Commercial/Industrial	Runoff			371 to 397					
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			3.2					
			Agriculture	Runoff			220					
			Residential	Runoff			70					
			Commercial/Industrial	Runoff			160 to 200					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			40	1.2				
			Residential	Runoff			73 to 95					
			Commercial/Industrial	Runoff			150 to 200	0.8 to 1.0				
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream			140 to 190					
	Industrial-Area Creek, WA	Ecology (2006a)	Commercial/Industrial	Runoff	5.0	105						
				Runoff	6.0	89						
				Runoff	19	76						
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	53	158						
		King County (2006)	Commercial/Industrial	Runoff	427	3,020	1,240					

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Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
Mercury (Total)	Stillaguamish River, WA	Ecology (2004a)	Forest & Field	In-Stream	0.002 to 0.0036	0.015 to 0.05						
	Green River, WA	King County (2007)	Forest & Field	In-Stream			0.005 (B)					
				In-Stream			0.005 (S)					
	Major Streams: Green-Duwamish Watershed		Mixed Forest & Urban	In-Stream			0.0013 to 0.005 (B)					
				In-Stream			0.0036 to 0.0075 (S)					
	Green-Duwamish Watershed		Forest	In-Stream			0.0012 to 0.005 (B)					
				In-Stream			0.0029 to 0.0079 (S)					
			Agriculture	In-Stream			0.0043 to 0.0054 (B)					
				In-Stream			0.0073 to 0.0086 (S)					
			Low/Medium Development	In-Stream			0.0014 to 0.005 (B)					
				In-Stream			0.0057 to 0.03 (S)					
			High Development	In-Stream			0.005 (B)		**Forest & Field**	**0.005**	**1.5**	1
				In-Stream			0.0061 to 0.0094 (S)		**Agricultural**	**0.007**	**2.0**	1
	Snohomish River near Monroe, WA	Ecology and Other Agencies	Forest & Field	In-Stream			0.002		**Residential**	**0.01**	**1.5**	1
	Mill Creek, WA			In-Stream			0.0052		**Commercial/Industrial**	**0.2**	**1.5**	1
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			0.008 to 0.02					
			Industrial	Runoff			0.02 to 0.1					
			Low Development	Runoff			0.003 to 0.01					
			Moderate Development	Runoff			0.007 to 0.013					
			High Development	Runoff			0.005 to 0.026					
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			0.07					
			Agriculture	Runoff			0.11					
			Residential	Runoff			0.04					
			Commercial/Industrial	Runoff			0.02 to 0.06					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			0.15					
			Residential	Runoff			0.2					
			Commercial/Industrial	Runoff			0.2 to 0.3					
	Guadalupe River, CA	McKee et al. (2005)	Urban	In-Stream			0.8 to 3.8					
	Evergreen Point Bridge, WA	Colich (2003)	Commercial/Industrial	Runoff	0.003	0.012						
		King County (2006)	Commercial/Industrial	Runoff	0.01	0.04	0.0152					
Total PCBs	Green River, WA	Nairn (2007)	Forest & Field	In-Stream			0.001					
	Newport Bay TMDL, CA	Peng et al. (2002)	Residential	Runoff			0.15					
			Agriculture	Runoff			0.05					
	Switzerland	Rossi et al. (2004)	Urban	Runoff	0.00011 to	0.4			**Forest & Field**	**0.001**	**2.5**	1
				Runoff	0.00024				**Agricultural**	**0.01**	**2.0**	1
	Toronto Stormwater Outfall, CA	Pitt et al. (1996)	Residential	Runoff			< 0.020		**Residential**	**0.02**	**2.0**	1
			Industrial	Runoff			0.033		**Commercial/Industrial**	**0.03**	**2.0**	1
	Walla Walla River Watershed, WA	Ecology (2004c)	Rural/Agricultural	In-Stream			0.00042 to					
				In-Stream			0.0036					
	Baltic Sea, Europe	ter Schure et al. (2004)	Mixed	Rain			0.0001 to					
				Rain			0.002					

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	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
	Duwamish River, WA		Mixed Forest & Urban	In-Stream			< 3E-6					
	Lake Washington, WA		Urban	Lake	1E-6	80E-6						
	Upper Columbia River, WA		Forest & Field	In-Stream			16E-6					
	Middle Columbia River, WA		Mixed Forest & Agriculture	In-Stream			50E-6					
	Lower Columbia River, WA	Ecology (2006b)	Mixed Forest, Urban, Ag	In-Stream	21E-6	57E-6			**Forest & Field**	**8E-6**	**2.0**	1
	Yakima River, WA		Agriculture	In-Stream	3E-6	40E-6			**Agricultural**	**30E-6**	**2.0**	1
Total PBDEs	Queets River, WA		Forest & Field	In-Stream	8E-6	12E-6			**Residential**	**40E-6**	**1.5**	1
	Potholes Reservoir, WA		Agriculture	In-Stream			9E-6		**Commercial/Industrial**	**20E-6**	**2.0**	5
	Lake Ozette, WA		Forest & Field	Lake			4E-6					
			Urban (Light Industrial)	Runoff			< 0.05					
			Urban (Old Housing)	Runoff			0.8					
	United Kingdom	Rule et al. (2006)	Urban (New Housing)	Runoff			0.3					
			Urban (Town Center)	Runoff			<0.05 to 0.15					
			Urban (WWTP Influent)	Runoff			0.2					
			Non-Urban	Runoff			0.36					
	Boston, MA	Menzie et al. (2002)	Urban	Runoff			2.9					
			Urban Residential/Comm	Runoff			1.9 to 3.4					
			Suburban Residential	Runoff			0.042					
			Urban	Runoff			0.06 to 0.36 (E1)					
			Industrial	Runoff			0.06 to 0.11 (E1)		**Forest & Field**	**0.006**	**2.0**	6
cPAHs	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Low Development	Runoff			0.006 to 0.012 (E1)		**Agricultural**	**0.15**	**1.5**	4
			Moderate Development	Runoff			0.006 to 0.024 (E1)		**Residential**	**0.15**	**1.5**	1
			High Development	Runoff			0.012 to 0.036 (E1)		**Commercial/Industrial**	**1**	**1.5**	1
	Vancouver, British Columbia	Hall et al. (1996)	Mixed	Rain			0.26 (E1)					
			Urban (Light Industrial)	Runoff			0.29 (E1)					
			Urban (Old Housing)	Runoff			0.19 (E1)					
	United Kingdom	Rule et al. (2006)	Urban (New Housing)	Runoff			0.17 (E1)					
			Urban (Town Center)	Runoff			0.17 to 0.29 (E1)					
			Urban (WWTP Influent)	Runoff			0.38 (E1)					
			Non-Urban	Runoff			0.29					
	Boston, MA	Menzie et al. (2002)	Urban	Runoff			2.2					
			Urban Residential/Comm	Runoff			1.4 to 2.5					
			Suburban Residential	Runoff			0.036					
			Urban	Runoff			0.05 to 0.27 (E2)		**Forest & Field**	**0.005**	**2.0**	6
			Industrial	Runoff			0.05 to 0.081 (E2)		**Agricultural**	**0.1**	**1.5**	4
HPAHs	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Low Development	Runoff			0.005 to 0.009 (E2)		**Residential**	**0.1**	**1.5**	1
			Moderate Development	Runoff			0.005 to 0.018 (E2)		**Commercial/Industrial**	**0.8**	**1.5**	1
			High Development	Runoff			0.01 to 0.027 (E2)					
	Vancouver, British Columbia	Hall et al. (1996)	Mixed	Rain			0.18 (E2)					
			Urban (Light Industrial)	Runoff			0.22 (E2)					
			Urban (Old Housing)	Runoff			0.14 (E2)					
	United Kingdom	Rule et al. (2006)	Urban (New Housing)	Runoff			0.13 (E2)					
			Urban (Town Center)	Runoff			0.13 to 0.22 (E2)					
			Urban (WWTP Influent)	Runoff			0.29 (E2)					

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
LPAHs	Boston, MA	Menzie et al. (2002)	Non-Urban	Runoff			0.66					
			Urban	Runoff			7.1					
			Urban Residential/Comm	Runoff			3.9 to 10					
			Suburban Residential	Runoff			0.23					
	Sinclair/Dyes Inlets Watersheds, WA	ENVVEST (Cullinan et al. 2006)	Urban	Runoff			0.15 to 0.87 (E3)					
			Industrial	Runoff			0.15 to 0.26 (E3)		Forest & Field	0.015	2.0	6
			Low Development	Runoff			0.015 to 0.029 (E3)		Agricultural	0.3	1.5	4
			Moderate Development	Runoff			0.015 to 0.058 (E3)		Residential	0.3	1.5	1
			High Development	Runoff			0.029 to 0.087 (E3)		Commercial/Industrial	3	1.5	1
	Vancouver, British Columbia	Hall et al. (1996)	Mixed	Rain			0.58 (E3)					
	United Kingdom	Rule et al. (2006)	Urban (Light Industrial)	Runoff			0.70 (E3)					
			Urban (Old Housing)	Runoff			0.46 (E3)					
			Urban (New Housing)	Runoff			0.41 (E3)					
			Urban (Town Center)	Runoff			0.41 to 0.70 (E3)					
			Urban (WWTP Influent)	Runoff			0.93 (E3)					
BEHP	Thornton Creek (Seattle), WA	Ecology and Other Agencies	Urban	In-Stream			0.12 to 0.24					
	King County, WA	King County DNRP EDC Study	Stream/River (dry weather)	In-Stream		16	0.5 to 2 (E4)					
			Stream/River (wet weather)	In-Stream		4.6	0.2 to 0.5 (E4)					
			100% Bridge/Road Runoff	Runoff		20	0.7 to 2 (E4)					
			Mixed	Lake		13	0.4 to 1 (E4)					
			Mixed	Marine		40	1 to 4 (E4)					
	U.S. Streams	Kolpin et al. (2002)	Urban & Agricultural	In-Stream		20	7					
	United Kingdom	Rule et al. (2006)	Urban (Light Industrial)	Runoff			6					
			Urban (Old Housing)	Runoff			9					
			Urban (New Housing)	Runoff			57					
			Urban (Town Center)	Runoff			18 to 23					
			Urban (WWTP Influent)	Runoff			23					
	Netherlands	Peijnenburg and Struijs (2006)	Freshwater (spring)	I-S+Runoff			0.27					
			Freshwater (summer)	I-S+Runoff			0.39		Forest & Field	0.1	2.5	1
			Freshwater (autumn)	I-S+Runoff			0.32		Agricultural	10	2.0	4
			"Pristine" Waters	I-S+Runoff			~0.01 (est.)		Residential	10	2.0	1
	Three Puget Sound Boatyards, WA	Ecology (2006c)	Commercial/Industrial	Runoff	2.1	15			Commercial/Industrial	10	2.0	1
	Evergreen Point Bridge, WA	King County (2006)	Commercial/Industrial	Runoff	4	15						
	Various Locations, U.S. (17 Cities)	Pitt et al. (1994)	Residential	Runoff	4	62						
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	All	Runoff			10					
	Sweden (Rivers)	Thuren (1986)	Maximum=Industrial	In-Stream	0.32	3.1						
	Various Rivers, Japan	WHO (1992)	Freshwater	In-Stream	ND	3.1						
	Various Cities, Japan				0.1	2.2						
	River Meuse, Netherlands			In-Stream	<0.1	3.5						
	River Rhine, Netherlands			In-Stream	ND	1.2						
	River Rhine, Netherlands			In-Stream	ND	4.0						
	Lake Yssel, Netherlands			Lake	<0.1	0.3						
	River Rhine, Netherlands	WHO (2003)		In-Stream	0.1	0.7	0.3					
	U.S. (2 cities)			Tapwater			1					
	Japan				1.2	1.8						
	U.S. (2 cities)			Drinking Wat	0.05	11						
	Several Major Cities, Eastern U.S.			Drinking Wat			<1					
	Japan		Highest=Industrial	Rain			0.6 to 3.2					
	North Pacific			Rain	0.0053	0.21	0.055					

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
Triclopyr	Thornton Creek (Seattle), WA	Ecology and Other Agencies	Urban	In-Stream			0.0039 to 0.024					
	Samish River, WA		Forest & Field	In-Stream			0.001 to 0.002					
	Juanita Creek, WA		Urban/Residential	In-Stream			0.090					
	Indian Creek, WA		Urban/Residential	In-Stream			0.019		**Forest & Field**	**0.004**	**2.0**	1
	Indian Slough, WA		Agriculture	In-Stream			0.15		**Agricultural**	**0.06**	**2.0**	1
	Browns Slough, WA		Agriculture	In-Stream			0.043		**Residential**	**0.03**	**2.0**	1
	Big Ditch, WA		Agriculture	In-Stream			0.05		**Commercial/Industrial**	**0.03**	**2.5**	4
	King County Streams, WA	USGS (1999)	Urban	In-Stream	0.03	1						
	Skokomish, Nooksack, Green Rivers, WA	USGS (2003)	Forest & Field	In-Stream	<0.25	0.12	0.004 to 0.01 (E4)					
	Thornton Creek (Seattle), WA	USGS (2003)	Urban	In-Stream	<0.25	0.82						
	Willamette River, OR	USGS (1997)	Forest & Field	In-Stream	<0.05	6	<0.05					
	Juanita Creek, WA	Ecology (1997b)	Urban/Residential	In-Stream	ND	0.24	0.03					
	Indian Creek, WA		Urban/Residential	In-Stream	ND	0.088	0.02					
Nonylphenol	King County, WA	King County DNRP EDC Study	Stream/River (dry weather)	In-Stream		0.46	0.02 to 0.05 (E4)					
			Stream/River (wet weather)	In-Stream		0.84	0.03 to 0.08 (E4)					
			100% Bridge/Road Runoff	Runoff		44	1 to 4 (E4)					
			100% Stormwater	Runoff		8.9	0.3 to 0.9 (E4)					
				Lake		0.15	0.005 to 0.02 (E4)					
				Marine		0.25	0.008 to 0.03 (E4)					
	Evergreen Point Bridge, WA	King County (2006)	Commercial/Industrial	Runoff	0.5	9.1	2.6					
	U.S. Streams	Kolpin et al. (2002)	Urban & Agricultural	In-Stream		40	0.8		**Forest & Field**	**0.03**	**2.5**	1
	United Kingdom	Rule et al. (2006)	Urban (Light Industrial)	Runoff			11		**Agricultural**	**0.3**	**2.0**	4
			Urban (Old Housing)	Runoff			7		**Residential**	**0.3**	**2.0**	1
			Urban (New Housing)	Runoff			8		**Commercial/Industrial**	**4**	**2.0**	1
			Urban (Town Center)	Runoff			45 to 98					
			Urban (WWTP Influent)	Runoff			16					
	Various Industrial Sources, U.S.	Shackelford et al. (1983)	Industrial	Runoff	2	1,600						
	Great Lakes, U.S.	Bennie et al. (1997)		Lake	0.01	0.92						
	30 U.S. Rivers	Radian (1990), Naylor (1992)		In-Stream	0.20	0.64						
	Airport Runoff	Corsi et al. (2003)	Commercial/Industrial	Runoff	0.98	7.7						
	Hamburg, Germany	Jahnke et al. (2004)	WWTP Effluent	Effluent	0.14	0.24						
	Lower Hudson River Estuary	Dachs et al. (1999)	Urban	In-Stream	0.012	0.095						
Total Dioxin TEQs	San Francisco Bay Watershed, CA	Wenning et al. (1999)	Mixed Urban/Rural	Runoff	4E-6	16E-6						
				Runoff	8E-6	30E-6						
			Petroleum Refinery Outfall	Runoff	5E-6	72E-6						
				Runoff	11E-6	73E-6			**Forest & Field**	**0.1E-6**	**2.5**	7
	Palo Alto, CA	EIP Associates (1997)	Urban	Runoff	0.8E-6	10E-6	8.7E-6		**Agricultural**	**5E-6**	**2.0**	4
	Houston, TX	Suarez et al. (2006)	Urban	Runoff	0.01E-6	0.88E-6			**Residential**	**5E-6**	**2.0**	1
	Santa Monica Bay Watershed, CA	Fisher et al. (1999)	Urban	Runoff	0.8E-6	8.9E-6			**Commercial/Industrial**	**10E-6**	**2.0**	1
	San Francisco Area, CA	Paustenbach et al. (1996)	Varied/Urban	Runoff	0.01E-6	65E-6	<15E-6					
	Bayreuth, Germany	Horstmann & McLachlan (1995)	Urban	Runoff	1E-6	11E-6						
	Ohio River, U.S.	Dinkins and Heath (1995)	Varied	In-Stream	0.1E-6	0.5E-6						
	Denmark	NERI (2006)	Mixed	Rain	1E-6	2E-6						

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range Min	Range Max	Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
Total DDT	Lower Mission Creek Watershed, WA	Ecology (2004d)	Forest & Fields	In-Stream	0.0004	0.0032						
				In-Stream	0.0036	0.031						
				In-Stream			0.0032					
				In-Stream	0.0081	0.13						
	Lake Chelan Watershed, WA	Ecology (2005)	Forest & Fields	In-Stream	0.022	0.036	0.028					
				In-Stream	0.0077	0.017	0.013					
				In-Stream	0.0016	0.0039	0.0026					
				In-Stream	0.011	0.018	0.014					
				In-Stream	0.0046	0.0087	0.0062					
				In-Stream			0.0002					
				In-Stream	0.0014	0.0021	0.0018					
				In-Stream	0.011	0.025	0.015					
				In-Stream	0.0017	0.0033	0.0022					
				In-Stream	0.0034	0.0046	0.0038					
				In-Stream	0.0013	0.0026	0.0020					
	Walla Walla River Watershed, WA	Ecology (2004c)	Agriculture	In-Stream			0.00031					
				In-Stream			0.00056					
				In-Stream			0.0037		**Forest & Field**	**0.003**	**2.0**	1
				In-Stream			0.0019		**Agricultural**	**0.006**	**2.0**	1
				In-Stream			0.0014		**Residential**	**0.001**	**2.0**	1
				In-Stream			0.0024		**Commercial/Industrial**	**0.0002**	**2.0**	8
				In-Stream			0.00095					
				In-Stream			0.0020					
				In-Stream			0.00042					
				In-Stream			0.0013					
	Yakima River Basin, WA	Ecology (1997)	Yakima River	In-Stream	0.005	0.1						
		USGS (2004)	Agriculture (Tributaries)	In-Stream		0.015						
			Yakima River	In-Stream		<0.001						
				In-Stream								
				In-Stream								
	Johnson Creek, Milwaukie, OR	Johnson Creek (1995)	Main Stem Johnson Creek	In-Stream	0.001	0.035	0.013					
			Rural Tributary	In-Stream			0.006					
			Urban Tributary	In-Stream			0.001					
			Urban Stormwater Outfall	In-Stream			0.002					
	Southern California Bight	Ackerman and Schiff (2003)	Open	Runoff			0.0					
			Agriculture	Runoff			0.51					
			Residential	Runoff			0.001					
			Commercial/Industrial	Runoff			0.0 to 0.005					
	Newport Bay TMDL, CA	Peng et al. (2002)	Residential	Runoff			0.005					
			Agriculture	Runoff			0.5					

Table 4 - Selection of Runoff Concentrations

Chemical of Concern	Measured Concentrations in Runoff (ug/L)								Selected Value for Loading Calculations (ug/L)			
	Location	Reference	Land Use	Sample Type	Range		Median	Standard Deviation of ln[c]	Land Use	Best Estimate of Median	Standard Deviation of ln[c]	Comments (Footnotes)
					Min	Max						
Oil or Petroleum	San Gabriel River	Los Angeles County, CA	Urban	In-Stream	640	4,230	1,900					
	Coyote Creek		Urban	In-Stream	2,500	3,000	3,000					
	Los Angeles River		Urban	In-Stream	1,380	5,550	3,080					
	Dominquez Channel		Urban	In-Stream	2,180	3,800	2,650					
	Ballona Creek		Urban	In-Stream	2,100	7,100	3,600					
	Malibu Creek		Urban	In-Stream	950	3,830	2,500					
	Santa Clara River		Urban	In-Stream	2,220	2,500	2,400		**Forest & Field**	**100**	**2.0**	9
	Loadings to San Francisco Bay, CA	Silverman et al. (1988)	0-10% CO/IN	Runoff	1,000	2,000			**Agricultural**	**1,000**	**1.5**	1
			10-40% CO/IN	Runoff	3,000	10,000			**Residential**	**3,000**	**1.2**	1
			40-80% CO/IN	Runoff	3,000	20,000			**Commercial/Industrial**	**6,000**	**0.9**	1
			80-100% CO/IN	Runoff	5,000	40,000						
	California Stormwater	California EPA (2006)	Agriculture	Runoff			0 to 900					
			Commercial/Industrial	Runoff			<13,000					
	Various Locations, U.S.	NSQD (Maestre and Pitt 2005)	Open	Runoff			1,300					
			Residential	Runoff			4,000	1.2				
			Commercial/Industrial	Runoff			4,500 to 9,000	0.6 to 1.1				

NOTES:

ND = Not Detectable
B = Baseflow conditions
S = Stormflow conditions
E1 = Estimated as 0.24*Total PAH
E2 = Estimated as 0.18*Total PAH
E3 = Estimated as 0.58*Total PAH
E4 = Estimated as 0.1-0.03*Maximum based on Table 3-4 POEs

FOOTNOTES:

1.) Approximate midpoint of highlighted measured concentration ranges.
2.) Used average of Forest & Residential best estimate median land use concentrations.
3.) Geometric mean of highlighted measured concentration ranges.
4.) Assumed to be equal to the Residential land use best estimate median concentration.
5.) Assumed to be one-half of the Residential best estimate median concentration based on the findings of the United Kingdom study.
6.) Used the lowermost of the highlighted medians.
7.) Estimated from minimum reported concentrations.
8.) Assumed to be a factor of 5 smaller than the best estimate median Residential land use concentration.
9.) About 80 percent of the reported Oil & Grease concentrations for undeveloped areas in the National Stormwater Quality Database were less than a detection limit of approximately 1,000 ug/L. Therefore, this best estimate median concentration was estimated assuming a 20% (100% - 80%) probability of exceedance concentration of approximately 1,000 ug/L.

Table 5 - Surface Runoff Loadings

Chemical of Concern	Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)														
						Main Basin					South Sound					Hood Canal				
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
	1.1	0.49	0.40	0.19	95	0.67	0.78	0.20	1.9	3.6	0.27	0.30	0.124	1.2	1.9	0.073	0.058	0.055	1.0	1.2
	2.3	1.1	0.87	0.51	75	1.5	1.8	0.44	5.1	8.8	0.58	0.68	0.27	3.2	4.7	0.16	0.13	0.120	2.6	3.0
Arsenic	4	2	1.5	1	50	2.5	3.2	0.76	10	16	1.0	1.2	0.46	6.2	8.9	0.27	0.24	0.21	5.1	5.8
	6.9	3.5	2.6	2.0	25	4.3	5.6	1.3	20	31	1.7	2.2	0.79	12	17	0.47	0.42	0.35	10	11
	15	8.1	5.6	5.2	5	9.3	13	2.8	52	77	3.7	4.9	1.7	32	43	1.0	1.0	0.77	26	29
	0.25	0.069	0.082	1.8E-04	95	0.15	0.110	0.041	0.002	0.31	0.06	0.04	0.025	0.0011	0.130	0.017	0.0082	0.011	9.2E-04	0.037
	0.71	0.22	0.24	0.0022	75	0.45	0.35	0.12	0.02	0.94	0.18	0.13	0.073	0.014	0.40	0.049	0.026	0.033	0.01	0.12
Cadmium	1.5	0.5	0.5	0.013	50	0.94	0.79	0.25	0.1	2.1	0.37	0.30	0.15	0.08	0.9	0.102	0.059	0.069	0.1	0.3
	3.2	1.1	1.1	0.075	25	2.0	1.8	0.53	0.8	5.0	0.79	0.68	0.32	0.47	2.3	0.21	0.13	0.14	0.4	0.9
	9.2	3.6	3.1	0.94	5	5.7	5.7	1.5	9	22	2.3	2.2	0.94	6	11	0.62	0.42	0.42	4.8	6.2
	5.7	0.77	0.69	0.14	95	3.6	1.2	0.35	1.4	6.5	1.42	0.47	0.21	0.86	3.0	0.39	0.091	0.10	0.71	1.3
	14	2.0	2.2	0.44	75	8.5	3.2	1.1	4.5	17	3.4	1.2	0.68	2.8	8.1	0.93	0.24	0.31	2.3	3.7
Copper	25	4	5	1	50	16	6.3	2.5	10	35	6.2	2.4	1.5	6.2	16	1.7	0.47	0.69	5.1	8.0
	46	7.9	11	2.2	25	29	12	5.7	23	69	11.4	4.8	3.5	14	34	3.1	0.93	1.5	11	17
	110	21	36	7.2	5	69	32	18	72	191	27	13	11	45	96	7.5	2.4	5.0	36	51
	3.0	0.85	0.75	0.022	95	1.9	1.3	0.38	0.22	3.8	0.75	0.51	0.23	0.14	1.6	0.21	0.10	0.10	0.11	0.52
	9.2	3.6	2.3	0.14	75	5.7	5.8	1.2	1.4	14	2.3	2.2	0.71	0.86	6.1	0.63	0.43	0.32	0.71	2.1
Lead	20	10	5	0.5	50	12	16	2.5	5.0	36	5.0	6.1	1.5	3.1	16	1.4	1.2	0.69	2.5	5.8
	43	28	11	1.8	25	27	44	5.5	18	94	11	17	3.3	11	42	3.0	3.2	1.5	9.2	17
	130	110	33	11	5	81	170	17	110	378	32	67	10	70	179	8.8	13	4.6	58	84
	27	5.8	1.4	0.28	95	17	9.2	0.70	2.8	30	6.8	3.5	0.43	1.7	12	1.9	0.68	0.19	1.4	4.1
	65	15	4.4	0.89	75	41	24	2.2	8.9	76	16	9.3	1.4	5.5	32	4.4	1.8	0.61	4.5	11
Zinc	120	30	10	2	50	75	48	5.1	20	148	30	18	3.1	12	64	8.2	3.5	1.4	10	23
	220	50	22	4.5	25	137	79	11	45	273	55	30	6.9	20	112	15	5.9	3.1	23	47
	520	150	71	14	5	320	230	36	140	726	130	91	21.9	86	328	35	18	9.8	71	134
	0.017	0.0008	2.6E-04	4.2E-04	95	0.011	0.0013	1.3E-04	0.0043	0.016	0.0042	5.1E-04	8.0E-05	0.0026	0.0075	0.0012	1.0E-04	3.6E-05	0.0022	0.0034
	0.073	0.0036	0.0018	0.0018	75	0.045	0.0058	9.2E-04	0.018	0.070	0.018	0.0022	5.6E-04	0.011	0.032	0.0049	4.3E-04	2.5E-04	0.0093	0.015
Mercury	0.2	0.01	0.007	0.005	50	0.12	0.016	0.0035	0.050	0.19	0.050	0.0061	0.0022	0.031	0.089	0.014	0.0012	0.0010	0.025	0.041
	0.55	0.028	0.027	0.014	25	0.34	0.04	0.014	0.14	0.54	0.14	0.017	0.0083	0.085	0.25	0.037	0.0032	0.0037	0.070	0.11
	2.4	0.12	0.19	0.059	5	1.5	0.19	0.095	0.59	2.3	0.59	0.072	0.058	0.37	1.1	0.16	0.014	0.0259	0.30	0.50
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	7.0E-04	1.2E-03	1.9E-04	1.6E-04	2.2E-03	2.8E-04	4.5E-04	1.1E-04	1.0E-04	9.5E-04	7.6E-05	8.8E-05	5.1E-05	8.3E-05	3.0E-04
	0.008	0.0052	0.0026	1.8E-04	75	0.0049	0.0082	1.3E-03	0.0019	0.016	0.0019	0.0031	8.0E-04	0.0011	0.0070	5.3E-04	6.1E-04	3.6E-04	9.4E-04	0.0024
Total PCBs	0.03	0.02	0.01	0.001	50	0.019	0.0317	5.1E-03	0.010	0.066	0.0075	0.012	3.1E-03	0.0062	0.029	0.0020	2.4E-03	1.4E-03	0.0051	0.011
	0.12	0.077	0.039	0.0054	25	0.072	0.12	0.020	0.054	0.27	0.029	0.047	0.0119	0.034	0.12	0.0079	0.0091	0.0053	0.028	0.050
	0.8	0.54	0.27	0.061	5	0.50	0.85	0.14	0.61	2.10	0.20	0.33	0.083	0.38	0.99	0.055	0.063	0.037	0.31	0.47
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	4.7E-07	5.4E-06	5.7E-07	3.0E-06	9.4E-06	1.9E-07	2.1E-06	3.4E-07	1.9E-06	4.4E-06	5.1E-08	4.0E-07	1.5E-07	1.5E-06	2.1E-06
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	3.2E-06	2.3E-05	3.9E-06	2.1E-05	5.1E-05	1.3E-06	8.8E-06	2.4E-06	1.3E-05	2.5E-05	3.5E-07	1.7E-06	1.1E-06	1.1E-05	1.4E-05
Total PBDEs	2.0E-05	4.0E-05	3.0E-05	8.0E-06	50	1.2E-05	6.3E-05	1.5E-05	8.0E-05	1.7E-04	5.0E-06	2.4E-05	9.2E-06	5.0E-05	8.8E-05	1.4E-06	4.7E-06	4.1E-06	4.1E-05	5.1E-05
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	4.8E-05	1.7E-04	5.9E-05	3.1E-04	5.9E-04	1.9E-05	6.7E-05	3.6E-05	1.9E-04	3.1E-04	5.2E-06	1.3E-05	1.6E-05	1.6E-04	1.9E-04
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	3.4E-04	7.5E-04	4.1E-04	2.2E-03	3.6E-03	1.3E-04	2.9E-04	2.5E-04	1.3E-03	2.0E-03	3.7E-05	5.6E-05	1.1E-04	1.1E-03	1.3E-03
	0.085	0.013	0.013	2.2E-04	95	0.053	0.0202	0.0064	0.0022	0.082	0.021	0.0077	0.0039	0.0014	0.034	0.0058	0.0015	0.0018	0.0011	0.010
PAHs	0.36	0.054	0.054	0.0016	75	0.23	0.086	0.028	0.016	0.36	0.091	0.033	0.017	0.010	0.15	0.0247	0.0064	0.0075	0.0079	0.047
(carcinogenic	1	0.15	0.15	0.006	50	0.62	0.24	0.076	0.060	1.00	0.25	0.091	0.046	0.037	0.42	0.068	0.018	0.021	0.031	0.14
PAHs)	2.8	0.41	0.41	0.023	25	1.7	0.66	0.21	0.23	2.8	0.69	0.25	0.13	0.14	1.2	0.19	0.049	0.057	0.12	0.41
	12	1.8	1.8	0.16	5	7.4	2.8	0.89	1.6	13	2.9	1.1	0.54	1.00	5.6	0.80	0.21	0.24	0.82	2.1

Table 5 - Surface Runoff Loadings

Chemical of Concern	Runoff Concentration (ug/L)				Proba-bility of Exceed-ance	Average Annual Mass Loading (metric tons / year)														
						Main Basin					South Sound					Hood Canal				
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
	0.068	0.0085	0.0085	1.9E-04	95	0.042	0.013	0.0043	0.0019	0.062	0.017	0.0051	0.0026	0.0012	0.026	0.0046	0.0010	0.0012	9.5E-04	0.0077
PAHs	0.29	0.036	0.036	0.0013	75	0.18	0.058	0.018	0.013	0.27	0.072	0.022	0.011	0.008	0.11	0.020	0.0043	0.0050	0.0066	0.036
(Other High	0.8	0.1	0.1	0.005	50	0.50	0.16	0.051	0.050	0.76	0.20	0.061	0.031	0.031	0.32	0.054	0.012	0.014	0.025	0.11
Molecular	2.2	0.28	0.28	0.019	25	1.4	0.44	0.14	0.19	2.1	0.55	0.17	0.085	0.12	0.92	0.15	0.032	0.038	0.10	0.32
Weight PAHs)	9.4	1.2	1.2	0.13	5	5.9	1.9	0.60	1.3	9.7	2.4	0.72	0.363	0.83	4.3	0.64	0.14	0.16	0.68	1.6
	0.25	0.025	0.025	5.6E-04	95	0.16	0.040	0.013	0.0056	0.22	0.063	0.015	0.0078	0.0035	0.090	0.017	0.0030	0.0035	0.0028	0.027
PAHs	1.1	0.11	0.11	0.0039	75	0.68	0.17	0.055	0.039	0.95	0.27	0.066	0.034	0.024	0.40	0.074	0.013	0.0150	0.020	0.12
(Low Molecular	3	0.3	0.3	0.015	50	1.9	0.48	0.15	0.15	2.7	0.75	0.18	0.092	0.093	1.1	0.20	0.035	0.041	0.076	0.36
Weight PAHs)	8.3	0.83	0.83	0.058	25	5.2	1.3	0.42	0.58	7.5	2.1	0.50	0.25	0.36	3.2	0.56	0.10	0.11	0.29	1.1
	35	3.5	3.5	0.40	5	22	5.6	1.8	4.0	34	8.8	2.1	1.1	2.5	15	2.4	0.42	0.49	2.1	5.4
	0.37	0.37	0.37	0.0016	95	0.23	0.59	0.19	0.016	1.03	0.093	0.23	0.11	0.010	0.44	0.025	0.044	0.051	0.0083	0.13
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	1.6	4.1	1.3	0.19	7.2	0.65	1.6	0.80	0.11	3.1	0.18	0.31	0.36	0.094	0.93
hexyl)-	10	10	10	0.1	50	6.2	16	5.1	1.0	28	2.5	6.1	3.1	0.62	12	0.68	1.2	1.4	0.51	3.7
phthalate	39	39	39	0.54	25	24	61	20	5.4	110	9.6	23	12	3.4	48	2.6	4.6	5.3	2.8	15
	260	260	268	6.1	5	162	410	136	61	769	65	158	83	38	343	18	31	37	31	116
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	2.3E-07	3.0E-07	9.4E-08	1.6E-08	6.4E-07	9.3E-08	1.1E-07	5.7E-08	1.0E-08	2.7E-07	2.5E-08	2.2E-08	2.6E-08	8.3E-09	8.1E-08
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	1.6E-06	2.1E-06	6.6E-07	1.9E-07	4.5E-06	6.5E-07	7.9E-07	4.0E-07	1.1E-07	1.9E-06	1.8E-07	1.5E-07	1.8E-07	9.4E-08	6.0E-07
Total Dioxin	1.0E-05	5.0E-06	5.0E-06	1.0E-07	50	6.2E-06	7.9E-06	2.5E-06	1.0E-06	1.8E-05	2.5E-06	3.0E-06	1.5E-06	6.2E-07	7.7E-06	6.8E-07	5.9E-07	6.9E-07	5.1E-07	2.5E-06
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	2.4E-05	3.1E-05	9.8E-06	5.4E-06	7.0E-05	9.6E-06	1.2E-05	5.9E-06	3.4E-06	3.1E-05	2.6E-06	2.3E-06	2.7E-06	2.8E-06	1.0E-05
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	1.7E-04	2.1E-04	6.8E-05	6.1E-05	5.1E-04	6.7E-05	8.1E-05	4.1E-05	3.8E-05	2.3E-04	1.8E-05	1.6E-05	1.8E-05	3.1E-05	8.4E-05
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	4.7E-06	5.9E-05	1.1E-04	1.1E-03	1.3E-03	1.9E-06	2.3E-05	6.9E-05	6.9E-04	7.9E-04	5.1E-07	4.4E-06	3.1E-05	5.7E-04	6.1E-04
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	3.2E-05	4.1E-04	7.9E-04	0.0078	0.0090	1.3E-05	1.6E-04	4.8E-04	0.0048	0.0055	3.5E-06	3.1E-05	2.1E-04	0.0040	0.0042
Total DDT	2.0E-04	0.001	0.006	0.003	50	1.2E-04	1.6E-03	0.0030	0.030	0.035	5.0E-05	6.1E-04	0.0018	0.019	0.021	1.4E-05	1.2E-04	0.0008	0.015	0.0162
	7.7E-04	0.0039	0.023	0.012	25	4.8E-04	0.0061	0.0117	0.12	0.135	1.9E-04	0.0023	0.0071	0.072	0.082	5.2E-05	4.6E-04	0.0032	0.059	0.063
	0.0054	0.027	0.16	0.081	5	3.4E-03	0.043	0.081	0.81	0.94	1.3E-03	0.016	0.050	0.50	0.57	3.7E-04	0.0032	0.022	0.41	0.44
	4.9E-04	0.0011	0.0022	1.5E-04	95	3.1E-04	1.8E-03	1.1E-03	1.5E-03	4.7E-03	1.2E-04	6.8E-04	6.9E-04	9.3E-04	2.4E-03	3.3E-05	1.3E-04	3.1E-04	7.6E-04	1.2E-03
	0.0055	0.0078	0.016	0.0010	75	3.5E-03	0.012	0.0079	0.010	0.034	1.4E-03	0.0047	0.0048	0.0064	0.017	3.8E-04	9.2E-04	0.0021	0.0053	0.0087
Triclopyr	0.03	0.03	0.06	0.004	50	0.019	0.048	0.030	0.040	0.14	0.0075	0.018	0.018	0.025	0.07	2.0E-03	0.0035	0.0083	0.020	0.034
	0.16	0.12	0.23	0.015	25	0.10	0.18	0.117	0.16	0.56	0.040	0.070	0.071	0.10	0.28	0.0110	0.014	0.032	0.079	0.14
	1.8	0.81	1.6	0.11	5	1.1	1.3	0.81	1.1	4.3	0.46	0.49	0.50	0.67	2.1	0.12	0.10	0.22	0.55	0.99
	0.15	0.011	0.011	4.9E-04	95	9.3E-02	1.8E-02	5.7E-03	4.9E-03	0.12	3.7E-02	6.8E-03	3.4E-03	3.0E-03	0.050	1.0E-02	1.3E-03	1.5E-03	2.5E-03	0.015
	1.0	0.078	0.078	0.0055	75	0.65	0.12	0.039	0.056	0.87	0.26	0.047	0.024	0.034	0.36	0.071	0.0092	0.011	0.028	0.12
Nonylphenol	4	0.3	0.3	0.03	50	2.5	0.48	0.15	0.30	3.4	1.00	0.18	0.092	0.19	1.5	0.27	0.035	0.041	0.15	0.50
	15	1.2	1.2	0.16	25	9.6	1.8	0.59	1.6	14	3.85	0.70	0.36	1.01	5.9	1.0	0.14	0.16	0.83	2.2
	107	8.1	8.1	1.8	5	67	13	4.1	18	102	26.8	4.9	2.5	11	46	7.3	0.95	1.1	9.3	19
	1,365	417	85	3.7	95	850	660	42	37	1,589	340	250	26	23	639	93	49	11	19	172
Oil or	3,268	1,335	363	26	75	2,040	2,110	183	260	4,593	810	800	111	161	1,882	220	157	50	130	557
Petroleum	6,000	3,000	1,000	100	50	3,700	4,700	505	1,000	9,905	1,490	1,820	307	620	4,237	400	350	137	500	1,387
Product	11,000	6,700	2,700	386	25	6,800	10,600	1,360	3,800	22,560	2,700	4,000	830	2,300	9,830	740	790	370	1,960	3,860
	26,300	21,500	11,700	2,600	5	16,400	34,000	5,910	26,000	82,310	6,500	13,000	3,600	16,100	39,200	1,780	2,530	1,610	13,200	19,120

Table 5 - Surface Runoff Loadings

Chemical of Concern	Average Annual Mass Loading (metric tons / year)																			
	Whidbey Basin					Bellingham					Olympic Peninsula					Totals by Land Use				
	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
	0.145	0.12	0.43	3.4	4.1	0.063	0.061	0.33	0.75	1.2	0.024	0.020	0.059	0.83	0.94	1.2	1.3	1.2	9.1	13
	0.31	0.28	0.94	9.0	11	0.14	0.14	0.71	2.0	3.0	0.053	0.047	0.129	2.2	2.4	2.7	3.1	2.6	24	32
Arsenic	0.54	0.50	1.6	18	20	0.23	0.25	1.2	3.9	5.6	0.091	0.083	0.22	4.3	4.7	4.6	5.5	4.5	47	62
	0.93	0.89	2.8	35	39	0.40	0.44	2.1	7.6	11	0.16	0.15	0.38	8.5	9.1	8.0	9.7	7.7	93	118
	2.01	2.0	6.0	92	102	0.88	1.0	4.6	20	26	0.34	0.33	0.82	22	24	17	22	17	240	296
	0.033	0.017	0.088	0.0032	0.14	0.014	0.0086	0.067	7.0E-04	0.091	0.0056	0.0029	0.012	7.8E-04	0.021	0.28	0.19	0.24	0.0085	0.73
	0.096	0.056	0.26	0.040	0.45	0.042	0.028	0.19	0.0087	0.27	0.0163	0.0092	0.035	0.010	0.070	0.83	0.61	0.71	0.11	2.3
Cadmium	0.20	0.13	0.54	0.23	1.1	0.088	0.062	0.41	0.050	0.61	0.034	0.021	0.074	0.056	0.18	1.7	1.4	1.5	0.61	5.2
	0.43	0.28	1.1	1.3	3.2	0.19	0.14	0.86	0.29	1.5	0.072	0.046	0.15	0.32	0.60	3.7	3.1	3.1	3.6	13
	1.2	0.91	3.3	17	22	0.54	0.45	2.5	3.6	7.1	0.21	0.15	0.45	4.0	4.8	11	9.8	9.1	40	70
	0.77	0.19	0.75	2.5	4.2	0.33	0.10	0.57	0.54	1.5	0.130	0.032	0.10	0.60	0.86	6.6	2.1	2.1	6.6	17
	1.8	0.51	2.4	7.9	13	0.80	0.25	1.8	1.7	4.6	0.31	0.084	0.33	1.9	2.6	16	5.6	6.7	21	49
Copper	3.4	1.0	5.4	18	28	1.5	0.50	4.1	3.9	10	0.57	0.17	0.74	4.3	5.8	29	11	15	47	102
	6.2	2.0	12	30	50	2.7	1.0	9.2	8.7	22	1.0	0.32	1.7	10	13	53	21	34	90	198
	15	5.2	39	127	186	6.5	2.6	29	28	66	2.5	0.86	5.3	31	40	127	56	108	330	621
	0.41	0.21	0.81	0.39	1.8	0.18	0.11	0.62	0.085	0.98	0.069	0.035	0.11	0.095	0.31	3.5	2.3	2.3	1.0	9.1
	1.2	0.91	2.5	2.5	7.1	0.54	0.45	1.9	0.54	3.4	0.21	0.15	0.34	0.60	1.3	11	9.9	6.9	6.6	34
Lead	2.7	2.5	5.4	8.9	19	1.2	1.2	4.1	1.9	8.4	0.46	0.41	0.735	2.2	3.8	23	27	15	24	89
	5.9	6.9	12	32	56	2.6	3.4	8.9	7.0	22	0.99	1.1	1.6	7.8	11	50	75	33	80	238
	18	28	36	200	281	7.6	14	27	44	92	3.0	4.5	4.9	49	61	151	296	99	530	1,075
	3.7	1.5	1.5	4.9	12	1.6	0.72	1.1	1.1	4.5	0.62	0.24	0.20	1.2	2.3	32	16	4	13	65
	8.8	3.8	4.8	16	33	3.8	1.9	3.6	3.4	13	1.5	0.6	0.65	3.8	6.6	76	42	13	42	173
Zinc	16	7.5	11	36	70	7.0	3.7	8.2	7.7	27	2.7	1.2	1.5	8.6	14	139	81	30	94	344
	30	13	24	70	136	13	6.2	18	17	55	5.0	2.1	3.3	19	30	250	130	67	190	637
	70	38	76	240	424	31	19	58	54	161	12	6.2	10	60	88	590	400	212	650	1,852
	0.0023	2.1E-04	2.8E-04	0.0075	0.010	1.0E-03	1.1E-04	2.1E-04	0.0016	0.0030	3.9E-04	3.5E-05	3.8E-05	0.0018	0.0023	0.020	0.0023	7.8E-04	0.020	0.043
	0.0098	9.1E-04	2.0E-03	0.032	0.045	0.0043	4.5E-04	1.5E-03	0.0070	0.013	1.7E-03	1.5E-04	2.7E-04	0.0078	0.0099	0.084	0.010	0.0054	0.086	0.19
Mercury	0.027	0.0025	0.0075	0.09	0.13	0.012	0.0012	0.0057	0.019	0.038	0.0046	4.1E-04	0.0010	0.022	0.028	0.23	0.027	0.021	0.24	0.52
	0.074	0.0069	0.029	0.24	0.35	0.032	0.0034	0.022	0.053	0.11	0.013	0.0011	0.0040	0.059	0.077	0.64	0.075	0.081	0.7	1.4
	0.32	0.030	0.20	1.0	1.6	0.139	0.015	0.15	0.23	0.53	0.054	0.0049	0.028	0.25	0.34	2.7	0.32	0.56	2.8	6.4
	1.5E-04	1.9E-04	4.0E-04	2.9E-04	1.0E-03	6.6E-05	9.3E-05	3.0E-04	6.3E-05	5.3E-04	2.5E-05	3.1E-05	5.5E-05	7.0E-05	1.8E-04	0.0013	2.0E-03	1.1E-03	7.7E-04	0.0052
	0.0011	1.3E-03	2.8E-03	0.0033	0.0084	4.6E-04	6.4E-04	2.1E-03	0.0007	0.0039	1.8E-04	2.1E-04	3.8E-04	8.0E-04	0.0016	0.0090	0.014	7.8E-03	0.0087	0.040
Total PCBs	0.0041	0.0050	1.1E-02	0.018	0.038	0.0018	0.0025	8.2E-03	0.0039	0.016	6.8E-04	8.3E-04	1.5E-03	0.0043	0.0073	0.035	0.055	0.030	0.047	0.17
	0.016	0.019	0.041	0.096	0.17	0.0068	0.0096	0.032	0.021	0.069	0.0026	0.0032	0.0057	0.023	0.035	0.13	0.21	0.12	0.26	0.72
	0.11	0.14	0.29	1.1	1.6	0.047	0.067	0.22	0.24	0.57	0.018	0.022	0.039	0.26	0.34	0.93	1.5	0.80	2.9	6.1
	1.0E-07	8.5E-07	1.2E-06	5.3E-06	7.4E-06	4.4E-08	4.2E-07	9.1E-07	1.2E-06	2.5E-06	1.7E-08	1.4E-07	1.6E-07	1.3E-06	1.6E-06	8.6E-07	9.3E-06	3.3E-06	1.4E-05	2.8E-05
	7.0E-07	3.7E-06	8.4E-06	3.7E-05	5.0E-05	3.0E-07	1.8E-06	6.4E-06	8.0E-06	1.6E-05	1.2E-07	6.0E-07	1.1E-06	8.9E-06	1.1E-05	6.0E-06	4.0E-05	2.3E-05	9.8E-05	1.7E-04
Total PBDEs	2.7E-06	1.0E-05	3.2E-05	1.4E-04	1.9E-04	1.2E-06	5.0E-06	2.5E-05	3.1E-05	6.2E-05	4.6E-07	1.7E-06	4.4E-06	3.4E-05	4.1E-05	2.3E-05	1.1E-04	9.0E-05	3.8E-04	6.0E-04
	1.0E-05	2.8E-05	1.2E-04	5.5E-04	7.1E-04	4.5E-06	1.4E-05	9.5E-05	1.2E-04	2.3E-04	1.8E-06	4.5E-06	1.7E-05	1.3E-04	1.6E-04	8.9E-05	3.0E-04	3.5E-04	1.5E-03	2.2E-03
	7.2E-05	1.2E-04	8.7E-04	3.8E-03	4.9E-03	3.2E-05	5.9E-05	6.6E-04	8.3E-04	1.6E-03	1.2E-05	1.9E-05	1.2E-04	9.2E-04	1.1E-03	6.2E-04	1.3E-03	2.4E-03	1.0E-02	1.4E-02
	0.011	0.0032	0.0137	0.0040	0.032	0.0050	0.0016	0.010	8.6E-04	0.018	0.0019	5.3E-04	0.0019	0.0010	0.0053	0.098	0.035	0.038	0.011	0.18
PAHs	0.049	0.014	0.059	0.028	0.15	0.021	0.0068	0.045	0.0060	0.079	0.0083	0.0023	0.0080	0.007	0.025	0.42	0.15	0.16	0.074	0.81
(carcinogenic	0.14	0.038	0.16	0.11	0.44	0.059	0.019	0.12	0.023	0.22	0.023	0.0062	0.022	0.026	0.077	1.2	0.41	0.45	0.28	2.3
PAHs)	0.37	0.104	0.44	0.41	1.33	0.16	0.051	0.34	0.089	0.64	0.063	0.017	0.061	0.100	0.24	3.2	1.1	1.2	1.1	6.6
	1.6	0.44	1.9	2.9	6.8	0.69	0.22	1.4	0.62	3.0	0.27	0.073	0.26	0.69	1.30	14	4.8	5.3	7.6	31

Table 5 - Surface Runoff Loadings

Chemical of Concern	Average Annual Mass Loading (metric tons / year)																			
	Whidbey Basin					Bellingham					Olympic Peninsula					Totals by Land Use				
	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
PAHs (Other High Molecular Weight PAHs)	0.0092	0.0021	0.0091	0.0033	0.024	0.0040	0.0011	0.0069	7.2E-04	0.013	0.0015	3.5E-04	1.2E-03	8.0E-04	0.0039	0.079	0.023	0.025	0.0088	0.14
	0.039	0.0091	0.039	0.023	0.11	0.0171	0.0045	0.0297	0.0050	0.056	0.0066	0.0015	5.3E-03	0.0056	0.019	0.34	0.099	0.109	0.061	0.61
	0.11	0.025	0.11	0.089	0.33	0.047	0.012	0.082	0.019	0.16	0.018	0.0041	0.015	0.022	0.059	0.93	0.27	0.30	0.24	1.7
	0.30	0.069	0.30	0.34	1.01	0.13	0.034	0.23	0.075	0.46	0.050	0.011	0.040	0.083	0.19	2.6	0.75	0.82	0.91	5.0
	1.3	0.30	1.3	2.4	5.2	0.55	0.15	0.96	0.52	2.2	0.22	0.049	0.17	0.58	1.02	11	3.2	3.5	6.3	24
PAHs (Low Molecular Weight PAHs)	0.034	0.0064	0.027	0.010	0.078	0.015	0.0032	0.021	0.0022	0.041	0.0058	0.0011	0.0037	0.0024	0.013	0.29	0.069	0.076	0.026	0.47
	0.15	0.027	0.12	0.069	0.36	0.064	0.014	0.089	0.015	0.18	0.025	0.0045	0.016	0.017	0.062	1.3	0.30	0.33	0.18	2.1
	0.41	0.075	0.32	0.27	1.1	0.18	0.037	0.25	0.058	0.52	0.068	0.012	0.044	0.065	0.19	3.5	0.82	0.90	0.71	5.9
	1.1	0.21	0.89	1.0	3.2	0.49	0.10	0.68	0.22	1.5	0.19	0.034	0.12	0.25	0.59	9.6	2.3	2.5	2.7	17
	4.8	0.89	3.8	7.1	17	2.1	0.44	2.9	1.6	7.0	0.81	0.15	0.52	1.7	3.2	41	9.7	11	19	80
Bis(2-ethyl-hexyl)-phthalate	0.050	0.094	0.40	0.029	0.57	0.022	0.046	0.30	0.0063	0.38	0.0085	0.015	0.055	0.0070	0.086	0.43	1.0	1.1	0.077	2.6
	0.35	0.65	2.8	0.33	4.1	0.152	0.32	2.1	0.072	2.7	0.059	0.11	0.38	0.080	0.63	3.0	7.1	7.8	0.87	19
	1.4	2.5	11	1.8	16	0.59	1.2	8.2	0.39	10.4	0.23	0.41	1.5	0.43	2.5	12	27	30	4.7	74
	5.2	9.7	41	9.0	65	2.3	4.8	32	2.1	41	0.88	1.6	5.7	2.3	10.5	45	105	115	24	289
	35	65	289	100	489	15	32	219	24	291	5.9	11	39	26	82	300	700	800	270	2,070
Total Dioxin TEQs	5.0E-08	4.7E-08	2.0E-07	2.9E-08	3.3E-07	2.2E-08	2.3E-08	1.5E-07	6.3E-09	2.0E-07	8.5E-09	7.7E-09	2.7E-08	7.0E-09	5.1E-08	4.3E-07	5.1E-07	5.6E-07	7.7E-08	1.6E-06
	3.5E-07	3.3E-07	1.4E-06	3.3E-07	2.4E-06	1.5E-07	1.6E-07	1.1E-06	7.2E-08	1.4E-06	5.9E-08	5.4E-08	1.9E-07	8.0E-08	3.8E-07	3.0E-06	3.5E-06	3.9E-06	8.7E-07	1.1E-05
	1.4E-06	1.3E-06	5.4E-06	1.8E-06	9.8E-06	5.9E-07	6.2E-07	4.1E-06	3.9E-07	5.7E-06	2.3E-07	2.1E-07	7.4E-07	4.3E-07	1.6E-06	1.2E-05	1.4E-05	1.5E-05	4.7E-06	4.5E-05
	5.2E-06	4.9E-06	2.1E-05	9.6E-06	4.0E-05	2.3E-06	2.4E-06	1.6E-05	2.1E-06	2.3E-05	8.8E-07	8.0E-07	2.8E-06	2.3E-06	6.8E-06	4.5E-05	5.3E-05	5.8E-05	2.6E-05	1.8E-04
	3.6E-05	3.4E-05	1.4E-04	1.1E-04	3.2E-04	1.6E-05	1.7E-05	1.1E-04	2.4E-05	1.7E-04	6.1E-06	5.5E-06	2.0E-05	2.6E-05	5.8E-05	3.1E-04	3.7E-04	4.0E-04	2.9E-04	1.4E-03
Total DDT	1.0E-06	9.4E-06	2.4E-04	0.0020	0.0022	4.4E-07	4.6E-06	1.8E-04	4.3E-04	6.2E-04	1.7E-07	1.5E-06	3.3E-05	4.8E-04	5.2E-04	8.6E-06	1.0E-04	6.7E-04	0.0053	0.0061
	7.0E-06	6.5E-05	1.7E-03	0.014	0.016	3.0E-06	3.2E-05	1.3E-03	0.0030	0.0043	1.2E-06	1.1E-05	2.3E-04	0.0033	0.0036	6.0E-05	7.1E-04	0.0047	0.037	0.042
	2.7E-05	2.5E-04	0.0065	0.053	0.060	1.2E-05	1.2E-04	0.0049	0.012	0.017	4.6E-06	4.1E-05	0.0009	0.013	0.014	2.3E-04	0.0027	0.018	0.14	0.16
	1.0E-04	9.7E-04	0.025	0.21	0.23	4.5E-05	4.8E-04	0.019	0.045	0.064	1.8E-05	1.6E-04	0.0034	0.050	0.053	8.9E-04	0.0105	0.069	0.55	0.63
	7.2E-04	0.0068	0.17	1.4	1.6	3.2E-04	0.0033	0.13	0.31	0.45	1.2E-04	1.1E-03	0.024	0.35	0.37	0.0062	0.073	0.48	3.8	4.4
Triclopyr	6.6E-05	2.8E-04	2.4E-03	2.6E-03	5.4E-03	2.9E-05	1.4E-04	1.8E-03	5.8E-04	2.6E-03	1.1E-05	4.6E-05	3.3E-04	6.4E-04	1.0E-03	5.7E-04	3.0E-03	6.7E-03	7.0E-03	0.017
	7.5E-04	0.0020	0.017	0.018	0.038	3.3E-04	9.7E-04	1.3E-02	4.0E-03	0.018	1.3E-04	3.2E-04	0.0023	4.5E-03	0.0072	0.0064	0.021	0.047	0.049	0.12
	4.1E-03	0.0075	0.065	0.071	0.15	1.8E-03	0.0037	0.049	0.015	0.070	6.8E-04	0.0012	0.0088	0.017	0.028	0.035	0.082	0.18	0.19	0.49
	0.022	0.029	0.25	0.27	0.57	0.0095	0.014	0.189	0.060	0.27	3.7E-03	0.0048	0.034	0.066	0.109	0.19	0.32	0.69	0.73	1.9
	0.25	0.20	1.7	1.9	4.1	0.11	0.10	1.3	0.42	1.9	0.042	0.033	0.24	0.46	0.77	2.1	2.2	4.8	5.1	14
Nonylphenol	2.0E-02	2.8E-03	0.012	8.7E-03	0.044	8.8E-03	1.4E-03	9.1E-03	1.9E-03	0.021	3.4E-03	4.6E-04	1.6E-03	2.1E-03	0.0076	0.17	0.030	0.033	0.023	0.26
	0.14	0.020	0.084	0.10	0.34	0.061	0.0097	0.064	0.021	0.16	0.024	0.0032	0.011	0.024	0.062	1.2	0.21	0.23	0.26	1.9
	0.54	0.075	0.32	0.53	1.47	0.23	0.037	0.25	0.12	0.63	0.091	0.012	0.044	0.13	0.28	4.6	0.82	0.90	1.4	7.8
	2.1	0.29	1.2	2.9	6.5	0.91	0.14	0.95	0.63	2.6	0.35	0.048	0.17	0.70	1.3	18	3.2	3.5	7.7	32
	14	2.0	8.7	33	58	6.31	1.00	6.6	7.1	21	2.4	0.33	1.2	7.9	12	124	22	24	87	257
Oil or Petroleum Product	184	105	91	66	446	80	52	69	14	215	31	17	12	16	76	1,570	1,130	250	170	3,120
	440	330	390	460	1,620	192	166	297	100	755	75	55	53	112	294	3,700	3,600	1,080	1,200	9,580
	810	750	1,075	1,770	4,405	350	370	817	380	1,917	137	124	147	430	838	6,800	8,100	2,980	4,700	22,580
	1,480	1,680	2,900	6,840	12,900	640	830	2,200	1,490	5,160	250	270	390	1,600	2,510	12,600	18,100	8,050	17,000	55,750
	3,550	5,400	12,580	46,100	67,630	1,540	2,670	9,560	10,000	23,770	590	880	1,720	11,100	14,290	30,000	58,000	34,000	122,000	244,000

Notes:
CO/IN - Commercial/Industrial Land Use
RES - Residential Land Use
AGR - Agricultural Land Use
FOR - Forest & Fields Land Use

Table 6 - Surface Runoff Loadings per Unit Drainage Area

Chemical of Concern	Average Annual Median Mass Loading (metric tons / year)																			
	Main Basin					South Sound					Hood Canal					Whidbey Basin				
	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
Arsenic	**2.5**	**3.2**	**0.76**	**10**	**16**	**1.0**	**1.2**	**0.46**	**6.2**	**8.9**	**0.27**	**0.24**	**0.21**	**5.1**	**5.8**	**0.54**	**0.50**	**1.6**	**18**	**20**
% by Study Unit					27					14					9.4					33
Area Loading in mt/yr/ha					2.0E-05					1.2E-05					1.6E-05					2.0E-05
Cadmium	**0.94**	**0.79**	**0.25**	**0.13**	**2.1**	**0.37**	**0.30**	**0.15**	**0.081**	**0.91**	**0.10**	**0.059**	**0.069**	**0.066**	**0.30**	**0.20**	**0.13**	**0.54**	**0.23**	**1.1**
% by Study Unit					41					17					5.7					21
Area Loading in mt/yr/ha					2.6E-06					1.2E-06					8.4E-07					1.1E-06
Copper	**16**	**6.3**	**2.5**	**10**	**35**	**6.2**	**2.4**	**1.5**	**6.2**	**16**	**1.7**	**0.47**	**0.69**	**5.1**	**8.0**	**3.4**	**1.0**	**5.4**	**18**	**28**
% by Study Unit					34					16					7.8					27
Area Loading (mt/yr/ha)					4.2E-05					2.2E-05					2.2E-05					2.7E-05
Lead	**12**	**16**	**2.5**	**5.0**	**36**	**5.0**	**6.1**	**1.5**	**3.1**	**16**	**1.4**	**1.2**	**0.69**	**2.5**	**5.8**	**2.7**	**2.5**	**5.4**	**8.9**	**19**
% by Study Unit					40					18					6.5					22
Area Loading in mt/yr/ha					4.4E-05					2.1E-05					1.6E-05					1.9E-05
Zinc	**75**	**48**	**5.1**	**20**	**148**	**30**	**18**	**3.1**	**12**	**64**	**8.2**	**3.5**	**1.4**	**10**	**23**	**16**	**7.5**	**11**	**36**	**70**
% by Study Unit					43					18					6.8					20
Area Loading in mt/yr/ha					1.8E-04					8.6E-05					6.6E-05					6.9E-05
Mercury	**0.12**	**0.016**	**0.0035**	**0.050**	**0.19**	**0.050**	**0.0061**	**0.0022**	**0.031**	**0.089**	**0.014**	**0.0012**	**0.0010**	**0.025**	**0.041**	**0.027**	**0.0025**	**0.0075**	**0.089**	**0.13**
% by Study Unit					38					17					8.0					24
Area Loading in mt/yr/ha					2.4E-07					1.2E-07					1.2E-07					1.2E-07
Total PCBs	**0.019**	**0.032**	**0.0051**	**0.010**	**0.066**	**0.0075**	**0.012**	**0.0031**	**0.0062**	**0.029**	**0.0020**	**0.0024**	**0.0014**	**0.0051**	**0.011**	**0.0041**	**0.0050**	**0.011**	**0.018**	**0.038**
% by Study Unit					39					17					6.5					23
Area Loading in mt/yr/ha					8.0E-08					3.9E-08					3.1E-08					3.7E-08
Total PBDEs	**1.2E-05**	**6.3E-05**	**1.5E-05**	**8.0E-05**	**1.7E-04**	**5.0E-06**	**2.4E-05**	**9.2E-06**	**5.0E-05**	**8.8E-05**	**1.4E-06**	**4.7E-06**	**4.1E-06**	**4.1E-05**	**5.1E-05**	**2.7E-06**	**1.0E-05**	**3.2E-05**	**1.4E-04**	**1.9E-04**
% by Study Unit					29					15					8.5					31
Area Loading in mt/yr/ha					2.1E-10					1.2E-10					1.4E-10					1.8E-10
cPAHs	**0.62**	**0.24**	**0.076**	**0.060**	**1.0**	**0.25**	**0.091**	**0.046**	**0.037**	**0.42**	**0.068**	**0.018**	**0.021**	**0.031**	**0.14**	**0.14**	**0.038**	**0.161**	**0.11**	**0.44**
% by Study Unit					43					18					6.0					19
Area Loading in mt/yr/ha					1.2E-06					5.7E-07					3.9E-07					4.3E-07
HPAHs	**0.50**	**0.16**	**0.051**	**0.050**	**0.76**	**0.20**	**0.061**	**0.031**	**0.031**	**0.32**	**0.054**	**0.012**	**0.014**	**0.025**	**0.11**	**0.11**	**0.025**	**0.11**	**0.089**	**0.33**
% by Study Unit					44					19					6.1					19
Area Loading in mt/yr/ha					9.2E-07					4.4E-07					3.0E-07					3.2E-07
LPAHs	**1.9**	**0.48**	**0.15**	**0.15**	**2.7**	**0.75**	**0.18**	**0.092**	**0.093**	**1.1**	**0.20**	**0.035**	**0.041**	**0.076**	**0.36**	**0.41**	**0.075**	**0.32**	**0.27**	**1.1**
% by Study Unit					45					19					6.1					18
Area Loading in mt/yr/ha					3.2E-06					1.5E-06					1.0E-06					1.1E-06
BEHP	**6.2**	**16**	**5.1**	**1.0**	**28**	**2.5**	**6.1**	**3.1**	**0.62**	**12**	**0.68**	**1.2**	**1.4**	**0.51**	**3.7**	**1.4**	**2.5**	**11**	**1.8**	**16**
% by Study Unit					38					17					5.1					22
Area Loading in mt/yr/ha					3.4E-05					1.7E-05					1.1E-05					1.6E-05
Total Dioxin TEQs	**6.2E-06**	**7.9E-06**	**2.5E-06**	**1.0E-06**	**1.8E-05**	**2.5E-06**	**3.0E-06**	**1.5E-06**	**6.2E-07**	**7.7E-06**	**6.8E-07**	**5.9E-07**	**6.9E-07**	**5.1E-07**	**2.5E-06**	**1.4E-06**	**1.3E-06**	**5.4E-06**	**1.8E-06**	**9.8E-06**
% by Study Unit					39					17					5.5					22
Area Loading in mt/yr/ha					2.2E-11					1.0E-11					7.0E-12					9.6E-12
Total DDT	**1.2E-04**	**0.0016**	**0.0030**	**0.030**	**0.035**	**5.0E-05**	**6.1E-04**	**0.0018**	**0.019**	**0.021**	**1.4E-05**	**1.2E-04**	**8.3E-04**	**0.015**	**0.0162**	**2.7E-05**	**2.5E-04**	**0.0065**	**0.053**	**0.060**
% by Study Unit					21					13					10					37
Area Loading in mt/yr/ha					4.2E-08					2.9E-08					4.6E-08					5.9E-08

Table 6 - Surface Runoff Loadings per Unit Drainage Area

Chemical of Concern	Average Annual Median Mass Loading (metric tons / year)																			
	Main Basin					South Sound					Hood Canal					Whidbey Basin				
	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
Triclopyr	**0.019**	**0.048**	**0.030**	**0.040**	**0.14**	**0.0075**	**0.018**	**0.018**	**0.025**	**0.07**	**0.0020**	**0.0035**	**0.0083**	**0.020**	**0.034**	**0.0041**	**0.0075**	**0.065**	**0.071**	**0.15**
% by Study Unit					28					14					7.1					30
Area Loading in mt/yr/ha					1.7E-07					9.3E-08					9.7E-08					1.4E-07
Nonylphenol	**2.5**	**0.48**	**0.15**	**0.30**	**3.4**	**1.00**	**0.18**	**0.092**	**0.19**	**1.5**	**0.27**	**0.035**	**0.041**	**0.15**	**0.50**	**0.54**	**0.075**	**0.32**	**0.53**	**1.5**
% by Study Unit					44					19					6.5					19
Area Loading in mt/yr/ha					4.2E-06					2.0E-06					1.4E-06					1.4E-06
Oil or Petroleum	**3,700**	**4,700**	**505**	**1,000**	**9,905**	**1,490**	**1,820**	**307**	**620**	**4,237**	**400**	**350**	**137**	**500**	**1,387**	**810**	**750**	**1,075**	**1,770**	**4,405**
% by Study Unit					44					19					6.1					20
Area Loading in mt/yr/ha					1.2E-02					5.7E-03					3.9E-03					4.3E-03

Table 6 - Surface Runoff Loadings per Unit Drainage Area

Chemical of Concern	Average Annual Median Mass Loading (metric tons / year)														
	Bellingham					Olympic Peninsula					Totals by Land Use				
	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	TOTAL
Arsenic	**0.23**	**0.25**	**1.2**	**3.9**	**5.6**	**0.091**	**0.083**	**0.22**	**4.3**	**4.7**	**4.6**	**5.5**	**4.5**	**47**	**62**
% by Study Unit					9.0					7.6	7.5	8.8	7.3	76.4	100
Area Loading in mt/yr/ha					1.9E-05					1.7E-05					1.8E-05
Cadmium	**0.088**	**0.062**	**0.41**	**0.050**	**0.61**	**0.034**	**0.021**	**0.074**	**0.056**	**0.18**	**1.7**	**1.4**	**1.5**	**0.61**	**5.2**
% by Study Unit					12					3.5	33.3	26.2	28.7	11.8	100
Area Loading in mt/yr/ha					2.1E-06					6.7E-07					1.5E-06
Copper	**1.5**	**0.50**	**4.1**	**3.9**	**9.9**	**0.57**	**0.17**	**0.74**	**4.3**	**5.8**	**29**	**11**	**15**	**47**	**102**
% by Study Unit					9.7					5.7	28.4	10.7	14.6	46.3	100
Area Loading (mt/yr/ha)					3.4E-05					2.1E-05					2.9E-05
Lead	**1.2**	**1.2**	**4.1**	**1.9**	**8.4**	**0.46**	**0.41**	**0.74**	**2.2**	**3.8**	**23**	**27**	**15**	**24**	**89**
% by Study Unit					9.5					4.2	26.0	30.6	16.8	26.5	100
Area Loading in mt/yr/ha					2.9E-05					1.4E-05					2.6E-05
Zinc	**7.0**	**3.7**	**8.2**	**7.7**	**27**	**2.7**	**1.2**	**1.5**	**8.6**	**14**	**139**	**81**	**30**	**94**	**344**
% by Study Unit					7.8					4.1	40.4	23.6	8.7	27.3	100
Area Loading in mt/yr/ha					9.3E-05					5.1E-05					9.8E-05
Mercury	**0.012**	**0.0012**	**0.0057**	**0.019**	**0.038**	**0.0046**	**4.1E-04**	**0.0010**	**0.022**	**0.028**	**0.23**	**0.027**	**0.021**	**0.24**	**0.52**
% by Study Unit					7.4					5.3	44.9	5.3	4.1	45.8	100
Area Loading in mt/yr/ha					1.3E-07					1.0E-07					1.5E-07
Total PCBs	**0.0018**	**0.0025**	**0.0082**	**0.0039**	**0.016**	**6.8E-04**	**8.3E-04**	**0.0015**	**0.0043**	**0.0073**	**0.035**	**0.055**	**0.030**	**0.047**	**0.17**
% by Study Unit					9.8					4.4	20.9	32.8	18.0	28.4	100
Area Loading in mt/yr/ha					5.7E-08					2.7E-08					4.8E-08
Total PBDEs	**1.2E-06**	**5.0E-06**	**2.5E-05**	**3.1E-05**	**6.2E-05**	**4.6E-07**	**1.7E-06**	**4.4E-06**	**3.4E-05**	**4.1E-05**	**2.3E-05**	**1.1E-04**	**9.0E-05**	**3.8E-04**	**6.0E-04**
% by Study Unit					10					6.8	3.9	18.2	14.9	63.0	100
Area Loading in mt/yr/ha					2.1E-10					1.5E-10					1.7E-10
cPAHs	**0.059**	**0.019**	**0.12**	**0.023**	**0.22**	**0.023**	**0.0062**	**0.022**	**0.026**	**0.077**	**1.2**	**0.41**	**0.45**	**0.28**	**2.3**
% by Study Unit					9.7					3.3	50.4	17.8	19.5	12.3	100
Area Loading in mt/yr/ha					7.7E-07					2.8E-07					6.6E-07
HPAHs	**0.047**	**0.012**	**0.082**	**0.019**	**0.16**	**0.018**	**0.0041**	**0.015**	**0.022**	**0.059**	**0.93**	**0.27**	**0.30**	**0.24**	**1.7**
% by Study Unit					9.2					3.4	53.4	15.7	17.2	13.6	100
Area Loading in mt/yr/ha					5.6E-07					2.1E-07					5.0E-07
LPAHs	**0.18**	**0.037**	**0.25**	**0.058**	**0.52**	**0.068**	**0.012**	**0.044**	**0.065**	**0.19**	**3.5**	**0.82**	**0.90**	**0.71**	**5.9**
% by Study Unit					8.8					3.2	58.9	13.9	15.2	12.0	100
Area Loading in mt/yr/ha					1.8E-06					6.9E-07					1.7E-06
BEHP	**0.59**	**1.2**	**8.2**	**0.39**	**10**	**0.23**	**0.41**	**1.5**	**0.43**	**2.5**	**12**	**27**	**30**	**4.7**	**74**
% by Study Unit					14					3.5	15.8	37.1	40.7	6.4	100
Area Loading in mt/yr/ha					3.6E-05					9.3E-06					2.1E-05
Total Dioxin TEQs	**5.9E-07**	**6.2E-07**	**4.1E-06**	**3.9E-07**	**5.7E-06**	**2.3E-07**	**2.1E-07**	**7.4E-07**	**4.3E-07**	**1.6E-06**	**1.2E-05**	**1.4E-05**	**1.5E-05**	**4.7E-06**	**4.5E-05**
% by Study Unit					13					3.6	25.8	30.4	33.3	10.5	100
Area Loading in mt/yr/ha					2.0E-11					5.9E-12					1.3E-11
Total DDT	**1.2E-05**	**1.2E-04**	**0.0049**	**0.012**	**0.017**	**4.6E-06**	**4.1E-05**	**8.8E-04**	**0.013**	**0.014**	**2.3E-04**	**0.0027**	**0.018**	**0.14**	**0.16**
% by Study Unit					10					8.5	0.1	1.7	11.0	87.2	100
Area Loading in mt/yr/ha					5.8E-08					5.1E-08					4.7E-08

Table 6 - Surface Runoff Loadings per Unit Drainage Area

Chemical of Concern	Average Annual Median Mass Loading (metric tons / year)														
	Bellingham					Olympic Peninsula					Totals by Land Use				
	CO/IN	**RES**	**AGR**	**FOR**	**TOTAL**	**CO/IN**	**RES**	**AGR**	**FOR**	**TOTAL**	**CO/IN**	**RES**	**AGR**	**FOR**	**TOTAL**
Triclopyr	**0.0018**	**0.0037**	**0.049**	**0.015**	**0.070**	**6.8E-04**	**0.0012**	**0.0088**	**0.017**	**0.028**	**0.035**	**0.082**	**0.18**	**0.19**	**0.49**
% by Study Unit					14					5.8	7.2	16.9	37.0	39.0	100
Area Loading in mt/yr/ha					2.4E-07					1.0E-07					1.4E-07
Nonylphenol	**0.23**	**0.037**	**0.25**	**0.12**	**0.63**	**0.091**	**0.012**	**0.044**	**0.13**	**0.28**	**4.6**	**0.82**	**0.90**	**1.4**	**7.8**
% by Study Unit					8.2					3.6	59.7	10.5	11.6	18.3	100
Area Loading in mt/yr/ha					2.2E-06					1.0E-06					2.2E-06
Oil or Petroleum	**350**	**370**	**817**	**380**	**1,917**	**137**	**124**	**147**	**430**	**838**	**6,800**	**8,100**	**2,980**	**4,700**	**22,580**
% by Study Unit					8.5					3.7	30.1	35.9	13.2	20.8	100
Area Loading in mt/yr/ha					6.7E-03					3.1E-03					6.5E-03

Table 7 - Study Unit Relative Monthly Surface Runoff Rates

Study Unit	Total Monthly Runoff as a Fraction of Annual Runoff Volume					
	January	February	March	April	May	June
Main Basin	0.1530	0.0910	0.0705	0.0666	0.0988	0.1224
South Sound	0.1631	0.1166	0.1042	0.0804	0.0727	0.0702
Hood Canal	0.1662	0.0959	0.0965	0.0717	0.0792	0.0733
Whidbey Basin	0.1144	0.0855	0.0819	0.0818	0.0945	0.1003
Bellingham	0.1072	0.0918	0.0801	0.0808	0.0976	0.1039
Olympic Peninsula	0.1172	0.0996	0.0791	0.0714	0.0968	0.1104

Study Unit	Total Monthly Runoff as a Fraction of Annual Runoff Volume						
	July	August	September	October	November	December	Average Annual
Main Basin	0.0759	0.0264	0.0245	0.0402	0.1174	0.1132	1.0000
South Sound	0.0488	0.0350	0.0317	0.0490	0.0958	0.1326	1.0000
Hood Canal	0.0440	0.0247	0.0206	0.0578	0.1219	0.1482	1.0000
Whidbey Basin	0.0784	0.0489	0.0429	0.0646	0.1007	0.1063	1.0000
Bellingham	0.0745	0.0450	0.0398	0.0598	0.1080	0.1115	1.0000
Olympic Peninsula	0.0754	0.0412	0.0305	0.0539	0.1019	0.1228	1.0000

Table 8 - Selection of Atmospheric Deposition Rates

Chemical of Concern	Measured Atmospheric Deposition Rate ($ug/m^2/day$)							Flux for Loading Calculations ($ug/m^2/day$)			
	Location	Reference	Land Use	Flux Type	Range		Average	Probability of Exceedance			Comments (footnotes)
					Min	Max		High	Medium	Low	
Arsenic (Total)	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			1.8	**0.1**	**1**	**5**	1, 2
			Industrial				9.8 to 18				
			All Sites				7.4				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			2.1				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	Great Lakes, U.S.	IADN (2000)		wet+dry	0.1	0.3					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry			0.4				
Cadmium (Total)	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			1.4	**0.1**	**0.5**	**2**	3
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	Great Lakes, U.S.	IADN (2000)		wet+dry	0.1	0.3					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry			0.2				
	San Francisco Bay, CA	Davis et al. (2000)		wet			0.0071				
				dry			0.077				
Copper (Total)	Sinclair/Dyes Inlets, WA	Crecelius et al. (2003)	Varied	wet+dry	3	150	20	**1**	**10**	**50**	1, 2
	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			20 to 44				
			Industrial				68 to 149				
			All Sites				80				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			6.6				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	San Francisco Bay, CA	Davis et al. (2000)		wet			0.3				
				dry			2.1				
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry			2				

Table 8 - Selection of Atmospheric Deposition Rates

Chemical of Concern	Measured Atmospheric Deposition Rate ($ug/m^2/day$)							Flux for Loading Calculations ($ug/m^2/day$)			
	Location	Reference	Land Use	Flux Type	Range Min	Range Max	Average	Probability of Exceedance High	Probability of Exceedance Medium	Probability of Exceedance Low	Comments (footnotes)
Lead (Total)	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			22 to 38	**1**	**10**	**50**	1, 2
			Industrial				55 to 653				
			All Sites				180				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			0.58				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	Great Lakes, U.S.	IADN (2000)		wet+dry	1	4					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry			3				
	Wisconsin Lake, U.S.	Doskey and Talbot (2000)		wet+dry			27				
Zinc (Total)	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			36 to 116	**2**	**20**	**100**	1, 2
			Industrial				230 to 872				
			All Sites				300				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			68				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry			10				
Mercury (Total)	Seattle/King County, WA	National Atmospheric Deposition Program	Urban	wet+dry			0.017	**0.002**	**0.01**	**0.05**	4, 5
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry+net gas			0.02				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			0.01				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
	San Francisco Bay, CA	Davis et al. (2000)		wet	0.0031	0.0089	0.0067				
Total PCBs	Lower Duwamish River, WA	King County Passive Deposition Sampling	Urban	wet+dry			0.01 (ND=0)	**0.0005**	**0.002**	**0.02**	6
							0.11 (ND=1/2DL)				
	Green-Duwamish Watershed, WA	Nairn (2007)	Mixed Urban & Forest	wet+dry			0.024				
	Southern British Columbia, Canada	Shaw (2007)		wet+dry	0.0021	0.0047					
	Great Lakes, U.S.	IADN (2000)		wet	0.0018	0.0030					
				net gas exchange	-0.007	-0.050					
Total PBDEs	Southern British Columbia, Canada	Shaw (2007)		wet+dry	0.0022	0.0058		**0.0005**	**0.002**	**0.006**	6
	Lake Maggiore, Italy & Switzerland	Vives et al. (2007)		wet+dry	0.0007	0.032					
	Coastal Areas of Korea	Moon et al. (2007)		wet+dry	0.028	0.24					

Table 8 - Selection of Atmospheric Deposition Rates

Chemical of Concern	Measured Atmospheric Deposition Rate ($ug/m^2/day$)							Flux for Loading Calculations ($ug/m^2/day$)			
	Location	Reference	Land Use	Flux Type	Range		Average	Probability of Exceedance			Comments (footnotes)
					Min	Max		High	Medium	Low	
cPAHs	Lower Duwamish River, WA	King County Passive Deposition Sampling	Urban	wet+dry	0.0	13	2.4	0.1	1	5	7, 8
	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			2.1 to 5.6				
			Industrial				5.5 to 29				
			All Sites				10				
	Great Lakes, U.S.	IADN (2000)		wet	0.014	0.078					
				dry	0.0085	0.074					
				net gas exchange	0.00013	0.0096					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry+gas ex			0.05				
HPAHs	Lower Duwamish River, WA	King County Passive Deposition Sampling	Urban	wet+dry	0.0	6.0	1.1	0.1	0.5	2	7, 8
	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			1.4 to 3.4				
			Industrial				3.8 to 12				
			All Sites				5.2				
	Great Lakes, U.S.	IADN (2000)		wet	0.0052	0.050					
				dry	0.0026	0.020					
				net gas exchange	0.016	0.11					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry+gas ex			0.3				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			0.20				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
LPAHs	Commencement Bay, Tacoma, WA	Crecelius (1991)	Rural & Marine	wet+dry			0.45 to 0.68	0.1	0.5	2	9
			Industrial				1.1 to 3.8				
			All Sites				1.5				
	Great Lakes, U.S.	IADN (2000)		wet	0.0080	0.082					
				dry	0.0031	0.016					
				net gas exchange	0.089	1.2					
	Chesapeake Bay, U.S.	Chesapeake Bay Program (1999)	Average Regional	wet+dry+gas ex			1				
	Vancouver, British Columbia	Hall et al. (1996)	Residential = 46%	wet			0.92				
			Industrial = 13%								
			Commercial = 4%								
			Institutional = 6%								
			Agricultural = 0%								
			Other = 31%								
BEHP	Lower Duwamish River, WA	King County Passive Deposition Sampling	Urban	wet+dry	0.26	12	2.6	0.1	1	5	5, 10

Table 8 - Selection of Atmospheric Deposition Rates

Chemical of Concern	Measured Atmospheric Deposition Rate (ug/m^2/day)							Flux for Loading Calculations (ug/m^2/day)			
	Location	Reference	Land Use	Flux Type	Range		Average	Probability of Exceedance			Comments (footnotes)
					Min	Max		High	Medium	Low	
Total Dioxin TEQs	Denmark	NERI (2006)		wet+dry	0.3E-6	14E-6	2.9E-6	**1E-7**	**1E-6**	**1E-5**	11
					0.5E-6	17E-6	4.4E-6				
					0.5E-6	32E-6	6.1E-6				
					1.7E-6	32E-6	8E-6				
	Italy				0.03E-6	6.2E-6					
	Belgium				0.68E-6	25E-6					
	Germany				2.7E-6	82E-6					
					0.7E-6	11E-6					
	Baltic Sea Region, Europe	HELCOM (2004)	Over Water	wet+dry	0.03E-6	0.1E-6					
			Over Land	wet+dry	0.1E-6	1E-6					
	Denmark	NERI (2006)	Average for Country	wet+dry			4.4E-6				
Total DDT	Great Lakes, U.S.	IADN (2000)		wet	0.00015	0.0021	0.00085	**0.0004**	**0.002**	**0.01**	12
				net gas exchange	0.00047	0.0057	0.0024				
	New Jersey, U.S.	NJADN (2001)	Multiple Sites	wet	0.00017	0.0011	0.00061				
				dry	0.00025	0.0021	0.0012				

ND = Not Detectable

FOOTNOTES:

1.) Used approximately 1/2 of Crecelius (1991) Rural & Marine value (low value in range) as medium Probability of Exceedance flux for entire Puget Sound water surface.
2.) The assumed factor of two reduction is designed to account for the higher degree of urbanization in the Tacoma, WA area compared to Puget Sound as a whole.
3.) Medium Probability of Exceedance flux estimated as the approximate midpoint of the reported flux measurements.
4.) Used approximately 1/2 of the Seattle/King County value as medium Probability of Exceedance flux for entire Puget Sound water surface.
5.) The assumed factor of two reduction is designed to account for the higher degree of urbanization in the Seattle, WA area compared to Puget Sound as a whole.
6.) Used lower of Southern British Columbia values as medium Probability of Exceedance flux for entire Puget Sound water surface.
7.) Used approximately 1/2 of the average Duwamish and the lowest Commencement Bay measurements as medium Probability of Exceedance flux for entire Puget Sound water surface.
8.) The assumed factor of two reduction is designed to account for the higher degree of urbanization in the Seattle and Tacoma, WA areas compared to Puget Sound as a whole.
9.) Used lowest of the Tacoma and approximately 1/2 of the Vancouver values as medium Probability of Exceedance flux for entire Puget Sound water surface.
10.) Used approximately 1/2 of the average Duwamish measurement as medium Probability of Exceedance flux for entire Puget Sound water surface.
11.) Based on reported air concentrations for NW Washington State (see Appendix B), use about 1/5 of the mean Denmark fluxes as the medium Probability of Exceedance flux for entire Puget Sound water surface. This assumes that the total dioxin deposition rate is generally proportional to the air concentration.
12.) Used approximate average of total deposition fluxes from New Jersey and Great Lakes.

Table 9 - Atmospheric Loadings

Chemical of Concern	Probability of Exceedance	Atmospheric Deposition Pathway		
		Flux ($ug/m^2/day$)	Loading (metric tons/year)	% of Surface Runoff Pathway
Arsenic	High Medium Low	0.1 1 5	**0.3** **3.1** **16**	**5**
Cadmium	High Medium Low	0.1 0.5 2	**0.31** **1.6** **6.2**	**30**
Copper	High Medium Low	1 10 50	**3.1** **31** **150**	**30**
Lead	High Medium Low	1 10 50	**3.1** **31** **150**	**35**
Zinc	High Medium Low	2 20 100	**6** **60** **310**	**17**
Mercury	High Medium Low	0.002 0.01 0.05	**0.0062** **0.031** **0.16**	**6**
Total PCBs	High Medium Low	0.0005 0.002 0.02	**0.0016** **0.0062** **0.062**	**4**
Total PBDEs	High Medium Low	0.0005 0.002 0.006	**0.0016** **0.0062** **0.019**	**1,037**
PAHs (Carcinogenic)	High Medium Low	0.1 1 5	**0.31** **3.1** **16**	**135**
PAHs (High Molecular Weight)	High Medium Low	0.1 0.5 2	**0.31** **1.6** **6.2**	**90**
PAHs (Low Molecular Weight)	High Medium Low	0.1 0.5 2	**0.31** **1.6** **6.2**	**26**
Bis(2-ethylhexyl)phthalate	High Medium Low	0.1 1 5	**0.31** **3.1** **16**	**4**
Total Dioxin TEQs	High Medium Low	1.0E-07 1.0E-06 1.0E-05	**3.1E-07** **3.1E-06** **3.1E-05**	**7**
Total DDT	High Medium Low	0.0004 0.002 0.01	**0.0012** **0.0062** **0.031**	**4**

TABLE 10 – Sources of Data

Data Source	Matrix	Parameter
Ecology (TRI)	Air, Wastewater	Cd, Hg, Pb, Zn, Dioxin, PAH, PCB
Ecology	Combined sewer outfalls	Flow
Ecology (EIM)	Rivers and streams	Metals, Dioxin, PAH, PBDEs, PCB, Pesticides, Phthalates, Petroleum hydrocarbons
Ecology (ERTS)	Spills to surface waters	Chemicals, Petroleum, Pesticides, Medical wastes, Oils
Ecology (PSAMP)	Sediment	PCBs
Ecology (WPLCS)	Wastewater, Stormwater	As, Cd, Cu, Pb, Hg, Zn, Dioxin, DDT, PCB, PAH, Phthalates, Oil
King County	Air	PAH, PCB, Phthalates
King County	Combined sewer outfalls	Flow, Metals, Organics
King County	Groundwater	Metals
King County	Rivers and streams	Metals, PAHs, PCBs
King County	Wastewater	Metals, Organics
King County		GIS Shape files
National Oceanic and Atmospheric Administration		Various studies
People for Puget Sound	Combined Sewer Outfalls	Locations
Puget Sound Action Team	Combined sewer outfalls, Wastewater	Locations
Puget Sound Clean Air Agency	Air	As, Cd, Pb
City of Tacoma	Stormwater	Hg, Pb, Zn, PAH, Phthalates
United States Department of Agriculture		GIS Shape files
United States Environmental Protection Agency	Wastewater, Rivers and streams	Flow, Metals, Oil
United States Geological Survey	Stormwater	Hg, Organics, Pesticides
Washington Department of Natural Resources		GIS Shape files

EIM = Environmental Information Management System
ERTS = Environmental Reporting Tracking System
PSAMP = Puget Sound Ambient Monitoring Program
WPLCS = Water Quality Permit Life Cycle System (queried in February 2007)

Table 11 - Geographic Information System Data Sources

Digital Elevation Models (DEMS) presenting Washington State Surface Elevation
Washington State Department of Natural Resources
Geographic Information System
http://www3.wadnr.gov/dnrapp6/dataweb/metadata/DEM90_meta.htm

USGS Stream Gage Locations
USGS Stream gages linked to the Medium Resolution NHD
http://water.usgs.gov/GIS/metadata/usgswrd/XML/streamgages.xml

USGS Stream Gage Historical Data
http://waterdata.usgs.gov/wa/nwis/monthly/?referred_module=sw

Washington Hydrography Framework for Water Bodies (1:100,000 scale layers)
http://www.ecy.wa.gov/services/gis/data/hydro/wahyfw_100k.htm

Ecology Lakes - Major Lakes in Washington State
http://www.ecy.wa.gov/services/gis/data/data.htm

Ecology Rivers - Washington Rivers and Connecting Water Bodies
http://www.ecy.wa.gov/services/gis/data/data.htm

Ecology Water Resource Inventory Areas (WRIA)
http://www.ecy.wa.gov/services/gis/data/data.htm

Multi-Resolution Land Characteristics (MRLC) Consortium
Land Coverage and Land Use Data
http://www.mrlc.gov/

Hydrological Unit (HU) Boundaries for Oregon, Washington, and California
http://www.reo.gov/gis/projects/watersheds/REOHUCv1_3.htm

Table 12 - Wastewater Loadings

Chemical of Concern	Treatment of Non-Detects (ND)	Average Annual Mass Loading from Wastewater (metric tons / year)														
		Main Basin (33 permitted facilities)		South Sound (29 permitted facilities)		Hood Canal (2 permitted facilities)		Whidbey Basin (6 permitted facilities)		Bellingham (12 permitted facilities)		Olympic Peninsula (2 permitted facilities)		Total (84 permitted facilities)		
		Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal + Industrial
Arsenic	ND = 0	0.0000	0.030	-	0.17	-	-	-	0.00081	-	0.0035	-	-	**0.0000**	**0.20**	**0.20**
	ND = 1/2 DL	0.0005	7.2	-	0.17	-	-	-	0.00081	-	0.0035	-	-	**0.0005**	**7.4**	**7.4**
	ND = DL	0.0010	14.4	-	0.17	-	-	-	0.00081	-	0.0035	-	-	**0.0010**	**14.6**	**14.6**
Cadmium	ND = 0	0.00052	0.017	0.00030	0.00000	-	0.00020	-	0.00085	-	0.00014	-	-	**0.00083**	**0.019**	**0.019**
	ND = 1/2 DL	0.0016	0.45	0.00063	0.00021	-	0.00024	-	0.0013	-	0.00014	-	-	**0.0023**	**0.45**	**0.45**
	ND = DL	0.0028	0.88	0.00095	0.00043	-	0.00028	-	0.0018	-	0.00014	-	-	**0.0037**	**0.88**	**0.89**
Copper	ND = 0	0.25	5.3	0.86	0.52	-	0.040	-	0.051	0.051	0.0067	-	-	**1.2**	**6.0**	**7.1**
	ND = 1/2 DL	0.25	5.3	0.86	0.52	-	0.040	-	0.051	0.066	0.0067	-	-	**1.2**	**6.0**	**7.1**
	ND = DL	0.25	5.3	0.86	0.52	-	0.040	-	0.051	0.081	0.0067	-	-	**1.2**	**6.0**	**7.2**
Lead	ND = 0	0.021	0.26	0.079	0.012	-	0.0039	-	0.0035	-	0.0011	-	-	**0.10**	**0.28**	**0.38**
	ND = 1/2 DL	0.023	4.6	0.084	0.035	-	0.0046	-	0.0037	-	0.0011	-	-	**0.11**	**4.6**	**4.7**
	ND = DL	0.026	8.9	0.090	0.058	-	0.0054	-	0.0039	-	0.0011	-	-	**0.12**	**9.0**	**9.1**
Zinc	ND = 0	0.31	15.1	2.3	0.28	-	0.060	-	0.030	-	0.014	-	0.045	**2.6**	**15.5**	**18.1**
	ND = 1/2 DL	0.31	15.1	2.3	0.28	-	0.060	-	0.030	-	0.017	-	0.045	**2.6**	**15.5**	**18.1**
	ND = DL	0.32	15.1	2.3	0.28	-	0.060	-	0.030	-	0.020	-	0.045	**2.6**	**15.5**	**18.2**
Mercury	ND = 0	-	0.0000	-	-	-	-	-	-	-	-	-	-	-	**0.0000**	**0.0000**
	ND = 1/2 DL	-	0.015	-	-	-	-	-	-	-	-	-	-	-	**0.015**	**0.015**
	ND = DL	-	0.029	-	-	-	-	-	-	-	-	-	-	-	**0.029**	**0.029**
PAHs (Carcinogenic)	ND = 0	-	0.00018	-	-	-	-	-	-	-	-	-	-	-	**0.00018**	**0.00018**
	ND = 1/2 DL	-	0.024	-	-	-	-	-	-	-	-	-	-	-	**0.024**	**0.024**
	ND = DL	-	0.048	-	-	-	-	-	-	-	-	-	-	-	**0.048**	**0.048**
PAHs (Other High Molecular Weight)	ND = 0	-	0.00079	-	-	-	-	-	-	-	-	-	-	-	**0.00079**	**0.00079**
	ND = 1/2 DL	-	0.0070	-	-	-	-	-	-	-	-	-	-	-	**0.0070**	**0.0070**
	ND = DL	-	0.013	-	-	-	-	-	-	-	-	-	-	-	**0.013**	**0.013**
PAHs (Low Molecular Weight)	ND = 0	-	0.0010	-	-	-	-	-	-	-	-	-	-	-	**0.00099**	**0.00099**
	ND = 1/2 DL	-	0.014	-	-	-	-	-	-	-	-	-	-	-	**0.014**	**0.014**
	ND = DL	-	0.026	-	-	-	-	-	-	-	-	-	-	-	**0.026**	**0.026**
bis(2-Ethylhexyl)phthalate	ND = 0	-	0.082	-	-	-	-	-	-	-	-	-	-	-	**0.082**	**0.082**
	ND = 1/2 DL	-	0.082	-	-	-	-	-	-	-	-	-	-	-	**0.082**	**0.082**
	ND = DL	-	0.082	-	-	-	-	-	-	-	-	-	-	-	**0.082**	**0.082**
Oil or Petroleum Product	ND = 0	-	35.8	-	1.3	-	-	-	-	6.05	1.5	-	0.00	**6.1**	**38.6**	**44.7**
	ND = 1/2 DL	-	44.9	-	4.0	-	-	-	-	6.05	2.1	-	0.29	**6.1**	**51.3**	**57.4**
	ND = DL	-	54.0	-	9.4	-	-	-	-	6.05	2.7	-	0.57	**6.1**	**66.7**	**72.8**

NOTE: The loading estimates for each Study Area Basin do not represent the total loadings from all the facilities in the Study Area Basin.
The estimated values represent only those permitted facilities who had paired flow and concentration data. The numbers of those facilities with data are identified in the table.
The total number of permitted facilities within each Study Area Basin are:

Main Basin =	**65**	**Whidbey Island =**	**28**		
South Sound =	**61**	**Bellingham =**	**29**		
Hood Canal =	**6**	**Olympic Peninsula =**	**11**	**Total =**	**200**

Table 13 - Combined Sewer Overflow Loadings

Chemical of Concern	CSO Effluent Concentration (ug/L)	CSO Loading Rate (mt/yr)	Comments (Footnotes)
Arsenic (Total)	3	0.014	
Cadmium (Total)	1	0.0046	
Copper (Total)	50	0.23	
Lead (Total)	30	0.14	
Zinc (Total)	130	0.59	
Mercury (Total)	0.15	0.00069	1
Total PCBs	ND	-	
Total PBDEs	NM	-	
cPAHs	0.2	0.00093	2
HPAHs	0.37	0.0017	
LPAHs	0.47	0.0021	
BEHP	10.2	0.047	
Total Dioxin TEQs	5.0E-06	2.3E-08	3
Total DDT	ND	-	
Triclopyr	NM	-	
Nonylphenol	9	0.041	4
Oil or Petroleum	7,880	36	

NOTES:

1.) CSO mass loadings based on an average total reported overflow rate of 5.12 cfs for the years 2001 to 2005 at the following facilities:

City of Anacortes WWTP	Bremerton WWTP
City of Bellingham WWTP	Snohomish WWTP
City of Port Angeles WWTP	City of Seattle
City of Mt. Vernon WWTP	City of Olympia
City of Everett	
Metropolitan King County - West Point	

2.) CSO effluent concentrations based on average of detected concentrations during City of Seattle CSO characterization project (Seattle Public Utilities 2000).

3.) ND = Not Detected

4.) NM = Not Measured

FOOTNOTES:

1.) Mercury was detected in 51 of 141 samples. The average of the detected concentrations was 0.3 ug/L. One-half of the average detected concentration was assumed for the loading calculation.

2.) cPAH concentration estimated as 0.24*Total PAH.

3.) Average concentration is based on the assumption of zero for non-detects.

4.) Nonylphenol was detected in 10 of 40 samples. The average of the detected concentrations was 17.2 ug/L. One-half of the average detected concentration was assumed for the loading calculation.

Table 14 - Historical Puget Sound Loading Studies

Chemical of Concern	Probability of Exceedance	Runoff (metric tons/year)			Municipal and Industrial Discharges (metric tons/year)			Atmospheric Deposition (metric tons/year)	
		This Study	Strayer and Pavlou 1987	NOAA 1988	This Study	Strayer and Pavlou 1987	NOAA 1988	This Study	Strayer and Pavlou 1987
Arsenic	High	**32**	64	8.2	**0.20**	64.5	31	**0.3**	11
	Medium	**62**			**7.4**			**3.1**	
	Low	**118**			**14.6**			**16**	
Cadmium	High	**2.3**	19	0.9	**0.019**	3.5	10	**0.31**	0.5
	Medium	**5.2**			**0.45**			**1.6**	
	Low	**13**			**0.89**			**6.2**	
Copper	High	**49**	108	75	**7.1**	80	35	**3.1**	32
	Medium	**102**			**7.1**			**31**	
	Low	**198**			**7.2**			**150**	
Lead	High	**34**	55	130	**0.38**	40	38	**3.1**	121
	Medium	**89**			**4.7**			**31**	
	Low	**238**			**9.1**			**150**	
Zinc	High	**173**	384	220	**18**	98	153	**6.2**	27
	Medium	**344**			**18**			**60**	
	Low	**637**			**18**			**310**	
Mercury	High	**0.19**	4	0.23	**0**	0.30	0.3	**0.0062**	0.1
	Medium	**0.52**			**0.015**			**0.031**	
	Low	**1.4**			**0.029**			**0.16**	
Total PCBs	High	**0.040**	0.12	-	**-**	0.36	-	**0.0016**	-
	Medium	**0.17**			**-**			**0.0062**	
	Low	**0.72**			**-**			**0.062**	
PAHs (Carcinogenic)	High	**0.81**	4.8	-	**0.00018**	0.38	-	**0.31**	1.8
	Medium	**2.3**			**0.024**			**3.1**	
	Low	**6.6**			**0.048**			**16**	
Oil or Petroleum Product	High	**9,580**	-	4,300	**45**	-	9,250	**-**	-
	Medium	**22,580**			**57**			**-**	
	Low	**55,750**			**73**			**-**	

Notes:

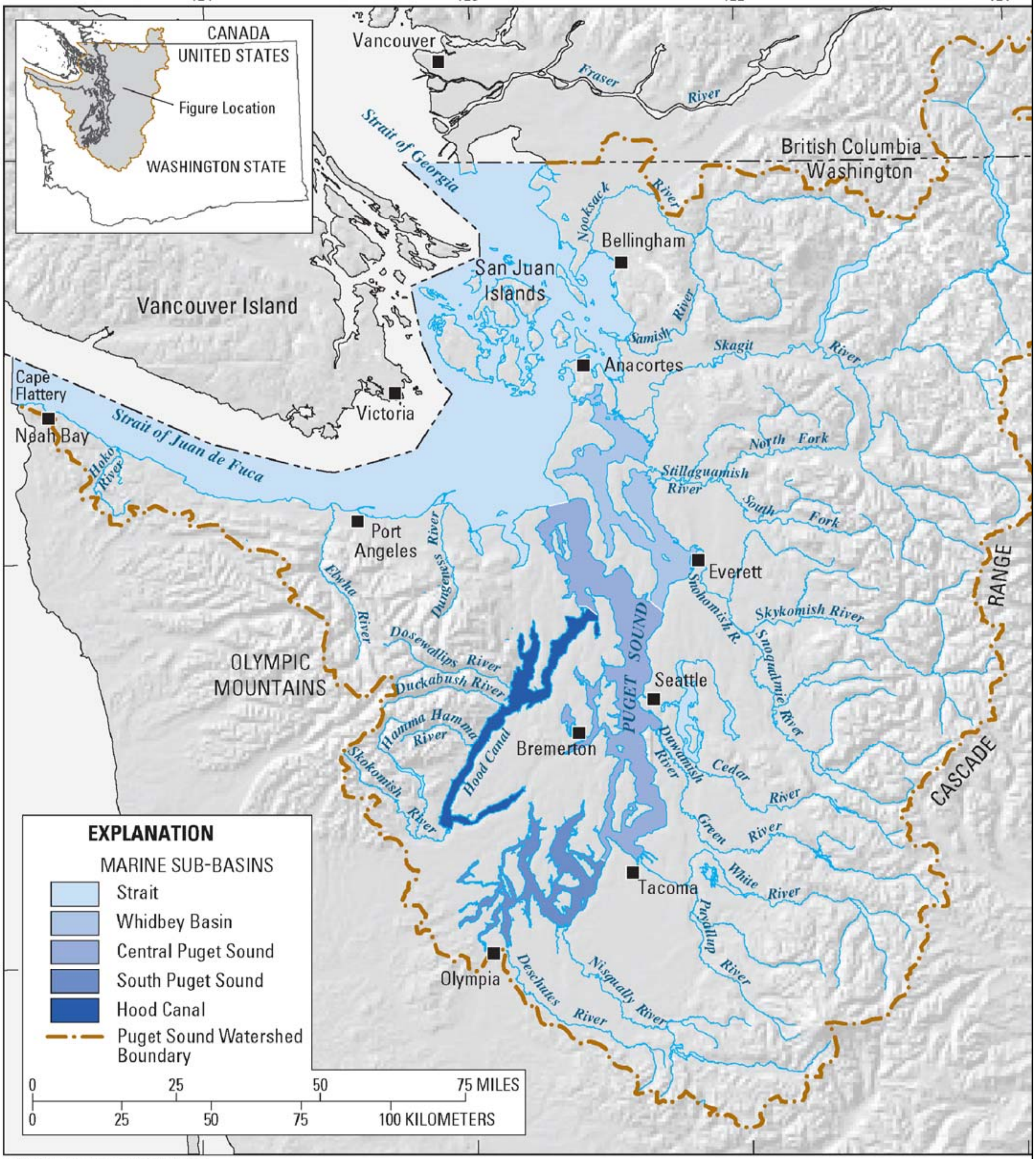
1.) For Stormwater Loadings, High = 75 percent probability of exceedance (assumed)
For Stormwater Loadings, Medium = 50 percent probability (median) of exceedance (assumed)
For Stormwater Loadings, Low = 25 percent probability of exceedance (assumed)
2.) For Municipal and Industrial Discharges, High probability of exceedance assumes Non-detects = 0
For Municipal and Industrial Discharges, Medium probability of exceedance assumes Non-detects = 1/2 of the Detection Limit
For Municipal and Industrial Discharges, Low probability of exceedance assumes Non-detects = the Detection Limit

Table 15 - Degree of Certainty

Chemical of Concern	Degree of Certainty					
	Surface Runoff				Wastewater	Atmospheric
	Forest & Field	Agricultural	Residential	Commercial / Industrial		
Metals	Medium	Medium/Low	Medium	Medium	Medium/Low	Medium/Low
PAHs (a)	Low	Incomplete	Medium	Medium	Low	Low
PCBs (b)	Low	Low	Low	Low	Incomplete	Low
Dioxins & Furans	Incomplete	Incomplete	Low	Low	Incomplete	Low
PBDEs (c)	Low	Low	Low	Low	Incomplete	Low
DDT (d)	Medium	Medium	Medium	Low	Incomplete	Low
Triclopyr	Low	Low/Medium	Low/Medium	Low	Incomplete	Incomplete
bis(2-Ethylhexyl) phthalate	Low	Low	Low	Low	Incomplete	Low
Nonylphenol	Low	Low	Low	Low	Incomplete	Incomplete
Oil and Petroleum	Medium	Medium	Medium	Medium	Medium	Incomplete

(a) = Polyaromatic hydrocarbons
(b) = Polychlorinated biphenyls
(c) = Polybrominated diphenyl ethers
(d) = Dichlorodiphenyltrichloroethane and metabolites

Figures



PSNERP base map from U.S. Geological
Survey digital data 1:2,000,000, 1972
Albers Equal-Area Conic Projection
Standard parallels 47° and 49°, central meridian 122°
Washington shaded relief, USGS, 30 meter DEM
British Columbia shaded relief, NASA, SRTM 90 meter

Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Regional Map of Puget Sound and Surrounding Area

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Figure **1**

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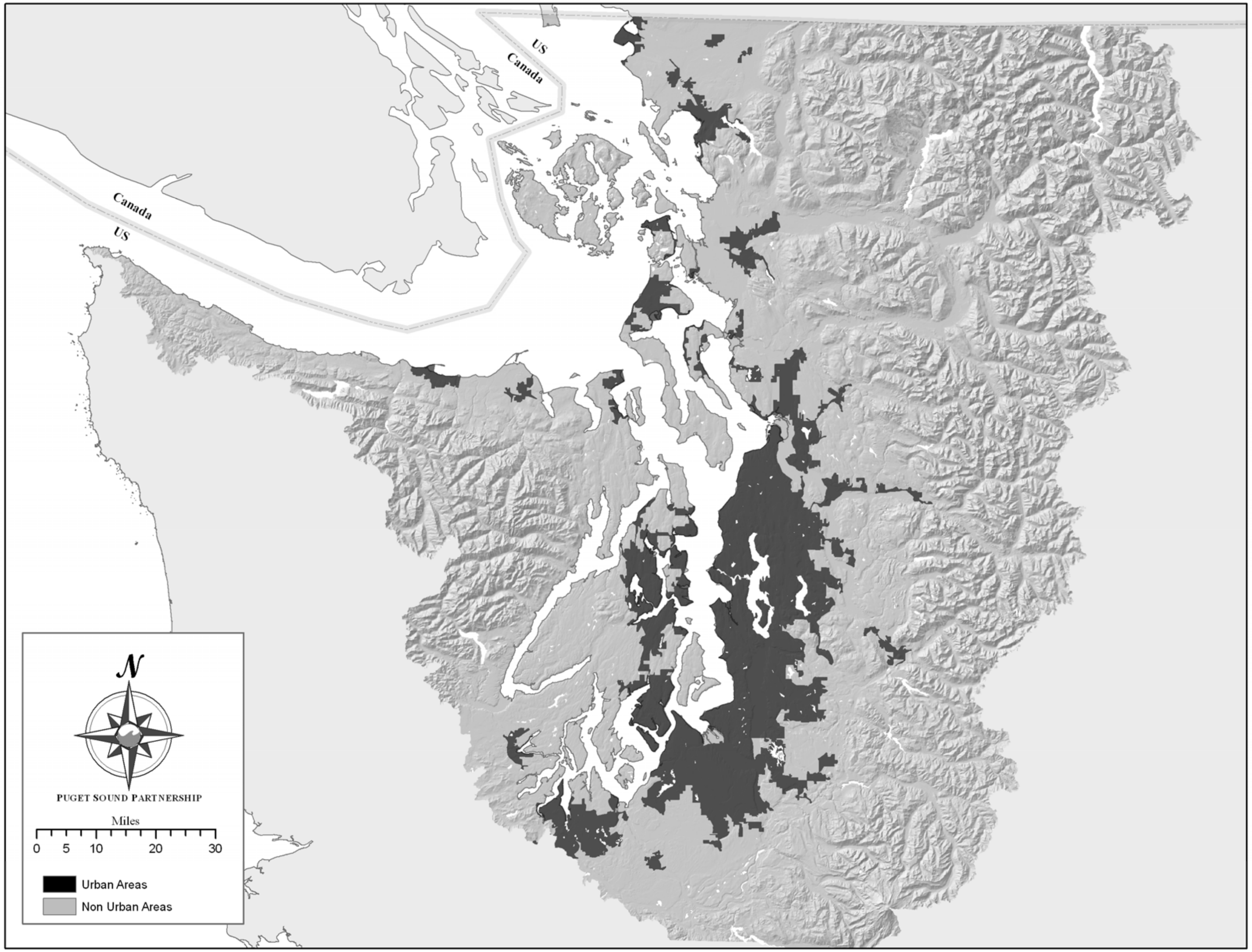
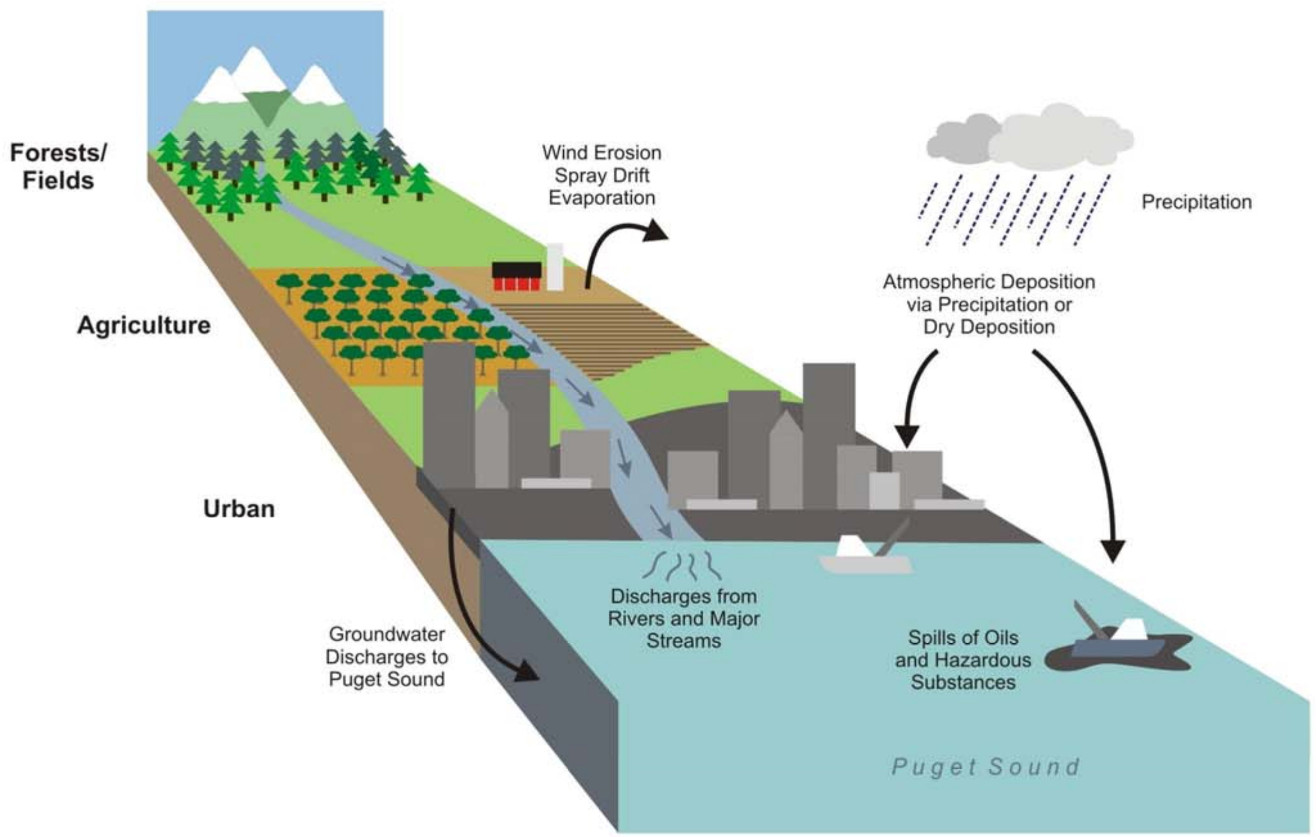
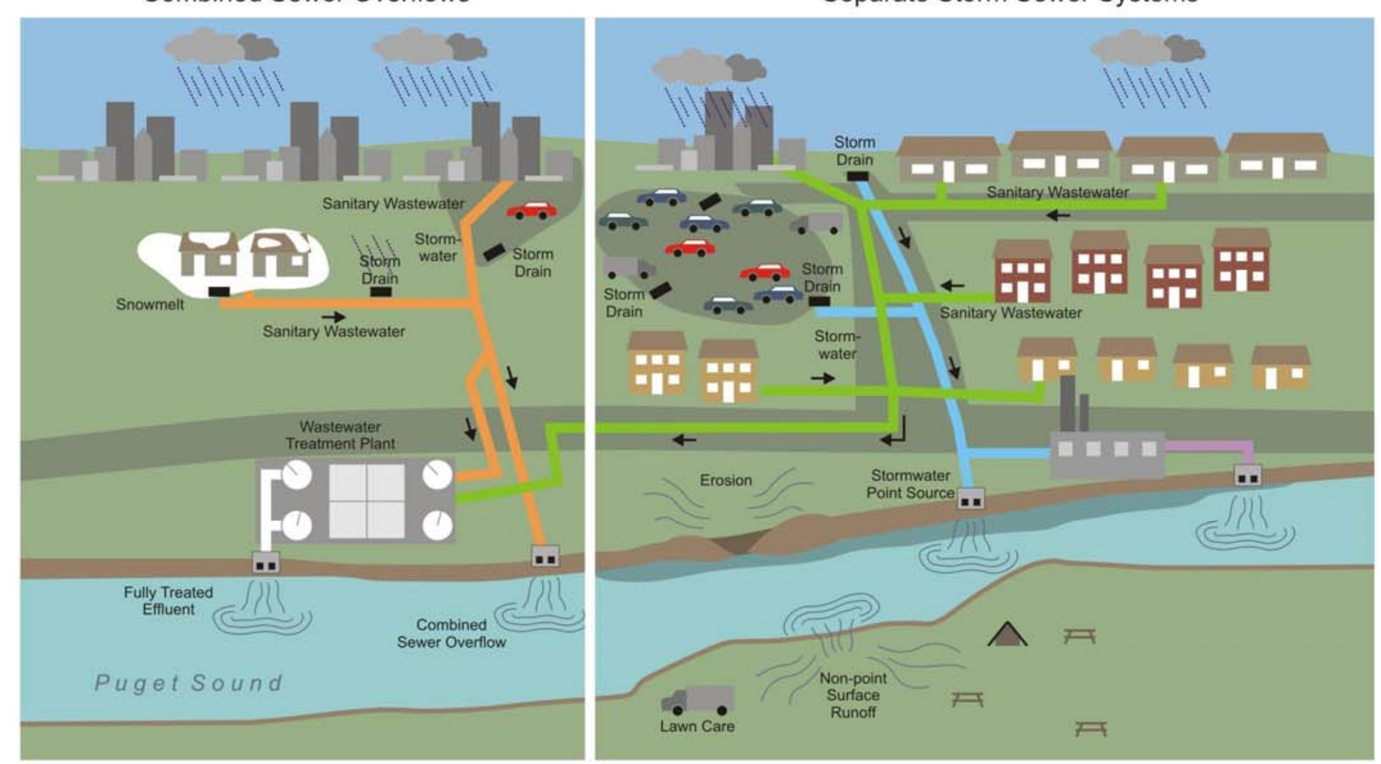


Figure 2 – Urban Areas within the Puget Sound Watershed

(a)



(b)



Stormwater from Municipal, WSDOT, and Commercial/Industrial Stormwater Management Systems

Sanitary Sewer Effluent

Combined Sanitary Sewage/Wastewater/Stormwater Runoff

Industrial Wastewater

Sources of toxic chemicals make their way into Puget Sound through a variety of pathways. The sources associated with major pathways addressed in this Phase 1 study include:

- Point Source Discharge of Industrial and Municipal Wastewater
- Surface Runoff including Discharges from Rivers and Streams
- Point Source Overflows from Combined Sanitary/Stormwater Sewer Outfalls
- Atmospheric (Aerial) Deposition

Additional sources/pathways that were identified but could not be addressed in the Phase 1 study include:

- Groundwater Discharge to Surface Waters
- Spills Direct to Aquatic Systems
- Flow of Marine Waters from the Pacific Ocean
- Leaching or Biotic Activations of Contaminated Sediment Sites

Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Pathways of Chemical Loadings to Puget Sound

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Figure **3**

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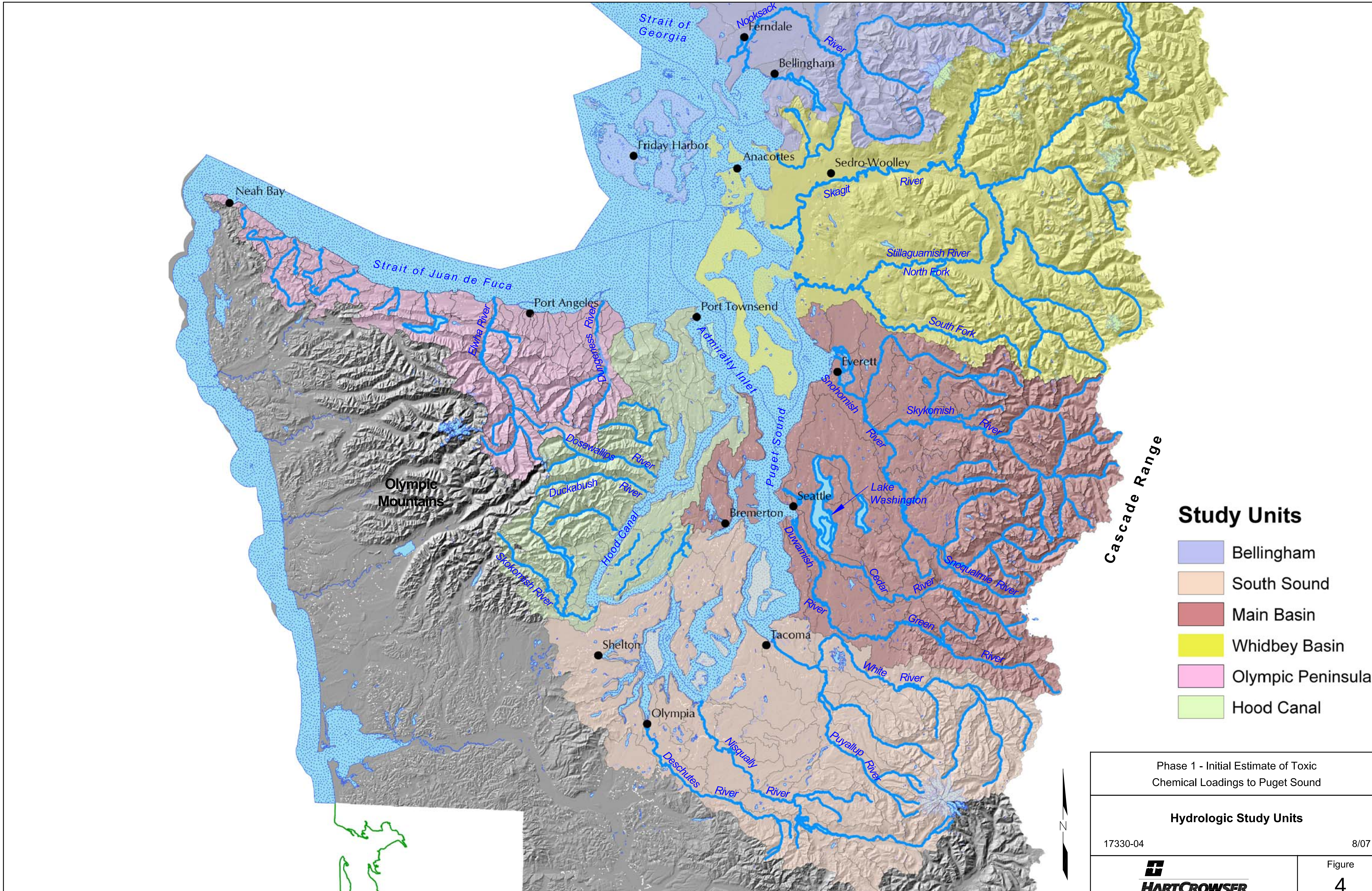

Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Hydrologic Study Units

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Figure 4

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Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Land Use Map

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Figure 5

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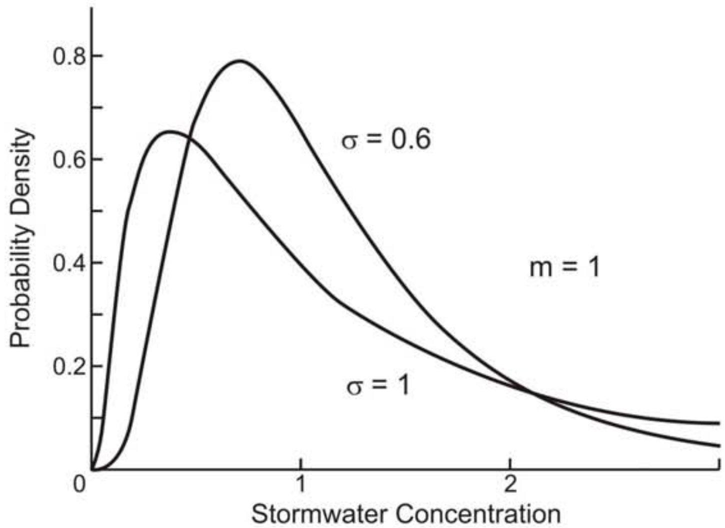
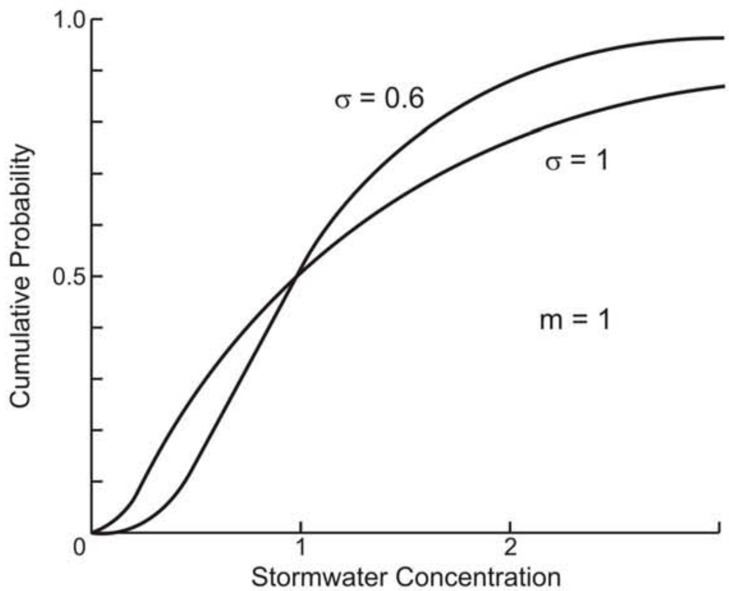


(a) Probability Density Function (PDF)



(b) Cumulative Probability Function (CPF)

Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Illustration of a Lognormally Distributed Stormwater Concentration Variable

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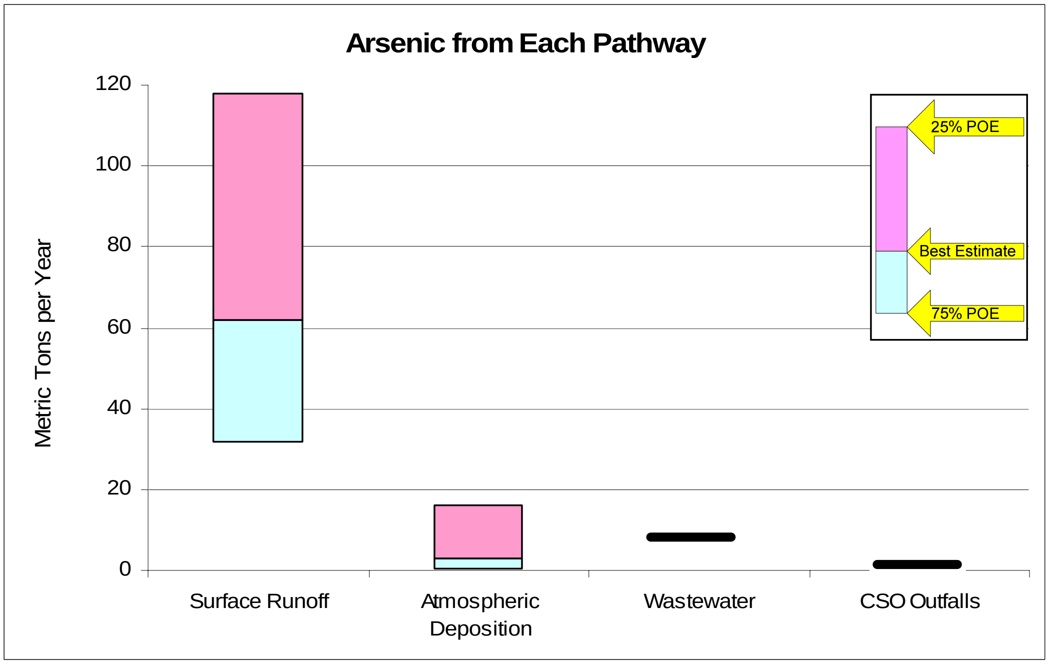
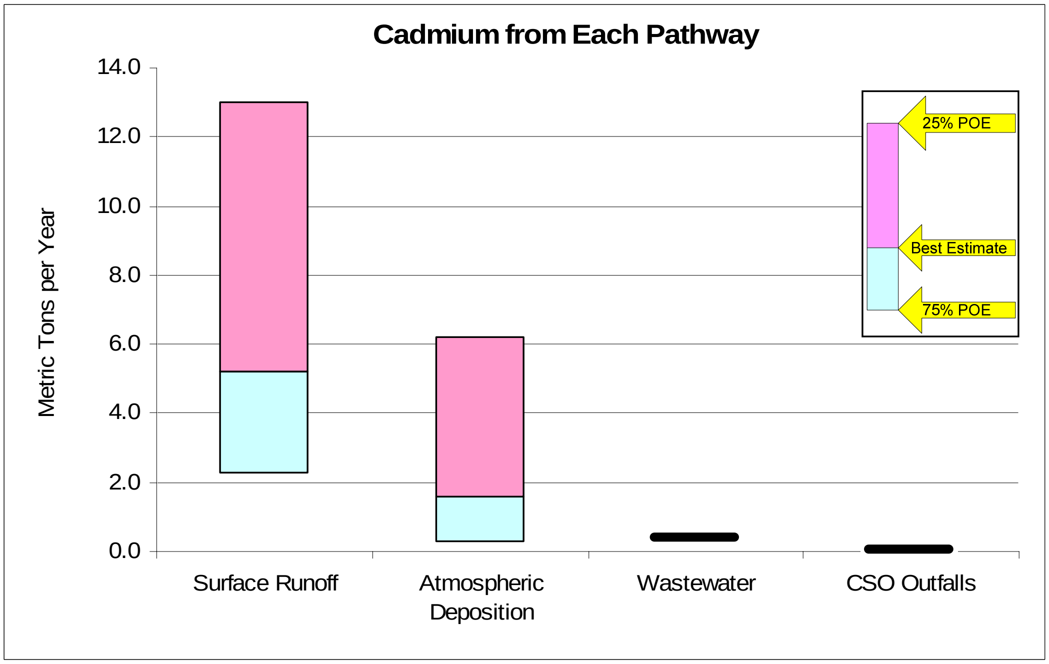
Figure 6

EAL 08/08/07 1733004-AC.cdr

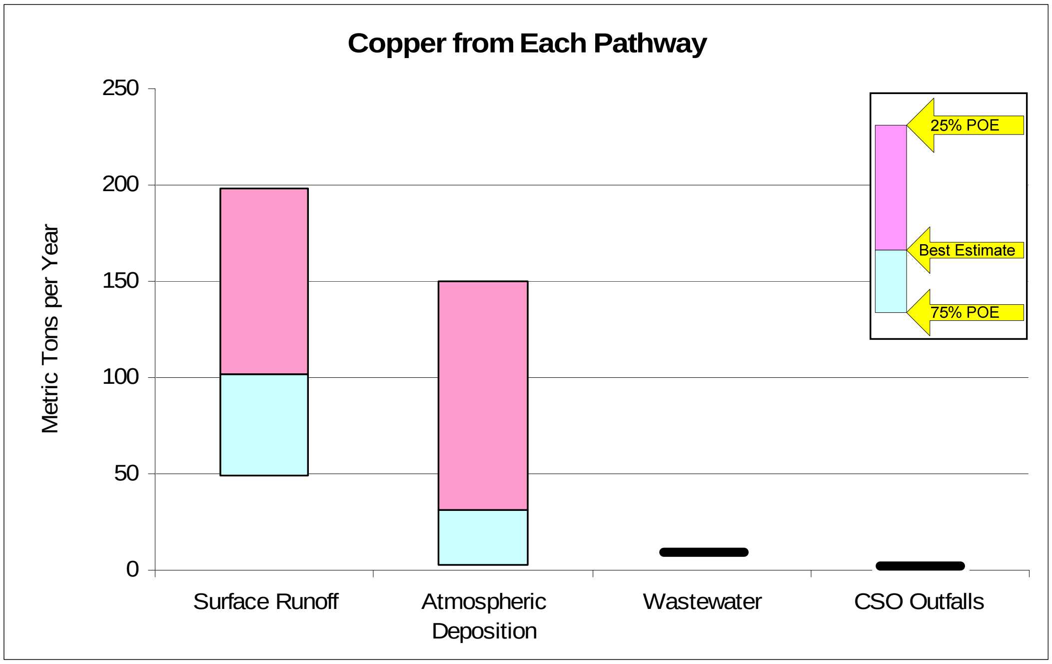


The wastewater value represents paired flow and concentration data from only 16 of about 200 permitted dischargers.

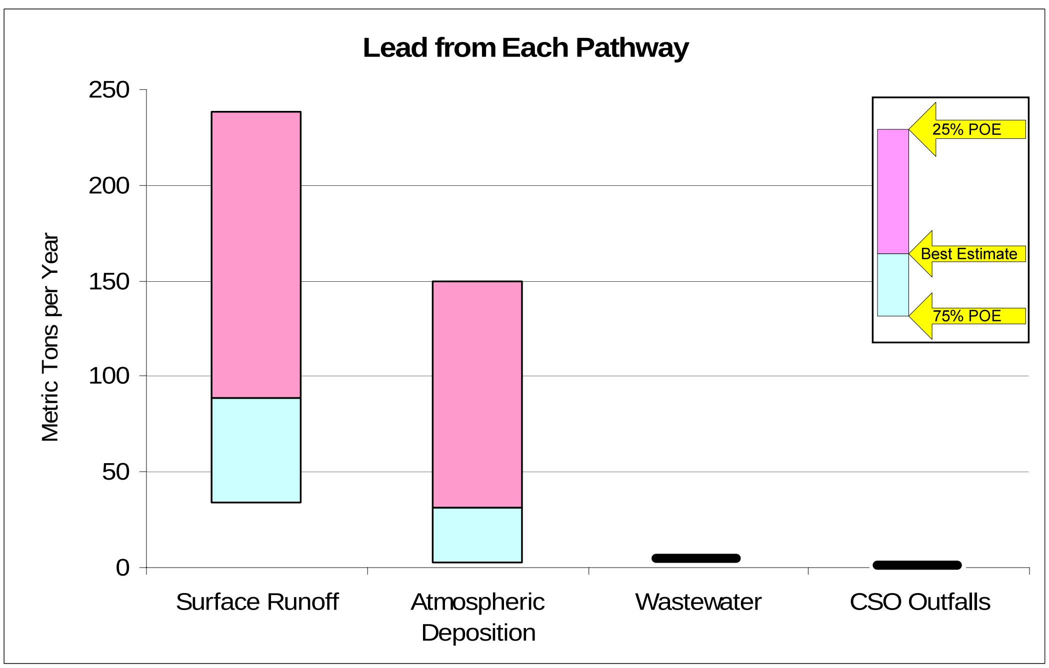


The wastewater value represents paired flow and concentration data from only 24 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway

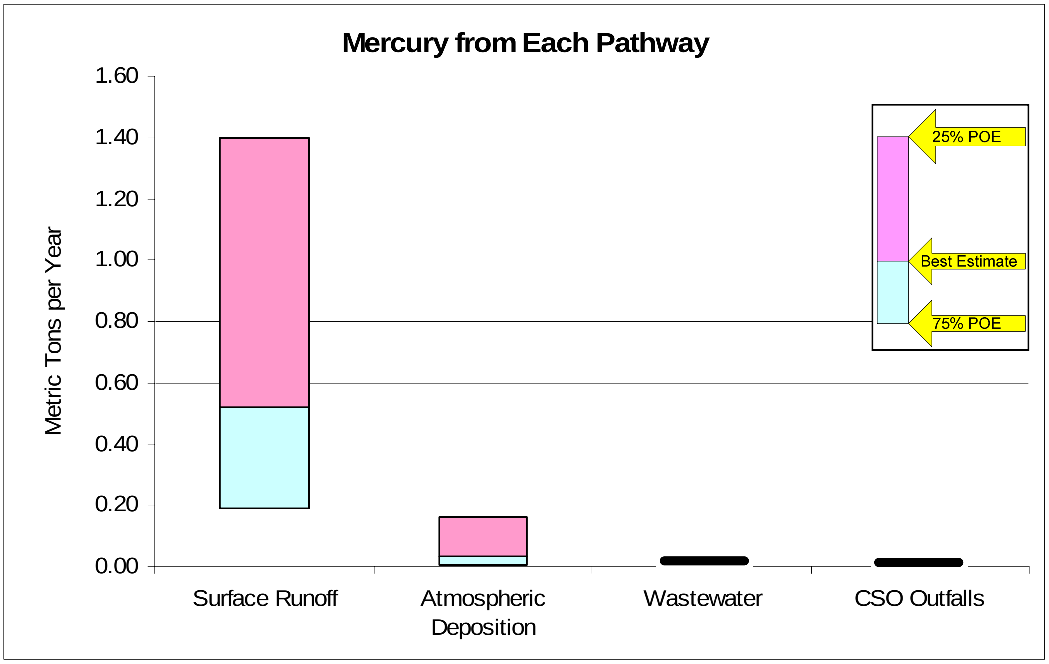


The wastewater value represents paired flow and concentration data from only 61 of about 200 permitted dischargers.

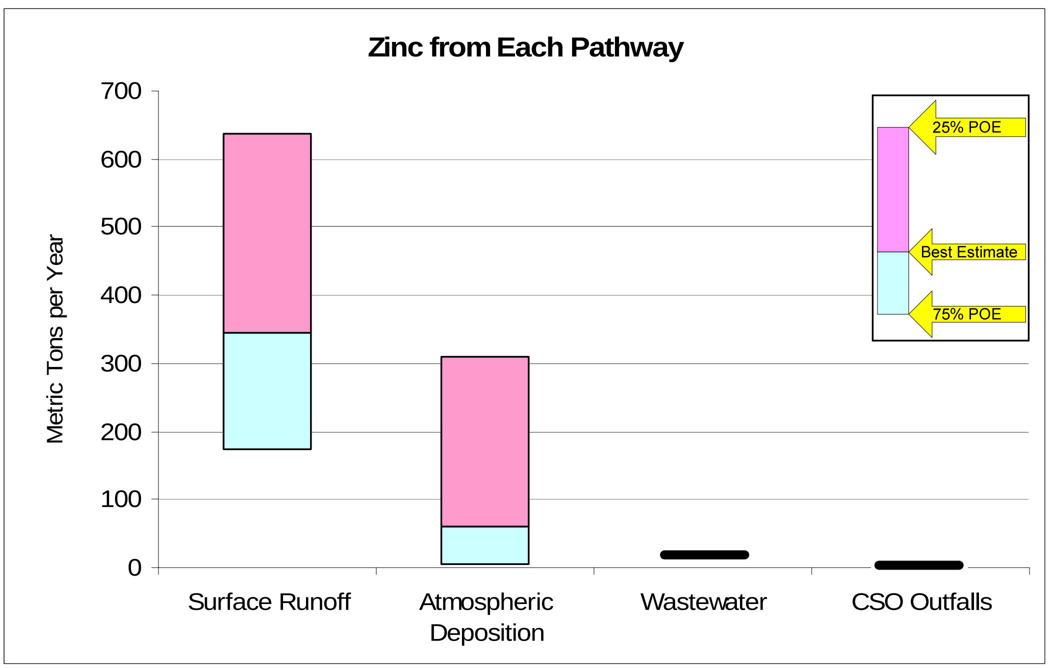


The wastewater value represents paired flow and concentration data from only 43 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)

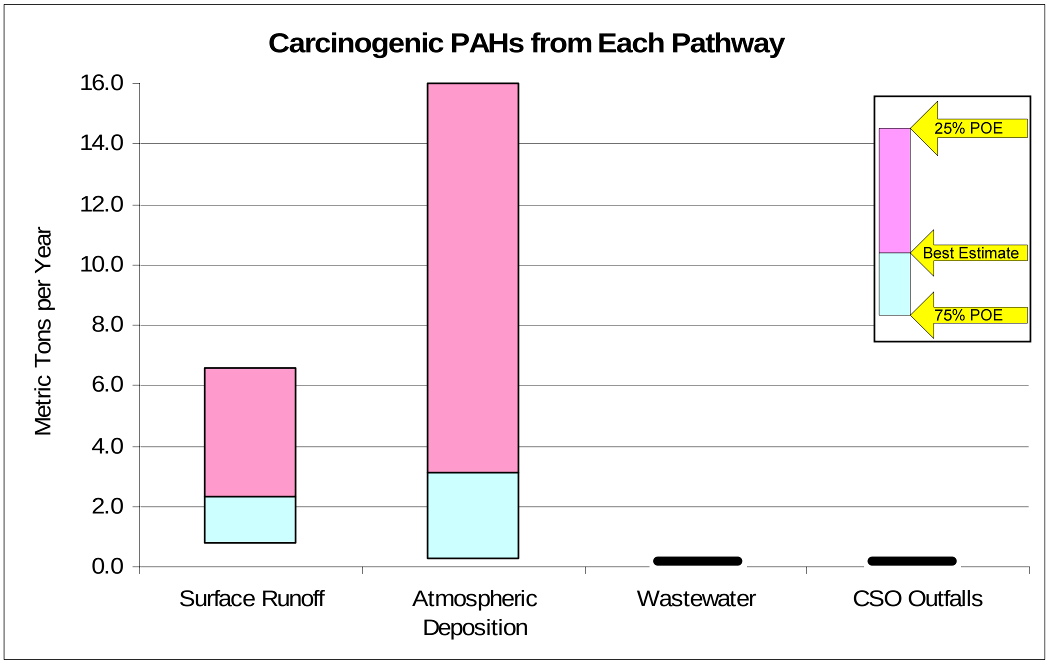


The wastewater value represents paired flow and concentration data from only 3 of about 200 permitted dischargers.

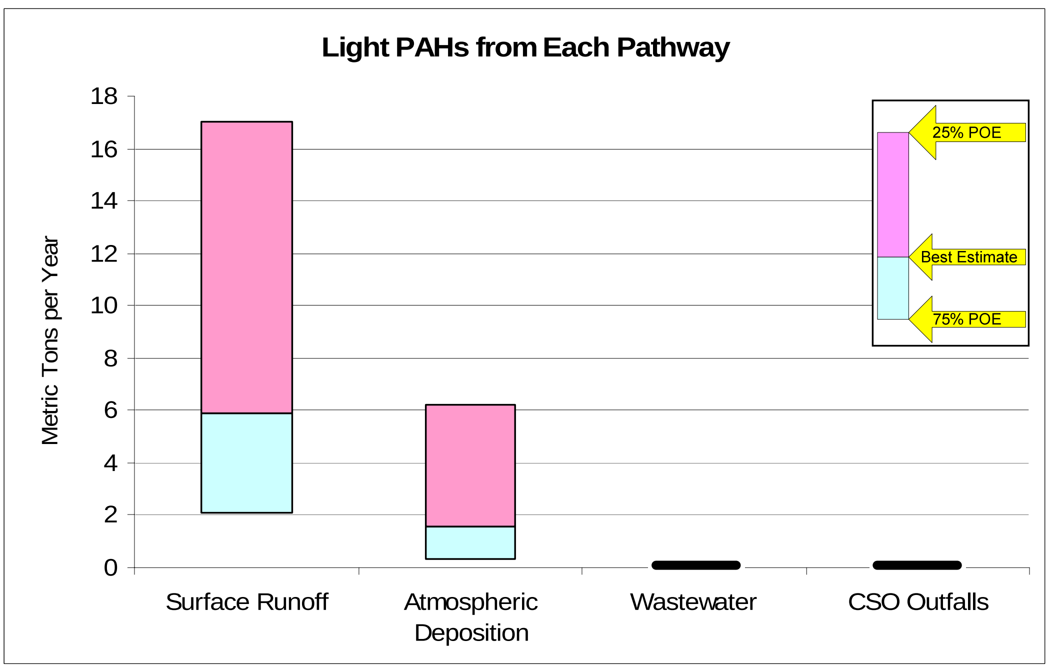


The wastewater value represents paired flow and concentration data from only 46 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)

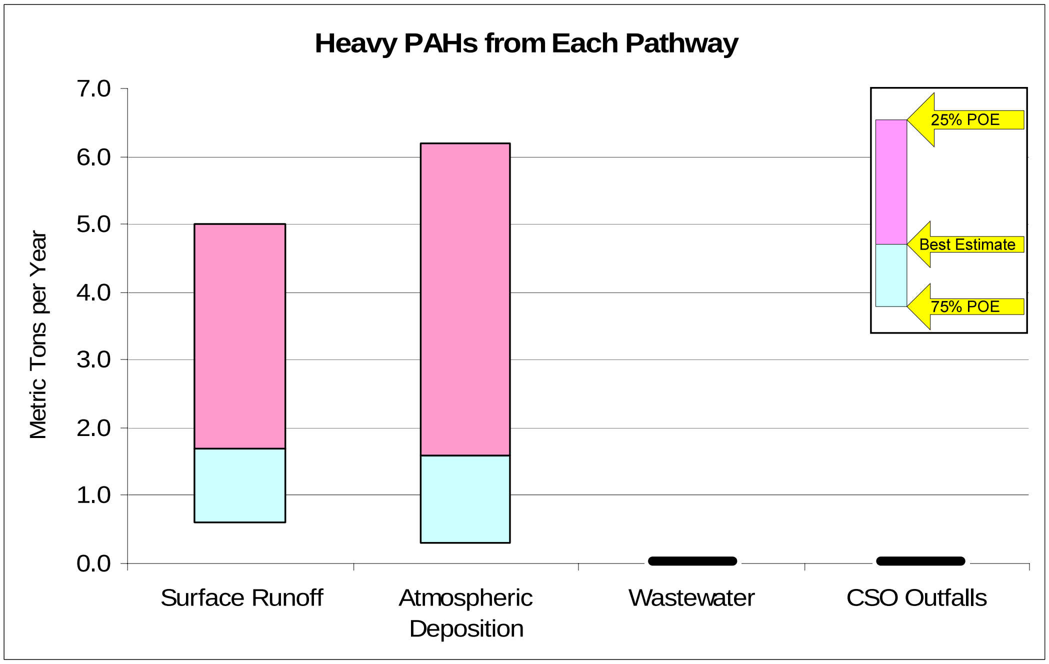


The wastewater value represents paired flow and concentration data from only 1 of about 200 permitted dischargers.

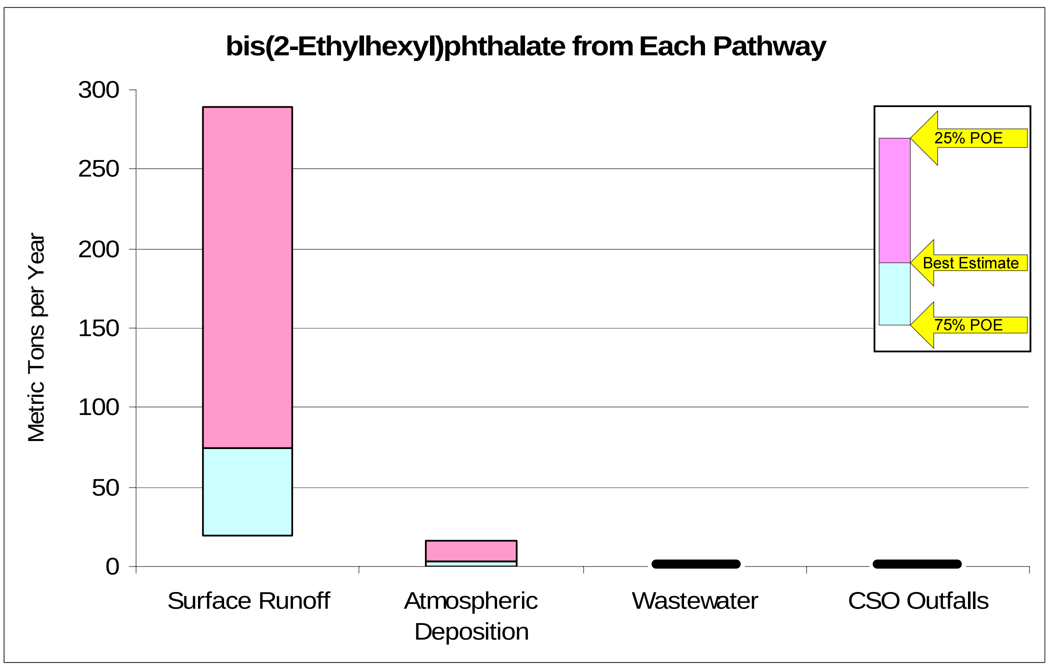


The wastewater value represents paired flow and concentration data from only 1 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)

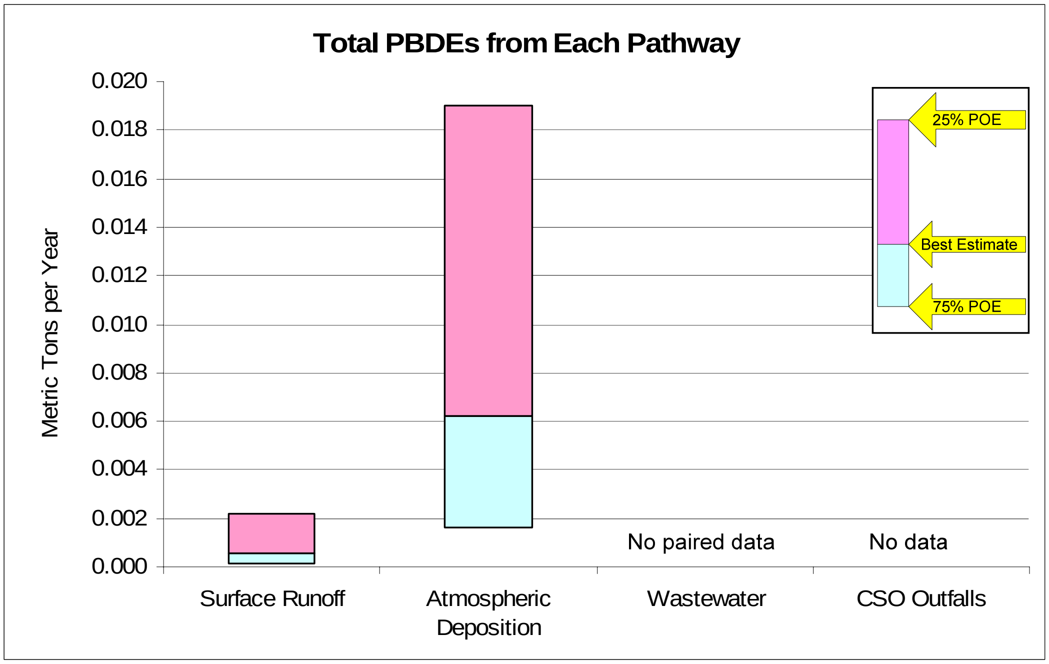


The wastewater value represents paired flow and concentration data from only 1 of about 200 permitted dischargers.



The wastewater value represents paired flow and concentration data from only 1 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)



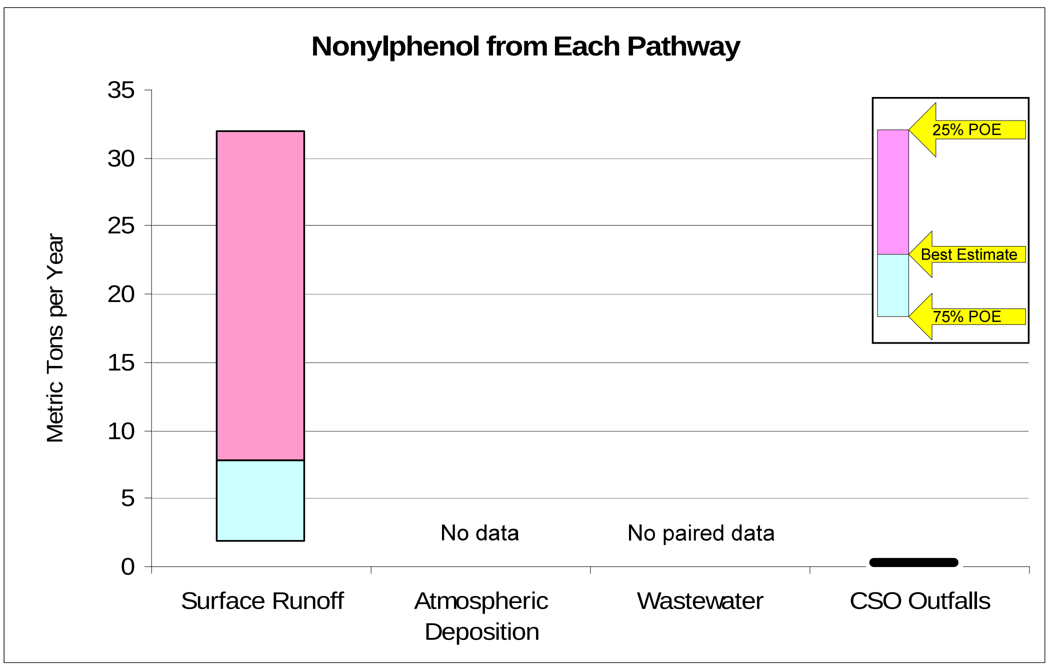
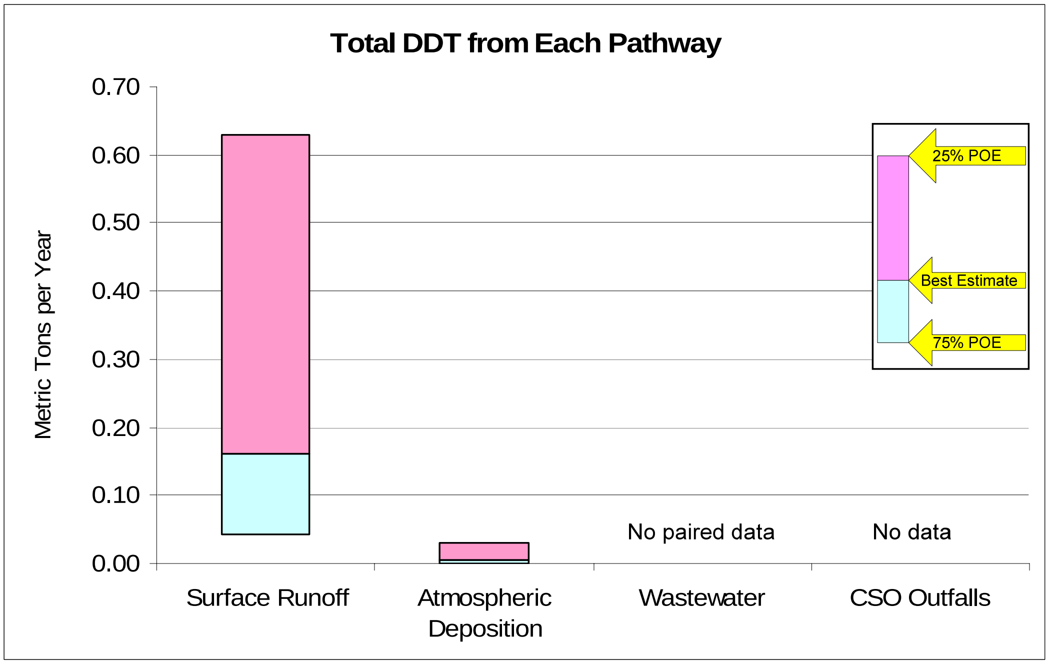


Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)



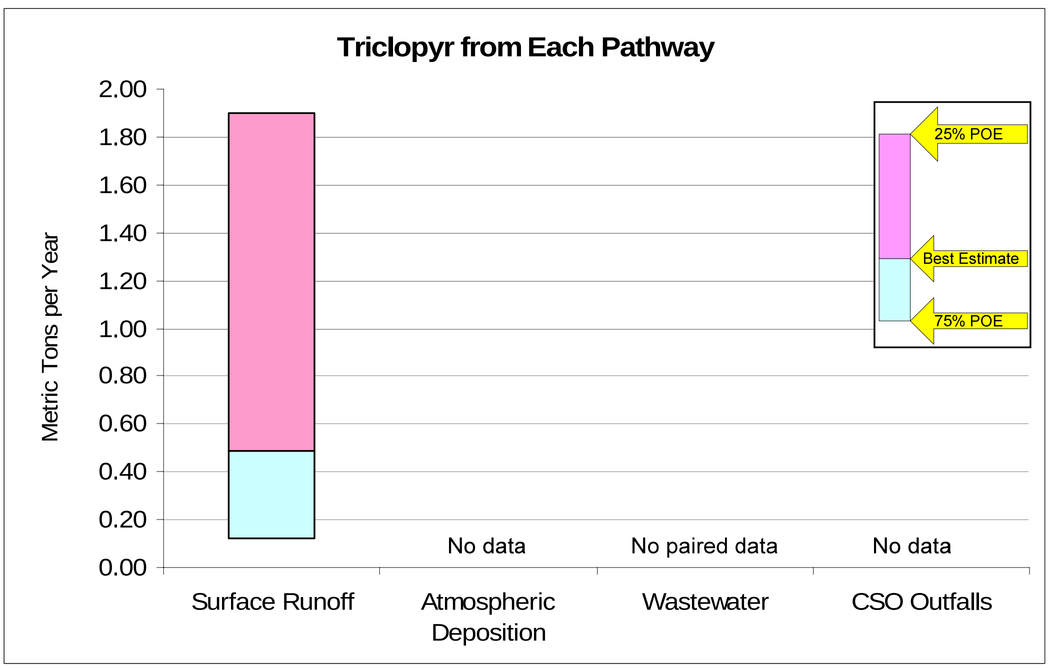
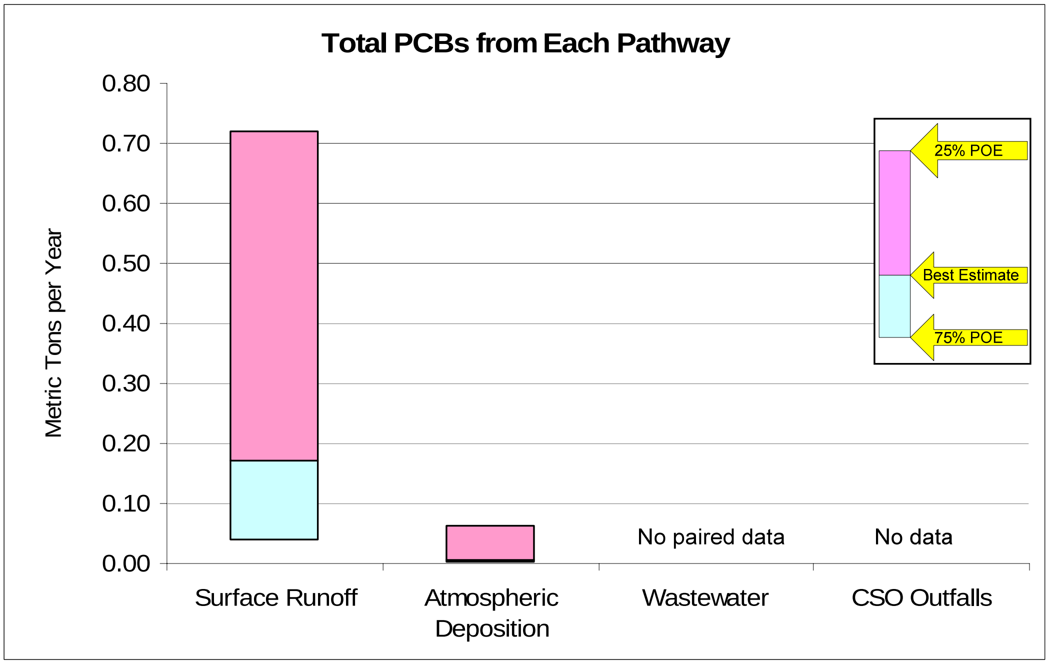


Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)



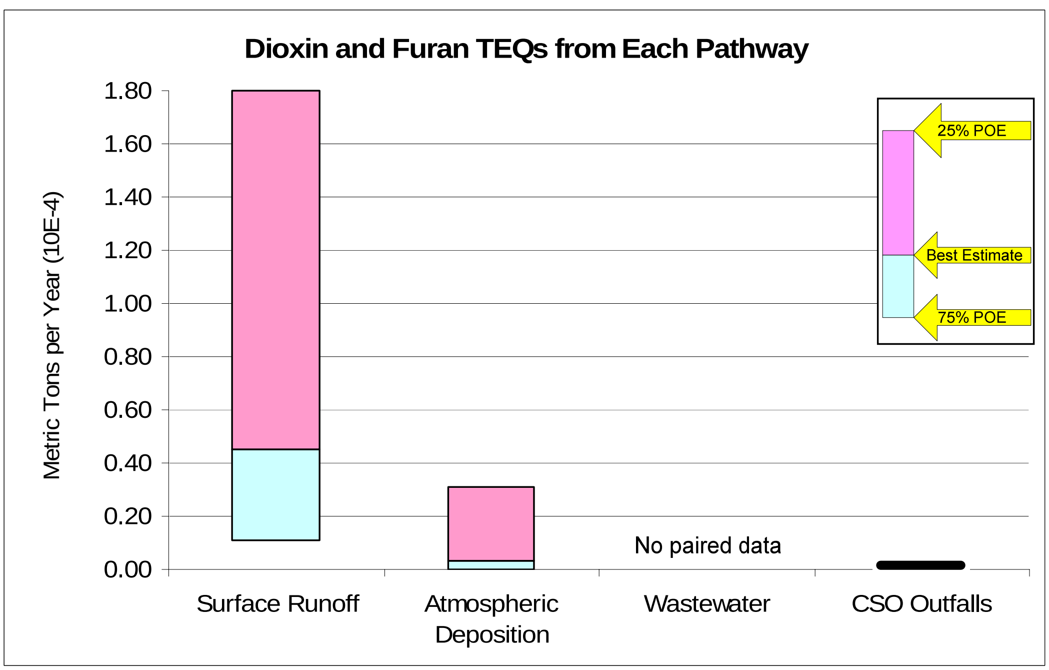
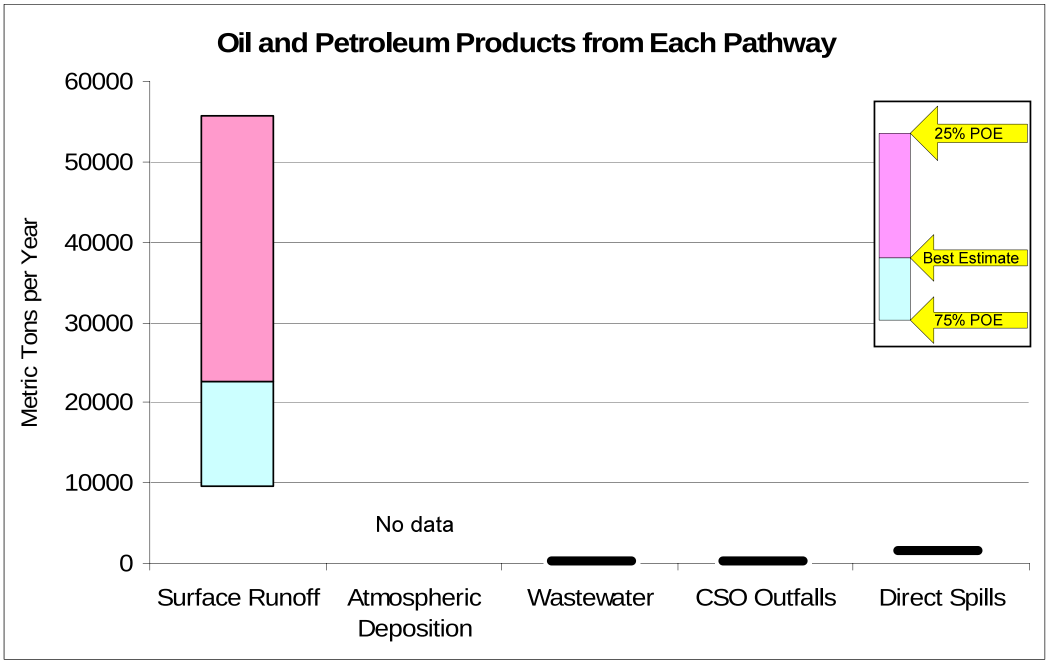
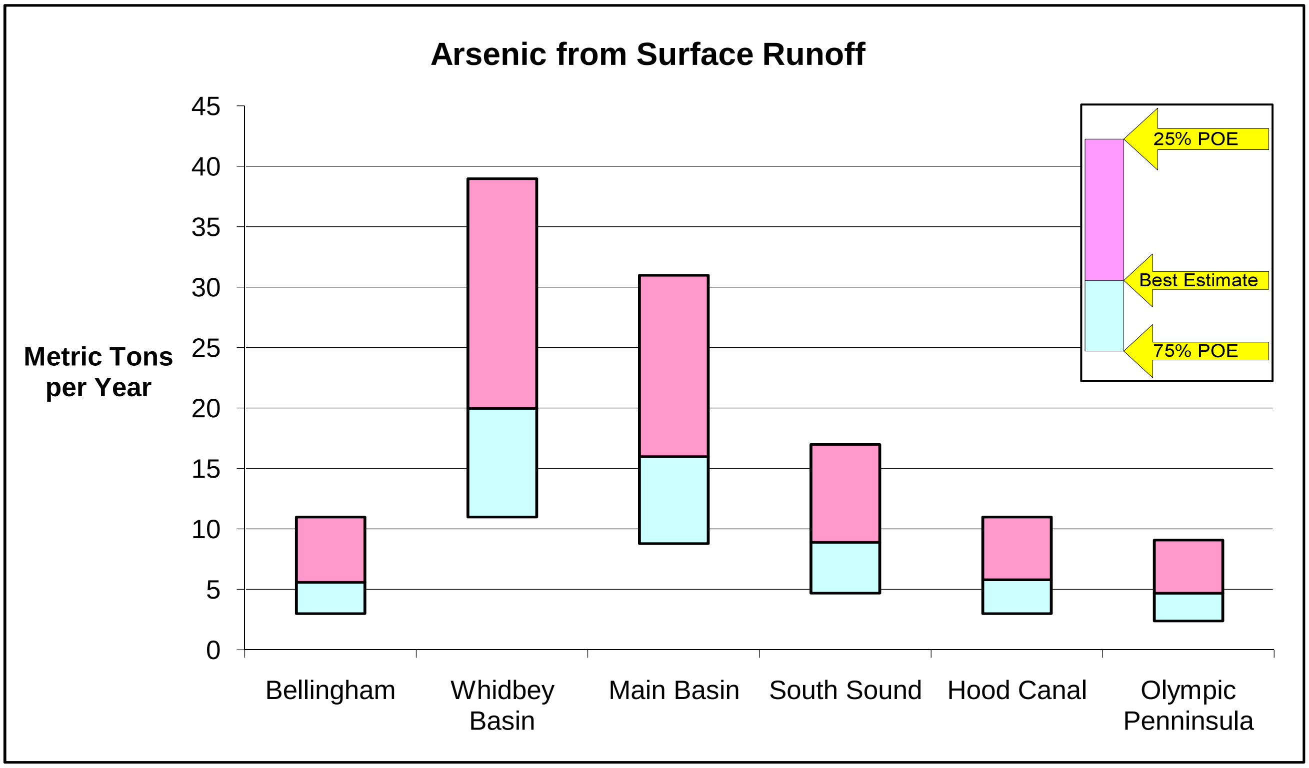


Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)



The wastewater value represents paired flow and concentration data from only 16 of about 200 permitted dischargers.

Figure 7 – Ranges of Toxic Chemical Loadings for Each Pathway (continued)



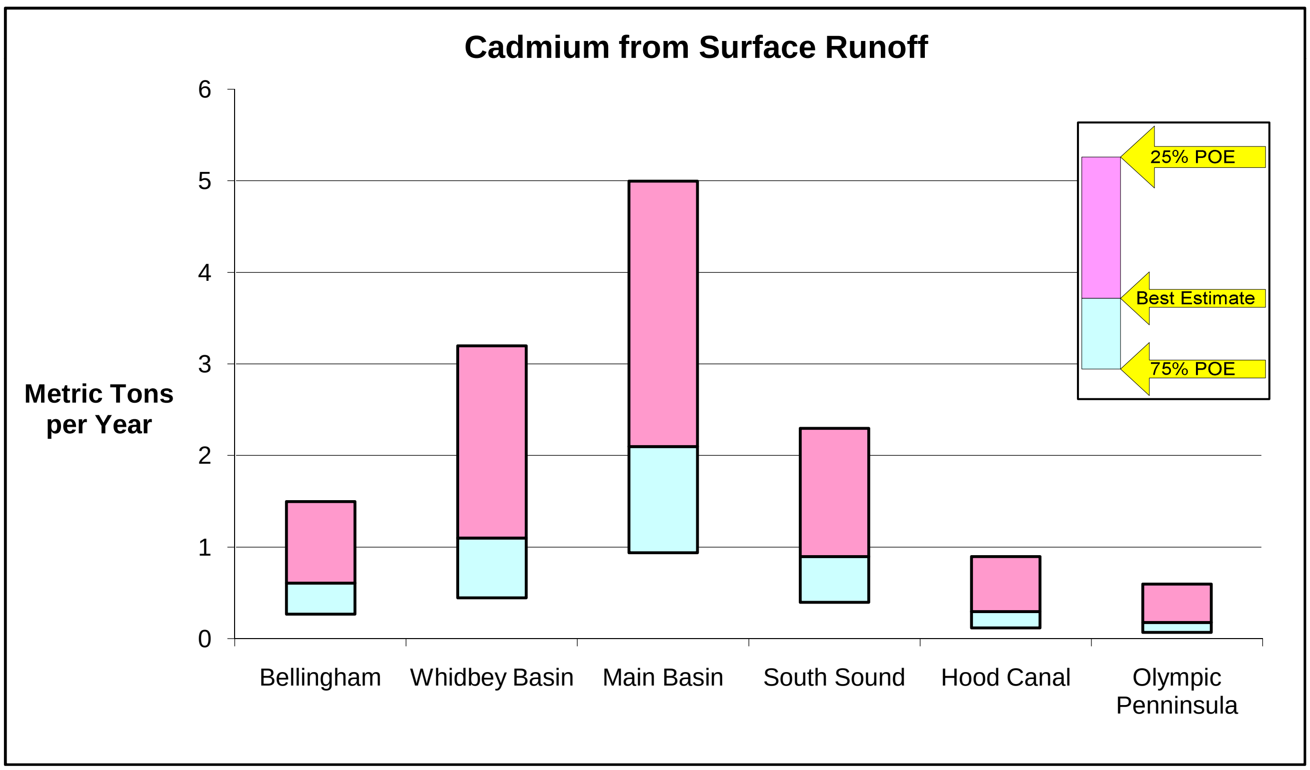
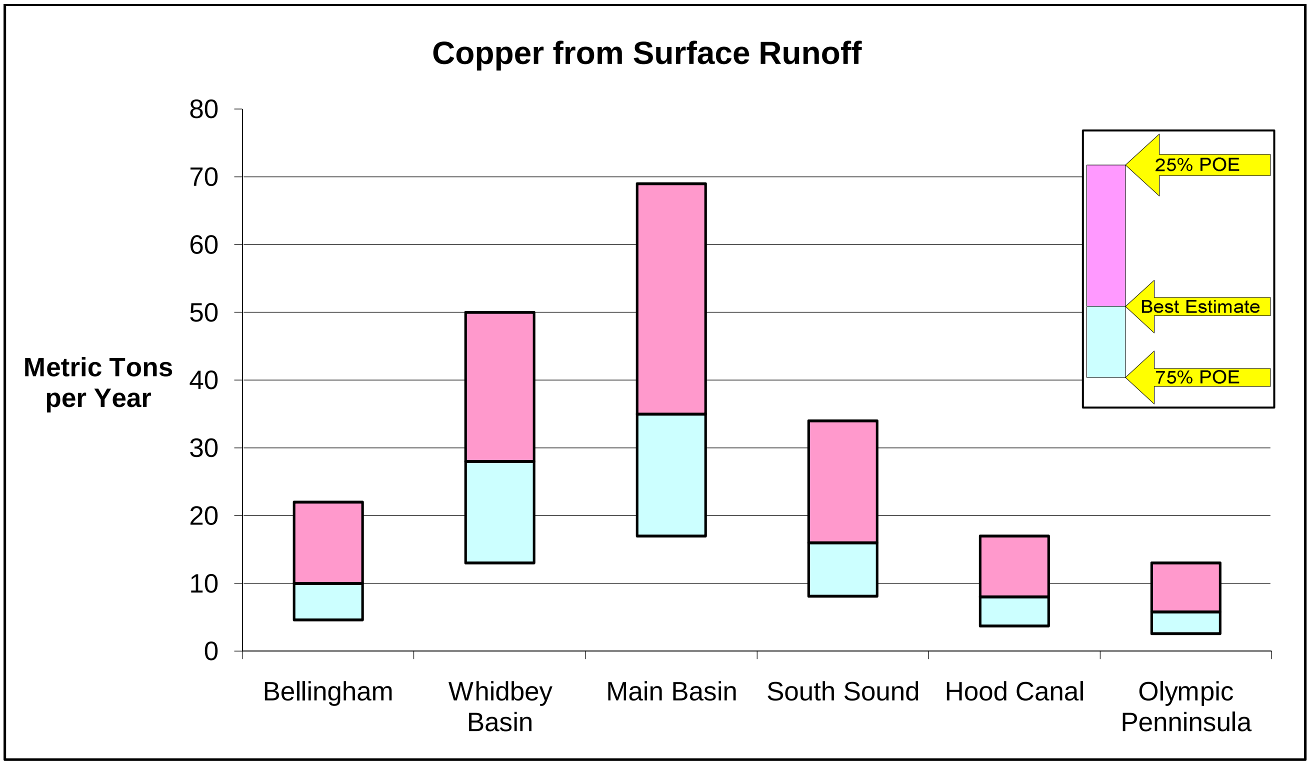


Figure 8 - Ranges of Toxic Chemical Loadings from Surface Runoff for Each Study Area



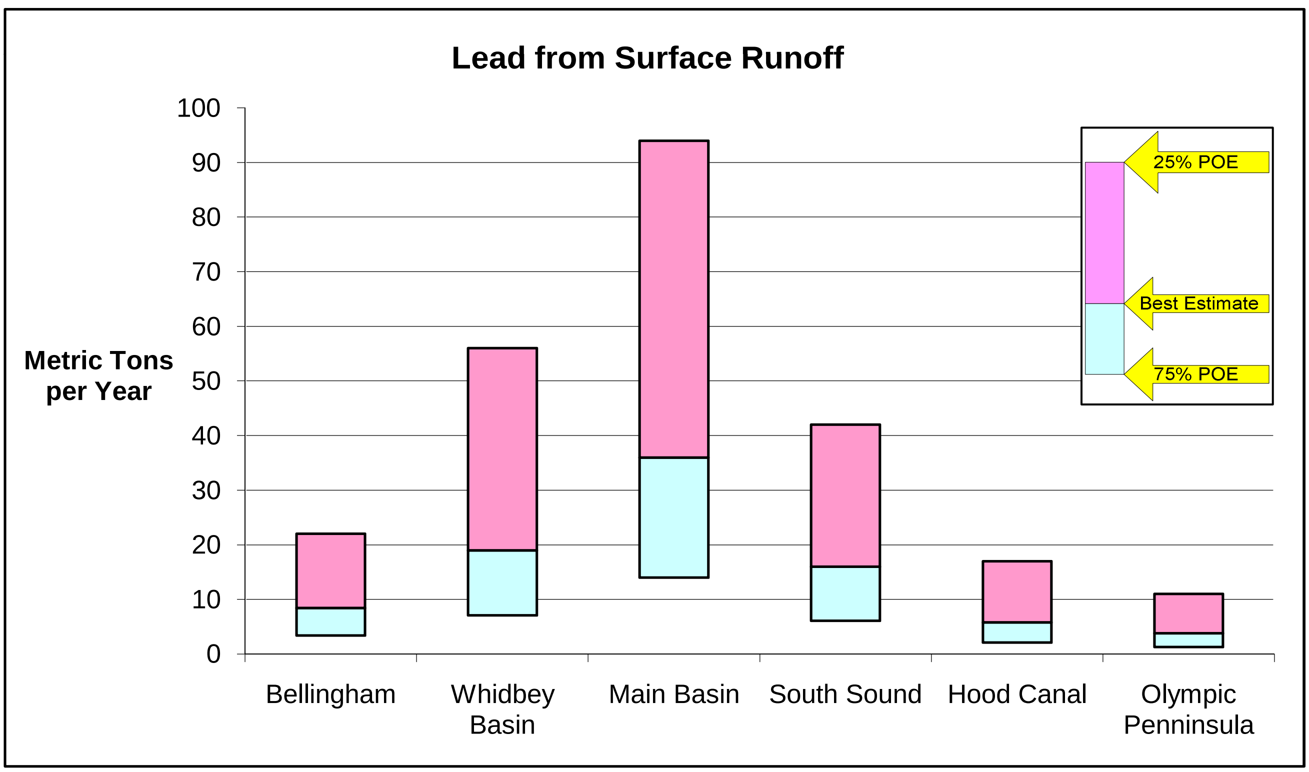
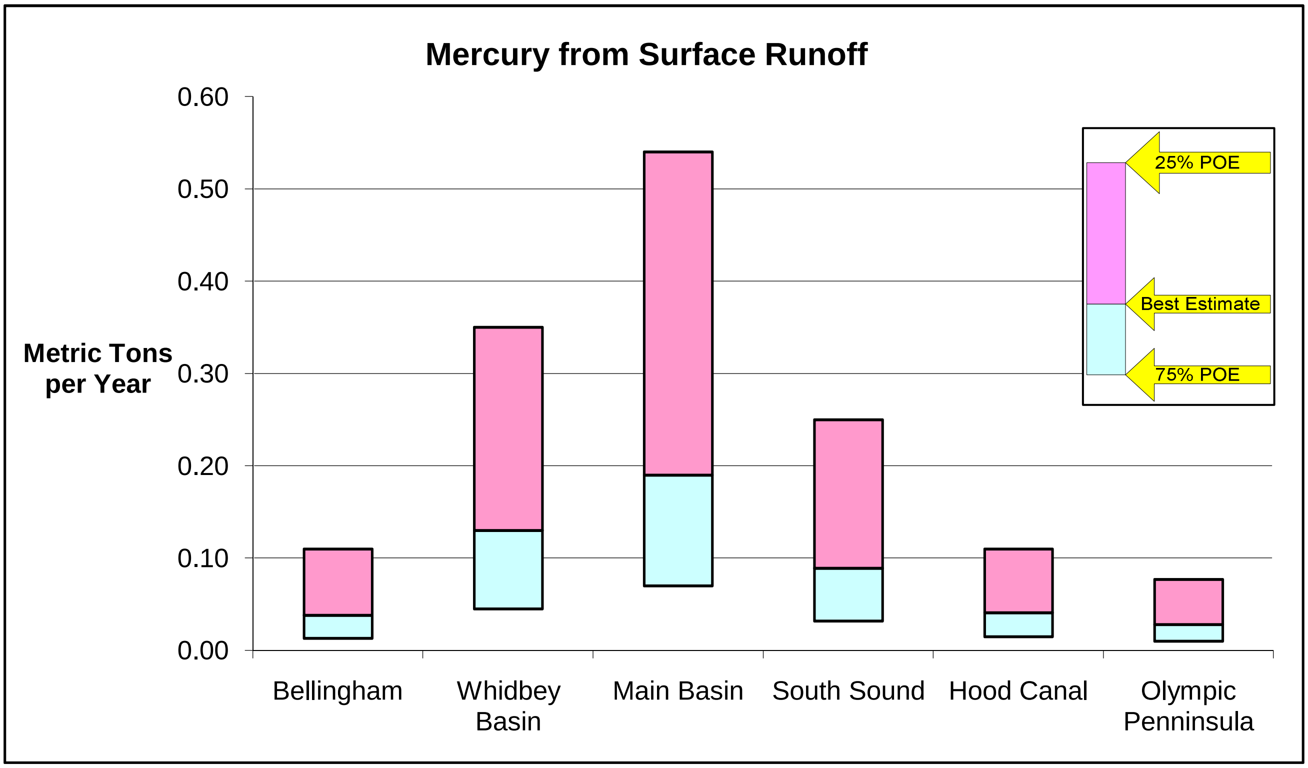
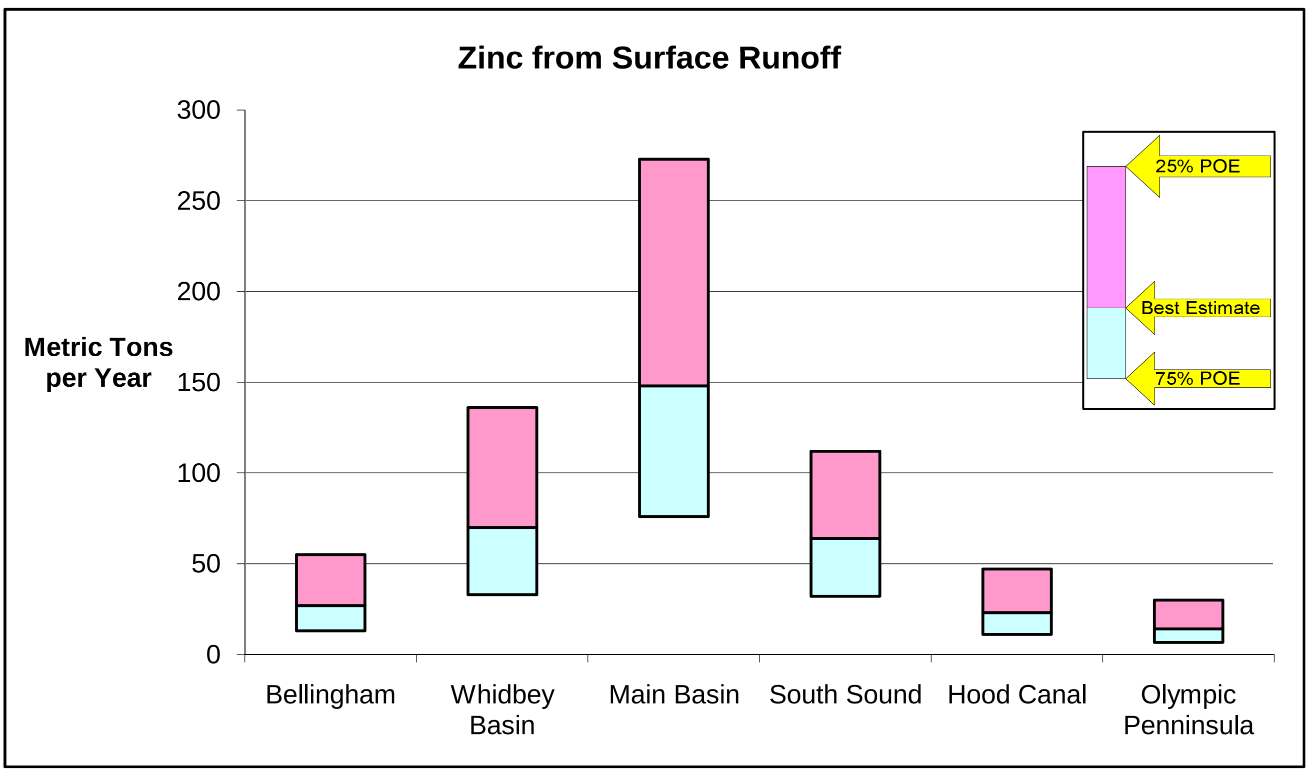


Figure 8 - Ranges of Toxic Chemical Loadings from Surface Runoff for Each Study Area





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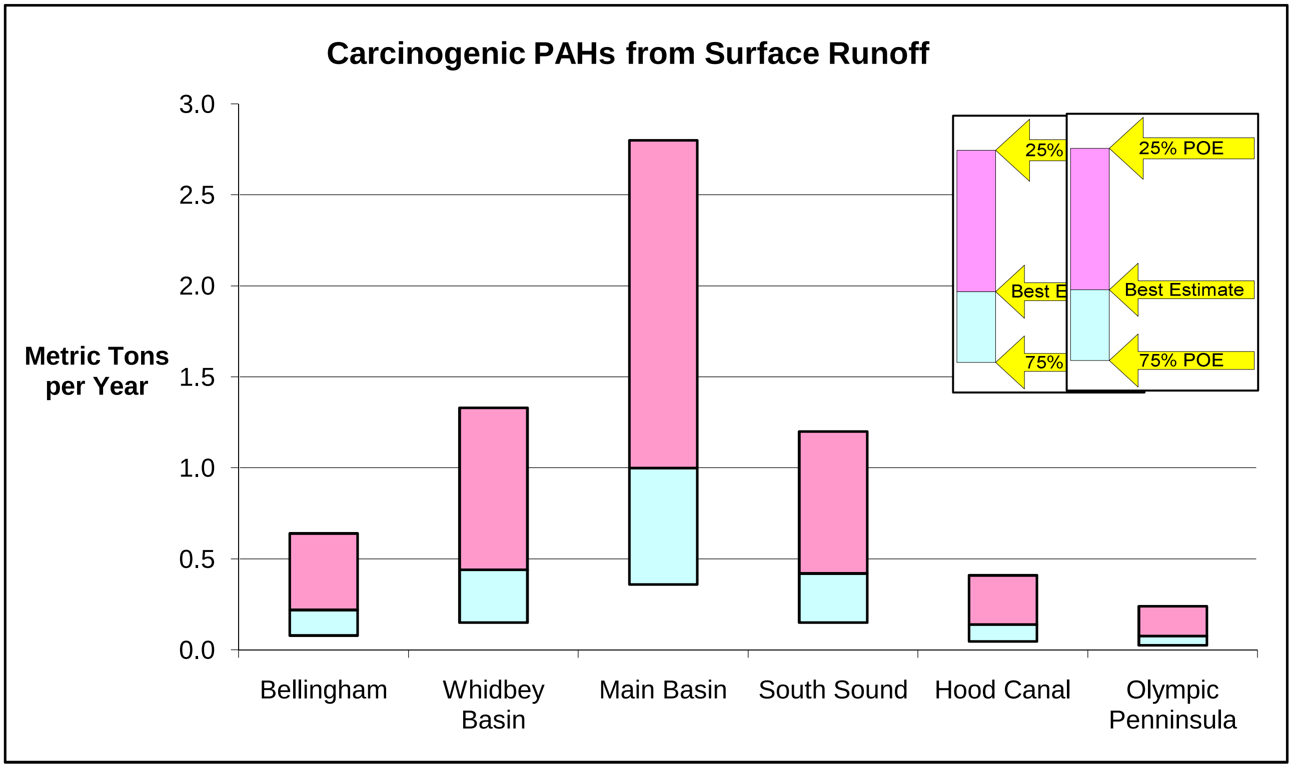

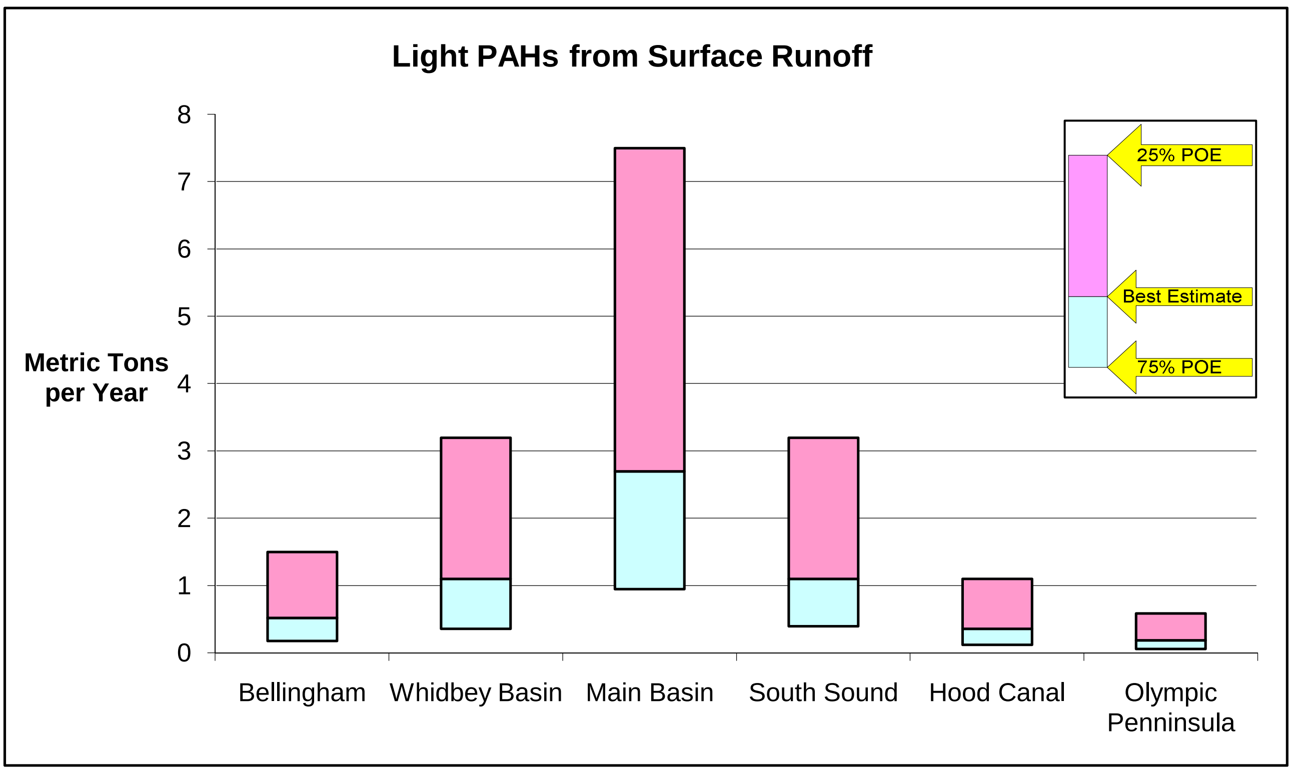

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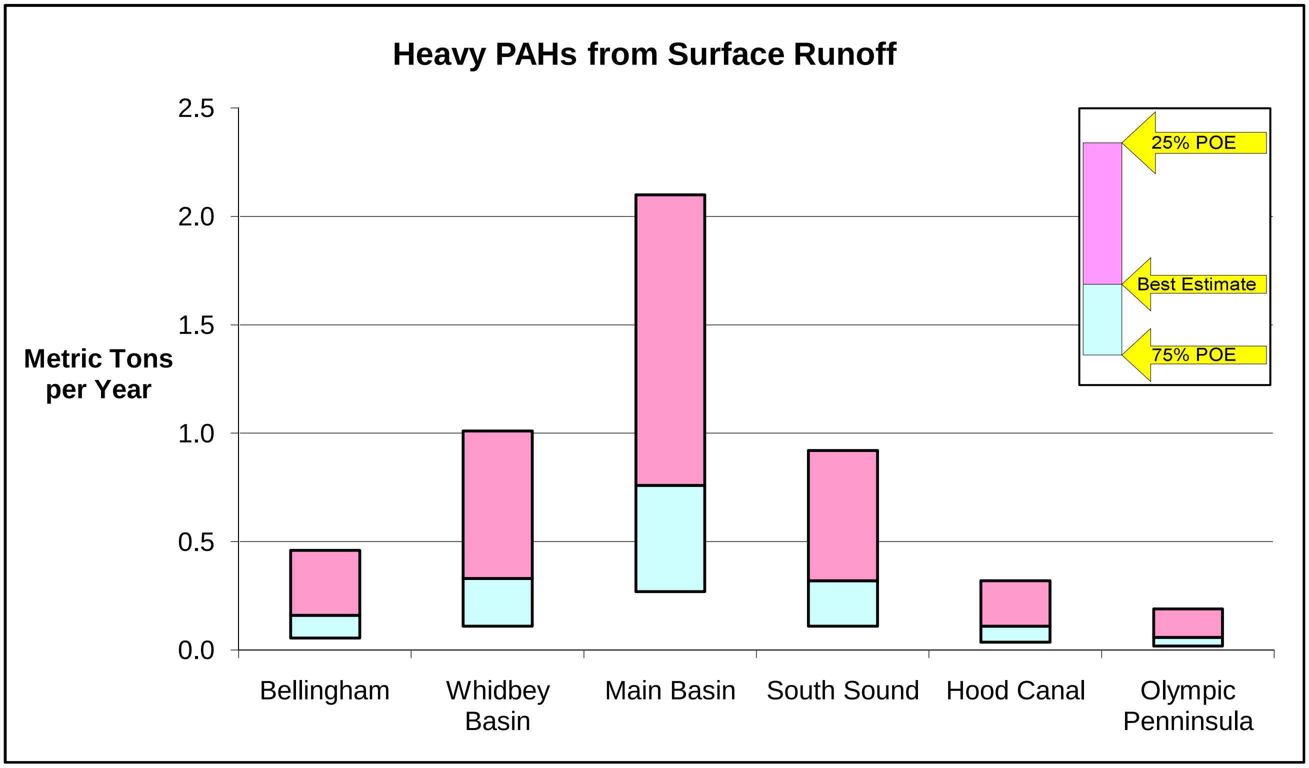

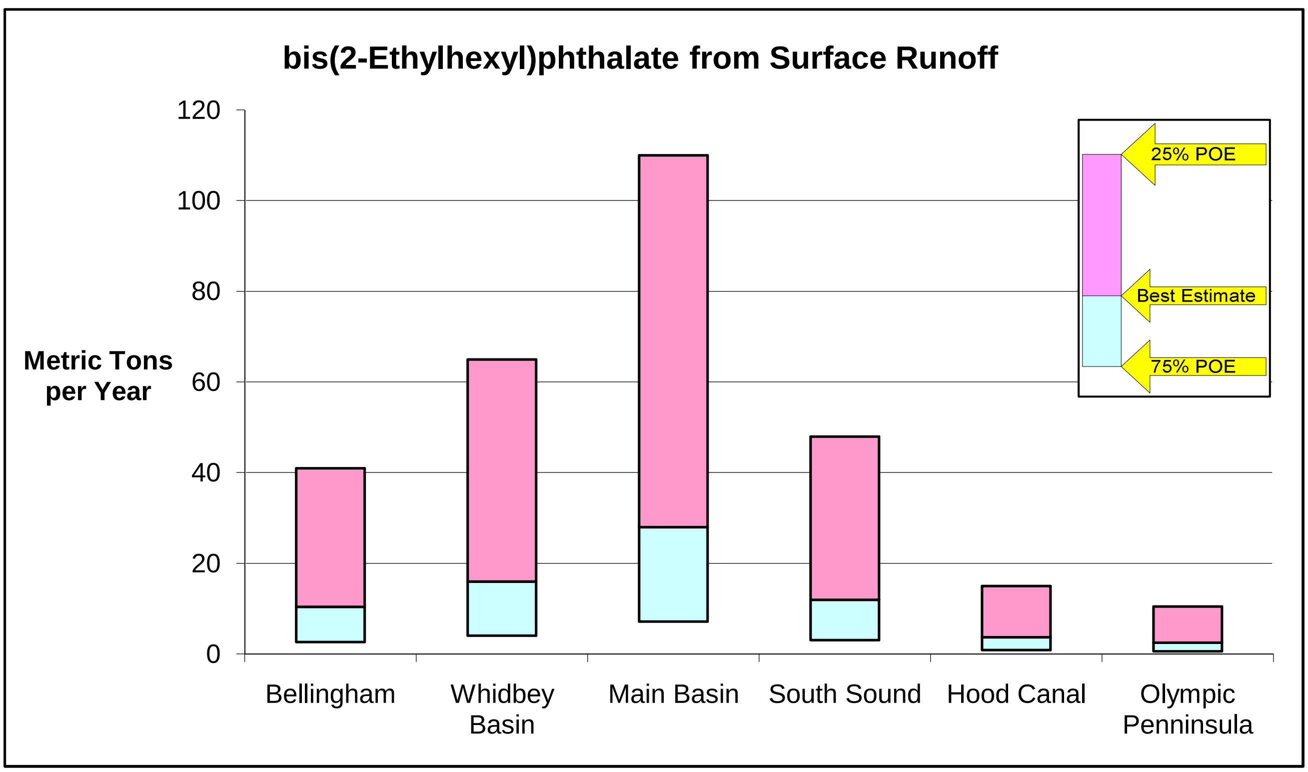

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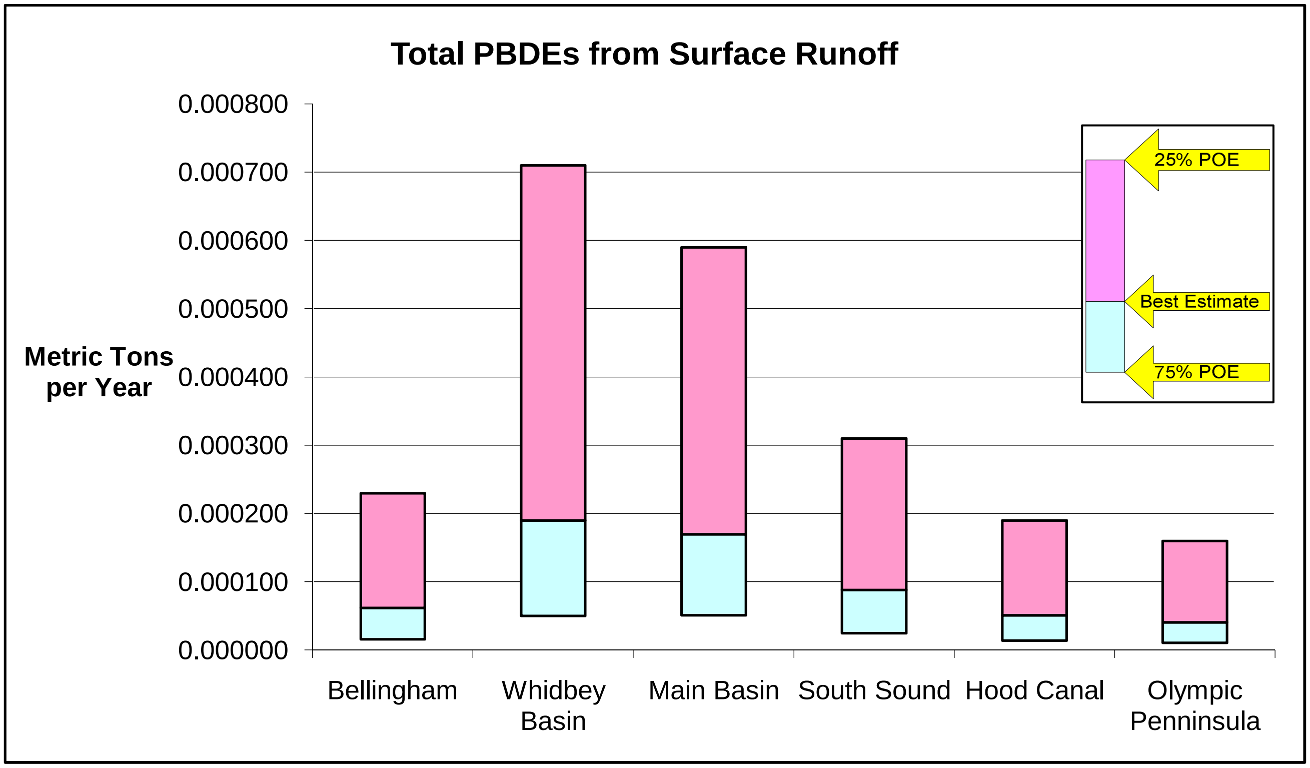

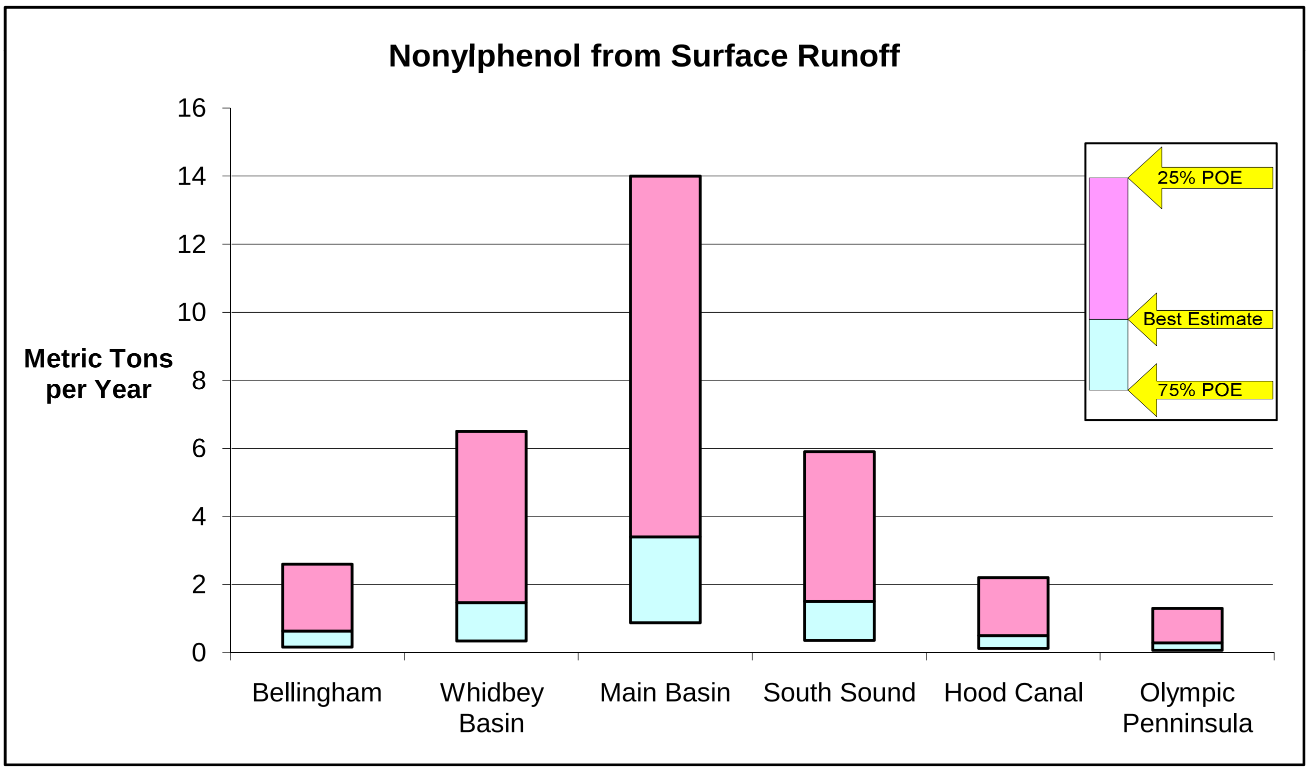

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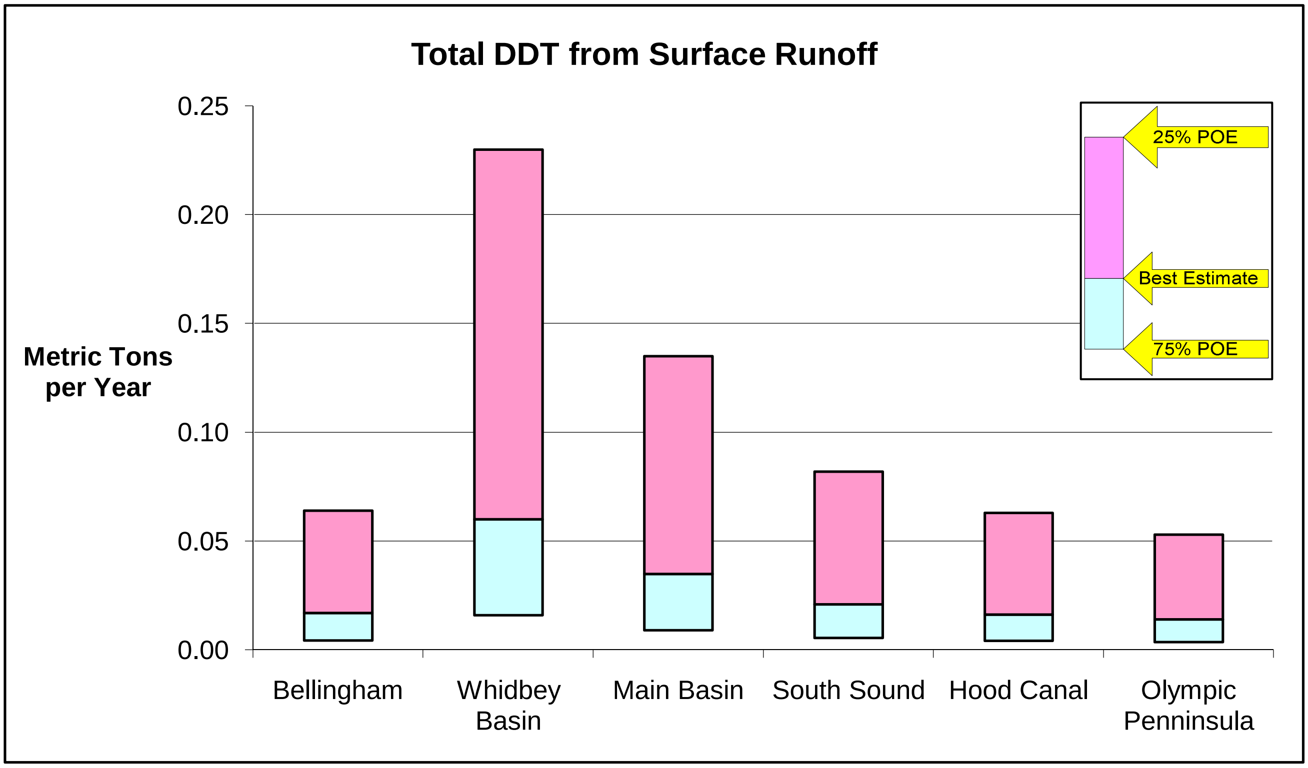

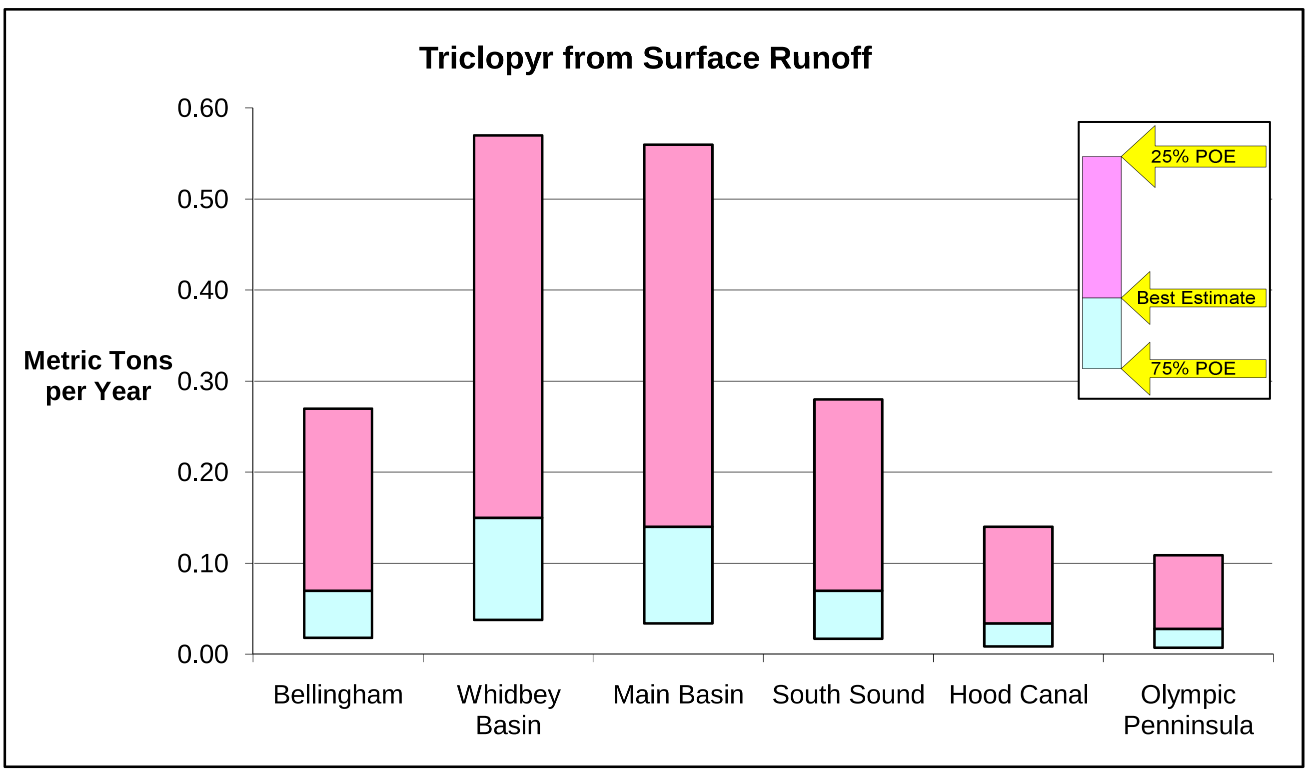

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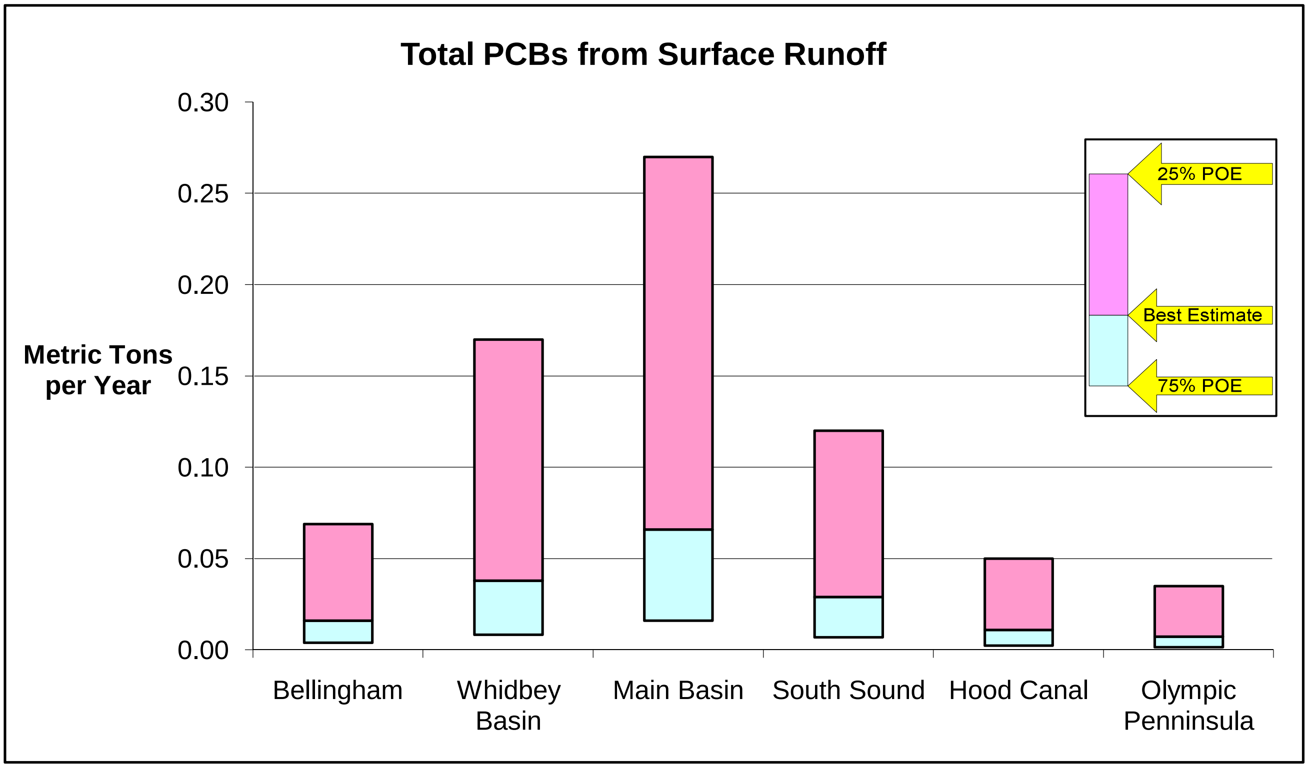

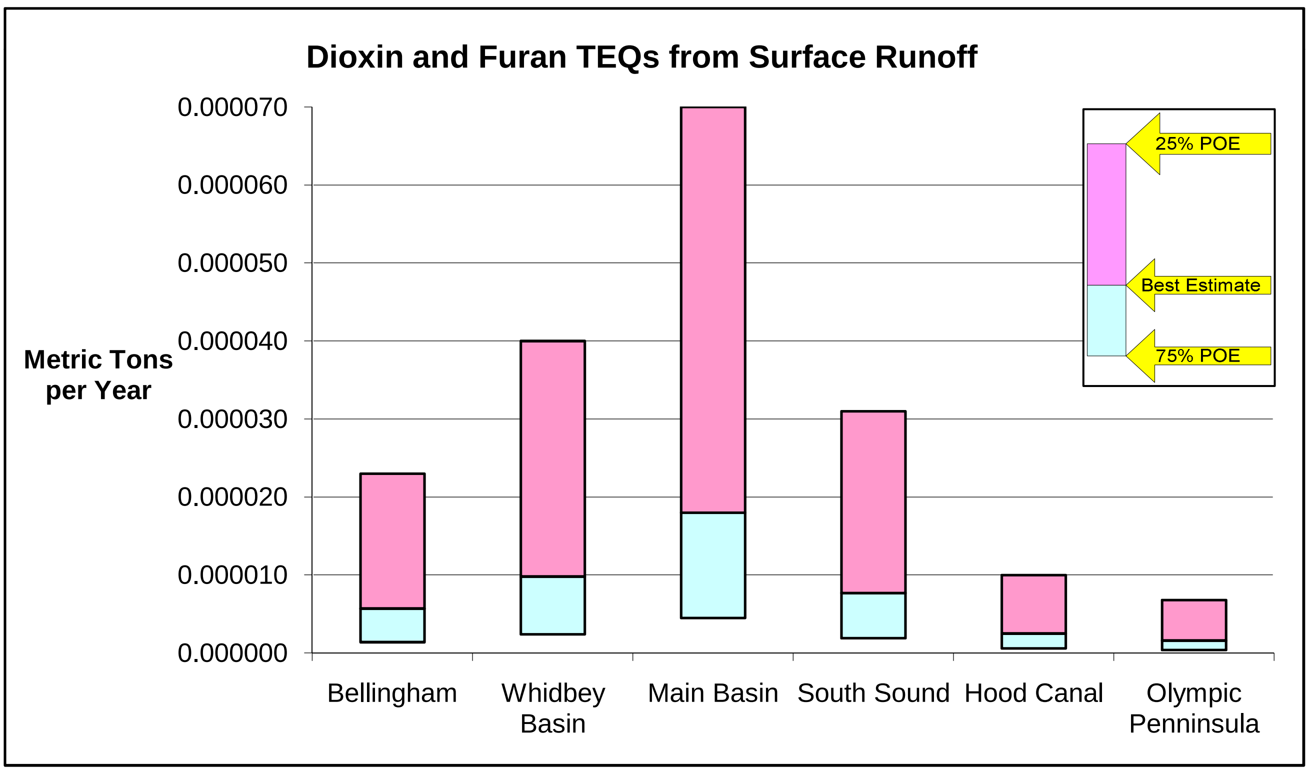

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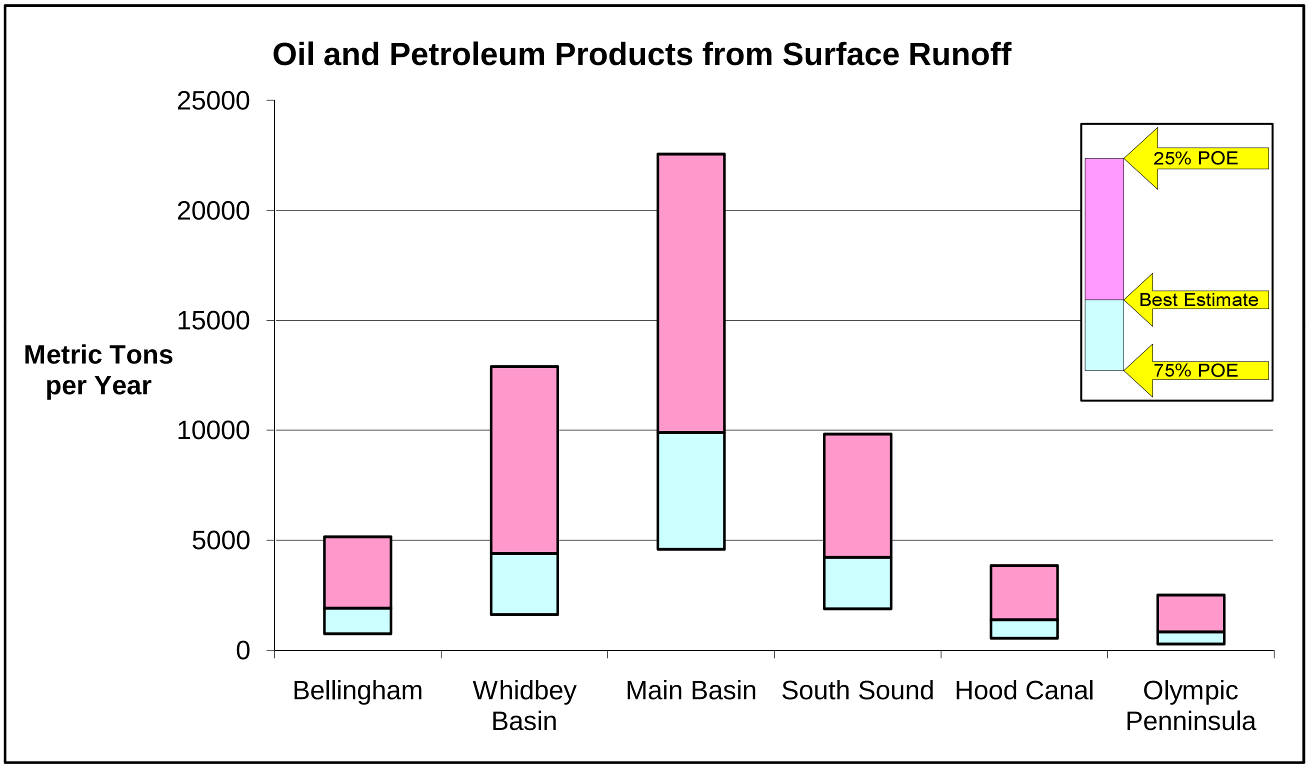


Figure 8 - Ranges of Toxic Chemical Loadings from Surface Runoff for Each Study Area

Appendices

Appendix A

Runoff Concentration Observations from Various Studies

Appendix A – Runoff Concentration Observations from Various Studies

As part of this Phase 1 study, Hart Crowser performed an extensive literature survey to obtain runoff water quality data that could be used for the loading calculations. This appendix summarizes the results of this literature review.

Arsenic

The probability distributions of observed arsenic (total) concentrations, as defined in the National Stormwater Quality Database (NSQD), vary with land use as follows:

Land Use	*Median (ug/L)*	σ
Open	3.0 to 4.0	-
Residential	3.0	0.85
Commercial/Industrial	2.0 to 4.0	0.66 to 0.95

Monitoring of stormwater outfalls during the ENVVEST study (Cullinan et al. 2006) indicates (total arsenic):

Outfall Type	*Median (ug/L)*
Urban	0.9 to 1.5
Industrial	6 to 9

Surface water concentrations of arsenic (total recoverable) were measured during the Stillaguamish River Total Maximum Daily Load (TMDL) study at the following sites on the dates indicated (Ecology 2004a):

Site	*Concentration Range (ug/L)*	*Date*
North Fork Stillaguamish River	0.43, 1.1	5/8/01, 1/31/01
South Fork Stillaguamish River at Confluence	0.44, 4.1	5/8/01, 1/31/01
Stillaguamish River at Interstate 5	0.6, 2.4	5/8/01, 1/31/01
Stillaguamish River at Marine Drive	0.47, 2.7	5/8/01, 1/31/01
North Fork Stillaguamish River near Darrington	0.19, 2.0	6/19/02, 2/27/02
Stillaguamish River at Silvana	0.37, 2.65	6/19/02, 8/21/01

Measured monthly average arsenic concentrations (total recoverable) in the Lower Similkameen River at Oroville, Washington, for the period May 2000 to June 2001 (Ecology 2004b) generally varied between 1.0 and 1.5 ug/L for most of the monitoring period, and were as great as 2.5 ug/L for 2 months.

McKee et al. (2005) monitored arsenic concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range 2.2 to 4.2 ug/L.

Colich (2003) detected total arsenic concentrations of 0.3 to 2.0 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in the Seattle, Washington area.

Cadmium

The probability distributions of observed cadmium (total) concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	*Median (ug/L)*	σ
Open	0.4	2.6
Residential	0.5 to 0.9	1.2
Commercial/Industrial	0.9 to 2.0	0.8 to 1.3

Monitoring of stormwater outfalls during the ENVVEST study indicates (total cadmium):

Outfall Type	*Median (ug/L)*
Urban	0.2
Industrial	0.6

The mean cadmium concentrations used in the San Francisco Bay study (Davis et al., 2000) were:

Land Use	*Mean (ug/L)*
Open	0.4
Residential	1.7
Commercial	1.9
Industrial	3.1

The mean cadmium concentrations used in the Southern California Bight study (Los Angeles and San Diego areas) (Ackerman and Schiff 2003) were:

Land Use	*Geometric Mean (ug/L)*
Open	0.09
Residential	0.20
Commercial	0.26
Industrial	0.46
Agriculture	4.3

A 1994 study of the Green, Duwamish, Puyallup, and Yakima Rivers (Ecology 1994) measured the following cadmium (total) concentrations:

River	Median (ug/L)	Range (ug/L)
Green	0.006	0.002 to 0.051
Duwamish	0.012	0.005 to 0.041
Puyallup	0.026	0.005 to 0.091
Yakima	0.015	0.010 to 0.045

Ecology (1994) also presents total cadmium data for other rivers (Table 9 of the report):

River	Median (ug/L)
Snohomish	0.014
Lower Columbia	0.029
Upper Columbia	0.17
Spokane	0.28

McKee et al. (2005) monitored cadmium concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range 0.48 to 0.69 ug/L.

Colich (2003) detected total cadmium concentrations of 0.2 to 0.5 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in Seattle, Washington.

Copper

The probability distributions of observed copper (total) concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	Median (ug/L)	σ
Open	10	1.2
Residential	12 to 16	-
Commercial/Industrial	17 to 23 (35 highways)	0.8 to 1.0

Monitoring of stormwater outfalls during the ENVVEST study indicates (total copper):

Outfall Type	Median (ug/L)
Urban	6 to 15
Industrial	25 to 75
Low Development	1 to 4
Moderate Development	2.5 to 4.5
High Development	4 to 9

As part of the copper mass balance calculation for Sinclair and Dyes Inlets (Crecelius et al. 2003), the following mean monthly copper (total) concentrations were measured in inflowing streams during baseflow (non-storm event) conditions:

Stream	*Monthly Mean (ug/L)*	
	Wet Season	*Dry Season*
Clear Creek	2.0	0.33
Strawberry Creek	1.9	0.47
Barker Creek	2.5	0.31
Chico Creek	2.5	0.60
Gorst Creek	1.5	1.1
Blackjack Creek	1.5	0.26
Olney Creek	9.9	0.47
Anderson Creek	16	0.26

The mean copper concentrations used in the San Francisco Bay study were:

Land Use	*Mean (ug/L)*
Open	11
Residential	51
Commercial	51
Industrial	53

The mean copper concentrations used in the Southern California Bight study were:

Land Use	*Geometric Mean (ug/L)*
Open	5
Residential	16
Commercial	21
Industrial	28
Agriculture	150

A 1994 study of the Green, Duwamish, Puyallup, and Yakima Rivers (Ecology 1994) measured the following copper (total) concentrations:

River	*Median (ug/L)*	*Range (ug/L)*
Green	0.41	0.26 to 17
Duwamish	0.96	0.69 to 3.8
Puyallup	17	1.1 to 41
Yakima	2.2	1.0 to 2.9

Ecology (1994) also presents total copper data for other rivers (Table 9 of the report):

River	*Median (ug/L)*
Snohomish	1.3
Lower Columbia	1.7
Upper Columbia	1.7
Spokane	0.74

A water quality monitoring study of an industrial area creek (Ecology 2006a) detected total recoverable copper concentrations ranging from 0.94 to 13.6 ug/L (August 28-29, 2005), 0.89 to 14 ug/L (September 29 – October 1, 2005), and 1.2 to 6.0 ug/L (December 19-20, 2005).

A large-scale water quality analysis of the Green-Duwamish Watershed (King County 2007) measured total copper concentrations at the following sites during the period 2001-2003 (Table B-15 of the report):

Location/Land Use	*Median (ug/L)*	
	Baseflow	*Stormflow*
Green River	0.40 to 0.70	0.87 to 1.4
Major Streams	0.48 to 1.6	1.3 to 5.0
Forest	0.20 to 0.63	0.52 to 2.0
Agriculture	1.6 to 4.9	4.7 to 7.2
Low/Medium Development	0.67 to 1.2	2.1 to 4.6
High Development	1.6 to 3.2	3.7 to 5.0

Surface water monitoring data provided by Ecology and other agencies indicated the following average total copper concentrations in rivers and streams:

Location	*Time Period*	*No. of Observations*	*Mean (ug/L)*
Snohomish River near Monroe	07/24/01 – 05/15/02	6	0.51
Quilceda Creek (downstream)	02/08/01 – 04/10/01	5	2.0
May Creek (lower)	07/24/01 – 05/15/02	6	1.3
Allen Creek (upstream)	06/13/00 – 04/10/01	5	3.0

McKee et al. (2005) monitored copper concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range 9 to 55 ug/L.

Colich (2003) detected total copper concentrations of 34 to 59 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in the Seattle, Washington area.

Lead

The probability distributions of observed lead (total) concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	*Median (ug/L)*	σ
Open	10	1.9
Residential	12 to 16	-
Commercial/Industrial	17 to 25	1.0 to 1.3

Monitoring of stormwater outfalls during the ENVVEST study indicates (total lead):

Outfall Type	*Median (ug/L)*
Urban	9 to 10
Industrial	10 to 14
Low Development	0.3 to 1.4
Moderate Development	1.3 to 2.4
High Development	3 to 11

The mean lead concentrations used in the San Francisco Bay study were:

Land Use	*Mean (ug/L)*
Open	7
Residential	52
Commercial	151
Industrial	143

The mean lead concentrations used in the Southern California Bight study were:

Land Use	*Geometric Mean (ug/L)*
Open	0.7
Residential	4.0
Commercial	3.7
Industrial	5.9
Agriculture	43

A 1994 study of the Green, Duwamish, Puyallup, and Yakima Rivers (Ecology 1994) measured the following lead (total) concentrations:

River	*Median (ug/L)*	*Range (ug/L)*
Green	0.099	0.035 to 2.0
Duwamish	0.26	0.13 to 2.0
Puyallup	1.5	0.19 to 4.5
Yakima	0.64	0.21 to 1.0

Ecology (1994) also presents total lead data for other rivers (Table 9 of the report):

River	*Median (ug/L)*
Snohomish	0.17
Lower Columbia	0.35
Upper Columbia	3.2
Spokane	1.1

Surface water monitoring data provided by Ecology and other agencies indicated the following average total lead concentrations in rivers and streams:

Location	*Time Period*	*No. of Observations*	*Mean (ug/L)*
Snohomish River near Monroe	07/24/01 – 11/13/01	3	0.0074
Quilceda Creek (downstream)	06/13/00 – 04/10/01	5	0.39
Quilceda Creek (middle fork)	02/08/01 – 04/10/01	2	0.83
May Creek (lower)	07/24/01 – 05/15/02	6	0.13
Allen Creek (upstream)	06/13/00 – 04/10/01	5	0.29

McKee et al. (2005) monitored lead concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range of 19 to 34 ug/L.

Colich (2003) detected total lead concentrations of 6 to 18 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in the Seattle, Washington area.

Zinc

The probability distributions of observed zinc (total) concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	*Median (ug/L)*	σ
Open	40	1.2
Residential	73 to 95	-
Commercial/Industrial	150 to 200	0.8 to 1.0

Monitoring of stormwater outfalls during the ENVVEST study indicates (total zinc):

Outfall Type	*Median (ug/L)*
Urban	50 to 65
Industrial	80 to 130
Low Development	4 to 9
Moderate Development	13 to 18
High Development	14 to 35

The mean zinc concentrations used in the San Francisco Bay study were:

Land Use	*Mean (ug/L)*
Open	34
Residential	188
Commercial	397
Industrial	371

The mean zinc concentrations used in the Southern California Bight study were:

Land Use	*Geometric Mean (ug/L)*
Open	3.2
Residential	70
Commercial	160
Industrial	200
Agriculture	220

A 1994 study of the Green, Duwamish, Puyallup, and Yakima Rivers (Ecology 1994) measured the following zinc (total) concentrations:

River	*Median (ug/L)*	*Range (ug/L)*
Green	1.3	0.38 to 7.5
Duwamish	2.2	0.88 to 9.5
Puyallup	17	1.4 to 44
Yakima	3.0	1.3 to 5.7

Ecology (1994) also presents total zinc data for other rivers (Table 9 of the report):

River	*Median (ug/L)*
Snohomish	3.1
Lower Columbia	1.4
Upper Columbia	2.1
Spokane	109

A water quality monitoring study of an industrial area creek (Ecology 2006a) detected total recoverable zinc concentrations ranging from 5.0 to 105 ug/L (August 28-29, 2005), 6.0 to 89 ug/L (September 29 – October 1, 2005), and 19 to 76 ug/L (December 19-20, 2005).

A large-scale water quality analysis of the Green-Duwamish Watershed (King County 2007) measured total zinc concentrations at the following sites during the period 2001-2003 (Table B-15 of the report):

Location/Land Use	*Median (ug/L)*	
	Baseflow	*Stormflow*
Green River	0.59 to 1.0	1.7 to 3.6
Major Streams	0.67 to 10	1.8 to 30
Forest	0.38 to 0.60	0.95 to 2.5
Agriculture	2.4 to 6.6	6.6 to 20
Low/Medium Development	0.94 to 4.0	3.0 to 10
High Development	10 to 24	20 to 40

Surface water monitoring data provided by Ecology and other agencies indicated the following average total zinc concentrations in rivers and streams:

Location	*Time Period*	*No. of Observations*	*Mean (ug/L)*
Snohomish River near Monroe	07/24/01 – 11/13/01	3	0.44
Quilceda Creek (downstream)	06/13/00 – 04/10/01	5	6.4
Quilceda Creek (middle fork)	02/08/01 – 04/10/01	2	4.5
May Creek (lower)	07/24/01 – 05/15/02	6	3.4
Allen Creek (upstream)	06/13/00 – 04/10/01	5	6.0

McKee et al. (2005) monitored zinc concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range of 140 to 190 ug/L.

Colich (2003) detected total zinc concentrations of 53 to 158 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in the Seattle, Washington.

Mercury

The probability distributions of observed mercury (total) concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	*Median (ug/)L*
Mixed Open	0.15
Residential	0.2
Commercial/Industrial	0.2 to 0.3

Monitoring of stormwater outfalls during the ENVVEST study indicates (total mercury):

Outfall Type	*Median (ug/L)*
Urban	0.008 to 0.02
Industrial	0.02 to 0.1
Low Development	0.003 to 0.01
Moderate Development	0.007 to 0.013
High Development	0.005 to 0.026

Surface water concentrations of mercury (total recoverable) were measured during the Stillaguamish River TMDL study at the following sites on the dates indicated (Ecology 2004a):

Site	*Concentration Range (ug/L)*	*Date*
North Fork Stillaguamish River	0.002, 0.016	7/12/01, 6/12/01
South Fork Stillaguamish River at Confluence	0.0021, 0.050	10/5/00, 1/31/01
Stillaguamish River at Interstate 5	0.0026, 0.022	7/12/01, 1/31/01
Stillaguamish River at Marine Drive	0.0036, 0.022	7/12/01, 1/31/01
North Fork Stillaguamish River near Darrington	0.002, 0.015	8/21/02, 2/27/02

Surface water monitoring data provided by Ecology and other agencies indicated the following average total mercury concentrations in rivers and streams:

Location	*Time Period*	*No. of Observations*	*Mean (ug/L)*
Snohomish River near Monroe	07/24/01 – 05/15/02	6	0.0020
Mill Creek (at mouth)	07/24/01 – 05/15/02	6	0.0052

The mean mercury concentrations used in the Southern California Bight study were:

Land Use	*Geometric Mean (ug/L)*
Open	0.07
Residential	0.04
Commercial	0.02
Industrial	0.06
Agriculture	0.11

A large-scale water quality analysis of the Green-Duwamish Watershed (King County 2007) measured total mercury concentrations at the following sites during the period 2001-2003 (Table B-15 of the report):

Location/Land Use	Median (ug/L)	
	Baseflow	*Stormflow*
Green River	0.0050	0.0050
Major Streams	0.0013 to 0.0050	0.0036 to 0.0075
Forest	0.0012 to 0.0050	0.0029 to 0.0079
Agriculture	0.0043 to 0.0054	0.0073 to 0.0086
Low/Medium Development	0.0014 to 0.0050	0.0057 to 0.030
High Development	0.0050	0.0061 to 0.0094

McKee et al. (2005) monitored mercury concentrations in the Guadalupe River as part of the San Francisco Bay toxic chemical loading study from November 2002 to May 2003 and detected flow-weighted total mean concentrations in the range of 0.8 to 3.8 ug/L.

Colich (2003) detected total mercury concentrations of 0.003 to 0.012 ug/L in stormwater runoff samples collected from four different drains on the Evergreen Point floating bridge in the Seattle, Washington area.

PCBs

Analyses by King County presented at the 2007 Georgia Basin Puget Sound Research Conference (Nairn 2007) indicate an average PCB concentration in the Green River (near the confluence with the Duwamish River) of about 0.001 ug/L. This value is based on a reported 1 kg/yr mass loading (Nairn 2007) and an estimated average annual flow rate of 31 m3/sec.

The average annual total PCB concentrations detected in streams during the Walla Walla River TMDL (Ecology 2004c) are:

Stream	*Mean (ug/L)*
Yellowhawk Creek	0.00086
Garrison Creek	0.0036
Lower Mill Creek	0.00069
Middle Walla Walla River	0.00061
Lower Walla Walla River	0.00042

Rossi et al. (2004) conducted a one-year study of PCB concentrations in urban stormwater in Switzerland and identified concentrations ranging from below the detection limit (0.00011 to 0.00024 ug/L) to 0.40 ug/L.

Peng et al. (2002) reported the following total PCB concentrations in stormwater based on the TMDL for Newport Bay in Southern California: Agriculture = 0.05 ug/L; Residential = 0.15 ug/L.

Pitt et al. (1996) reported average PCB concentration data for a Toronto stormwater outfall (Table 15 of the book): Residential = <0.020 ug/L; Industrial = 0.033 ug/L.

PCB concentrations in rain were monitored by ter Schure et al. (2004) on an island in the central basin of the Baltic Sea. Detected average concentrations ranged from 0.0001 to 0.002 ug/L.

Total PBDEs

Water samples obtained during a study of Washington State rivers and lakes (Ecology 2006b) indicated the following concentrations:

Location	*Date*	*Total PBDEs (ug/L)*
Duwamish River	08-09/2005	< 3E-6
Upper Columbia River	08-09/2005	16E-6
Middle Columbia River	08-09/2005	50E-6
Lower Columbia River	08-09/2005	21E-6
Lower Columbia River	03-04/2006	57E-6
Yakima River	08-09/2005	3E-6
Yakima River	03-04/2006	40E-6
Lake Washington	08-09/2005	1E-6
Lake Washington	03-04/2006	80E-6
Queets River	08-09/2005	12E-6
Queets River	03-04/2006	8E-6
Potholes Reservoir	08-09/2005	9E-6
Lake Ozette	08-09/2005	4E-6

PAHs

Monitoring of stormwater outfalls during the ENVVEST study detected total PAH concentrations in the following ranges:

Outfall Type	*Total PAH (ug/L)*
Low Development	0.025 to 0.05
Moderate Development	0.025 to 0.1
High Development	0.05 to 0.15
Urban	0.25 to 1.5
Industrial	0.25 to 0.45

Pitt et al. (1994) reported PAH data for 121 stormwater samples collected mostly from residential areas of 17 cities:

Constituent	*Frequency of Detection (percent)*	*Concentration (ug/L)*
Chrysene	10	0.6 to 10
Fluoranthene	16	0.3 to 21
Phenanthrene	12	0.3 to 10
Pyrene	15	0.3 to 16

Menzie et al. (2002) conducted a detailed analysis of urban and suburban stormwater runoff to evaluate the significance of PAHs as sources of contamination in Massachusetts estuarine and coastal environments (i.e., Boston and surrounding areas, Boston Harbor, and Massachusetts Bay) with the following findings:

PAH Group	*Land Use*	*Median (ug/L)*
Total	Urban	12
Total	Non-Urban	1.3
Total	Mixed Urban Residential/Commercial and Suburban Residential	7.0 to 14
Total	Suburban Residential	0.30
Carcinogenic (total)	Urban	2.9
Carcinogenic (total)	Non-Urban	0.36
Carcinogenic (total)	Mixed Urban Residential/Commercial and Suburban Residential	1.9 to 3.4
Carcinogenic (total)	Suburban Residential	0.042
Other HMW (total)	Urban	2.2
Other HMW (total)	Non-Urban	0.29
Other HMW (total)	Mixed Urban Residential/Commercial and Suburban Residential	1.4 to 2.5
Other HMW (total)	Suburban Residential	0.036
LMW (total)	Urban	7.1
LMW (total)	Non-Urban	0.66
LMW (total)	Mixed Urban Residential/Commercial and Suburban Residential	3.9 to 10
LMW (total)	Suburban Residential	0.23

HMW = High Molecular Weight
LMW = Low Molecular Weight

The mean total PAH concentration in Vancouver, British Columbia (Brunette River Watershed) rainfall samples (Hall et al. 1996) collected between January 31 and November 14, 1995 (36 weekly samples) was 1.1 ug/L.

bis(2-Ethylhexyl)phthalate (BEHP)

Surface water monitoring data provided by Ecology and other agencies indicated the following average total BEHP concentrations in rivers and streams:

Location	*Time Period*	*No. of Observations*	*Mean (ug/L)*
Thornton Creek 3	04/16/03 – 06/24/03	5	0.18
Thornton Creek 2	04/16/03 – 06/24/03	6	0.24
Thornton Creek 1	04/16/03 – 04/30/03	2	0.12

Data from the NSQD indicate an overall median BEHP concentration in stormwater samples of 10 ug/L.

A characterization of stormwater runoff from three Puget Sound boatyards (Ecology 2006c) identified BEHP concentrations in the range of 2.1 to 15 ug/L.

King County initiated a pilot monitoring study in 2003 to evaluate surface water concentrations of Endocrine Disrupting Compounds (EDCs). The King County Department of Natural Resources and Parks reports the following data for BEHP based on 30 samples and a 100 percent detection frequency:

Location	*Maximum Detection (ug/L)*
Stream/River (dry weather)	15.8
Stream/River (wet weather)	4.6
100% Road/Bridge Runoff	20
Lakes	13
Marine	40

Pitt et al. (1994) reported BEHP data for 121 stormwater samples collected mostly from residential areas of 17 cities:

Constituent	*Frequency of Detection (percent)*	*Concentration (ug/L)*
BEHP	22	4 to 62

Triclopyr

Surface water monitoring data provided by Ecology and other agencies indicated the following average total triclopyr concentrations in rivers and streams:

Location	Time Period	No. of Observations	Mean (ug/L)
Thornton Creek 3	04/08/03 – 09/11/06	93	0.023
Thornton Creek 2	04/08/03 – 06/24/03	12	0.0039
Thornton Creek 1	04/08/03 – 04/30/03	5	0.024
Thornton Creek 1.1	03/30/04 – 09/05/06	41	0.015
Juanita Creek (mouth)	05/12/97 – 08/18/97	4	0.090
Indian Creek (lower)	04/28/97 – 07/07/97	6	0.019
Indian Slough 1	03/21/06 – 09/05/06	17	0.14
Browns Slough 1	03/02/06 – 08/02/06	16	0.019
Big Ditch 1	03/02/06 – 09/05/06	24	0.036
Samish River (lower)	03/07/06 – 09/11/06	25	0.002
Samish River (upper)	03/02/06 – 09/11/06	26	0.001

The USGS, Ecology, and King County studied the types of pesticides and herbicides in urban stream waters in the County (USGS 1999). Triclopyr detections ranged from 0.03 to 1 ug/L.

A USGS study of surface water quality of the Skokomish, Nooksack, and Green-Duwamish Rivers and Thornton Creek (USGS 2003) detected triclopyr in the Duwamish River at a concentration of 0.12 ug/L in one of 24 samples collected between March 1996 and May 1997 (0.25 ug/L detection limit). Triclopyr was detected in one of 46 samples from Thornton Creek at a concentration of 0.82 ug/L.

A USGS (1997) water quality study of streams in the Willamette River Basin, Oregon detected triclopyr in 22 of 94 samples (0.05 ug/L detection limit). The maximum concentration was 6.0 ug/L, the 90th percentile value was 0.55 ug/L, and the median (50th percentile) concentration was below the detection limit. During previous studies in the Willamette Basin (USGS 1997), triclopyr was detected in 8 percent of approximately 200 samples at a maximum value of 0.72 ug/L.

Nonylphenol

King County initiated a pilot monitoring study in 2003 to evaluate surface water concentrations of EDCs. The King County Department of Natural Resources and Parks reports the following data for nonylphenol based on 272 samples and a 15.8 percent detection frequency:

Location	Maximum Detection (ug/L)
Stream/River (dry weather)	0.46
Stream/River (wet weather)	0.84
100% Stormwater	8.9
100% Road/Bridge Runoff	44
Lakes	0.15
Marine	0.25

Shackelford et al. (1983) measured 4-nonylphenols at average concentrations ranging from 2 to 1,600 ug/L in 11 water samples from various industrial sources. Bennie et al. (1997) detected nonylphenol in 25 percent of the samples collected in the Great Lakes (0.01 to 0.92 ug/L). In a 1989-90 study of 30 U.S. rivers, Radian (1990) and Naylor et al. (1992) identified nonylphenol in 30 percent of the water samples at concentrations ranging from 0.20 to 0.64 ug/L. Several studies have documented the common occurrence of nonylphenol in treatment plant wastewaters (e.g., Ellis et al. 1982; Giger et al. 1981; Maguire 1999). In a 1999-2000 survey of wastewater constituents in 139 U.S. streams (Kolpin et al. 2002), nonylphenol was one of the most commonly occurring contaminants and was measured at higher concentrations than most of the other compounds. Corsi et al. (2003) measured nonylphenol concentrations in airport runoff (possibly contaminated with aircraft deicer fluid) that varied between 0.98 and 7.7 ug/L.

Nonylphenol is the main metabolite of nonylphenol polyethoxylates (NPEOs) during sewage treatment (Xie et al. 2004). The biodegradation of NPEOs in water leads to the formation of estrogenic nonylphenols. For example, Jahnke et al. (2004) reported nonylphenol concentrations of 0.140 to 0.242 ug/L in effluent from a sewage treatment plant in Hamburg, Germany. NPEOs and their metabolites have been documented in sewage sludge, sewage effluents, and in river water in Europe (Field and Reed 1996). NPEOs have also been widely used as surfactants in many industrial and household applications (Field and Reed 1996).

Water-to-air volatilization of nonylphenols from estuarine waters has been documented as a source of nonylphenols to the estuarine atmosphere (Dachs et al. 1999). Nonylphenol concentrations in surface water from the Lower Hudson River Estuary ranged from 0.012 to 0.095 ug/L in the dissolved phase, which are 10 to 100 times higher than water concentrations of PCBs and DDTs in this and other urban-impacted estuaries, rivers, and coastal waters (Dachs et al. 1999). Nonylphenol concentrations in water reported in other rives, estuaries, and coastal zones of the world are often much higher than those in the Hudson River Estuary. For example, nonylphenol concentrations reported for the Glatt River in Switzerland or the Krka River Estuary in Croatia are one to two orders of magnitude higher than those in the Hudson River Estuary (Dachs et al. 1999).

Dioxins and Furans

Wenning et al. (1999) collected stormwater samples from 15 outfalls adjacent to urban areas and petroleum refineries in the San Francisco Bay area. Total dioxins/furans toxic equivalents (TEQ) concentrations in samples from mixed urban/rural outfalls (two storm events) ranged from 4 to 16 and 8 to 30 picograms per liter (pg/L). Samples from petroleum refinery outfalls obtained during two storm events contained 5 to 72 and 11 to 73 pg/L TEQ. In a Palo Alto, California, stormwater investigation dioxins concentrations were between 0.8 and 10 pg/L TEQ and averaged 8.7 pg/L TEQ (EIP Associates 1997).

Suarez et al. (2006) measured dioxin concentrations in runoff from 10 small flood control drainage channels in the Houston, Texas, area. Concentrations in the dissolved phase ranged from 0.01 to 0.11 pg/L TEQ. Suspended phase concentrations varied from 0.01 to 0.88 pg/L TEQ.

Eighteen stormwater samples were collected from eight storm drains and runoff streams in the Santa Monica Bay, California, drainage area during a 1-year period (Fisher et al. 1999). Total dioxins concentrations varied between 0.8 and 8.9 pg/L TEQ. The mean storm event concentration (18 pg/L TEQ) was higher than the average during dry periods (1 pg/L TEQ).

Paustenbach et al. (1996) reported that stormwater runoff from 15 sites in the San Francisco area contained dioxins at concentrations ranging from 0.01 to 65 pg/L TEQ. The sites differed widely in land use, and the highest concentrations were measured in an urban, non-industrialized area. Most samples contained less than 15 pg/L TEQ.

Horstmann and McLachlan (1995) measured dioxin concentrations of 1 to 11 pg/L TEQ in street runoff samples from Bayreuth, Germany.

Atmospheric investigations in Denmark identified dioxin concentrations of 1 to 2 pg/L TEQ in rainfall (NERI 2006).

Total DDT

A TMDL assessment for total DDT (DDT+DDD+DDE) in the Lower Mission Creek, Washington, Basin (Ecology 2004d) detected the following concentrations during the period April to June, 2003:

Site	*Concentration (ug/L)*
Mission Creek	0.0004 to 0.0032
Brender Creek	0.0036 to 0.031
Peshastin Canal	0.0032
Yaksum Creek	0.0081 to 0.133

Total DDT concentrations detected in tributaries and irrigation drains during the Lake Chelan, Washington, TMDL (Ecology 2005b) for the period May-November, 2003 include:

	Concentration (ug/L)	
Site	*Range*	*Mean*
Keupkin Street	0.022 to 0.036	0.028
Buck Orchards	0.0077 to 0.017	0.013
Purtteman Creek	0.0016 to 0.0039	0.0026
Culvert at Veroske’s	0.011 to 0.018	0.014
Knapp Coulee	0.0046 to 0.0087	0.0062
First Creek	0.2	0.0002
Stink Creek	0.0014 to 0.0021	0.0018
Cooper drainage	0.011 to 0.025	0.015

Bennet Road	0.0017 to 0.0033	0.0022
Culvert near Crystal View	0.0034 to 0.0046	0.0038
Joe Creek	0.0013 to 0.0026	0.0020

A TMDL assessment for the Walla Walla River, Washington (Ecology 2004c) detected the following average annual dissolved DDT concentrations from 2002 to 2003:

Location	*Total Dissolved DDT (ug/L)*
Upper Mill Creek	0.00031
Upper Walla Walla	0.00056
Yellowhawk Creek	0.0037
Garrison Creek	0.0019
Lower Mill Creek	0.0014
Middle Walla Walla	0.0024
Dry Creek	0.00095
Pine Creek	0.0020
Touchet River	0.00042
Lower Walla Walla	0.0013

Total DDT concentrations measured in 1995 during a TMDL assessment for the Yakima River Basin (includes main stem of river, tributaries, canals, and drains), Washington, ranged from 0.005 to 0.1 ug/L (Ecology 1997a). A 1999-2000 study of the Yakima River Basin (USGS 2004) showed that total DDT concentrations in surface water decreased to a maximum of about 0.015 ug/L in agricultural tributaries and <0.001 ug/L in the Yakima River.

A pesticide study of Johnson Creek, a tributary of the Willamette River, located near Milwaukie, Oregon, (Johnson Creek Watershed Council 1995) identified total DDT surface water concentrations ranging from 0.001 to 0.035 ug/L. In addition, the following average land-use related concentrations were reported:

Land Use/Location	*Average Total DDT Concentration (ug/L)*
Main Stem Johnson Creek	0.013
Rural Tributary	0.006
Urban Tributary	0.001
Urban Stormwater Outfall	0.002

The mean total DDT concentrations identified in the Southern California Bight study were:

Land Use	*Arithmetic Mean (ug/L)*
Open	0.0
Residential	0.001
Commercial	0.0
Industrial	0.005
Agriculture	0.51

Peng et al. (2002) reported the following total DDT concentrations in stormwater based on the TMDL for Newport Bay in Southern California: Agriculture = 0.5 ug/L; Residential = 0.005 ug/L.

Oil or Petroleum Product

The probability distributions of observed oil and grease concentrations, as defined in the NSQD, vary with land use as follows:

Land Use	*Median (ug/L)*	σ
Open	1,300	-
Residential	4,000	1.2
Commercial/Industrial	4,500 to 9,000	0.6 to 1.1

Silverman et al. (1988) analyzed the input of oil and grease to San Francisco Bay from local drainage areas and reported the following oil and grease concentrations in runoff as a function of commercial/industrial land use development:

Percent Commercial/Industrial Land Use	*Oil and Grease (ug/L)*
0 to 10	1,000 to 2,000
10 to 40	3,000 to 10,000
40 to 80	3,000 to 20,000
80 to 100	5,000 to 40,000

A large-scale evaluation of oil in stormwater runoff in California (California EPA 2006) identified mean oil and grease concentrations in commercial areas as high as 13,000 ug/L. Mean values for agricultural areas ranged from 0 to 900 ug/L. Annual mean oil and grease concentrations for rivers and streams in Los Angeles County for the period 1994-2005 varied as follows:

Location	*Annual Concentration (ug/L)*	
	Range	*Mean*
San Gabriel River	640 to 4,230	1,900
Coyote Creek	2,500 to 3,000	3,000
Los Angeles River	1,380 to 5,550	3,080
Dominquez Channel	2,180 to 3,800	2,650
Ballona Creek	2,100 to 7,100	3,600
Malibu Creek	950 to 3,830	2,500
Santa Clara River	2,220 to 2,500	2,400

Appendix B

Runoff Loadings for Puget Sound Box Model

Appendix B – Runoff Loadings for Puget Sound Box Model

This appendix presents the estimated surface runoff loadings for watersheds that Ecology has delineated for its Puget Sound circulation and transport box models, currently under development. Table B-1 presents the surface runoff rates for the 14 box model watersheds. Table B-2 summarizes the estimated surface runoff loadings for each of the chemicals of concern, along with a breakdown into contributions from urban and non-urban areas. Table B-3 shows the loadings from the discharge of wastewater from a limited number of NPDES-permitted facilities. Figure B-1 shows the box model study areas, and Figure B-2 distinguishes the urban and non-urban areas.

Table B-1 – Surface Runoff Rates for Box Model Study Areas

Box Model Study Area	**Runoff Rate (m^3/sec)**
Main Basin	57.4
Port Gardner	313.
Elliot Bay	46.0
Commencement Bay	99.5
South Sound (east)	84.6
South Sound (west)	44.7
Hood Canal (south)	132.
Hood Canal (north)	8.0
Sinclair/Dyes Inlet	17.5
Admiralty Inlet	14.6
Strait of Juan de Fuca	165.
Strait of Georgia	194.
Whidbey Basin	573.
San Juan Islands	35.7

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Main Basin											Port Gardner										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	1.4E-01	2.5E-01	6.5E-03	7.5E-02	4.7E-01	1.3E-02	1.5E-02	3.4E-03	1.4E-01	1.7E-01	6.4E-01	8.2E-02	1.1E-01	3.5E-02	8.1E-02	3.1E-01	5.5E-02	4.1E-02	1.5E-01	1.7E+00	1.9E+00	2.2E+00
	2.3	1.1	0.87	0.51	75	3.1E-01	5.6E-01	1.4E-02	2.0E-01	1.1E+00	2.8E-02	3.5E-02	7.4E-03	3.7E-01	4.4E-01	1.5E+00	1.8E-01	2.5E-01	7.6E-02	2.1E-01	7.2E-01	1.2E-01	9.4E-02	3.2E-01	4.4E+00	4.9E+00	5.6E+00
Arsenic	**4**	**2**	**1.5**	**1**	**50**	**5.4E-01**	**1.0E+00**	**2.4E-02**	**3.9E-01**	**1.9E+00**	**4.8E-02**	**6.2E-02**	**1.3E-02**	**7.2E-01**	**8.5E-01**	**2.8E+00**	**3.1E-01**	**4.5E-01**	**1.3E-01**	**4.2E-01**	**1.3E+00**	**2.1E-01**	**1.7E-01**	**5.4E-01**	**8.6E+00**	**9.5E+00**	**1.1E+01**
	6.9	3.5	2.6	2.0	25	9.2E-01	1.8E+00	4.2E-02	7.6E-01	3.5E+00	8.2E-02	1.1E-01	2.2E-02	1.4E+00	1.6E+00	5.1E+00	5.3E-01	8.0E-01	2.2E-01	8.2E-01	2.4E+00	3.5E-01	3.0E-01	9.3E-01	1.7E+01	1.8E+01	2.1E+01
	15	8.1	5.6	5.2	5	2.0E+00	4.0E+00	9.1E-02	2.0E+00	8.1E+00	1.8E-01	2.5E-01	4.7E-02	3.7E+00	4.2E+00	1.2E+01	1.1E+00	1.8E+00	4.9E-01	2.2E+00	5.6E+00	7.7E-01	6.7E-01	2.0E+00	4.4E+01	4.8E+01	5.3E+01
	0.25	0.069	0.082	1.8E-04	95	3.3E-02	3.5E-02	1.3E-03	7.0E-05	6.9E-02	2.9E-03	2.2E-03	7.0E-04	1.3E-04	5.9E-03	7.5E-02	1.9E-02	1.6E-02	7.1E-03	7.6E-05	4.2E-02	1.3E-02	5.8E-03	3.0E-02	1.5E-03	5.0E-02	9.1E-02
	0.71	0.22	0.24	0.0022	75	9.6E-02	1.1E-01	3.9E-03	8.7E-04	2.1E-01	8.5E-03	6.9E-03	2.0E-03	1.6E-03	1.9E-02	2.3E-01	5.5E-02	5.0E-02	2.1E-02	9.4E-04	1.3E-01	3.7E-02	1.9E-02	8.6E-02	1.9E-02	1.6E-01	2.9E-01
Cadmium	**1.5**	**0.5**	**0.5**	**0.013**	**50**	**2.0E-01**	**2.5E-01**	**8.1E-03**	**5.1E-03**	**4.6E-01**	**1.8E-02**	**1.6E-02**	**4.2E-03**	**9.4E-03**	**4.7E-02**	**5.1E-01**	**1.1E-01**	**1.1E-01**	**4.3E-02**	**5.5E-03**	**2.8E-01**	**7.7E-02**	**4.2E-02**	**1.8E-01**	**1.1E-01**	**4.1E-01**	**6.9E-01**
	3.2	1.1	1.1	0.075	25	4.2E-01	5.6E-01	1.7E-02	2.9E-02	1.0E+00	3.8E-02	3.5E-02	8.9E-03	5.4E-02	1.4E-01	1.2E+00	2.4E-01	2.5E-01	9.1E-02	3.2E-02	6.2E-01	1.6E-01	9.4E-02	3.8E-01	6.4E-01	1.3E+00	1.9E+00
	9.2	3.6	3.1	0.94	5	1.2E+00	1.8E+00	5.0E-02	3.6E-01	3.4E+00	1.1E-01	1.1E-01	2.6E-02	6.8E-01	9.2E-01	4.4E+00	7.0E-01	8.1E-01	2.7E-01	3.9E-01	2.2E+00	4.7E-01	3.0E-01	1.1E+00	8.0E+00	9.9E+00	1.2E+01
	5.7	0.77	0.69	0.14	95	7.6E-01	3.9E-01	1.1E-02	5.4E-02	1.2E+00	6.8E-02	2.4E-02	5.9E-03	1.0E-01	2.0E-01	1.4E+00	4.4E-01	1.7E-01	6.0E-02	5.8E-02	7.3E-01	2.9E-01	6.4E-02	2.5E-01	1.2E+00	1.8E+00	2.5E+00
	14	2.0	2.2	0.44	75	1.8E+00	1.0E+00	3.6E-02	1.7E-01	3.0E+00	1.6E-01	6.3E-02	1.9E-02	3.2E-01	5.7E-01	3.6E+00	1.0E+00	4.6E-01	1.9E-01	1.9E-01	1.9E+00	7.0E-01	1.7E-01	8.0E-01	3.8E+00	5.5E+00	7.4E+00
Copper	**25**	**4**	**5**	**1**	**50**	**3.3E+00**	**2.0E+00**	**8.1E-02**	**3.9E-01**	**5.8E+00**	**3.0E-01**	**1.2E-01**	**4.2E-02**	**7.2E-01**	**1.2E+00**	**7.0E+00**	**1.9E+00**	**9.0E-01**	**4.3E-01**	**4.2E-01**	**3.7E+00**	**1.3E+00**	**3.3E-01**	**1.8E+00**	**8.6E+00**	**1.2E+01**	**1.6E+01**
	46	7.9	11	2.2	25	6.1E+00	3.9E+00	1.8E-01	8.7E-01	1.1E+01	5.5E-01	2.4E-01	9.5E-02	1.6E+00	2.5E+00	1.4E+01	3.5E+00	1.8E+00	9.8E-01	9.4E-01	7.2E+00	2.4E+00	6.5E-01	4.1E+00	1.9E+01	2.6E+01	3.4E+01
	110	21	36	7.2	5	1.5E+01	1.0E+01	5.8E-01	2.8E+00	2.8E+01	1.3E+00	6.5E-01	3.1E-01	5.2E+00	7.5E+00	3.6E+01	8.4E+00	4.7E+00	3.1E+00	3.0E+00	1.9E+01	5.7E+00	1.7E+00	1.3E+01	6.2E+01	8.2E+01	1.0E+02
	3.0	0.85	0.75	0.022	95	4.0E-01	4.2E-01	1.2E-02	8.5E-03	8.5E-01	3.6E-02	2.6E-02	6.4E-03	1.6E-02	8.5E-02	9.3E-01	2.3E-01	1.9E-01	6.5E-02	9.2E-03	5.0E-01	1.6E-01	7.1E-02	2.7E-01	1.9E-01	6.9E-01	1.2E+00
	9.2	3.6	2.3	0.14	75	1.2E+00	1.8E+00	3.7E-02	5.4E-02	3.1E+00	1.1E-01	1.1E-01	2.0E-02	1.0E-01	3.4E-01	3.5E+00	7.0E-01	8.2E-01	2.0E-01	5.8E-02	1.8E+00	4.8E-01	3.0E-01	8.3E-01	1.2E+00	2.8E+00	4.6E+00
Lead	**20**	**10**	**5**	**0.5**	**50**	**2.7E+00**	**5.0E+00**	**8.1E-02**	**1.9E-01**	**7.9E+00**	**2.4E-01**	**3.1E-01**	**4.2E-02**	**3.6E-01**	**9.5E-01**	**8.9E+00**	**1.5E+00**	**2.2E+00**	**4.3E-01**	**2.1E-01**	**4.4E+00**	**1.0E+00**	**8.3E-01**	**1.8E+00**	**4.3E+00**	**8.0E+00**	**1.2E+01**
	43	28	11	1.8	25	5.8E+00	1.4E+01	1.8E-01	7.0E-01	2.0E+01	5.2E-01	8.6E-01	9.2E-02	1.3E+00	2.8E+00	2.3E+01	3.3E+00	6.2E+00	9.4E-01	7.6E-01	1.1E+01	2.2E+00	2.3E+00	3.9E+00	1.5E+01	2.4E+01	3.5E+01
	130	110	33	11	5	1.7E+01	5.5E+01	5.4E-01	4.4E+00	7.7E+01	1.6E+00	3.4E+00	2.8E-01	8.2E+00	1.3E+01	9.1E+01	9.9E+00	2.5E+01	2.9E+00	4.8E+00	4.2E+01	6.7E+00	9.2E+00	1.2E+01	9.8E+01	1.3E+02	1.7E+02
	27	5.8	1.4	0.28	95	3.7E+00	2.9E+00	2.3E-02	1.1E-01	6.7E+00	3.3E-01	1.8E-01	1.2E-02	2.0E-01	7.2E-01	7.4E+00	2.1E+00	1.3E+00	1.2E-01	1.2E-01	3.6E+00	1.4E+00	4.8E-01	5.0E-01	2.4E+00	4.8E+00	8.4E+00
	65	15	4.4	0.89	75	8.8E+00	7.6E+00	7.2E-02	3.5E-01	1.7E+01	7.8E-01	4.8E-01	3.8E-02	6.4E-01	1.9E+00	1.9E+01	5.0E+00	3.4E+00	3.9E-01	3.7E-01	9.2E+00	3.4E+00	1.3E+00	1.6E+00	7.6E+00	1.4E+01	2.3E+01
Zinc	**120**	**30**	**10**	**2**	**50**	**1.6E+01**	**1.5E+01**	**1.6E-01**	**7.8E-01**	**3.2E+01**	**1.4E+00**	**9.3E-01**	**8.5E-02**	**1.4E+00**	**3.9E+00**	**3.6E+01**	**9.2E+00**	**6.7E+00**	**8.7E-01**	**8.4E-01**	**1.8E+01**	**6.2E+00**	**2.5E+00**	**3.6E+00**	**1.7E+01**	**2.9E+01**	**4.7E+01**
	220	50	22	4.5	25	2.9E+01	2.5E+01	3.6E-01	1.7E+00	5.7E+01	2.6E+00	1.6E+00	1.9E-01	3.2E+00	7.6E+00	6.4E+01	1.7E+01	1.1E+01	2.0E+00	1.9E+00	3.2E+01	1.1E+01	4.2E+00	8.1E+00	3.9E+01	6.2E+01	9.4E+01
	520	150	71	14	5	7.0E+01	7.5E+01	1.2E+00	5.4E+00	1.5E+02	6.2E+00	4.7E+00	6.0E-01	1.0E+01	2.2E+01	1.7E+02	4.0E+01	3.4E+01	6.2E+00	5.9E+00	8.6E+01	2.7E+01	1.3E+01	2.6E+01	1.2E+02	1.8E+02	2.7E+02
	0.017	0.0008	2.6E-04	4.2E-04	95	2.3E-03	4.2E-04	4.2E-06	1.6E-04	2.9E-03	2.0E-04	2.6E-05	2.2E-06	3.1E-04	5.4E-04	3.4E-03	1.3E-03	1.9E-04	2.3E-05	1.8E-04	1.7E-03	8.8E-04	7.1E-05	9.4E-05	3.6E-03	4.7E-03	6.4E-03
	0.073	0.0036	0.0018	0.0018	75	9.7E-03	1.8E-03	2.9E-05	7.1E-04	1.2E-02	8.7E-04	1.1E-04	1.5E-05	1.3E-03	2.3E-03	1.5E-02	5.6E-03	8.2E-04	1.6E-04	7.6E-04	7.3E-03	3.8E-03	3.0E-04	6.6E-04	1.6E-02	2.0E-02	2.8E-02
Mercury	**0.2**	**0.01**	**0.007**	**0.005**	**50**	**2.7E-02**	**5.0E-03**	**1.1E-04**	**1.9E-03**	**3.4E-02**	**2.4E-03**	**3.1E-04**	**5.9E-05**	**3.6E-03**	**6.4E-03**	**4.0E-02**	**1.5E-02**	**2.2E-03**	**6.1E-04**	**2.1E-03**	**2.0E-02**	**1.0E-02**	**8.3E-04**	**2.5E-03**	**4.3E-02**	**5.7E-02**	**7.7E-02**
	0.55	0.028	0.027	0.014	25	7.4E-02	1.4E-02	4.4E-04	5.3E-03	9.3E-02	6.6E-03	8.6E-04	2.3E-04	9.9E-03	1.8E-02	1.1E-01	4.2E-02	6.2E-03	2.3E-03	5.8E-03	5.6E-02	2.8E-02	2.3E-03	9.8E-03	1.2E-01	1.6E-01	2.1E-01
	2.4	0.12	0.19	0.059	5	3.2E-01	5.9E-02	3.0E-03	2.3E-02	4.0E-01	2.8E-02	3.7E-03	1.6E-03	4.3E-02	7.6E-02	4.8E-01	1.8E-01	2.7E-02	1.6E-02	2.5E-02	2.5E-01	1.2E-01	9.8E-03	6.8E-02	5.1E-01	7.0E-01	9.5E-01
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	1.5E-04	3.7E-04	6.0E-06	6.4E-06	5.3E-04	1.3E-05	2.3E-05	3.2E-06	1.2E-05	5.2E-05	5.9E-04	8.6E-05	1.7E-04	3.2E-05	6.9E-06	2.9E-04	5.8E-05	6.2E-05	1.3E-04	1.4E-04	3.9E-04	6.9E-04
	0.008	0.0052	0.0026	1.8E-04	75	1.0E-03	2.6E-03	4.2E-05	7.2E-05	3.7E-03	9.3E-05	1.6E-04	2.2E-05	1.3E-04	4.1E-04	4.2E-03	6.0E-04	1.2E-03	2.3E-04	7.8E-05	2.1E-03	4.0E-04	4.3E-04	9.4E-04	1.6E-03	3.4E-03	5.4E-03
Total PCBs	**0.03**	**0.02**	**0.01**	**0.001**	**50**	**4.0E-03**	**1.0E-02**	**1.6E-04**	**3.9E-04**	**1.5E-02**	**3.6E-04**	**6.2E-04**	**8.5E-05**	**7.2E-04**	**1.8E-03**	**1.6E-02**	**2.3E-03**	**4.5E-03**	**8.7E-04**	**4.2E-04**	**8.1E-03**	**1.5E-03**	**1.7E-03**	**3.6E-03**	**8.6E-03**	**1.5E-02**	**2.3E-02**
	0.12	0.077	0.039	0.0054	25	1.6E-02	3.8E-02	6.3E-04	2.1E-03	5.7E-02	1.4E-03	2.4E-03	3.3E-04	3.9E-03	8.0E-03	6.5E-02	8.9E-03	1.7E-02	3.3E-03	2.3E-03	3.2E-02	6.0E-03	6.4E-03	1.4E-02	4.6E-02	7.3E-02	1.0E-01
	0.8	0.54	0.27	0.061	5	1.1E-01	2.7E-01	4.4E-03	2.4E-02	4.0E-01	9.6E-03	1.7E-02	2.3E-03	4.4E-02	7.3E-02	4.8E-01	6.2E-02	1.2E-01	2.3E-02	2.6E-02	2.3E-01	4.2E-02	4.5E-02	9.7E-02	5.2E-01	7.1E-01	9.4E-01

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Elliot Bay											Commencement Bay										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	1.4E-01	6.7E-02	1.4E-02	2.8E-02	2.4E-01	7.2E-03	6.9E-03	2.6E-02	1.8E-01	2.2E-01	4.6E-01	1.1E-01	8.2E-02	1.5E-02	4.2E-02	2.5E-01	4.5E-02	7.0E-03	3.2E-02	4.8E-01	5.6E-01	8.1E-01
	2.3	1.1	0.87	0.51	75	2.9E-01	1.5E-01	3.0E-02	7.5E-02	5.5E-01	1.6E-02	1.6E-02	5.7E-02	4.7E-01	5.6E-01	1.1E+00	2.3E-01	1.9E-01	3.3E-02	1.1E-01	5.6E-01	9.7E-02	1.6E-02	6.9E-02	1.3E+00	1.4E+00	2.0E+00
Arsenic	**4**	**2**	**1.5**	**1**	**50**	**5.1E-01**	**2.7E-01**	**5.1E-02**	**1.5E-01**	**9.7E-01**	**2.7E-02**	**2.8E-02**	**9.7E-02**	**9.2E-01**	**1.1E+00**	**2.0E+00**	**4.0E-01**	**3.3E-01**	**5.7E-02**	**2.2E-01**	**1.0E+00**	**1.7E-01**	**2.8E-02**	**1.2E-01**	**2.5E+00**	**2.8E+00**	**3.8E+00**
	6.9	3.5	2.6	2.0	25	8.7E-01	4.8E-01	8.7E-02	2.9E-01	1.7E+00	4.6E-02	5.0E-02	1.7E-01	1.8E+00	2.1E+00	3.8E+00	6.9E-01	5.9E-01	9.7E-02	4.3E-01	1.8E+00	2.9E-01	5.0E-02	2.0E-01	4.9E+00	5.4E+00	7.2E+00
	15	8.1	5.6	5.2	5	1.9E+00	1.1E+00	1.9E-01	7.6E-01	3.9E+00	1.0E-01	1.1E-01	3.6E-01	4.8E+00	5.3E+00	9.3E+00	1.5E+00	1.3E+00	2.1E-01	1.1E+00	4.2E+00	6.2E-01	1.1E-01	4.4E-01	1.3E+01	1.4E+01	1.8E+01
	0.25	0.069	0.082	1.8E-04	95	3.1E-02	9.4E-03	2.8E-03	2.7E-05	4.3E-02	1.6E-03	9.7E-04	5.3E-03	1.7E-04	8.1E-03	5.1E-02	2.5E-02	1.1E-02	3.1E-03	3.9E-05	3.9E-02	1.0E-02	9.8E-04	6.4E-03	4.5E-04	1.8E-02	5.7E-02
	0.71	0.22	0.24	0.0022	75	9.0E-02	3.0E-02	8.1E-03	3.3E-04	1.3E-01	4.8E-03	3.1E-03	1.5E-02	2.1E-03	2.5E-02	1.5E-01	7.2E-02	3.7E-02	9.0E-03	4.9E-04	1.2E-01	3.0E-02	3.2E-03	1.9E-02	5.6E-03	5.7E-02	1.8E-01
Cadmium	**1.5**	**0.5**	**0.5**	**0.013**	**50**	**1.9E-01**	**6.8E-02**	**1.7E-02**	**1.9E-03**	**2.8E-01**	**1.0E-02**	**7.0E-03**	**3.2E-02**	**1.2E-02**	**6.1E-02**	**3.4E-01**	**1.5E-01**	**8.3E-02**	**1.9E-02**	**2.8E-03**	**2.6E-01**	**6.3E-02**	**7.1E-03**	**3.9E-02**	**3.2E-02**	**1.4E-01**	**4.0E-01**
	3.2	1.1	1.1	0.075	25	4.0E-01	1.5E-01	3.6E-02	1.1E-02	6.0E-01	2.1E-02	1.6E-02	6.8E-02	6.9E-02	1.7E-01	7.7E-01	3.2E-01	1.9E-01	4.0E-02	1.6E-02	5.6E-01	1.3E-01	1.6E-02	8.3E-02	1.9E-01	4.2E-01	9.8E-01
	9.2	3.6	3.1	0.94	5	1.2E+00	4.9E-01	1.0E-01	1.4E-01	1.9E+00	6.1E-02	5.1E-02	2.0E-01	8.6E-01	1.2E+00	3.1E+00	9.2E-01	6.0E-01	1.2E-01	2.0E-01	1.8E+00	3.8E-01	5.1E-02	2.4E-01	2.3E+00	3.0E+00	4.8E+00
	5.7	0.77	0.69	0.14	95	7.2E-01	1.0E-01	2.4E-02	2.0E-02	8.7E-01	3.8E-02	1.1E-02	4.5E-02	1.3E-01	2.2E-01	1.1E+00	5.7E-01	1.3E-01	2.6E-02	3.0E-02	7.6E-01	2.4E-01	1.1E-02	5.5E-02	3.4E-01	6.5E-01	1.4E+00
	14	2.0	2.2	0.44	75	1.7E+00	2.8E-01	7.5E-02	6.6E-02	2.1E+00	9.1E-02	2.9E-02	1.4E-01	4.1E-01	6.7E-01	2.8E+00	1.4E+00	3.4E-01	8.4E-02	9.7E-02	1.9E+00	5.7E-01	2.9E-02	1.7E-01	1.1E+00	1.9E+00	3.8E+00
Copper	**25**	**4**	**5**	**1**	**50**	**3.2E+00**	**5.4E-01**	**1.7E-01**	**1.5E-01**	**4.0E+00**	**1.7E-01**	**5.6E-02**	**3.2E-01**	**9.2E-01**	**1.5E+00**	**5.5E+00**	**2.5E+00**	**6.6E-01**	**1.9E-01**	**2.2E-01**	**3.6E+00**	**1.0E+00**	**5.7E-02**	**3.9E-01**	**2.5E+00**	**4.0E+00**	**7.6E+00**
	46	7.9	11	2.2	25	5.8E+00	1.1E+00	3.8E-01	3.3E-01	7.6E+00	3.1E-01	1.1E-01	7.3E-01	2.1E+00	3.2E+00	1.1E+01	4.6E+00	1.3E+00	4.3E-01	4.9E-01	6.8E+00	1.9E+00	1.1E-01	8.8E-01	5.6E+00	8.5E+00	1.5E+01
	110	21	36	7.2	5	1.4E+01	2.8E+00	1.2E+00	1.1E+00	1.9E+01	7.4E-01	2.9E-01	2.3E+00	6.6E+00	1.0E+01	2.9E+01	1.1E+01	3.4E+00	1.4E+00	1.6E+00	1.7E+01	4.6E+00	2.9E-01	2.8E+00	1.8E+01	2.6E+01	4.3E+01
	3.0	0.85	0.75	0.022	95	3.8E-01	1.2E-01	2.6E-02	3.2E-03	5.2E-01	2.0E-02	1.2E-02	4.9E-02	2.0E-02	1.0E-01	6.3E-01	3.0E-01	1.4E-01	2.9E-02	4.8E-03	4.8E-01	1.3E-01	1.2E-02	5.9E-02	5.5E-02	2.5E-01	7.3E-01
	9.2	3.6	2.3	0.14	75	1.2E+00	4.9E-01	7.8E-02	2.0E-02	1.8E+00	6.2E-02	5.1E-02	1.5E-01	1.3E-01	3.9E-01	2.1E+00	9.3E-01	6.0E-01	8.7E-02	3.0E-02	1.6E+00	3.8E-01	5.2E-02	1.8E-01	3.4E-01	9.6E-01	2.6E+00
Lead	**20**	**10**	**5**	**0.5**	**50**	**2.5E+00**	**1.4E+00**	**1.7E-01**	**7.4E-02**	**4.1E+00**	**1.3E-01**	**1.4E-01**	**3.2E-01**	**4.6E-01**	**1.1E+00**	**5.2E+00**	**2.0E+00**	**1.7E+00**	**1.9E-01**	**1.1E-01**	**4.0E+00**	**8.4E-01**	**1.4E-01**	**3.9E-01**	**1.2E+00**	**2.6E+00**	**6.6E+00**
	43	28	11	1.8	25	5.5E+00	3.7E+00	3.7E-01	2.7E-01	9.9E+00	2.9E-01	3.9E-01	7.1E-01	1.7E+00	3.0E+00	1.3E+01	4.4E+00	4.6E+00	4.1E-01	3.9E-01	9.7E+00	1.8E+00	3.9E-01	8.5E-01	4.5E+00	7.5E+00	1.7E+01
	130	110	33	11	5	1.6E+01	1.5E+01	1.1E+00	1.7E+00	3.4E+01	8.7E-01	1.5E+00	2.2E+00	1.0E+01	1.5E+01	4.9E+01	1.3E+01	1.8E+01	1.3E+00	2.5E+00	3.5E+01	5.4E+00	1.6E+00	2.6E+00	2.8E+01	3.8E+01	7.3E+01
	27	5.8	1.4	0.28	95	3.4E+00	7.9E-01	4.7E-02	4.1E-02	4.3E+00	1.8E-01	8.1E-02	9.0E-02	2.6E-01	6.1E-01	4.9E+00	2.7E+00	9.6E-01	5.3E-02	6.0E-02	3.8E+00	1.1E+00	8.2E-02	1.1E-01	6.9E-01	2.0E+00	5.8E+00
	65	15	4.4	0.89	75	8.3E+00	2.1E+00	1.5E-01	1.3E-01	1.1E+01	4.4E-01	2.1E-01	2.9E-01	8.2E-01	1.8E+00	1.2E+01	6.6E+00	2.5E+00	1.7E-01	1.9E-01	9.5E+00	2.7E+00	2.2E-01	3.5E-01	2.2E+00	5.5E+00	1.5E+01
Zinc	**120**	**30**	**10**	**2**	**50**	**1.5E+01**	**4.1E+00**	**3.4E-01**	**2.9E-01**	**2.0E+01**	**8.1E-01**	**4.2E-01**	**6.5E-01**	**1.8E+00**	**3.7E+00**	**2.4E+01**	**1.2E+01**	**5.0E+00**	**3.8E-01**	**4.3E-01**	**1.8E+01**	**5.0E+00**	**4.3E-01**	**7.9E-01**	**5.0E+00**	**1.1E+01**	**2.9E+01**
	220	50	22	4.5	25	2.8E+01	6.8E+00	7.6E-01	6.6E-01	3.6E+01	1.5E+00	7.0E-01	1.5E+00	4.1E+00	7.8E+00	4.4E+01	2.2E+01	8.3E+00	8.5E-01	9.8E-01	3.2E+01	9.2E+00	7.1E-01	1.8E+00	1.1E+01	2.3E+01	5.5E+01
	520	150	71	14	5	6.6E+01	2.0E+01	2.4E+00	2.1E+00	9.0E+01	3.5E+00	2.1E+00	4.6E+00	1.3E+01	2.3E+01	1.1E+02	5.2E+01	2.5E+01	2.7E+00	3.0E+00	8.3E+01	2.2E+01	2.1E+00	5.6E+00	3.5E+01	6.4E+01	1.5E+02
	0.017	0.0008	2.6E-04	4.2E-04	95	2.1E-03	1.2E-04	8.8E-06	6.2E-05	2.3E-03	1.1E-04	1.2E-05	1.7E-05	3.9E-04	5.3E-04	2.9E-03	1.7E-03	1.4E-04	9.9E-06	9.2E-05	1.9E-03	7.1E-04	1.2E-05	2.0E-05	1.1E-03	1.8E-03	3.7E-03
	0.073	0.0036	0.0018	0.0018	75	9.2E-03	4.9E-04	6.2E-05	2.7E-04	1.0E-02	4.9E-04	5.1E-05	1.2E-04	1.7E-03	2.3E-03	1.2E-02	7.3E-03	6.0E-04	6.9E-05	3.9E-04	8.4E-03	3.0E-03	5.2E-05	1.4E-04	4.5E-03	7.7E-03	1.6E-02
Mercury	**0.2**	**0.01**	**0.007**	**0.005**	**50**	**2.5E-02**	**1.4E-03**	**2.4E-04**	**7.4E-04**	**2.8E-02**	**1.3E-03**	**1.4E-04**	**4.5E-04**	**4.6E-03**	**6.5E-03**	**3.4E-02**	**2.0E-02**	**1.7E-03**	**2.7E-04**	**1.1E-03**	**2.3E-02**	**8.4E-03**	**1.4E-04**	**5.5E-04**	**1.2E-02**	**2.1E-02**	**4.5E-02**
	0.55	0.028	0.027	0.014	25	7.0E-02	3.7E-03	9.2E-04	2.0E-03	7.6E-02	3.7E-03	3.9E-04	1.8E-03	1.3E-02	1.8E-02	9.5E-02	5.5E-02	4.6E-03	1.0E-03	3.0E-03	6.4E-02	2.3E-02	3.9E-04	2.1E-03	3.4E-02	6.0E-02	1.2E-01
	2.4	0.12	0.19	0.059	5	3.0E-01	1.6E-02	6.4E-03	8.7E-03	3.3E-01	1.6E-02	1.7E-03	1.2E-02	5.4E-02	8.4E-02	4.1E-01	2.4E-01	2.0E-02	7.1E-03	1.3E-02	2.8E-01	9.9E-02	1.7E-03	1.5E-02	1.5E-01	2.6E-01	5.4E-01
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	1.4E-04	1.0E-04	1.3E-05	2.4E-06	2.6E-04	7.5E-06	1.0E-05	2.4E-05	1.5E-05	5.7E-05	3.1E-04	1.1E-04	1.2E-04	1.4E-05	3.6E-06	2.5E-04	4.7E-05	1.1E-05	2.9E-05	4.1E-05	1.3E-04	3.8E-04
	0.008	0.0052	0.0026	1.8E-04	75	9.8E-04	7.0E-04	8.8E-05	2.7E-05	1.8E-03	5.2E-05	7.3E-05	1.7E-04	1.7E-04	4.6E-04	2.3E-03	7.8E-04	8.6E-04	9.8E-05	4.0E-05	1.8E-03	3.3E-04	7.4E-05	2.0E-04	4.6E-04	1.1E-03	2.8E-03
Total PCBs	**0.03**	**0.02**	**0.01**	**0.001**	**50**	**3.8E-03**	**2.7E-03**	**3.4E-04**	**1.5E-04**	**7.0E-03**	**2.0E-04**	**2.8E-04**	**6.5E-04**	**9.2E-04**	**2.1E-03**	**9.0E-03**	**3.0E-03**	**3.3E-03**	**3.8E-04**	**2.2E-04**	**6.9E-03**	**1.3E-03**	**2.8E-04**	**7.9E-04**	**2.5E-03**	**4.8E-03**	**1.2E-02**
	0.12	0.077	0.039	0.0054	25	1.5E-02	1.0E-02	1.3E-03	8.0E-04	2.7E-02	7.8E-04	1.1E-03	2.5E-03	5.0E-03	9.3E-03	3.7E-02	1.2E-02	1.3E-02	1.5E-03	1.2E-03	2.7E-02	4.8E-03	1.1E-03	3.0E-03	1.3E-02	2.2E-02	4.9E-02
	0.8	0.54	0.27	0.061	5	1.0E-01	7.3E-02	9.1E-03	9.0E-03	1.9E-01	5.4E-03	7.5E-03	1.7E-02	5.6E-02	8.7E-02	2.8E-01	8.1E-02	8.9E-02	1.0E-02	1.3E-02	1.9E-01	3.4E-02	7.6E-03	2.1E-02	1.5E-01	2.1E-01	4.1E-01

Table B-2 - Box Model Surface Runoff Loadings

Average Annual Mass Loading (metric tons / year) — South Sound (east)

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	5.4E-02	9.7E-02	9.3E-03	4.9E-02	**2.1E-01**	2.2E-02	1.6E-02	3.8E-02	3.9E-01	**4.6E-01**	**6.7E-01**
	2.3	1.1	0.87	0.51	75	1.2E-01	2.2E-01	2.0E-02	1.3E-01	**4.9E-01**	4.9E-02	3.6E-02	8.3E-02	1.0E+00	**1.2E+00**	**1.7E+00**
Arsenic	**4**	**2**	**1.5**	**1**	**50**	**2.0E-01**	**3.9E-01**	**3.5E-02**	**2.5E-01**	**8.8E-01**	**8.4E-02**	**6.5E-02**	**1.4E-01**	**2.0E+00**	**2.3E+00**	**3.2E+00**
	6.9	3.5	2.6	2.0	25	3.5E-01	7.0E-01	6.0E-02	5.0E-01	**1.6E+00**	1.4E-01	1.1E-01	2.5E-01	3.9E+00	**4.4E+00**	**6.0E+00**
	15	8.1	5.6	5.2	5	7.5E-01	1.6E+00	1.3E-01	1.3E+00	**3.8E+00**	3.1E-01	2.6E-01	5.3E-01	1.0E+01	**1.1E+01**	**1.5E+01**
	0.25	0.069	0.082	1.8E-04	95	1.2E-02	1.4E-02	1.9E-03	4.6E-05	**2.8E-02**	5.1E-03	2.2E-03	7.8E-03	3.6E-04	**1.6E-02**	**4.4E-02**
	0.71	0.22	0.24	0.0022	75	3.6E-02	4.4E-02	5.5E-03	5.7E-04	**8.6E-02**	1.5E-02	7.2E-03	2.3E-02	4.5E-03	**4.9E-02**	**1.4E-01**
Cadmium	**1.5**	**0.5**	**0.5**	**0.013**	**50**	**7.6E-02**	**9.8E-02**	**1.2E-02**	**3.3E-03**	**1.9E-01**	**3.1E-02**	**1.6E-02**	**4.8E-02**	**2.6E-02**	**1.2E-01**	**3.1E-01**
	3.2	1.1	1.1	0.075	25	1.6E-01	2.2E-01	2.4E-02	1.9E-02	**4.2E-01**	6.6E-02	3.6E-02	1.0E-01	1.5E-01	**3.5E-01**	**7.8E-01**
	9.2	3.6	3.1	0.94	5	4.6E-01	7.1E-01	7.1E-02	2.4E-01	**1.5E+00**	1.9E-01	1.2E-01	2.9E-01	1.9E+00	**2.5E+00**	**3.9E+00**
	5.7	0.77	0.69	0.14	95	2.9E-01	1.5E-01	1.6E-02	3.5E-02	**4.9E-01**	1.2E-01	2.5E-02	6.6E-02	2.8E-01	**4.9E-01**	**9.8E-01**
	14	2.0	2.2	0.44	75	6.9E-01	4.0E-01	5.1E-02	1.1E-01	**1.3E+00**	2.9E-01	6.6E-02	2.1E-01	8.9E-01	**1.5E+00**	**2.7E+00**
Copper	**25**	**4**	**5**	**1**	**50**	**1.3E+00**	**7.9E-01**	**1.2E-01**	**2.5E-01**	**2.4E+00**	**5.2E-01**	**1.3E-01**	**4.8E-01**	**2.0E+00**	**3.1E+00**	**5.5E+00**
	46	7.9	11	2.2	25	2.3E+00	1.5E+00	2.6E-01	5.7E-01	**4.7E+00**	9.6E-01	2.5E-01	1.1E+00	4.5E+00	**6.8E+00**	**1.1E+01**
	110	21	36	7.2	5	5.6E+00	4.1E+00	8.3E-01	1.8E+00	**1.2E+01**	2.3E+00	6.7E-01	3.4E+00	1.4E+01	**2.1E+01**	**3.3E+01**
	3.0	0.85	0.75	0.022	95	1.5E-01	1.7E-01	1.7E-02	5.6E-03	**3.4E-01**	6.3E-02	2.7E-02	7.2E-02	4.4E-02	**2.1E-01**	**5.5E-01**
	9.2	3.6	2.3	0.14	75	4.7E-01	7.2E-01	5.3E-02	3.5E-02	**1.3E+00**	1.9E-01	1.2E-01	2.2E-01	2.8E-01	**8.1E-01**	**2.1E+00**
Lead	**20**	**10**	**5**	**0.5**	**50**	**1.0E+00**	**2.0E+00**	**1.2E-01**	**1.3E-01**	**3.2E+00**	**4.2E-01**	**3.2E-01**	**4.8E-01**	**1.0E+00**	**2.2E+00**	**5.4E+00**
	43	28	11	1.8	25	2.2E+00	5.4E+00	2.5E-01	4.6E-01	**8.3E+00**	9.1E-01	8.9E-01	1.0E+00	3.6E+00	**6.4E+00**	**1.5E+01**
	130	110	33	11	5	6.6E+00	2.2E+01	7.7E-01	2.9E+00	**3.2E+01**	2.7E+00	3.5E+00	3.2E+00	2.3E+01	**3.2E+01**	**6.4E+01**
	27	5.8	1.4	0.28	95	1.4E+00	1.1E+00	3.2E-02	7.0E-02	**2.6E+00**	5.7E-01	1.9E-01	1.3E-01	5.5E-01	**1.4E+00**	**4.1E+00**
	65	15	4.4	0.89	75	3.3E+00	3.0E+00	1.0E-01	2.3E-01	**6.6E+00**	1.4E+00	4.9E-01	4.2E-01	1.8E+00	**4.1E+00**	**1.1E+01**
Zinc	**120**	**30**	**10**	**2**	**50**	**6.1E+00**	**5.9E+00**	**2.3E-01**	**5.1E-01**	**1.3E+01**	**2.5E+00**	**9.7E-01**	**9.5E-01**	**4.0E+00**	**8.4E+00**	**2.1E+01**
	220	50	22	4.5	25	1.1E+01	9.8E+00	5.2E-01	1.1E+00	**2.3E+01**	4.6E+00	1.6E+00	2.1E+00	9.0E+00	**1.7E+01**	**4.0E+01**
	520	150	71	14	5	2.6E+01	3.0E+01	1.6E+00	3.6E+00	**6.1E+01**	1.1E+01	4.8E+00	6.8E+00	2.8E+01	**5.0E+01**	**1.1E+02**
	0.017	0.0008	2.6E-04	4.2E-04	95	8.6E-04	1.7E-04	6.0E-06	1.1E-04	**1.1E-03**	3.6E-04	2.7E-05	2.5E-05	8.5E-04	**1.3E-03**	**2.4E-03**
	0.073	0.0036	0.0018	0.0018	75	3.7E-03	7.2E-04	4.2E-05	4.6E-04	**4.9E-03**	1.5E-03	1.2E-04	1.7E-04	3.6E-03	**5.4E-03**	**1.0E-02**
Mercury	**0.2**	**0.01**	**0.007**	**0.005**	**50**	**1.0E-02**	**2.0E-03**	**1.6E-04**	**1.3E-03**	**1.4E-02**	**4.2E-03**	**3.2E-04**	**6.7E-04**	**1.0E-02**	**1.5E-02**	**2.9E-02**
	0.55	0.028	0.027	0.014	25	2.8E-02	5.4E-03	6.2E-04	3.5E-03	**3.7E-02**	1.2E-02	8.9E-04	2.6E-03	2.7E-02	**4.2E-02**	**8.0E-02**
	2.4	0.12	0.19	0.059	5	1.2E-01	2.3E-02	4.3E-03	1.5E-02	**1.6E-01**	4.9E-02	3.8E-03	1.8E-02	1.2E-01	**1.9E-01**	**3.5E-01**
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	5.6E-05	1.5E-04	8.6E-06	4.2E-06	**2.2E-04**	2.3E-05	2.4E-05	3.6E-05	3.3E-05	**1.2E-04**	**3.3E-04**
	0.008	0.0052	0.0026	1.8E-04	75	3.9E-04	1.0E-03	6.0E-05	4.7E-05	**1.5E-03**	1.6E-04	1.7E-04	2.5E-04	3.7E-04	**9.5E-04**	**2.5E-03**
Total PCBs	**0.03**	**0.02**	**0.01**	**0.001**	**50**	**1.5E-03**	**3.9E-03**	**2.3E-04**	**2.5E-04**	**5.9E-03**	**6.3E-04**	**6.5E-04**	**9.5E-04**	**2.0E-03**	**4.2E-03**	**1.0E-02**
	0.12	0.077	0.039	0.0054	25	5.8E-03	1.5E-02	8.9E-04	1.4E-03	**2.3E-02**	2.4E-03	2.5E-03	3.7E-03	1.1E-02	**1.9E-02**	**4.3E-02**
	0.8	0.54	0.27	0.061	5	4.1E-02	1.1E-01	6.2E-03	1.5E-02	**1.7E-01**	1.7E-02	1.7E-02	2.6E-02	1.2E-01	**1.8E-01**	**3.5E-01**

Average Annual Mass Loading (metric tons / year) — South Sound (west)

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	2.1E-02	3.4E-02	5.9E-03	1.8E-02	**7.9E-02**	2.1E-02	1.7E-02	1.4E-02	2.2E-01	**2.7E-01**	**3.5E-01**
	75	4.6E-02	7.8E-02	1.3E-02	4.7E-02	**1.8E-01**	4.5E-02	3.8E-02	3.0E-02	5.7E-01	**6.9E-01**	**8.7E-01**
Arsenic	**50**	**7.9E-02**	**1.4E-01**	**2.2E-02**	**9.2E-02**	**3.3E-01**	**7.8E-02**	**6.8E-02**	**5.2E-02**	**1.1E+00**	**1.3E+00**	**1.7E+00**
	25	1.3E-01	2.4E-01	3.8E-02	1.8E-01	**6.0E-01**	1.3E-01	1.2E-01	9.0E-02	2.2E+00	**2.6E+00**	**3.2E+00**
	5	2.9E-01	5.6E-01	8.2E-02	4.8E-01	**1.4E+00**	2.9E-01	2.7E-01	1.9E-01	5.8E+00	**6.6E+00**	**8.0E+00**
	95	4.8E-03	4.8E-03	1.2E-03	1.7E-05	**1.1E-02**	4.8E-03	2.3E-03	2.9E-03	2.0E-04	**1.0E-02**	**2.1E-02**
	75	1.4E-02	1.5E-02	3.5E-03	2.1E-04	**3.3E-02**	1.4E-02	7.5E-03	8.3E-03	2.5E-03	**3.2E-02**	**6.5E-02**
Cadmium	**50**	**2.9E-02**	**3.5E-02**	**7.3E-03**	**1.2E-03**	**7.3E-02**	**2.9E-02**	**1.7E-02**	**1.7E-02**	**1.5E-02**	**7.8E-02**	**1.5E-01**
	25	6.2E-02	7.8E-02	1.5E-02	6.9E-03	**1.6E-01**	6.1E-02	3.8E-02	3.7E-02	8.5E-02	**2.2E-01**	**3.8E-01**
	5	1.8E-01	2.5E-01	4.5E-02	8.6E-02	**5.6E-01**	1.8E-01	1.2E-01	1.1E-01	1.1E+00	**1.5E+00**	**2.0E+00**
	95	1.1E-01	5.3E-02	1.0E-02	1.3E-02	**1.9E-01**	1.1E-01	2.6E-02	2.4E-02	1.6E-01	**3.2E-01**	**5.1E-01**
	75	2.7E-01	1.4E-01	3.3E-02	4.1E-02	**4.8E-01**	2.6E-01	6.9E-02	7.7E-02	5.0E-01	**9.1E-01**	**1.4E+00**
Copper	**50**	**4.9E-01**	**2.8E-01**	**7.3E-02**	**9.2E-02**	**9.3E-01**	**4.9E-01**	**1.4E-01**	**1.7E-01**	**1.1E+00**	**1.9E+00**	**2.9E+00**
	25	9.0E-01	5.4E-01	1.7E-01	2.1E-01	**1.8E+00**	8.9E-01	2.7E-01	3.9E-01	2.5E+00	**4.1E+00**	**5.9E+00**
	5	2.2E+00	1.4E+00	5.3E-01	6.6E-01	**4.8E+00**	2.1E+00	7.0E-01	1.3E+00	8.1E+00	**1.2E+01**	**1.7E+01**
	95	5.9E-02	5.9E-02	1.1E-02	2.0E-03	**1.3E-01**	5.9E-02	2.9E-02	2.6E-02	2.5E-02	**1.4E-01**	**2.7E-01**
	75	1.8E-01	2.5E-01	3.4E-02	1.3E-02	**4.8E-01**	1.8E-01	1.2E-01	8.0E-02	1.6E-01	**5.4E-01**	**1.0E+00**
Lead	**50**	**3.9E-01**	**6.9E-01**	**7.3E-02**	**4.6E-02**	**1.2E+00**	**3.9E-01**	**3.4E-01**	**1.7E-01**	**5.6E-01**	**1.5E+00**	**2.7E+00**
	25	8.5E-01	1.9E+00	1.6E-01	1.7E-01	**3.1E+00**	8.4E-01	9.3E-01	3.8E-01	2.0E+00	**4.2E+00**	**7.3E+00**
	5	2.6E+00	7.6E+00	4.9E-01	1.0E+00	**1.2E+01**	2.5E+00	3.7E+00	1.2E+00	1.3E+01	**2.0E+01**	**3.2E+01**
	95	5.4E-01	4.0E-01	2.0E-02	2.5E-02	**9.8E-01**	5.3E-01	2.0E-01	4.8E-02	3.1E-01	**1.1E+00**	**2.1E+00**
	75	1.3E+00	1.1E+00	6.5E-02	8.2E-02	**2.5E+00**	1.3E+00	5.2E-01	1.5E-01	1.0E+00	**2.9E+00**	**5.4E+00**
Zinc	**50**	**2.4E+00**	**2.1E+00**	**1.5E-01**	**1.8E-01**	**4.8E+00**	**2.3E+00**	**1.0E+00**	**3.5E-01**	**2.3E+00**	**5.9E+00**	**1.1E+01**
	25	4.3E+00	3.5E+00	3.3E-01	4.1E-01	**8.5E+00**	4.3E+00	1.7E+00	7.8E-01	5.1E+00	**1.2E+01**	**2.0E+01**
	5	1.0E+01	1.0E+01	1.0E+00	1.3E+00	**2.3E+01**	1.0E+01	5.1E+00	2.5E+00	1.6E+01	**3.3E+01**	**5.6E+01**
	95	3.3E-04	5.9E-05	3.8E-06	3.9E-05	**4.3E-04**	3.3E-04	2.9E-05	9.1E-06	4.8E-04	**8.4E-04**	**1.3E-03**
	75	1.4E-03	2.5E-04	2.7E-05	1.7E-04	**1.9E-03**	1.4E-03	1.2E-04	6.3E-05	2.0E-03	**3.6E-03**	**5.5E-03**
Mercury	**50**	**3.9E-03**	**6.9E-04**	**1.0E-04**	**4.6E-04**	**5.2E-03**	**3.9E-03**	**3.4E-04**	**2.4E-04**	**5.6E-03**	**1.0E-02**	**1.5E-02**
	25	1.1E-02	1.9E-03	4.0E-04	1.3E-03	**1.4E-02**	1.1E-02	9.3E-04	9.4E-04	1.6E-02	**2.8E-02**	**4.2E-02**
	5	4.6E-02	8.1E-03	2.8E-03	5.4E-03	**6.3E-02**	4.6E-02	4.0E-03	6.5E-03	6.6E-02	**1.2E-01**	**1.9E-01**
	95	2.2E-05	5.1E-05	5.5E-06	1.5E-06	**8.0E-05**	2.2E-05	2.5E-05	1.3E-05	1.8E-05	**7.8E-05**	**1.6E-04**
	75	1.5E-04	3.6E-04	3.8E-05	1.7E-05	**5.7E-04**	1.5E-04	1.8E-04	9.0E-05	2.1E-04	**6.3E-04**	**1.2E-03**
Total PCBs	**50**	**5.9E-04**	**1.4E-03**	**1.5E-04**	**9.2E-05**	**2.2E-03**	**5.8E-04**	**6.8E-04**	**3.5E-04**	**1.1E-03**	**2.7E-03**	**4.9E-03**
	25	2.3E-03	5.3E-03	5.7E-04	5.0E-04	**8.7E-03**	2.2E-03	2.6E-03	1.3E-03	6.1E-03	**1.2E-02**	**2.1E-02**
	5	1.6E-02	3.7E-02	3.9E-03	5.6E-03	**6.2E-02**	1.6E-02	1.8E-02	9.4E-03	6.9E-02	**1.1E-01**	**1.7E-01**

Table B-2 - Box Model Surface Runoff Loadings

Average Annual Mass Loading (metric tons / year)

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	Hood Canal (south) Non-Urban CO/IN	RES	AGR	FOR	TOTAL
	1.1	0.49	0.40	0.19	95	0.0E+00	1.9E-02	9.4E-03	7.9E-01	8.2E-01
	2.3	1.1	0.87	0.51	75	0.0E+00	4.4E-02	2.0E-02	2.1E+00	2.1E+00
Arsenic	4	2	1.5	1	50	0.0E+00	7.8E-02	3.5E-02	4.1E+00	4.2E+00
	6.9	3.5	2.6	2.0	25	0.0E+00	1.4E-01	6.0E-02	8.0E+00	8.2E+00
	15	8.1	5.6	5.2	5	0.0E+00	3.2E-01	1.3E-01	2.1E+01	2.2E+01
	0.25	0.069	0.082	1.8E-04	95	0.0E+00	2.7E-03	1.9E-03	7.4E-04	5.4E-03
	0.71	0.22	0.24	0.0022	75	0.0E+00	8.7E-03	5.5E-03	9.2E-03	2.3E-02
Cadmium	1.5	0.5	0.5	0.013	50	0.0E+00	2.0E-02	1.2E-02	5.3E-02	8.4E-02
	3.2	1.1	1.1	0.075	25	0.0E+00	4.4E-02	2.4E-02	3.1E-01	3.8E-01
	9.2	3.6	3.1	0.94	5	0.0E+00	1.4E-01	7.1E-02	3.8E+00	4.0E+00
	5.7	0.77	0.69	0.14	95	0.0E+00	3.0E-02	1.6E-02	5.7E-01	6.1E-01
	14	2.0	2.2	0.44	75	0.0E+00	8.0E-02	5.2E-02	1.8E+00	2.0E+00
Copper	25	4	5	1	50	0.0E+00	1.6E-01	1.2E-01	4.1E+00	4.4E+00
	46	7.9	11	2.2	25	0.0E+00	3.1E-01	2.6E-01	9.2E+00	9.8E+00
	110	21	36	7.2	5	0.0E+00	8.1E-01	8.4E-01	2.9E+01	3.1E+01
	3.0	0.85	0.75	0.022	95	0.0E+00	3.3E-02	1.8E-02	9.0E-02	1.4E-01
	9.2	3.6	2.3	0.14	75	0.0E+00	1.4E-01	5.3E-02	5.7E-01	7.6E-01
Lead	20	10	5	0.5	50	0.0E+00	3.9E-01	1.2E-01	2.0E+00	2.6E+00
	43	28	11	1.8	25	0.0E+00	1.1E+00	2.5E-01	7.4E+00	8.7E+00
	130	110	33	11	5	0.0E+00	4.3E+00	7.7E-01	4.7E+01	5.2E+01
	27	5.8	1.4	0.28	95	0.0E+00	2.3E-01	3.2E-02	1.1E+00	1.4E+00
	65	15	4.4	0.89	75	0.0E+00	6.0E-01	1.0E-01	3.6E+00	4.3E+00
Zinc	120	30	10	2	50	0.0E+00	1.2E+00	2.3E-01	8.2E+00	9.6E+00
	220	50	22	4.5	25	0.0E+00	2.0E+00	5.2E-01	1.8E+01	2.1E+01
	520	150	71	14	5	0.0E+00	5.9E+00	1.7E+00	5.7E+01	6.5E+01
	0.017	0.0008	2.6E-04	4.2E-04	95	0.0E+00	3.3E-05	6.1E-06	1.7E-03	1.8E-03
	0.073	0.0036	0.0018	0.0018	75	0.0E+00	1.4E-04	4.2E-05	7.4E-03	7.6E-03
Mercury	0.2	0.01	0.007	0.005	50	0.0E+00	3.9E-04	1.6E-04	2.0E-02	2.1E-02
	0.55	0.028	0.027	0.014	25	0.0E+00	1.1E-03	6.3E-04	5.6E-02	5.8E-02
	2.4	0.12	0.19	0.059	5	0.0E+00	4.6E-03	4.4E-03	2.4E-01	2.5E-01
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	0.0E+00	2.9E-05	8.7E-06	6.7E-05	1.0E-04
	0.008	0.0052	0.0026	1.8E-04	75	0.0E+00	2.0E-04	6.0E-05	7.6E-04	1.0E-03
Total PCBs	0.03	0.02	0.01	0.001	50	0.0E+00	7.8E-04	2.3E-04	4.1E-03	5.1E-03
	0.12	0.077	0.039	0.0054	25	0.0E+00	3.0E-03	9.0E-04	2.2E-02	2.6E-02
	0.8	0.54	0.27	0.061	5	0.0E+00	2.1E-02	6.2E-03	2.5E-01	2.8E-01

Chemical of Concern	(%)	Hood Canal (north) Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	95	8.2E-04	1.5E-03	5.2E-06	1.7E-03	4.0E-03	6.4E-03	3.7E-03	4.3E-04	4.3E-02	5.4E-02	5.8E-02
	75	1.8E-03	3.4E-03	1.1E-05	4.6E-03	9.8E-03	1.4E-02	8.3E-03	9.3E-04	1.1E-01	1.4E-01	1.5E-01
Arsenic	50	3.1E-03	6.0E-03	1.9E-05	9.0E-03	1.8E-02	2.4E-02	1.5E-02	1.6E-03	2.2E-01	2.7E-01	2.8E-01
	25	5.3E-03	1.1E-02	3.3E-05	1.8E-02	3.4E-02	4.1E-02	2.6E-02	2.7E-03	4.4E-01	5.1E-01	5.5E-01
	5	1.1E-02	2.4E-02	7.2E-05	4.6E-02	8.2E-02	9.0E-02	6.0E-02	6.0E-03	1.2E+00	1.3E+00	1.4E+00
	95	1.9E-04	2.1E-04	1.1E-06	1.6E-06	4.0E-04	1.5E-03	5.1E-04	8.7E-05	4.1E-05	2.1E-03	2.5E-03
	75	5.5E-04	6.7E-04	3.1E-06	2.0E-05	1.2E-03	4.3E-03	1.6E-03	2.5E-04	5.1E-04	6.7E-03	7.9E-03
Cadmium	50	1.2E-03	1.5E-03	6.4E-06	1.2E-04	2.8E-03	9.0E-03	3.7E-03	5.3E-04	2.9E-03	1.6E-02	1.9E-02
	25	2.4E-03	3.4E-03	1.4E-05	6.7E-04	6.5E-03	1.9E-02	8.3E-03	1.1E-03	1.7E-02	4.5E-02	5.2E-02
	5	7.0E-03	1.1E-02	3.9E-05	8.4E-03	2.6E-02	5.5E-02	2.7E-02	3.3E-03	2.1E-01	3.0E-01	3.2E-01
	95	4.4E-03	2.3E-03	8.9E-06	1.2E-03	8.0E-03	3.4E-02	5.7E-03	7.4E-04	3.1E-02	7.2E-02	8.0E-02
	75	1.0E-02	6.1E-03	2.9E-05	4.0E-03	2.1E-02	8.2E-02	1.5E-02	2.4E-03	1.0E-01	2.0E-01	2.2E-01
Copper	50	1.9E-02	1.2E-02	6.4E-05	9.0E-03	4.0E-02	1.5E-01	3.0E-02	5.3E-03	2.2E-01	4.1E-01	4.5E-01
	25	3.5E-02	2.4E-02	1.4E-04	2.0E-02	7.9E-02	2.8E-01	5.8E-02	1.2E-02	5.1E-01	8.5E-01	9.3E-01
	5	8.4E-02	6.2E-02	4.6E-04	6.4E-02	2.1E-01	6.6E-01	1.5E-01	3.8E-02	1.6E+00	2.5E+00	2.7E+00
	95	2.3E-03	2.6E-03	9.7E-06	2.0E-04	5.1E-03	1.8E-02	6.3E-03	8.0E-04	4.9E-03	3.0E-02	3.5E-02
	75	7.1E-03	1.1E-02	3.0E-05	1.2E-03	1.9E-02	5.5E-02	2.7E-02	2.5E-03	3.1E-02	1.2E-01	1.4E-01
Lead	50	1.5E-02	3.0E-02	6.4E-05	4.5E-03	5.0E-02	1.2E-01	7.4E-02	5.3E-03	1.1E-01	3.1E-01	3.6E-01
	25	3.3E-02	8.3E-02	1.4E-04	1.6E-02	1.3E-01	2.6E-01	2.0E-01	1.2E-02	4.1E-01	8.8E-01	1.0E+00
	5	1.0E-01	3.3E-01	4.3E-04	1.0E-01	5.3E-01	7.8E-01	8.1E-01	3.5E-02	2.6E+00	4.2E+00	4.7E+00
	95	2.1E-02	1.7E-02	1.8E-05	2.5E-03	4.1E-02	1.6E-01	4.3E-02	1.5E-03	6.2E-02	2.7E-01	3.1E-01
	75	5.0E-02	4.6E-02	5.7E-05	8.0E-03	1.0E-01	3.9E-01	1.1E-01	4.7E-03	2.0E-01	7.1E-01	8.1E-01
Zinc	50	9.2E-02	9.0E-02	1.3E-04	1.8E-02	2.0E-01	7.2E-01	2.2E-01	1.1E-02	4.5E-01	1.4E+00	1.6E+00
	25	1.7E-01	1.5E-01	2.9E-04	4.0E-02	3.6E-01	1.3E+00	3.7E-01	2.4E-02	1.0E+00	2.7E+00	3.1E+00
	5	4.0E-01	4.5E-01	9.1E-04	1.3E-01	9.8E-01	3.1E+00	1.1E+00	7.6E-02	3.1E+00	7.5E+00	8.4E+00
	95	1.3E-05	2.6E-06	3.4E-09	3.8E-06	1.9E-05	1.0E-04	6.3E-06	2.8E-07	9.5E-05	2.0E-04	2.2E-04
	75	5.6E-05	1.1E-05	2.3E-08	1.6E-05	8.3E-05	4.4E-04	2.7E-05	1.9E-06	4.1E-04	8.7E-04	9.6E-04
Mercury	50	1.5E-04	3.0E-05	9.0E-08	4.5E-05	2.3E-04	1.2E-03	7.4E-05	7.5E-06	1.1E-03	2.4E-03	2.6E-03
	25	4.2E-04	8.3E-05	3.5E-07	1.2E-04	6.3E-04	3.3E-03	2.0E-04	2.9E-05	3.1E-03	6.6E-03	7.3E-03
	5	1.8E-03	3.6E-04	2.4E-06	5.3E-04	2.7E-03	1.4E-02	8.7E-04	2.0E-04	1.3E-02	2.8E-02	3.1E-02
	95	8.6E-07	2.2E-06	4.8E-09	1.5E-07	3.3E-06	6.7E-06	5.5E-06	4.0E-07	3.7E-06	1.6E-05	2.0E-05
	75	6.0E-06	1.6E-05	3.3E-08	1.7E-06	2.3E-05	4.7E-05	3.8E-05	2.8E-06	4.2E-05	1.3E-04	1.5E-04
Total PCBs	50	2.3E-05	6.0E-05	1.3E-07	9.0E-06	9.2E-05	1.8E-04	1.5E-04	1.1E-05	2.2E-04	5.6E-04	6.6E-04
	25	8.9E-05	2.3E-04	5.0E-07	4.8E-05	3.7E-04	7.0E-04	5.7E-04	4.1E-05	1.2E-03	2.5E-03	2.9E-03
	5	6.2E-04	1.6E-03	3.5E-06	5.5E-04	2.8E-03	4.8E-03	4.0E-03	2.9E-04	1.4E-02	2.3E-02	2.6E-02

Chemical of Concern	(%)	Sinclair/Dyes Inlet Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	95	1.2E-02	2.0E-02	7.1E-04	1.2E-02	4.5E-02	1.5E-02	1.3E-02	2.5E-03	7.5E-02	1.1E-01	1.5E-01
	75	2.6E-02	4.6E-02	1.5E-03	3.2E-02	1.1E-01	3.2E-02	3.0E-02	5.5E-03	2.0E-01	2.6E-01	3.7E-01
Arsenic	50	4.4E-02	8.2E-02	2.6E-03	6.4E-02	1.9E-01	5.5E-02	5.2E-02	9.5E-03	3.9E-01	5.1E-01	7.0E-01
	25	7.5E-02	1.5E-01	4.5E-03	1.2E-01	3.5E-01	9.4E-02	9.3E-02	1.6E-02	7.6E-01	9.7E-01	1.3E+00
	5	1.6E-01	3.3E-01	9.9E-03	3.3E-01	8.3E-01	2.0E-01	2.1E-01	3.5E-02	2.0E+00	2.5E+00	3.3E+00
	95	2.7E-03	2.8E-03	1.4E-04	1.1E-05	5.7E-03	3.3E-03	1.8E-03	5.2E-04	7.0E-05	5.8E-03	1.1E-02
	75	7.8E-03	9.1E-03	4.2E-04	1.4E-04	1.7E-02	9.7E-03	5.8E-03	1.5E-03	8.7E-04	1.8E-02	3.5E-02
Cadmium	50	1.6E-02	2.1E-02	8.8E-04	8.3E-04	3.9E-02	2.0E-02	1.3E-02	3.2E-03	5.1E-03	4.2E-02	8.0E-02
	25	3.5E-02	4.6E-02	1.9E-03	4.8E-03	8.7E-02	4.3E-02	2.9E-02	6.6E-03	2.9E-02	1.1E-01	2.0E-01
	5	1.0E-01	1.5E-01	5.4E-03	5.9E-02	3.1E-01	1.2E-01	9.4E-02	1.9E-02	3.6E-01	6.0E-01	9.2E-01
	95	6.2E-02	3.2E-02	1.2E-03	8.8E-03	1.0E-01	7.8E-02	2.0E-02	4.4E-03	5.4E-02	1.6E-01	2.6E-01
	75	1.5E-01	8.4E-02	3.9E-03	2.8E-02	2.6E-01	1.9E-01	5.3E-02	1.4E-02	1.7E-01	4.3E-01	6.9E-01
Copper	50	2.7E-01	1.6E-01	8.8E-03	6.4E-02	5.1E-01	3.4E-01	1.0E-01	3.2E-02	3.9E-01	8.7E-01	1.4E+00
	25	5.0E-01	3.2E-01	2.0E-02	1.4E-01	9.9E-01	6.3E-01	2.1E-01	7.1E-02	8.7E-01	1.8E+00	2.8E+00
	5	1.2E+00	8.5E-01	6.3E-02	4.6E-01	2.6E+00	1.5E+00	5.4E-01	2.3E-01	2.8E+00	5.1E+00	7.6E+00
	95	3.3E-02	3.5E-02	1.3E-03	1.4E-03	7.1E-02	4.1E-02	2.2E-02	4.8E-03	8.5E-03	7.7E-02	1.5E-01
	75	1.0E-01	1.5E-01	4.1E-03	8.8E-03	2.6E-01	1.3E-01	9.5E-02	1.5E-02	5.4E-02	2.9E-01	5.5E-01
Lead	50	2.2E-01	4.1E-01	8.8E-03	3.2E-02	6.7E-01	2.7E-01	2.6E-01	3.2E-02	1.9E-01	7.6E-01	1.4E+00
	25	4.8E-01	1.1E+00	1.9E-02	1.1E-01	1.7E+00	5.9E-01	7.2E-01	6.9E-02	7.0E-01	2.1E+00	3.8E+00
	5	1.4E+00	4.5E+00	5.8E-02	7.2E-01	6.7E+00	1.8E+00	2.9E+00	2.1E-01	4.4E+00	9.3E+00	1.6E+01
	95	3.0E-01	2.4E-01	2.4E-03	1.8E-02	5.6E-01	3.7E-01	1.5E-01	8.8E-03	1.1E-01	6.4E-01	1.2E+00
	75	7.2E-01	6.3E-01	7.8E-03	5.7E-02	1.4E+00	8.9E-01	4.0E-01	2.8E-02	3.5E-01	1.7E+00	3.1E+00
Zinc	50	1.3E+00	1.2E+00	1.8E-02	1.3E-01	2.7E+00	1.6E+00	7.9E-01	6.3E-02	7.8E-01	3.3E+00	6.0E+00
	25	2.4E+00	2.1E+00	4.0E-02	2.9E-01	4.8E+00	3.0E+00	1.3E+00	1.4E-01	1.7E+00	6.2E+00	1.1E+01
	5	5.7E+00	6.2E+00	1.3E-01	8.9E-01	1.3E+01	7.1E+00	3.9E+00	4.5E-01	5.4E+00	1.7E+01	3.0E+01
	95	1.9E-04	3.5E-05	4.6E-07	2.7E-05	2.5E-04	2.3E-04	2.2E-05	1.6E-06	1.6E-04	4.2E-04	6.7E-04
	75	8.0E-04	1.5E-04	3.2E-06	1.2E-04	1.1E-03	9.9E-04	9.5E-05	1.1E-05	7.1E-04	1.8E-03	2.9E-03
Mercury	50	2.2E-03	4.1E-04	1.2E-05	3.2E-04	2.9E-03	2.7E-03	2.6E-04	4.4E-05	1.9E-03	5.0E-03	7.9E-03
	25	6.0E-03	1.1E-03	4.8E-05	8.7E-04	8.1E-03	7.5E-03	7.2E-04	1.7E-04	5.4E-03	1.4E-02	2.2E-02
	5	2.6E-02	4.8E-03	3.3E-04	3.7E-03	3.5E-02	3.2E-02	3.1E-03	1.2E-03	2.3E-02	5.9E-02	9.4E-02
	95	1.2E-05	3.1E-05	6.6E-07	1.0E-06	4.4E-05	1.5E-05	2.0E-05	2.4E-06	6.4E-06	4.3E-05	8.8E-05
	75	8.5E-05	2.1E-04	4.6E-06	1.2E-05	3.1E-04	1.1E-04	1.4E-04	1.6E-05	7.2E-05	3.3E-04	6.4E-04
Total PCBs	50	3.3E-04	8.2E-04	1.8E-05	6.4E-05	1.2E-03	4.1E-04	5.2E-04	6.3E-05	3.9E-04	1.4E-03	2.6E-03
	25	1.3E-03	3.2E-03	6.8E-05	3.4E-04	4.8E-03	1.6E-03	2.0E-03	2.4E-04	2.1E-03	5.9E-03	1.1E-02
	5	8.8E-03	2.2E-02	4.7E-04	3.9E-03	3.5E-02	1.1E-02	1.4E-02	1.7E-03	2.4E-02	5.1E-02	8.6E-02

Table B-2 - Box Model Surface Runoff Loadings

Average Annual Mass Loading (metric tons / year) — Admiralty Inlet

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	0.0E+00	7.0E-03	4.5E-04	3.8E-03	1.1E-02	9.1E-03	8.9E-03	1.7E-02	6.9E-02	1.0E-01	1.1E-01
	2.3	1.1	0.87	0.51	75	0.0E+00	1.6E-02	9.7E-04	1.0E-02	2.7E-02	2.0E-02	2.0E-02	3.6E-02	1.8E-01	2.6E-01	2.9E-01
Arsenic	4	2	1.5	1	50	0.0E+00	2.9E-02	1.7E-03	2.0E-02	5.0E-02	3.4E-02	3.6E-02	6.2E-02	3.6E-01	4.9E-01	5.4E-01
	6.9	3.5	2.6	2.0	25	0.0E+00	5.1E-02	2.9E-03	3.8E-02	9.2E-02	5.8E-02	6.4E-02	1.1E-01	7.0E-01	9.3E-01	1.0E+00
	15	8.1	5.6	5.2	5	0.0E+00	1.2E-01	6.2E-03	1.0E-01	2.2E-01	1.3E-01	1.5E-01	2.3E-01	1.9E+00	2.4E+00	2.6E+00
	0.25	0.069	0.082	1.8E-04	95	0.0E+00	9.9E-04	9.1E-05	3.5E-06	1.1E-03	2.1E-03	1.2E-03	3.4E-03	6.5E-05	6.8E-03	7.9E-03
	0.71	0.22	0.24	0.0022	75	0.0E+00	3.2E-03	2.7E-04	4.4E-05	3.5E-03	6.0E-03	4.0E-03	9.9E-03	8.0E-04	2.1E-02	2.4E-02
Cadmium	1.5	0.5	0.5	0.013	50	0.0E+00	7.1E-03	5.6E-04	2.5E-04	7.9E-03	1.3E-02	9.0E-03	2.1E-02	4.6E-03	4.7E-02	5.5E-02
	3.2	1.1	1.1	0.075	25	0.0E+00	1.6E-02	1.2E-03	1.5E-03	1.9E-02	2.7E-02	2.0E-02	4.4E-02	2.7E-02	1.2E-01	1.4E-01
	9.2	3.6	3.1	0.94	5	0.0E+00	5.1E-02	3.4E-03	1.8E-02	7.3E-02	7.7E-02	6.5E-02	1.3E-01	3.3E-01	6.0E-01	6.8E-01
	5.7	0.77	0.69	0.14	95	0.0E+00	1.1E-02	7.7E-04	2.7E-03	1.5E-02	4.8E-02	1.4E-02	2.9E-02	5.0E-02	1.4E-01	1.5E-01
	14	2.0	2.2	0.44	75	0.0E+00	2.9E-02	2.5E-03	8.7E-03	4.0E-02	1.1E-01	3.7E-02	9.3E-02	1.6E-01	4.0E-01	4.4E-01
Copper	25	4	5	1	50	0.0E+00	5.7E-02	5.6E-03	2.0E-02	8.2E-02	2.1E-01	7.2E-02	2.1E-01	3.6E-01	8.5E-01	9.3E-01
	46	7.9	11	2.2	25	0.0E+00	1.1E-01	1.3E-02	4.4E-02	1.7E-01	3.9E-01	1.4E-01	4.7E-01	8.0E-01	1.8E+00	2.0E+00
	110	21	36	7.2	5	0.0E+00	3.0E-01	4.0E-02	1.4E-01	4.8E-01	9.3E-01	3.7E-01	1.5E+00	2.6E+00	5.4E+00	5.8E+00
	3.0	0.85	0.75	0.022	95	0.0E+00	1.2E-02	8.4E-04	4.3E-04	1.3E-02	2.5E-02	1.5E-02	3.1E-02	7.9E-03	8.0E-02	9.3E-02
	9.2	3.6	2.3	0.14	75	0.0E+00	5.2E-02	2.6E-03	2.7E-03	5.7E-02	7.8E-02	6.5E-02	9.6E-02	5.0E-02	2.9E-01	3.5E-01
Lead	20	10	5	0.5	50	0.0E+00	1.4E-01	5.6E-03	9.8E-03	1.6E-01	1.7E-01	1.8E-01	2.1E-01	1.8E-01	7.4E-01	8.9E-01
	43	28	11	1.8	25	0.0E+00	3.9E-01	1.2E-02	3.5E-02	4.4E-01	3.7E-01	4.9E-01	4.5E-01	6.4E-01	2.0E+00	2.4E+00
	130	110	33	11	5	0.0E+00	1.6E+00	3.7E-02	2.2E-01	1.8E+00	1.1E+00	2.0E+00	1.4E+00	4.1E+00	8.5E+00	1.0E+01
	27	5.8	1.4	0.28	95	0.0E+00	8.3E-02	1.5E-03	5.4E-03	9.0E-02	2.3E-01	1.0E-01	5.8E-02	9.9E-02	4.9E-01	5.8E-01
	65	15	4.4	0.89	75	0.0E+00	2.2E-01	5.0E-03	1.7E-02	2.4E-01	5.5E-01	2.7E-01	1.9E-01	3.2E-01	1.3E+00	1.6E+00
Zinc	120	30	10	2	50	0.0E+00	4.3E-01	1.1E-02	3.9E-02	4.8E-01	1.0E+00	5.4E-01	4.2E-01	7.2E-01	2.7E+00	3.2E+00
	220	50	22	4.5	25	0.0E+00	7.1E-01	2.5E-02	8.8E-02	8.3E-01	1.9E+00	9.0E-01	9.4E-01	1.6E+00	5.3E+00	6.1E+00
	520	150	71	14	5	0.0E+00	2.1E+00	7.9E-02	2.7E-01	2.5E+00	4.4E+00	2.7E+00	3.0E+00	5.0E+00	1.5E+01	1.8E+01
	0.017	0.0008	2.6E-04	4.2E-04	95	0.0E+00	1.2E-05	2.9E-07	8.3E-06	2.1E-05	1.4E-04	1.5E-05	1.1E-05	1.5E-04	3.2E-04	3.4E-04
	0.073	0.0036	0.0018	0.0018	75	0.0E+00	5.2E-05	2.0E-06	3.6E-05	8.9E-05	6.1E-04	6.5E-05	7.6E-05	6.5E-04	1.4E-03	1.5E-03
Mercury	0.2	0.01	0.007	0.005	50	0.0E+00	1.4E-04	7.8E-06	9.8E-05	2.5E-04	1.7E-03	1.8E-04	2.9E-04	1.8E-03	3.9E-03	4.2E-03
	0.55	0.028	0.027	0.014	25	0.0E+00	3.9E-04	3.0E-05	2.7E-04	6.9E-04	4.6E-03	4.9E-04	1.1E-03	4.9E-03	1.1E-02	1.2E-02
	2.4	0.12	0.19	0.059	5	0.0E+00	1.7E-03	2.1E-04	1.2E-03	3.0E-03	2.0E-02	2.1E-03	7.8E-03	2.1E-02	5.1E-02	5.4E-02
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	0.0E+00	1.1E-05	4.2E-07	3.2E-07	1.1E-05	9.4E-06	1.3E-05	1.6E-05	5.9E-06	4.4E-05	5.6E-05
	0.008	0.0052	0.0026	1.8E-04	75	0.0E+00	7.4E-05	2.9E-06	3.6E-06	8.0E-05	6.6E-05	9.3E-05	1.1E-04	6.6E-05	3.3E-04	4.1E-04
Total PCBs	0.03	0.02	0.01	0.001	50	0.0E+00	2.9E-04	1.1E-05	2.0E-05	3.2E-04	2.5E-04	3.6E-04	4.2E-04	3.6E-04	1.4E-03	1.7E-03
	0.12	0.077	0.039	0.0054	25	0.0E+00	1.1E-03	4.3E-05	1.1E-04	1.2E-03	9.8E-04	1.4E-03	1.6E-03	1.9E-03	5.9E-03	7.1E-03
	0.8	0.54	0.27	0.061	5	0.0E+00	7.7E-03	3.0E-04	1.2E-03	9.2E-03	6.8E-03	9.6E-03	1.1E-02	2.2E-02	4.9E-02	5.9E-02

Average Annual Mass Loading (metric tons / year) — Strait of Juan de Fuca

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	1.0E-03	1.8E-02	6.5E-03	7.9E-03	3.4E-02	2.6E-02	1.5E-02	7.3E-02	9.4E-01	1.1E+00	1.1E+00
	75	2.2E-03	4.1E-02	1.4E-02	2.1E-02	7.9E-02	5.6E-02	3.4E-02	1.6E-01	2.5E+00	2.7E+00	2.8E+00
Arsenic	50	3.8E-03	7.3E-02	2.4E-02	4.1E-02	1.4E-01	9.5E-02	5.9E-02	2.7E-01	4.9E+00	5.3E+00	5.4E+00
	25	6.5E-03	1.3E-01	4.2E-02	8.0E-02	2.6E-01	1.6E-01	1.1E-01	4.7E-01	9.6E+00	1.0E+01	1.1E+01
	5	1.4E-02	3.0E-01	9.1E-02	2.1E-01	6.1E-01	3.6E-01	2.4E-01	1.0E+00	2.5E+01	2.7E+01	2.7E+01
	95	2.3E-04	2.6E-03	1.3E-03	7.4E-06	4.1E-03	5.9E-03	2.1E-03	1.5E-02	8.8E-04	2.4E-02	2.8E-02
	75	6.7E-04	8.2E-03	3.9E-03	9.2E-05	1.3E-02	1.7E-02	6.6E-03	4.3E-02	1.1E-02	7.8E-02	9.1E-02
Cadmium	50	1.4E-03	1.8E-02	8.1E-03	5.3E-04	2.8E-02	3.6E-02	1.5E-02	9.1E-02	6.3E-02	2.0E-01	2.3E-01
	25	3.0E-03	4.1E-02	1.7E-02	3.1E-03	6.4E-02	7.5E-02	3.3E-02	1.9E-01	3.7E-01	6.7E-01	7.3E-01
	5	8.6E-03	1.3E-01	5.0E-02	3.8E-02	2.3E-01	2.2E-01	1.1E-01	5.5E-01	4.6E+00	5.4E+00	5.7E+00
	95	5.3E-03	2.8E-02	1.1E-02	5.7E-03	5.1E-02	1.4E-01	2.3E-02	1.3E-01	6.8E-01	9.6E-01	1.0E+00
	75	1.3E-02	7.5E-02	3.6E-02	1.8E-02	1.4E-01	3.2E-01	6.1E-02	4.0E-01	2.2E+00	3.0E+00	3.1E+00
Copper	50	2.4E-02	1.5E-01	8.1E-02	4.1E-02	2.9E-01	6.0E-01	1.2E-01	9.1E-01	4.9E+00	6.5E+00	6.8E+00
	25	4.3E-02	2.9E-01	1.8E-01	9.2E-02	6.1E-01	1.1E+00	2.3E-01	2.0E+00	1.1E+01	1.4E+01	1.5E+01
	5	1.0E-01	7.6E-01	5.8E-01	2.9E-01	1.7E+00	2.6E+00	6.2E-01	6.5E+00	3.5E+01	4.5E+01	4.7E+01
	95	2.8E-03	3.1E-02	1.2E-02	9.0E-04	4.7E-02	7.2E-02	2.5E-02	1.4E-01	1.1E-01	3.4E-01	3.9E-01
	75	8.7E-03	1.3E-01	3.7E-02	5.7E-03	1.9E-01	2.2E-01	1.1E-01	4.2E-01	6.8E-01	1.4E+00	1.6E+00
Lead	50	1.9E-02	3.7E-01	8.1E-02	2.0E-02	4.9E-01	4.8E-01	3.0E-01	9.1E-01	2.4E+00	4.1E+00	4.6E+00
	25	4.1E-02	1.0E+00	1.8E-01	7.4E-02	1.3E+00	1.0E+00	8.2E-01	2.0E+00	8.8E+00	1.3E+01	1.4E+01
	5	1.2E-01	4.0E+00	5.4E-01	4.6E-01	5.2E+00	3.1E+00	3.3E+00	6.0E+00	5.5E+01	6.8E+01	7.3E+01
	95	2.6E-02	2.1E-01	2.3E-02	1.1E-02	2.7E-01	6.5E-01	1.7E-01	2.5E-01	1.4E+00	2.4E+00	2.7E+00
	75	6.1E-02	5.6E-01	7.2E-02	3.6E-02	7.3E-01	1.6E+00	4.5E-01	8.1E-01	4.3E+00	7.2E+00	7.9E+00
Zinc	50	1.1E-01	1.1E+00	1.6E-01	8.2E-02	1.5E+00	2.9E+00	8.9E-01	1.8E+00	9.7E+00	1.5E+01	1.7E+01
	25	2.1E-01	1.8E+00	3.6E-01	1.8E-01	2.6E+00	5.2E+00	1.5E+00	4.1E+00	2.2E+01	3.3E+01	3.5E+01
	5	4.9E-01	5.5E+00	1.2E+00	5.7E-01	7.7E+00	1.2E+01	4.5E+00	1.3E+01	6.8E+01	9.8E+01	1.1E+02
	95	1.6E-05	3.1E-05	4.2E-06	1.7E-05	6.9E-05	4.0E-04	2.5E-05	4.7E-05	2.1E-03	2.5E-03	2.6E-03
	75	6.8E-05	1.3E-04	2.9E-05	7.4E-05	3.1E-04	1.7E-03	1.1E-04	3.3E-04	8.8E-03	1.1E-02	1.1E-02
Mercury	50	1.9E-04	3.7E-04	1.1E-04	2.0E-04	8.7E-04	4.8E-03	3.0E-04	1.3E-03	2.4E-02	3.1E-02	3.2E-02
	25	5.2E-04	1.0E-03	4.4E-04	5.6E-04	2.5E-03	1.3E-02	8.2E-04	4.9E-03	6.7E-02	8.6E-02	8.8E-02
	5	2.2E-03	4.3E-03	3.0E-03	2.4E-03	1.2E-02	5.6E-02	3.5E-03	3.4E-02	2.9E-01	3.8E-01	3.9E-01
	95	1.1E-06	2.7E-05	6.0E-06	6.7E-07	3.5E-05	2.7E-05	2.2E-05	6.8E-05	8.0E-05	2.0E-04	2.3E-04
	75	7.3E-06	1.9E-04	4.2E-05	7.6E-06	2.5E-04	1.9E-04	1.5E-04	4.7E-04	9.0E-04	1.7E-03	2.0E-03
Total PCBs	50	2.8E-05	7.3E-04	1.6E-04	4.1E-05	9.7E-04	7.2E-04	5.9E-04	1.8E-03	4.9E-03	8.0E-03	9.0E-03
	25	1.1E-04	2.8E-03	6.3E-04	2.2E-04	3.8E-03	2.8E-03	2.3E-03	7.0E-03	2.6E-02	3.8E-02	4.2E-02
	5	7.6E-04	2.0E-02	4.4E-03	2.5E-03	2.7E-02	1.9E-02	1.6E-02	4.9E-02	3.0E-01	3.8E-01	4.1E-01

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Strait of Georgia											Whidbey Basin										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	3.0E-02	4.3E-02	2.0E-02	2.3E-02	1.2E-01	4.3E-02	3.1E-02	4.4E-01	9.0E-01	1.4E+00	1.5E+00	3.1E-02	4.8E-02	2.6E-02	3.6E-02	1.4E-01	6.3E-02	4.8E-02	2.6E-01	3.3E+00	3.6E+00	3.8E+00
	2.3	1.1	0.87	0.51	75	6.5E-02	9.8E-02	4.3E-02	6.0E-02	2.7E-01	9.3E-02	7.0E-02	9.5E-01	2.4E+00	3.5E+00	3.8E+00	6.8E-02	1.1E-01	5.7E-02	9.5E-02	3.3E-01	1.4E-01	1.1E-01	5.7E-01	8.6E+00	9.4E+00	9.7E+00
Arsenic	4	2	1.5	1	50	1.1E-01	1.7E-01	7.4E-02	1.2E-01	4.8E-01	1.6E-01	1.2E-01	1.6E+00	4.7E+00	6.6E+00	7.1E+00	1.2E-01	1.9E-01	9.8E-02	1.9E-01	6.0E-01	2.3E-01	2.0E-01	9.8E-01	1.7E+01	1.8E+01	1.9E+01
	6.9	3.5	2.6	2.0	25	1.9E-01	3.1E-01	1.3E-01	2.3E-01	8.6E-01	2.7E-01	2.2E-01	2.8E+00	9.1E+00	1.2E+01	1.3E+01	2.0E-01	3.4E-01	1.7E-01	3.7E-01	1.1E+00	4.0E-01	3.5E-01	1.7E+00	3.3E+01	3.6E+01	3.7E+01
	15	8.1	5.6	5.2	5	4.2E-01	7.0E-01	2.8E-01	6.1E-01	2.0E+00	6.0E-01	5.1E-01	6.1E+00	2.4E+01	3.1E+01	3.3E+01	4.3E-01	7.8E-01	3.7E-01	9.7E-01	2.6E+00	8.7E-01	7.9E-01	3.7E+00	8.7E+01	9.3E+01	9.5E+01
	0.25	0.069	0.082	1.8E-04	95	6.9E-03	6.0E-03	4.1E-03	2.1E-05	1.7E-02	9.8E-03	4.3E-03	8.9E-02	8.4E-04	1.0E-01	1.2E-01	7.2E-03	6.7E-03	5.3E-03	3.4E-05	1.9E-02	1.4E-02	6.8E-03	5.3E-02	3.0E-03	7.8E-02	9.7E-02
	0.71	0.22	0.24	0.0022	75	2.0E-02	1.9E-02	1.2E-02	2.7E-04	5.1E-02	2.9E-02	1.4E-02	2.6E-01	1.0E-02	3.1E-01	3.6E-01	2.1E-02	2.2E-02	1.6E-02	4.2E-04	5.8E-02	4.2E-02	2.2E-02	1.6E-01	3.8E-02	2.6E-01	3.2E-01
Cadmium	1.5	0.5	0.5	0.013	50	4.2E-02	4.3E-02	2.5E-02	1.5E-03	1.1E-01	6.0E-02	3.1E-02	5.4E-01	6.0E-02	7.0E-01	8.1E-01	4.4E-02	4.8E-02	3.3E-02	2.4E-03	1.3E-01	8.8E-02	4.9E-02	3.3E-01	2.2E-01	6.8E-01	8.1E-01
	3.2	1.1	1.1	0.075	25	8.8E-02	9.8E-02	5.2E-02	8.9E-03	2.5E-01	1.3E-01	7.0E-02	1.1E+00	3.5E-01	1.7E+00	1.9E+00	9.2E-02	1.1E-01	6.9E-02	1.4E-02	2.8E-01	1.8E-01	1.1E-01	6.9E-01	1.3E+00	2.2E+00	2.5E+00
	9.2	3.6	3.1	0.94	5	2.6E-01	3.1E-01	1.5E-01	1.1E-01	8.3E-01	3.7E-01	2.2E-01	3.3E+00	4.4E+00	8.3E+00	9.1E+00	2.7E-01	3.5E-01	2.0E-01	1.8E-01	9.9E-01	5.4E-01	3.5E-01	2.0E+00	1.6E+01	1.9E+01	2.0E+01
	5.7	0.77	0.69	0.14	95	1.6E-01	6.7E-02	3.4E-02	1.6E-02	2.8E-01	2.3E-01	4.8E-02	7.6E-01	6.5E-01	1.7E+00	2.0E+00	1.7E-01	7.5E-02	4.5E-02	2.6E-02	3.1E-01	3.3E-01	7.5E-02	4.5E-01	2.3E+00	3.2E+00	3.5E+00
	14	2.0	2.2	0.44	75	3.8E-01	1.8E-01	1.1E-01	5.3E-02	7.2E-01	5.4E-01	1.3E-01	2.4E+00	2.1E+00	5.2E+00	5.9E+00	4.0E-01	2.0E-01	1.5E-01	8.3E-02	8.2E-01	8.0E-01	2.0E-01	1.5E+00	7.5E+00	1.0E+01	1.1E+01
Copper	25	4	5	1	50	7.0E-01	3.5E-01	2.5E-01	1.2E-01	1.4E+00	1.0E+00	2.5E-01	5.4E+00	4.7E+00	1.1E+01	1.3E+01	7.3E-01	3.9E-01	3.3E-01	1.9E-01	1.6E+00	1.5E+00	3.9E-01	3.3E+00	1.7E+01	2.2E+01	2.4E+01
	46	7.9	11	2.2	25	1.3E+00	6.8E-01	5.6E-01	2.7E-01	2.8E+00	1.8E+00	4.9E-01	1.2E+01	1.0E+01	2.5E+01	2.8E+01	1.3E+00	7.6E-01	7.3E-01	4.2E-01	3.3E+00	2.7E+00	7.7E-01	7.3E+00	3.8E+01	4.9E+01	5.2E+01
	110	21	36	7.2	5	3.1E+00	1.8E+00	1.8E+00	8.5E-01	7.5E+00	4.4E+00	1.3E+00	3.9E+01	3.4E+01	7.8E+01	8.6E+01	3.2E+00	2.0E+00	2.4E+00	1.3E+00	8.9E+00	6.4E+00	2.0E+00	2.4E+01	1.2E+02	1.5E+02	1.6E+02
	3.0	0.85	0.75	0.022	95	8.5E-02	7.4E-02	3.7E-02	2.6E-03	2.0E-01	1.2E-01	5.3E-02	8.2E-01	1.0E-01	1.1E+00	1.3E+00	8.8E-02	8.2E-02	4.9E-02	4.1E-03	2.2E-01	1.8E-01	8.3E-02	4.9E-01	3.7E-01	1.1E+00	1.3E+00
	9.2	3.6	2.3	0.14	75	2.6E-01	3.2E-01	1.1E-01	1.6E-02	7.0E-01	3.7E-01	2.3E-01	2.5E+00	6.5E-01	3.7E+00	4.5E+00	2.7E-01	3.5E-01	1.5E-01	2.6E-02	8.0E-01	5.4E-01	3.6E-01	1.5E+00	2.3E+00	4.7E+00	5.5E+00
Lead	20	10	5	0.5	50	5.6E-01	8.7E-01	2.5E-01	5.9E-02	1.7E+00	8.0E-01	6.2E-01	5.4E+00	2.3E+00	9.2E+00	1.1E+01	5.8E-01	9.7E-01	3.3E-01	9.4E-02	2.0E+00	1.2E+00	9.8E-01	3.3E+00	8.4E+00	1.4E+01	1.6E+01
	43	28	11	1.8	25	1.2E+00	2.4E+00	5.4E-01	2.1E-01	4.4E+00	1.7E+00	1.7E+00	1.2E+01	8.4E+00	2.4E+01	2.8E+01	1.3E+00	2.7E+00	7.1E-01	3.4E-01	5.0E+00	2.5E+00	2.7E+00	7.1E+00	3.0E+01	4.3E+01	4.8E+01
	130	110	33	11	5	3.6E+00	9.6E+00	1.6E+00	1.3E+00	1.6E+01	5.2E+00	6.9E+00	3.6E+01	5.3E+01	1.0E+02	1.2E+02	3.8E+00	1.1E+01	2.2E+00	2.1E+00	1.9E+01	7.6E+00	1.1E+01	2.2E+01	1.9E+02	2.3E+02	2.5E+02
	27	5.8	1.4	0.28	95	7.7E-01	5.0E-01	6.9E-02	3.3E-02	1.4E+00	1.1E+00	3.6E-01	1.5E+00	1.3E+00	4.3E+00	5.6E+00	8.0E-01	5.6E-01	9.1E-02	5.2E-02	1.5E+00	1.6E+00	5.7E-01	9.1E-01	4.7E+00	7.8E+00	9.3E+00
	65	15	4.4	0.89	75	1.8E+00	1.3E+00	2.2E-01	1.1E-01	3.5E+00	2.6E+00	9.5E-01	4.8E+00	4.1E+00	1.3E+01	1.6E+01	1.9E+00	1.5E+00	2.9E-01	1.7E-01	3.8E+00	3.8E+00	1.5E+00	2.9E+00	1.5E+01	2.3E+01	2.7E+01
Zinc	120	30	10	2	50	3.4E+00	2.6E+00	5.0E-01	2.4E-01	6.7E+00	4.8E+00	1.9E+00	1.1E+01	9.3E+00	2.7E+01	3.4E+01	3.5E+00	2.9E+00	6.5E-01	3.7E-01	7.4E+00	7.0E+00	2.9E+00	6.5E+00	3.4E+01	5.0E+01	5.8E+01
	220	50	22	4.5	25	6.2E+00	4.3E+00	1.1E+00	5.3E-01	1.2E+01	8.8E+00	3.1E+00	2.4E+01	2.1E+01	5.7E+01	6.9E+01	6.4E+00	4.8E+00	1.5E+00	8.4E-01	1.4E+01	1.3E+01	4.9E+00	1.5E+01	7.6E+01	1.1E+02	1.2E+02
	520	150	71	14	5	1.5E+01	1.3E+01	3.5E+00	1.7E+00	3.3E+01	2.1E+01	9.4E+00	7.7E+01	6.5E+01	1.7E+02	2.1E+02	1.5E+01	1.5E+01	4.6E+00	2.6E+00	3.7E+01	3.0E+01	1.5E+01	4.6E+01	2.4E+02	3.3E+02	3.6E+02
	0.017	0.0008	2.6E-04	4.2E-04	95	4.8E-04	7.4E-05	1.3E-05	5.0E-05	6.1E-04	6.8E-04	5.3E-05	2.8E-04	2.0E-03	3.0E-03	3.6E-03	4.9E-04	8.2E-05	1.7E-05	7.9E-05	6.7E-04	9.9E-04	8.3E-05	1.7E-04	7.2E-03	8.4E-03	9.1E-03
	0.073	0.0036	0.0018	0.0018	75	2.0E-03	3.2E-04	9.0E-05	2.1E-04	2.7E-03	2.9E-03	2.3E-04	2.0E-03	8.5E-03	1.4E-02	1.6E-02	2.1E-03	3.5E-04	1.2E-04	3.4E-04	2.9E-03	4.3E-03	3.6E-04	1.2E-03	3.1E-02	3.6E-02	3.9E-02
Mercury	0.2	0.01	0.007	0.005	50	5.6E-03	8.7E-04	3.5E-04	5.9E-04	7.4E-03	8.0E-03	6.2E-04	7.6E-03	2.3E-02	4.0E-02	4.7E-02	5.8E-03	9.7E-04	4.6E-04	9.4E-04	8.2E-03	1.2E-02	9.8E-04	4.6E-03	8.4E-02	1.0E-01	1.1E-01
	0.55	0.028	0.027	0.014	25	1.5E-02	2.4E-03	1.3E-03	1.6E-03	2.1E-02	2.2E-02	1.7E-03	2.9E-02	6.4E-02	1.2E-01	1.4E-01	1.6E-02	2.7E-03	1.8E-03	2.6E-03	2.3E-02	3.2E-02	2.7E-03	1.8E-02	2.3E-01	2.8E-01	3.1E-01
	2.4	0.12	0.19	0.059	5	6.6E-02	1.0E-02	9.3E-03	7.0E-03	9.3E-02	9.4E-02	7.4E-03	2.0E-01	2.7E-01	5.8E-01	6.7E-01	6.9E-02	1.1E-02	1.2E-02	1.1E-02	1.0E-01	1.4E-01	1.2E-02	1.2E-01	9.9E-01	1.3E+00	1.4E+00
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	3.1E-05	6.5E-05	1.8E-05	1.9E-06	1.2E-04	4.5E-05	4.7E-05	4.1E-04	7.6E-05	5.7E-04	6.9E-04	3.3E-05	7.2E-05	2.4E-05	3.1E-06	1.3E-04	6.5E-05	7.3E-05	2.4E-04	2.8E-04	6.6E-04	7.9E-04
	0.008	0.0052	0.0026	1.8E-04	75	2.2E-04	4.5E-04	1.3E-04	2.2E-05	8.2E-04	3.1E-04	3.2E-04	2.8E-03	8.6E-04	4.3E-03	5.1E-03	2.3E-04	5.0E-04	1.7E-04	3.5E-05	9.3E-04	4.6E-04	5.1E-04	1.7E-03	3.1E-03	5.8E-03	6.7E-03
Total PCBs	0.03	0.02	0.01	0.001	50	8.4E-04	1.7E-03	5.0E-04	1.2E-04	3.2E-03	1.2E-03	1.2E-03	1.1E-02	4.7E-03	1.8E-02	2.1E-02	8.7E-04	1.9E-03	6.5E-04	1.9E-04	3.6E-03	1.8E-03	2.0E-03	6.5E-03	1.7E-02	2.7E-02	3.1E-02
	0.12	0.077	0.039	0.0054	25	3.2E-03	6.7E-03	1.9E-03	6.4E-04	1.2E-02	4.6E-03	4.8E-03	4.2E-02	2.5E-02	7.7E-02	8.9E-02	3.4E-03	7.5E-03	2.5E-03	1.0E-03	1.4E-02	6.8E-03	7.5E-03	2.5E-02	9.1E-02	1.3E-01	1.5E-01
	0.8	0.54	0.27	0.061	5	2.3E-02	4.7E-02	1.3E-02	7.2E-03	9.0E-02	3.2E-02	3.4E-02	2.9E-01	2.8E-01	6.4E-01	7.3E-01	2.3E-02	5.2E-02	1.8E-02	1.1E-02	1.0E-01	4.7E-02	5.2E-02	1.8E-01	1.0E+00	1.3E+00	1.4E+00

Table B-2 - Box Model Surface Runoff Loadings

Surface Runoff Concentration (ug/L) and Average Annual Mass Loading (metric tons / year) – San Juan Islands

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	San Juan Islands – Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	1.1	0.49	0.40	0.19	95	1.7E-02	1.2E-02	6.4E-03	1.2E-02	**4.8E-02**	1.0E-01	1.4E-01	4.4E-02	1.0E-01	**3.9E-01**	**4.3E-01**
	2.3	1.1	0.87	0.51	75	3.8E-02	2.7E-02	1.4E-02	3.2E-02	**1.1E-01**	2.2E-01	3.2E-01	9.5E-02	2.7E-01	**9.0E-01**	**1.0E+00**
Arsenic	**4**	**2**	**1.5**	**1**	**50**	**6.5E-02**	**4.8E-02**	**2.4E-02**	**6.3E-02**	**2.0E-01**	**3.8E-01**	**5.6E-01**	**1.6E-01**	**5.2E-01**	**1.6E+00**	**1.8E+00**
	6.9	3.5	2.6	2.0	25	1.1E-01	8.5E-02	4.1E-02	1.2E-01	**3.6E-01**	6.5E-01	9.9E-01	2.8E-01	1.0E+00	**3.0E+00**	**3.3E+00**
	15	8.1	5.6	5.2	5	2.4E-01	1.9E-01	8.9E-02	3.3E-01	**8.5E-01**	1.4E+00	2.3E+00	6.1E-01	2.7E+00	**7.0E+00**	**7.9E+00**
	0.25	0.069	0.082	1.8E-04	95	4.0E-03	1.7E-03	1.3E-03	1.1E-05	**7.0E-03**	2.3E-02	1.9E-02	8.9E-03	9.4E-05	**5.2E-02**	**5.9E-02**
	0.71	0.22	0.24	0.0022	75	1.2E-02	5.4E-03	3.8E-03	1.4E-04	**2.1E-02**	6.8E-02	6.2E-02	2.6E-02	1.2E-03	**1.6E-01**	**1.8E-01**
Cadmium	**1.5**	**0.5**	**0.5**	**0.013**	**50**	**2.4E-02**	**1.2E-02**	**7.9E-03**	**8.2E-04**	**4.5E-02**	**1.4E-01**	**1.4E-01**	**5.4E-02**	**6.8E-03**	**3.4E-01**	**3.9E-01**
	3.2	1.1	1.1	0.075	25	5.1E-02	2.7E-02	1.7E-02	4.7E-03	**1.0E-01**	3.0E-01	3.2E-01	1.1E-01	3.9E-02	**7.7E-01**	**8.7E-01**
	9.2	3.6	3.1	0.94	5	1.5E-01	8.7E-02	4.8E-02	5.9E-02	**3.4E-01**	8.7E-01	1.0E+00	3.3E-01	4.9E-01	**2.7E+00**	**3.0E+00**
	5.7	0.77	0.69	0.14	95	9.3E-02	1.9E-02	1.1E-02	8.7E-03	**1.3E-01**	5.4E-01	2.2E-01	7.5E-02	7.3E-02	**9.1E-01**	**1.0E+00**
	14	2.0	2.2	0.44	75	2.2E-01	4.9E-02	3.5E-02	2.8E-02	**3.3E-01**	1.3E+00	5.7E-01	2.4E-01	2.3E-01	**2.3E+00**	**2.7E+00**
Copper	**25**	**4**	**5**	**1**	**50**	**4.1E-01**	**9.6E-02**	**7.9E-02**	**6.3E-02**	**6.5E-01**	**2.4E+00**	**1.1E+00**	**5.4E-01**	**5.2E-01**	**4.6E+00**	**5.2E+00**
	46	7.9	11	2.2	25	7.5E-01	1.9E-01	1.8E-01	1.4E-01	**1.3E+00**	4.4E+00	2.2E+00	1.2E+00	1.2E+00	**9.0E+00**	**1.0E+01**
	110	21	36	7.2	5	1.8E+00	5.0E-01	5.7E-01	4.5E-01	**3.3E+00**	1.0E+01	5.8E+00	3.9E+00	3.8E+00	**2.4E+01**	**2.7E+01**
	3.0	0.85	0.75	0.022	95	4.9E-02	2.0E-02	1.2E-02	1.4E-03	**8.3E-02**	2.9E-01	2.4E-01	8.2E-02	1.1E-02	**6.2E-01**	**7.0E-01**
	9.2	3.6	2.3	0.14	75	1.5E-01	8.7E-02	3.7E-02	8.7E-03	**2.8E-01**	8.8E-01	1.0E+00	2.5E-01	7.3E-02	**2.2E+00**	**2.5E+00**
Lead	**20**	**10**	**5**	**0.5**	**50**	**3.3E-01**	**2.4E-01**	**7.9E-02**	**3.1E-02**	**6.8E-01**	**1.9E+00**	**2.8E+00**	**5.4E-01**	**2.6E-01**	**5.5E+00**	**6.2E+00**
	43	28	11	1.8	25	7.1E-01	6.6E-01	1.7E-01	1.1E-01	**1.7E+00**	4.1E+00	7.7E+00	1.2E+00	9.4E-01	**1.4E+01**	**1.6E+01**
	130	110	33	11	5	2.1E+00	2.6E+00	5.3E-01	7.2E-01	**6.0E+00**	1.2E+01	3.1E+01	3.6E+00	6.0E+00	**5.3E+01**	**5.9E+01**
	27	5.8	1.4	0.28	95	4.4E-01	1.4E-01	2.2E-02	1.7E-02	**6.2E-01**	2.6E+00	1.6E+00	1.5E-01	1.5E-01	**4.5E+00**	**5.1E+00**
	65	15	4.4	0.89	75	1.1E+00	3.7E-01	7.1E-02	5.6E-02	**1.6E+00**	6.2E+00	4.3E+00	4.8E-01	4.7E-01	**1.1E+01**	**1.3E+01**
Zinc	**120**	**30**	**10**	**2**	**50**	**2.0E+00**	**7.2E-01**	**1.6E-01**	**1.3E-01**	**3.0E+00**	**1.1E+01**	**8.4E+00**	**1.1E+00**	**1.0E+00**	**2.2E+01**	**2.5E+01**
	220	50	22	4.5	25	3.6E+00	1.2E+00	3.6E-01	2.8E-01	**5.4E+00**	2.1E+01	1.4E+01	2.4E+00	2.4E+00	**4.0E+01**	**4.5E+01**
	520	150	71	14	5	8.5E+00	3.6E+00	1.1E+00	8.8E-01	**1.4E+01**	5.0E+01	4.2E+01	7.7E+00	7.3E+00	**1.1E+02**	**1.2E+02**
	0.017	0.0008	2.6E-04	4.2E-04	95	2.8E-04	2.0E-05	4.1E-06	2.7E-05	**3.3E-04**	1.6E-03	2.4E-04	2.8E-05	2.2E-04	**2.1E-03**	**2.4E-03**
	0.073	0.0036	0.0018	0.0018	75	1.2E-03	8.7E-05	2.9E-05	1.1E-04	**1.4E-03**	6.9E-03	1.0E-03	2.0E-04	9.5E-04	**9.1E-03**	**1.1E-02**
Mercury	**0.2**	**0.01**	**0.007**	**0.005**	**50**	**3.3E-03**	**2.4E-04**	**1.1E-04**	**3.1E-04**	**3.9E-03**	**1.9E-02**	**2.8E-03**	**7.6E-04**	**2.6E-03**	**2.5E-02**	**2.9E-02**
	0.55	0.028	0.027	0.014	25	9.0E-03	6.6E-04	4.3E-04	8.6E-04	**1.1E-02**	5.3E-02	7.7E-03	2.9E-03	7.2E-03	**7.0E-02**	**8.1E-02**
	2.4	0.12	0.19	0.059	5	3.8E-02	2.8E-03	3.0E-03	3.7E-03	**4.8E-02**	2.3E-01	3.3E-02	2.0E-02	3.1E-02	**3.1E-01**	**3.6E-01**
	0.0011	7.5E-04	3.7E-04	1.6E-05	95	1.8E-05	1.8E-05	5.9E-06	1.0E-06	**4.3E-05**	1.1E-04	2.1E-04	4.0E-05	8.6E-06	**3.6E-04**	**4.1E-04**
	0.008	0.0052	0.0026	1.8E-04	75	1.3E-04	1.2E-04	4.1E-05	1.2E-05	**3.0E-04**	7.4E-04	1.5E-03	2.8E-04	9.7E-05	**2.6E-03**	**2.9E-03**
Total PCBs	**0.03**	**0.02**	**0.01**	**0.001**	**50**	**4.9E-04**	**4.8E-04**	**1.6E-04**	**6.3E-05**	**1.2E-03**	**2.9E-03**	**5.6E-03**	**1.1E-03**	**5.2E-04**	**1.0E-02**	**1.1E-02**
	0.12	0.077	0.039	0.0054	25	1.9E-03	1.9E-03	6.1E-04	3.4E-04	**4.7E-03**	1.1E-02	2.2E-02	4.2E-03	2.8E-03	**4.0E-02**	**4.4E-02**
	0.8	0.54	0.27	0.061	5	1.3E-02	1.3E-02	4.3E-03	3.8E-03	**3.4E-02**	7.7E-02	1.5E-01	2.9E-02	3.2E-02	**2.9E-01**	**3.2E-01**

Average Annual Mass Loading (metric tons / year) – Totals by Land Use

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	6.4E-01	7.9E-01	1.5E-01	3.9E-01	2.0E+00	4.3E-01	3.8E-01	1.1E+00	9.2E+00	1.1E+01	1.3E+01
	75	1.4E+00	1.8E+00	3.2E-01	1.0E+00	4.5E+00	9.3E-01	8.7E-01	2.4E+00	2.4E+01	2.9E+01	3.3E+01
Arsenic	**50**	**2.4E+00**	**3.2E+00**	**5.4E-01**	**2.0E+00**	**8.1E+00**	**1.6E+00**	**1.5E+00**	**4.1E+00**	**4.8E+01**	**5.5E+01**	**6.3E+01**
	25	4.1E+00	5.7E+00	9.3E-01	4.0E+00	1.5E+01	2.7E+00	2.7E+00	7.1E+00	9.4E+01	1.1E+02	1.2E+02
	5	8.9E+00	1.3E+01	2.0E+00	1.0E+01	3.4E+01	5.9E+00	6.2E+00	1.5E+01	2.5E+02	2.8E+02	3.1E+02
	95	1.5E-01	1.1E-01	3.0E-02	3.6E-04	2.9E-01	9.8E-02	5.3E-02	2.3E-01	8.6E-03	3.8E-01	6.7E-01
	75	4.2E-01	3.5E-01	8.6E-02	4.5E-03	8.7E-01	2.8E-01	1.7E-01	6.5E-01	1.1E-01	1.2E+00	2.1E+00
Cadmium	**50**	**8.9E-01**	**8.0E-01**	**1.8E-01**	**2.6E-02**	**1.9E+00**	**6.0E-01**	**3.8E-01**	**1.4E+00**	**6.2E-01**	**3.0E+00**	**4.9E+00**
	25	1.9E+00	1.8E+00	3.8E-01	1.5E-01	4.2E+00	1.3E+00	8.7E-01	2.9E+00	3.6E+00	8.6E+00	1.3E+01
	5	5.4E+00	5.7E+00	1.1E+00	1.9E+00	1.4E+01	3.6E+00	2.8E+00	8.4E+00	4.5E+01	6.0E+01	7.4E+01
	95	3.4E+00	1.2E+00	2.5E-01	2.8E-01	5.1E+00	2.3E+00	5.9E-01	1.9E+00	6.6E+00	1.1E+01	1.7E+01
	75	8.1E+00	3.2E+00	8.1E-01	9.0E-01	1.3E+01	5.4E+00	1.6E+00	6.1E+00	2.1E+01	3.4E+01	4.7E+01
Copper	**50**	**1.5E+01**	**6.4E+00**	**1.8E+00**	**2.0E+00**	**2.5E+01**	**1.0E+01**	**3.1E+00**	**1.4E+01**	**4.8E+01**	**7.5E+01**	**1.0E+02**
	25	2.7E+01	1.3E+01	4.1E+00	4.5E+00	4.8E+01	1.8E+01	6.0E+00	3.1E+01	1.1E+02	1.6E+02	2.1E+02
	5	6.5E+01	3.3E+01	1.3E+01	1.5E+01	**1.3E+02**	4.4E+01	1.6E+01	9.9E+01	3.4E+02	5.0E+02	6.3E+02
	95	1.8E+00	1.4E+00	2.7E-01	4.4E-02	3.5E+00	1.2E+00	6.5E-01	2.1E+00	1.0E+00	5.0E+00	8.4E+00
	75	5.5E+00	5.8E+00	8.3E-01	2.8E-01	1.2E+01	3.7E+00	2.8E+00	6.3E+00	6.6E+00	1.9E+01	3.2E+01
Lead	**50**	**1.2E+01**	**1.6E+01**	**1.8E+00**	**1.0E+00**	**3.1E+01**	**8.0E+00**	**7.7E+00**	**1.4E+01**	**2.4E+01**	**5.3E+01**	**8.4E+01**
	25	2.6E+01	4.4E+01	3.9E+00	3.6E+00	7.7E+01	1.7E+01	2.1E+01	3.0E+01	8.6E+01	1.5E+02	2.3E+02
	5	7.7E+01	1.8E+02	1.2E+01	2.3E+01	2.9E+02	5.2E+01	8.5E+01	9.1E+01	5.4E+02	7.7E+02	1.1E+03
	95	1.6E+01	9.2E+00	5.0E-01	5.6E-01	2.6E+01	1.1E+01	4.5E+00	3.8E+00	1.3E+01	3.2E+01	5.9E+01
	75	3.9E+01	2.4E+01	1.6E+00	1.8E+00	6.7E+01	2.6E+01	1.2E+01	1.2E+01	4.3E+01	9.3E+01	1.6E+02
Zinc	**50**	**7.1E+01**	**4.8E+01**	**3.6E+00**	**4.0E+00**	**1.3E+02**	**4.8E+01**	**2.3E+01**	**2.7E+01**	**9.6E+01**	**1.9E+02**	**3.2E+02**
	25	1.3E+02	8.0E+01	8.2E+00	9.1E+00	2.3E+02	8.8E+01	3.8E+01	6.2E+01	2.1E+02	4.0E+02	6.3E+02
	5	3.1E+02	2.4E+02	2.6E+01	2.8E+01	6.0E+02	2.1E+02	1.2E+02	2.0E+02	6.7E+02	1.2E+03	1.8E+03
	95	1.0E-02	1.4E-03	9.5E-05	8.6E-04	1.2E-02	6.8E-03	6.5E-04	7.2E-04	2.0E-02	2.8E-02	4.1E-02
	75	4.3E-02	5.8E-03	6.6E-04	3.7E-03	5.3E-02	2.9E-02	2.8E-03	5.0E-03	8.7E-02	1.2E-01	1.8E-01
Mercury	**50**	**1.2E-01**	**1.6E-02**	**2.5E-03**	**1.0E-02**	**1.5E-01**	**8.0E-02**	**7.7E-03**	**1.9E-02**	**2.4E-01**	**3.5E-01**	**4.9E-01**
	25	3.3E-01	4.4E-02	9.8E-03	2.8E-02	4.1E-01	2.2E-01	2.1E-02	7.4E-02	6.6E-01	9.7E-01	1.4E+00
	5	1.4E+00	1.9E-01	6.8E-02	1.2E-01	1.8E+00	9.4E-01	9.1E-02	5.2E-01	2.8E+00	4.4E+00	6.1E+00
	95	6.6E-04	1.2E-03	1.4E-04	3.3E-05	2.0E-03	4.5E-04	5.7E-04	1.0E-03	7.8E-04	2.8E-03	4.8E-03
	75	4.6E-03	8.3E-03	9.4E-04	3.7E-04	1.4E-02	3.1E-03	4.0E-03	7.1E-03	8.8E-03	2.3E-02	3.7E-02
Total PCBs	**50**	**1.8E-02**	**3.2E-02**	**3.6E-03**	**2.0E-03**	**5.5E-02**	**1.2E-02**	**1.5E-02**	**2.7E-02**	**4.8E-02**	**1.0E-01**	**1.6E-01**
	25	6.9E-02	1.2E-01	1.4E-02	1.1E-02	2.2E-01	4.6E-02	5.9E-02	1.1E-01	2.6E-01	4.7E-01	6.9E-01
	5	4.8E-01	8.6E-01	9.7E-02	1.2E-01	1.6E+00	3.2E-01	4.1E-01	7.4E-01	2.9E+00	4.4E+00	5.9E+00

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Main Basin											Port Gardner										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	1.0E-07	1.7E-06	1.8E-08	1.2E-07	1.9E-06	8.9E-09	1.1E-07	9.5E-09	2.2E-07	3.4E-07	2.3E-06	5.7E-08	7.6E-07	9.7E-08	1.3E-07	1.0E-06	3.8E-08	2.8E-07	4.0E-07	2.6E-06	3.3E-06	4.3E-06
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	6.9E-07	7.3E-06	1.3E-07	8.1E-07	8.9E-06	6.2E-08	4.5E-07	6.6E-08	1.5E-06	2.1E-06	1.1E-05	4.0E-07	3.3E-06	6.8E-07	8.7E-07	5.2E-06	2.7E-07	1.2E-06	2.8E-06	1.8E-05	2.2E-05	2.7E-05
Total PBDEs	**2.0E-05**	**4.0E-05**	**3.0E-05**	**8.0E-06**	**50**	**2.7E-06**	**2.0E-05**	**4.9E-07**	**3.1E-06**	**2.6E-05**	**2.4E-07**	**1.2E-06**	**2.5E-07**	**5.8E-06**	**7.5E-06**	**3.4E-05**	**1.5E-06**	**9.0E-06**	**2.6E-06**	**3.4E-06**	**1.6E-05**	**1.0E-06**	**3.3E-06**	**1.1E-05**	**6.9E-05**	**8.4E-05**	**1.0E-04**
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	1.0E-05	5.5E-05	1.9E-06	1.2E-05	7.9E-05	9.2E-07	3.4E-06	9.8E-07	2.2E-05	2.8E-05	1.1E-04	5.9E-06	2.5E-05	1.0E-05	1.3E-05	5.4E-05	4.0E-06	9.2E-06	4.2E-05	2.6E-04	3.2E-04	3.7E-04
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	7.2E-05	2.4E-04	1.3E-05	8.3E-05	4.0E-04	6.4E-06	1.5E-05	6.8E-06	1.6E-04	1.8E-04	5.9E-04	4.1E-05	1.1E-04	7.0E-05	9.0E-05	3.1E-04	2.8E-05	3.9E-05	2.9E-04	1.8E-03	2.2E-03	2.5E-03
	0.085	0.013	0.013	2.2E-04	95	1.1E-02	6.3E-03	2.1E-04	8.7E-05	1.8E-02	1.0E-03	4.0E-04	1.1E-04	1.6E-04	1.7E-03	2.0E-02	6.5E-03	2.9E-03	1.1E-03	9.4E-05	1.1E-02	4.4E-03	1.1E-03	4.6E-03	1.9E-03	1.2E-02	2.2E-02
cPAHs	0.36	0.054	0.054	0.0016	75	4.9E-02	2.7E-02	8.8E-04	6.0E-04	7.7E-02	4.3E-03	1.7E-03	4.6E-04	1.1E-03	7.6E-03	8.5E-02	2.8E-02	1.2E-02	4.7E-03	6.5E-04	4.5E-02	1.9E-02	4.5E-03	2.0E-02	1.3E-02	5.6E-02	1.0E-01
(carcinogenic	**1**	**0.15**	**0.15**	**0.006**	**50**	**1.3E-01**	**7.5E-02**	**2.4E-03**	**2.3E-03**	**2.1E-01**	**1.2E-02**	**4.7E-03**	**1.3E-03**	**4.3E-03**	**2.2E-02**	**2.4E-01**	**7.7E-02**	**3.4E-02**	**1.3E-02**	**2.5E-03**	**1.3E-01**	**5.2E-02**	**1.3E-02**	**5.4E-02**	**5.1E-02**	**1.7E-01**	**3.0E-01**
PAHs)	2.8	0.41	0.41	0.023	25	3.7E-01	2.1E-01	6.7E-03	9.0E-03	5.9E-01	3.3E-02	1.3E-02	3.5E-03	1.7E-02	6.6E-02	6.6E-01	2.1E-01	9.3E-02	3.6E-02	9.7E-03	3.5E-01	1.4E-01	3.4E-02	1.5E-01	2.0E-01	5.2E-01	8.7E-01
	12	1.8	1.8	0.16	5	1.6E+00	8.8E-01	2.9E-02	6.3E-02	2.6E+00	1.4E-01	5.5E-02	1.5E-02	1.2E-01	3.3E-01	2.9E+00	9.0E-01	4.0E-01	1.5E-01	6.8E-02	1.5E+00	6.1E-01	1.5E-01	6.4E-01	1.4E+00	2.8E+00	4.3E+00
	0.068	0.0085	0.0085	1.9E-04	95	9.1E-03	4.2E-03	1.4E-04	7.2E-05	1.4E-02	8.1E-04	2.6E-04	7.2E-05	1.3E-04	1.3E-03	1.5E-02	5.2E-03	1.9E-03	7.4E-04	7.8E-05	7.9E-03	3.5E-03	7.1E-04	3.1E-03	1.6E-03	8.9E-03	1.7E-02
HPAHs	0.29	0.036	0.036	0.0013	75	3.9E-02	1.8E-02	5.9E-04	5.0E-04	5.8E-02	3.5E-03	1.1E-03	3.1E-04	9.4E-04	5.8E-03	6.4E-02	2.2E-02	8.2E-03	3.2E-03	5.4E-04	3.4E-02	1.5E-02	3.0E-03	1.3E-02	1.1E-02	4.2E-02	7.6E-02
(Other High	**0.8**	**0.1**	**0.1**	**0.005**	**50**	**1.1E-01**	**5.0E-02**	**1.6E-03**	**1.9E-03**	**1.6E-01**	**9.6E-03**	**3.1E-03**	**8.5E-04**	**3.6E-03**	**1.7E-02**	**1.8E-01**	**6.1E-02**	**2.2E-02**	**8.7E-03**	**2.1E-03**	**9.4E-02**	**4.1E-02**	**8.3E-03**	**3.6E-02**	**4.3E-02**	**1.3E-01**	**2.2E-01**
Molecular	2.2	0.28	0.28	0.019	25	2.9E-01	1.4E-01	4.5E-03	7.5E-03	4.4E-01	2.6E-02	8.6E-03	2.3E-03	1.4E-02	5.1E-02	5.0E-01	1.7E-01	6.2E-02	2.4E-02	8.1E-03	2.6E-01	1.1E-01	2.3E-02	9.9E-02	1.7E-01	4.0E-01	6.6E-01
Weight PAHs)	9.4	1.2	1.2	0.13	5	1.3E+00	5.9E-01	1.9E-02	5.2E-02	1.9E+00	1.1E-01	3.7E-02	1.0E-02	9.7E-02	2.6E-01	2.2E+00	7.2E-01	2.7E-01	1.0E-01	5.6E-02	1.1E+00	4.9E-01	9.8E-02	4.3E-01	1.1E+00	2.2E+00	3.3E+00
	0.25	0.025	0.025	5.6E-04	95	3.4E-02	1.3E-02	4.1E-04	2.2E-04	4.7E-02	3.0E-03	7.9E-04	2.2E-04	4.0E-04	4.4E-03	5.2E-02	1.9E-02	5.7E-03	2.2E-03	2.3E-04	2.8E-02	1.3E-02	2.1E-03	9.2E-03	4.8E-03	2.9E-02	5.7E-02
LPAHs	1.1	0.11	0.11	0.0039	75	1.5E-01	5.4E-02	1.8E-03	1.5E-03	2.0E-01	1.3E-02	3.4E-03	9.3E-04	2.8E-03	2.0E-02	2.2E-01	8.3E-02	2.5E-02	9.5E-03	1.6E-03	1.2E-01	5.6E-02	9.1E-03	3.9E-02	3.3E-02	1.4E-01	2.6E-01
(Low Molecular	**3**	**0.3**	**0.3**	**0.015**	**50**	**4.0E-01**	**1.5E-01**	**4.9E-03**	**5.8E-03**	**5.6E-01**	**3.6E-02**	**9.3E-03**	**2.5E-03**	**1.1E-02**	**5.9E-02**	**6.2E-01**	**2.3E-01**	**6.7E-02**	**2.6E-02**	**6.3E-03**	**3.3E-01**	**1.5E-01**	**2.5E-02**	**1.1E-01**	**1.3E-01**	**4.2E-01**	**7.5E-01**
Weight PAHs)	8.3	0.83	0.83	0.058	25	1.1E+00	4.1E-01	1.3E-02	2.2E-02	1.6E+00	9.9E-02	2.6E-02	7.0E-03	4.2E-02	1.7E-01	1.7E+00	6.3E-01	1.9E-01	7.2E-02	2.4E-02	9.1E-01	4.3E-01	6.9E-02	3.0E-01	5.0E-01	1.3E+00	2.2E+00
	35	3.5	3.5	0.40	5	4.7E+00	1.8E+00	5.7E-02	1.6E-01	6.7E+00	4.2E-01	1.1E-01	3.0E-02	2.9E-01	8.5E-01	7.6E+00	2.7E+00	8.0E-01	3.1E-01	1.7E-01	4.0E+00	1.8E+00	2.9E-01	1.3E+00	3.4E+00	6.8E+00	1.1E+01
	0.37	0.37	0.37	0.0016	95	5.0E-02	1.9E-01	6.0E-03	6.4E-04	2.4E-01	4.4E-03	1.2E-02	3.2E-03	1.2E-03	2.0E-02	2.6E-01	2.9E-02	8.4E-02	3.2E-02	6.9E-04	1.5E-01	1.9E-02	3.1E-02	1.3E-01	1.4E-02	2.0E-01	3.4E-01
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	3.5E-01	1.3E+00	4.2E-02	7.2E-03	1.7E+00	3.1E-02	8.1E-02	2.2E-02	1.3E-02	1.5E-01	1.8E+00	2.0E-01	5.8E-01	2.3E-01	7.8E-03	1.0E+00	1.3E-01	2.2E-01	9.4E-01	1.6E-01	1.4E+00	2.5E+00
hexyl)-	**10**	**10**	**10**	**0.1**	**50**	**1.3E+00**	**5.0E+00**	**1.6E-01**	**3.9E-02**	**6.5E+00**	**1.2E-01**	**3.1E-01**	**8.5E-02**	**7.2E-02**	**5.9E-01**	**7.1E+00**	**7.7E-01**	**2.2E+00**	**8.7E-01**	**4.2E-02**	**3.9E+00**	**5.2E-01**	**8.3E-01**	**3.6E+00**	**8.6E-01**	**5.8E+00**	**9.7E+00**
phthalate	39	39	39	0.54	25	5.2E+00	1.9E+01	6.3E-01	2.1E-01	2.5E+01	4.6E-01	1.2E+00	3.3E-01	3.9E-01	2.4E+00	2.8E+01	3.0E+00	8.7E+00	3.3E+00	2.3E-01	1.5E+01	2.0E+00	3.2E+00	1.4E+01	4.6E+00	2.4E+01	3.9E+01
	260	260	268	6.1	5	3.5E+01	1.3E+02	4.4E+00	2.4E+00	1.7E+02	3.1E+00	8.1E+00	2.3E+00	4.4E+00	1.8E+01	1.9E+02	2.0E+01	5.8E+01	2.3E+01	2.6E+00	1.0E+02	1.3E+01	2.2E+01	9.7E+01	5.2E+01	1.8E+02	2.9E+02
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	5.0E-08	9.3E-08	3.0E-09	6.4E-10	1.5E-07	4.4E-09	5.8E-09	1.6E-09	1.2E-09	1.3E-08	1.6E-07	2.9E-08	4.2E-08	1.6E-08	6.9E-10	8.7E-08	1.9E-08	1.6E-08	6.7E-08	1.4E-08	1.2E-07	2.0E-07
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	3.5E-07	6.5E-07	2.1E-08	7.2E-09	1.0E-06	3.1E-08	4.0E-08	1.1E-08	1.3E-08	9.6E-08	1.1E-06	2.0E-07	2.9E-07	1.1E-07	7.8E-09	6.1E-07	1.3E-07	1.1E-07	4.7E-07	1.6E-07	8.7E-07	1.5E-06
Total Dioxin	**1.0E-05**	**5.0E-06**	**5.0E-06**	**1.0E-07**	**50**	**1.3E-06**	**2.5E-06**	**8.1E-08**	**3.9E-08**	**4.0E-06**	**1.2E-07**	**1.6E-07**	**4.2E-08**	**7.2E-08**	**3.9E-07**	**4.3E-06**	**7.7E-07**	**1.1E-06**	**4.3E-07**	**4.2E-08**	**2.4E-06**	**5.2E-07**	**4.2E-07**	**1.8E-06**	**8.6E-07**	**3.6E-06**	**6.0E-06**
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	5.2E-06	9.6E-06	3.1E-07	2.1E-07	1.5E-05	4.6E-07	6.0E-07	1.6E-07	3.9E-07	1.6E-06	1.7E-05	3.0E-06	4.3E-06	1.7E-06	2.3E-07	9.2E-06	2.0E-06	1.6E-06	7.0E-06	4.6E-06	1.5E-05	2.4E-05
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	3.6E-05	6.7E-05	2.2E-06	2.4E-06	1.1E-04	3.2E-06	4.2E-06	1.1E-06	4.4E-06	1.3E-05	1.2E-04	2.1E-05	3.0E-05	1.2E-05	2.6E-06	6.5E-05	1.4E-05	1.1E-05	4.8E-05	5.2E-05	1.3E-04	1.9E-04
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	1.0E-06	1.9E-05	3.6E-06	4.3E-05	6.7E-05	8.9E-08	1.2E-06	1.9E-06	8.1E-05	8.4E-05	1.5E-04	5.7E-07	8.4E-06	1.9E-05	4.7E-05	7.5E-05	3.8E-07	3.1E-06	8.1E-05	9.6E-04	1.0E-03	1.1E-03
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	6.9E-06	1.3E-04	2.5E-05	3.0E-04	4.6E-04	6.2E-07	8.1E-06	1.3E-05	5.6E-04	5.8E-04	1.0E-03	4.0E-06	5.8E-05	1.4E-04	3.3E-04	5.2E-04	2.7E-06	2.2E-05	5.6E-04	6.7E-03	7.2E-03	7.8E-03
Total DDT	**2.0E-04**	**0.001**	**0.006**	**0.003**	**50**	**2.7E-05**	**5.0E-04**	**9.7E-05**	**1.2E-03**	**1.8E-03**	**2.4E-06**	**3.1E-05**	**5.1E-05**	**2.2E-03**	**2.3E-03**	**4.0E-03**	**1.5E-05**	**2.2E-04**	**5.2E-04**	**1.3E-03**	**2.0E-03**	**1.0E-05**	**8.3E-05**	**2.2E-03**	**2.6E-02**	**2.8E-02**	**3.0E-02**
	7.7E-04	0.0039	0.023	0.012	25	1.0E-04	1.9E-03	3.8E-04	4.5E-03	6.9E-03	9.2E-06	1.2E-04	2.0E-04	8.4E-03	8.7E-03	1.6E-02	5.9E-05	8.7E-04	2.0E-03	4.9E-03	7.8E-03	4.0E-05	3.2E-04	8.4E-03	9.9E-02	1.1E-01	1.2E-01
	0.0054	0.027	0.16	0.081	5	7.2E-04	1.3E-02	2.6E-03	3.1E-02	4.8E-02	6.4E-05	8.4E-04	1.4E-03	5.8E-02	6.0E-02	1.1E-01	4.1E-04	6.0E-03	1.4E-02	3.4E-02	5.4E-02	2.8E-04	2.2E-03	5.8E-02	6.9E-01	7.5E-01	8.0E-01

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Elliot Bay											Commencement Bay										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	9.4E-08	4.6E-07	3.8E-08	4.4E-08	**6.4E-07**	5.0E-09	4.8E-08	7.3E-08	2.7E-07	**4.0E-07**	**1.0E-06**	7.5E-08	5.6E-07	4.2E-08	6.5E-08	**7.4E-07**	3.1E-08	4.8E-08	8.8E-08	7.4E-07	**9.1E-07**	**1.6E-06**
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	6.5E-07	2.0E-06	2.6E-07	3.1E-07	**3.2E-06**	3.5E-08	2.0E-07	5.0E-07	1.9E-06	**2.7E-06**	**5.8E-06**	5.2E-07	2.4E-06	2.9E-07	4.5E-07	**3.7E-06**	2.2E-07	2.1E-07	6.1E-07	5.1E-06	**6.2E-06**	**9.9E-06**
Total PBDEs	**2.0E-05**	**4.0E-05**	**3.0E-05**	**8.0E-06**	**50**	**2.5E-06**	**5.4E-06**	**1.0E-06**	**1.2E-06**	**1.0E-05**	**1.3E-07**	**5.6E-07**	**1.9E-06**	**7.4E-06**	**1.0E-05**	**2.0E-05**	**2.0E-06**	**6.6E-06**	**1.1E-06**	**1.7E-06**	**1.1E-05**	**8.4E-07**	**5.7E-07**	**2.4E-06**	**2.0E-05**	**2.4E-05**	**3.5E-05**
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	9.7E-06	1.5E-05	3.9E-06	4.5E-06	**3.3E-05**	5.2E-07	1.5E-06	7.5E-06	2.8E-05	**3.8E-05**	**7.1E-05**	7.8E-06	1.8E-05	4.4E-06	6.7E-06	**3.7E-05**	3.2E-06	1.6E-06	9.1E-06	7.7E-05	**9.1E-05**	**1.3E-04**
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	6.8E-05	6.4E-05	2.7E-05	3.2E-05	**1.9E-04**	3.6E-06	6.6E-06	5.2E-05	2.0E-04	**2.6E-04**	**4.5E-04**	5.4E-05	7.8E-05	3.0E-05	4.7E-05	**2.1E-04**	2.2E-05	6.7E-06	6.3E-05	5.3E-04	**6.3E-04**	**8.3E-04**
	0.085	0.013	0.013	2.2E-04	95	1.1E-02	1.7E-03	4.3E-04	3.3E-05	**1.3E-02**	5.7E-04	1.8E-04	8.3E-04	2.1E-04	**1.8E-03**	**1.5E-02**	8.5E-03	2.1E-03	4.8E-04	4.9E-05	**1.1E-02**	3.5E-03	1.8E-04	1.0E-03	5.6E-04	**5.3E-03**	**1.6E-02**
cPAHs	0.36	0.054	0.054	0.0016	75	4.6E-02	7.4E-03	1.8E-03	2.3E-04	**5.5E-02**	2.4E-03	7.6E-04	3.5E-03	1.4E-03	**8.2E-03**	**6.4E-02**	3.7E-02	9.0E-03	2.1E-03	3.4E-04	**4.8E-02**	1.5E-02	7.7E-04	4.3E-03	3.9E-03	**2.4E-02**	**7.2E-02**
(carcinogenic	**1**	**0.15**	**0.15**	**0.006**	**50**	**1.3E-01**	**2.0E-02**	**5.1E-03**	**8.8E-04**	**1.5E-01**	**6.7E-03**	**2.1E-03**	**9.7E-03**	**5.5E-03**	**2.4E-02**	**1.8E-01**	**1.0E-01**	**2.5E-02**	**5.7E-03**	**1.3E-03**	**1.3E-01**	**4.2E-02**	**2.1E-03**	**1.2E-02**	**1.5E-02**	**7.1E-02**	**2.0E-01**
PAHs)	2.8	0.41	0.41	0.023	25	3.5E-01	5.6E-02	1.4E-02	3.4E-03	**4.2E-01**	1.8E-02	5.8E-03	2.7E-02	2.1E-02	**7.2E-02**	**4.9E-01**	2.8E-01	6.8E-02	1.6E-02	5.0E-03	**3.7E-01**	1.2E-01	5.9E-03	3.2E-02	5.7E-02	**2.1E-01**	**5.8E-01**
	12	1.8	1.8	0.16	5	1.5E+00	2.4E-01	6.0E-02	2.4E-02	**1.8E+00**	7.9E-02	2.5E-02	1.1E-01	1.5E-01	**3.7E-01**	**2.2E+00**	1.2E+00	2.9E-01	6.7E-02	3.5E-02	**1.6E+00**	4.9E-01	2.5E-02	1.4E-01	4.0E-01	**1.1E+00**	**2.6E+00**
	0.068	0.0085	0.0085	1.9E-04	95	8.6E-03	1.2E-03	2.9E-04	2.7E-05	**1.0E-02**	4.6E-04	1.2E-04	5.5E-04	1.7E-04	**1.3E-03**	**1.1E-02**	6.8E-03	1.4E-03	3.2E-04	4.0E-05	**8.6E-03**	2.8E-03	1.2E-04	6.7E-04	4.6E-04	**4.1E-03**	**1.3E-02**
HPAHs	0.29	0.036	0.036	0.0013	75	3.7E-02	4.9E-03	1.2E-03	1.9E-04	**4.3E-02**	2.0E-03	5.1E-04	2.4E-03	1.2E-03	**6.0E-03**	**4.9E-02**	2.9E-02	6.0E-03	1.4E-03	2.8E-04	**3.7E-02**	1.2E-02	5.2E-04	2.9E-03	3.2E-03	**1.9E-02**	**5.6E-02**
(Other High	**0.8**	**0.1**	**0.1**	**0.005**	**50**	**1.0E-01**	**1.4E-02**	**3.4E-03**	**7.4E-04**	**1.2E-01**	**5.4E-03**	**1.4E-03**	**6.5E-03**	**4.6E-03**	**1.8E-02**	**1.4E-01**	**8.0E-02**	**1.7E-02**	**3.8E-03**	**1.1E-03**	**1.0E-01**	**3.3E-02**	**1.4E-03**	**7.9E-03**	**1.2E-02**	**5.5E-02**	**1.6E-01**
Molecular	2.2	0.28	0.28	0.019	25	2.8E-01	3.7E-02	9.3E-03	2.8E-03	**3.3E-01**	1.5E-02	3.9E-03	1.8E-02	1.8E-02	**5.4E-02**	**3.8E-01**	2.2E-01	4.6E-02	1.0E-02	4.2E-03	**2.8E-01**	9.2E-02	3.9E-03	2.2E-02	4.8E-02	**1.7E-01**	**4.5E-01**
Weight PAHs)	9.4	1.2	1.2	0.13	5	1.2E+00	1.6E-01	4.0E-02	2.0E-02	**1.4E+00**	6.3E-02	1.7E-02	7.7E-02	1.2E-01	**2.8E-01**	**1.7E+00**	9.5E-01	2.0E-01	4.5E-02	2.9E-02	**1.2E+00**	3.9E-01	1.7E-02	9.3E-02	3.3E-01	**8.4E-01**	**2.1E+00**
	0.25	0.025	0.025	5.6E-04	95	3.2E-02	3.5E-03	8.6E-04	8.2E-05	**3.7E-02**	1.7E-03	3.6E-04	1.7E-03	5.1E-04	**4.2E-03**	**4.1E-02**	2.6E-02	4.2E-03	9.6E-04	1.2E-04	**3.1E-02**	1.1E-02	3.6E-04	2.0E-03	1.4E-03	**1.4E-02**	**4.5E-02**
LPAHs	1.1	0.11	0.11	0.0039	75	1.4E-01	1.5E-02	3.7E-03	5.7E-04	**1.6E-01**	7.3E-03	1.5E-03	7.1E-03	3.6E-03	**1.9E-02**	**1.8E-01**	1.1E-01	1.8E-02	4.1E-03	8.4E-04	**1.3E-01**	4.6E-02	1.5E-03	8.6E-03	9.7E-03	**6.5E-02**	**2.0E-01**
(Low Molecular	**3**	**0.3**	**0.3**	**0.015**	**50**	**3.8E-01**	**4.1E-02**	**1.0E-02**	**2.2E-03**	**4.3E-01**	**2.0E-02**	**4.2E-03**	**1.9E-02**	**1.4E-02**	**5.8E-02**	**4.9E-01**	**3.0E-01**	**5.0E-02**	**1.1E-02**	**3.3E-03**	**3.7E-01**	**1.3E-01**	**4.3E-03**	**2.4E-02**	**3.7E-02**	**1.9E-01**	**5.6E-01**
Weight PAHs)	8.3	0.83	0.83	0.058	25	1.0E+00	1.1E-01	2.8E-02	8.5E-03	**1.2E+00**	5.5E-02	1.2E-02	5.4E-02	5.3E-02	**1.7E-01**	**1.4E+00**	8.3E-01	1.4E-01	3.1E-02	1.3E-02	**1.0E+00**	3.5E-01	1.2E-02	6.5E-02	1.4E-01	**5.7E-01**	**1.6E+00**
	35	3.5	3.5	0.40	5	4.5E+00	4.8E-01	1.2E-01	5.9E-02	**5.1E+00**	2.4E-01	5.0E-02	2.3E-01	3.7E-01	**8.9E-01**	**6.0E+00**	3.6E+00	5.9E-01	1.3E-01	8.7E-02	**4.4E+00**	1.5E+00	5.0E-02	2.8E-01	1.0E+00	**2.8E+00**	**7.2E+00**
	0.37	0.37	0.37	0.0016	95	4.7E-02	5.1E-02	1.3E-02	2.4E-04	**1.1E-01**	2.5E-03	5.2E-03	2.4E-02	1.5E-03	**3.3E-02**	**1.4E-01**	3.7E-02	6.2E-02	1.4E-02	3.6E-04	**1.1E-01**	1.6E-02	5.3E-03	2.9E-02	4.1E-03	**5.4E-02**	**1.7E-01**
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	3.3E-01	3.5E-01	8.8E-02	2.7E-03	**7.7E-01**	1.7E-02	3.6E-02	1.7E-01	1.7E-02	**2.4E-01**	**1.0E+00**	2.6E-01	4.3E-01	9.8E-02	4.0E-03	**7.9E-01**	1.1E-01	3.7E-02	2.0E-01	4.6E-02	**3.9E-01**	**1.2E+00**
hexyl)-	**10**	**10**	**10**	**0.1**	**50**	**1.3E+00**	**1.4E+00**	**3.4E-01**	**1.5E-02**	**3.0E+00**	**6.7E-02**	**1.4E-01**	**6.5E-01**	**9.2E-02**	**9.5E-01**	**3.9E+00**	**1.0E+00**	**1.7E+00**	**3.8E-01**	**2.2E-02**	**3.1E+00**	**4.2E-01**	**1.4E-01**	**7.9E-01**	**2.5E-01**	**1.6E+00**	**4.7E+00**
phthalate	39	39	39	0.54	25	4.9E+00	5.2E+00	1.3E+00	8.0E-02	**1.1E+01**	2.6E-01	5.4E-01	2.5E+00	5.0E-01	**3.8E+00**	**1.5E+01**	3.9E+00	6.4E+00	1.5E+00	1.2E-01	**1.2E+01**	1.6E+00	5.5E-01	3.0E+00	1.3E+00	**6.5E+00**	**1.8E+01**
	260	260	268	6.1	5	3.3E+01	3.5E+01	9.1E+00	9.0E-01	**7.8E+01**	1.7E+00	3.6E+00	1.7E+01	5.6E+00	**2.8E+01**	**1.1E+02**	2.6E+01	4.3E+01	1.0E+01	1.3E+00	**8.1E+01**	1.1E+01	3.7E+00	2.1E+01	1.5E+01	**5.1E+01**	**1.3E+02**
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	4.7E-08	2.5E-08	6.3E-09	2.4E-10	**7.9E-08**	2.5E-09	2.6E-09	1.2E-08	1.5E-09	**1.9E-08**	**9.8E-08**	3.7E-08	3.1E-08	7.1E-09	3.6E-10	**7.6E-08**	1.6E-08	2.6E-09	1.5E-08	4.1E-09	**3.7E-08**	**1.1E-07**
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	3.3E-07	1.8E-07	4.4E-08	2.7E-09	**5.5E-07**	1.7E-08	1.8E-08	8.4E-08	1.7E-08	**1.4E-07**	**6.9E-07**	2.6E-07	2.1E-07	4.9E-08	4.0E-09	**5.3E-07**	1.1E-07	1.8E-08	1.0E-07	4.6E-08	**2.7E-07**	**8.0E-07**
Total Dioxin	**1.0E-05**	**5.0E-06**	**5.0E-06**	**1.0E-07**	**50**	**1.3E-06**	**6.8E-07**	**1.7E-07**	**1.5E-08**	**2.1E-06**	**6.7E-08**	**7.0E-08**	**3.2E-07**	**9.2E-08**	**5.5E-07**	**2.7E-06**	**1.0E-06**	**8.3E-07**	**1.9E-07**	**2.2E-08**	**2.0E-06**	**4.2E-07**	**7.1E-08**	**3.9E-07**	**2.5E-07**	**1.1E-06**	**3.2E-06**
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	4.9E-06	2.6E-06	6.5E-07	8.0E-08	**8.2E-06**	2.6E-07	2.7E-07	1.3E-06	5.0E-07	**2.3E-06**	**1.1E-05**	3.9E-06	3.2E-06	7.3E-07	1.2E-07	**7.9E-06**	1.6E-06	2.7E-07	1.5E-06	1.3E-06	**4.7E-06**	**1.3E-05**
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	3.4E-05	1.8E-05	4.6E-06	9.0E-07	**5.8E-05**	1.8E-06	1.9E-06	8.7E-06	5.6E-06	**1.8E-05**	**7.6E-05**	2.7E-05	2.2E-05	5.1E-06	1.3E-06	**5.6E-05**	1.1E-05	1.9E-06	1.1E-05	1.5E-05	**3.9E-05**	**9.4E-05**
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	9.4E-07	5.1E-06	7.6E-06	1.6E-05	**3.0E-05**	5.0E-08	5.2E-07	1.5E-05	1.0E-04	**1.2E-04**	**1.5E-04**	7.5E-07	6.2E-06	8.5E-06	2.4E-05	**4.0E-05**	3.1E-07	5.3E-07	1.8E-05	2.8E-04	**3.0E-04**	**3.4E-04**
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	6.5E-06	3.5E-05	5.3E-05	1.1E-04	**2.1E-04**	3.5E-07	3.6E-06	1.0E-04	7.2E-04	**8.2E-04**	**1.0E-03**	5.2E-06	4.3E-05	5.9E-05	1.7E-04	**2.8E-04**	2.2E-06	3.7E-06	1.2E-04	1.9E-03	**2.1E-03**	**2.3E-03**
Total DDT	**2.0E-04**	**0.001**	**0.006**	**0.003**	**50**	**2.5E-05**	**1.4E-04**	**2.0E-04**	**4.4E-04**	**8.1E-04**	**1.3E-06**	**1.4E-05**	**3.9E-04**	**2.8E-03**	**3.2E-03**	**4.0E-03**	**2.0E-05**	**1.7E-04**	**2.3E-04**	**6.5E-04**	**1.1E-03**	**8.4E-06**	**1.4E-05**	**4.7E-04**	**7.4E-03**	**7.9E-03**	**9.0E-03**
	7.7E-04	0.0039	0.023	0.012	25	9.7E-05	5.2E-04	7.8E-04	1.7E-03	**3.1E-03**	5.2E-06	5.4E-05	1.5E-03	1.1E-02	**1.2E-02**	**1.5E-02**	7.8E-05	6.4E-04	8.8E-04	2.5E-03	**4.1E-03**	3.2E-05	5.5E-05	1.8E-03	2.9E-02	**3.1E-02**	**3.5E-02**
	0.0054	0.027	0.16	0.081	5	6.8E-04	3.6E-03	5.5E-03	1.2E-02	**2.2E-02**	3.6E-05	3.8E-04	1.0E-02	7.4E-02	**8.5E-02**	**1.1E-01**	5.4E-04	4.4E-03	6.1E-03	1.7E-02	**2.9E-02**	2.2E-04	3.8E-04	1.3E-02	2.0E-01	**2.1E-01**	**2.4E-01**

Table B-2 - Box Model Surface Runoff Loadings

Surface Runoff Concentration (ug/L); Average Annual Mass Loading (metric tons / year) — South Sound (east)

Chemical of Concern	CO/IN (ug/L)	RES (ug/L)	AGR (ug/L)	FOR (ug/L)	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	3.8E-08	6.7E-07	2.6E-08	7.6E-08	8.1E-07	1.6E-08	1.1E-07	1.1E-07	5.9E-07	8.3E-07	1.6E-06
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	2.6E-07	2.9E-06	1.8E-07	5.3E-07	3.8E-06	1.1E-07	4.7E-07	7.4E-07	4.1E-06	5.5E-06	9.3E-06
Total PBDEs	2.0E-05	4.0E-05	3.0E-05	8.0E-06	50	1.0E-06	7.9E-06	6.9E-07	2.0E-06	1.2E-05	4.2E-07	1.3E-06	2.9E-06	1.6E-05	2.1E-05	3.2E-05
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	3.9E-06	2.2E-05	2.7E-06	7.8E-06	3.6E-05	1.6E-06	3.6E-06	1.1E-05	6.2E-05	7.8E-05	1.1E-04
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	2.7E-05	9.3E-05	1.9E-05	5.4E-05	1.9E-04	1.1E-05	1.5E-05	7.7E-05	4.3E-04	5.3E-04	7.3E-04
	0.085	0.013	0.013	2.2E-04	95	4.3E-03	2.5E-03	2.9E-04	5.7E-05	7.1E-03	1.8E-03	4.1E-04	1.2E-03	4.5E-04	3.8E-03	1.1E-02
cPAHs	0.36	0.054	0.054	0.0016	75	1.8E-02	1.1E-02	1.3E-03	3.9E-04	3.1E-02	7.6E-03	1.8E-03	5.2E-03	3.1E-03	1.8E-02	4.8E-02
(carcinogenic	1	0.15	0.15	0.006	50	5.1E-02	3.0E-02	3.5E-03	1.5E-03	8.5E-02	2.1E-02	4.8E-03	1.4E-02	1.2E-02	5.2E-02	1.4E-01
PAHs)	2.8	0.41	0.41	0.023	25	1.4E-01	8.1E-02	9.5E-03	5.9E-03	2.4E-01	5.8E-02	1.3E-02	3.9E-02	4.6E-02	1.6E-01	3.9E-01
	12	1.8	1.8	0.16	5	6.0E-01	3.5E-01	4.1E-02	4.1E-02	1.0E+00	2.5E-01	5.7E-02	1.7E-01	3.2E-01	7.9E-01	1.8E+00
	0.068	0.0085	0.0085	1.9E-04	95	3.4E-03	1.7E-03	2.0E-04	4.7E-05	5.3E-03	1.4E-03	2.7E-04	8.1E-04	3.7E-04	2.9E-03	8.2E-03
HPAHs	0.29	0.036	0.036	0.0013	75	1.5E-02	7.2E-03	8.4E-04	3.3E-04	2.3E-02	6.1E-03	1.2E-03	3.5E-03	2.6E-03	1.3E-02	3.6E-02
(Other High	0.8	0.1	0.1	0.005	50	4.0E-02	2.0E-02	2.3E-03	1.3E-03	6.4E-02	1.7E-02	3.2E-03	9.5E-03	1.0E-02	3.9E-02	1.0E-01
Molecular	2.2	0.28	0.28	0.019	25	1.1E-01	5.4E-02	6.4E-03	4.9E-03	1.8E-01	4.6E-02	8.9E-03	2.6E-02	3.9E-02	1.2E-01	3.0E-01
Weight PAHs)	9.4	1.2	1.2	0.13	5	4.8E-01	2.3E-01	2.7E-02	3.4E-02	7.7E-01	2.0E-01	3.8E-02	1.1E-01	2.7E-01	6.2E-01	1.4E+00
	0.25	0.025	0.025	5.6E-04	95	1.3E-02	5.0E-03	5.9E-04	1.4E-04	1.9E-02	5.3E-03	8.2E-04	2.4E-03	1.1E-03	9.7E-03	2.8E-02
LPAHs	1.1	0.11	0.11	0.0039	75	5.5E-02	2.1E-02	2.5E-03	9.9E-04	8.0E-02	2.3E-02	3.5E-03	1.0E-02	7.8E-03	4.4E-02	1.2E-01
(Low Molecular	3	0.3	0.3	0.015	50	1.5E-01	5.9E-02	6.9E-03	3.8E-03	2.2E-01	6.3E-02	9.7E-03	2.9E-02	3.0E-02	1.3E-01	3.5E-01
Weight PAHs)	8.3	0.83	0.83	0.058	25	4.2E-01	1.6E-01	1.9E-02	1.5E-02	6.1E-01	1.7E-01	2.7E-02	7.9E-02	1.2E-01	3.9E-01	1.0E+00
	35	3.5	3.5	0.40	5	1.8E+00	7.0E-01	8.2E-02	1.0E-01	2.7E+00	7.4E-01	1.1E-01	3.4E-01	8.0E-01	2.0E+00	4.7E+00
	0.37	0.37	0.37	0.0016	95	1.9E-02	7.3E-02	8.6E-03	4.2E-04	1.0E-01	7.8E-03	1.2E-02	3.6E-02	3.3E-03	5.9E-02	1.6E-01
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	1.3E-01	5.1E-01	6.0E-02	4.7E-03	7.1E-01	5.4E-02	8.4E-02	2.5E-01	3.7E-02	4.2E-01	1.1E+00
hexyl)-	10	10	10	0.1	50	5.1E-01	2.0E+00	2.3E-01	2.5E-02	2.7E+00	2.1E-01	3.2E-01	9.5E-01	2.0E-01	1.7E+00	4.4E+00
phthalate	39	39	39	0.54	25	1.9E+00	7.6E+00	8.9E-01	1.4E-01	1.1E+01	8.1E-01	1.2E+00	3.7E+00	1.1E+00	6.8E+00	1.7E+01
	260	260	268	6.1	5	1.3E+01	5.1E+01	6.2E+00	1.5E+00	7.2E+01	5.4E+00	8.4E+00	2.6E+01	1.2E+01	5.2E+01	1.2E+02
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	1.9E-08	3.7E-08	4.3E-09	4.2E-10	6.0E-08	7.8E-09	6.0E-09	1.8E-08	3.3E-09	3.5E-08	9.5E-08
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	1.3E-07	2.6E-07	3.0E-08	4.7E-09	4.2E-07	5.4E-08	4.2E-08	1.2E-07	3.7E-08	2.6E-07	6.8E-07
Total Dioxin	1.0E-05	5.0E-06	5.0E-06	1.0E-07	50	5.1E-07	9.8E-07	1.2E-07	2.5E-08	1.6E-06	2.1E-07	1.6E-07	4.8E-07	2.0E-07	1.0E-06	2.7E-06
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	1.9E-06	3.8E-06	4.5E-07	1.4E-07	6.3E-06	8.1E-07	6.2E-07	1.8E-06	1.1E-06	4.3E-06	1.1E-05
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	1.4E-05	2.6E-05	3.1E-06	1.5E-06	4.5E-05	5.6E-06	4.3E-06	1.3E-05	1.2E-05	3.5E-05	8.0E-05
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	3.8E-07	7.3E-06	5.2E-06	2.8E-05	4.1E-05	1.6E-07	1.2E-06	2.1E-05	2.2E-04	2.5E-04	2.9E-04
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	2.6E-06	5.1E-05	3.6E-05	2.0E-04	2.9E-04	1.1E-06	8.4E-06	1.5E-04	1.6E-03	1.7E-03	2.0E-03
Total DDT	2.0E-04	0.001	0.006	0.003	50	1.0E-05	2.0E-04	1.4E-04	7.6E-04	1.1E-03	4.2E-06	3.2E-05	5.7E-04	6.0E-03	6.6E-03	7.7E-03
	7.7E-04	0.0039	0.023	0.012	25	3.9E-05	7.6E-04	5.4E-04	2.9E-03	4.3E-03	1.6E-05	1.2E-04	2.2E-03	2.3E-02	2.5E-02	3.0E-02
	0.0054	0.027	0.16	0.081	5	2.7E-04	5.3E-03	3.7E-03	2.0E-02	3.0E-02	1.1E-04	8.7E-04	1.5E-02	1.6E-01	1.8E-01	2.1E-01

Average Annual Mass Loading (metric tons / year) — South Sound (west)

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	1.5E-08	2.3E-07	1.6E-08	2.7E-08	2.9E-07	1.4E-08	1.1E-07	3.9E-08	3.4E-07	5.0E-07	8.0E-07
	75	1.0E-07	1.0E-06	1.1E-07	1.9E-07	1.4E-06	1.0E-07	4.9E-07	2.7E-07	2.3E-06	3.2E-06	4.6E-06
Total PBDEs	50	3.9E-07	2.8E-06	4.4E-07	7.3E-07	4.3E-06	3.9E-07	1.4E-06	1.0E-06	9.0E-06	1.2E-05	1.6E-05
	25	1.5E-06	7.6E-06	1.7E-06	2.8E-06	1.4E-05	1.5E-06	3.7E-06	4.0E-06	3.5E-05	4.4E-05	5.8E-05
	5	1.1E-05	3.3E-05	1.2E-05	2.0E-05	7.5E-05	1.0E-05	1.6E-05	2.8E-05	2.4E-04	3.0E-04	3.7E-04
	95	1.7E-03	8.8E-04	1.9E-04	2.0E-05	2.8E-03	1.6E-03	4.3E-04	4.4E-04	2.5E-04	2.8E-03	5.5E-03
cPAHs	75	7.1E-03	3.8E-03	8.0E-04	1.4E-04	1.2E-02	7.1E-03	1.8E-03	1.9E-03	1.8E-03	1.3E-02	2.4E-02
(carcinogenic	50	2.0E-02	1.0E-02	2.2E-03	5.5E-04	3.3E-02	1.9E-02	5.1E-03	5.2E-03	6.8E-03	3.6E-02	6.9E-02
PAHs)	25	5.4E-02	2.8E-02	6.1E-03	2.1E-03	9.1E-02	5.3E-02	1.4E-02	1.4E-02	2.6E-02	1.1E-01	2.0E-01
	5	2.3E-01	1.2E-01	2.6E-02	1.5E-02	3.9E-01	2.3E-01	6.0E-02	6.2E-02	1.8E-01	5.3E-01	9.3E-01
	95	1.3E-03	5.9E-04	1.2E-04	1.7E-05	2.1E-03	1.3E-03	2.9E-04	3.0E-04	2.1E-04	2.1E-03	4.2E-03
HPAHs	75	5.7E-03	2.5E-03	5.3E-04	1.2E-04	8.9E-03	5.6E-03	1.2E-03	1.3E-03	1.5E-03	9.6E-03	1.8E-02
(Other High	50	1.6E-02	6.9E-03	1.5E-03	4.6E-04	2.5E-02	1.6E-02	3.4E-03	3.5E-03	5.6E-03	2.8E-02	5.3E-02
Molecular	25	4.3E-02	1.9E-02	4.0E-03	1.8E-03	6.8E-02	4.3E-02	9.3E-03	9.6E-03	2.2E-02	8.3E-02	1.5E-01
Weight PAHs)	5	1.9E-01	8.1E-02	1.7E-02	1.2E-02	3.0E-01	1.8E-01	4.0E-02	4.1E-02	1.5E-01	4.2E-01	7.1E-01
	95	5.0E-03	1.8E-03	3.7E-04	5.1E-05	7.2E-03	4.9E-03	8.6E-04	8.9E-04	6.3E-04	7.3E-03	1.4E-02
LPAHs	75	2.1E-02	7.5E-03	1.6E-03	3.6E-04	3.1E-02	2.1E-02	3.7E-03	3.8E-03	4.4E-03	3.3E-02	6.4E-02
(Low Molecular	50	5.9E-02	2.1E-02	4.4E-03	1.4E-03	8.5E-02	5.8E-02	1.0E-02	1.0E-02	1.7E-02	9.6E-02	1.8E-01
Weight PAHs)	25	1.6E-01	5.7E-02	1.2E-02	5.3E-03	2.4E-01	1.6E-01	2.8E-02	2.9E-02	6.5E-02	2.8E-01	5.2E-01
	5	7.0E-01	2.4E-01	5.2E-02	3.7E-02	1.0E+00	6.9E-01	1.2E-01	1.2E-01	4.5E-01	1.4E+00	2.4E+00
	95	7.3E-03	2.6E-02	5.5E-03	1.5E-04	3.9E-02	7.2E-03	1.3E-02	1.3E-02	1.8E-03	3.5E-02	7.3E-02
Bis(2-ethyl-	75	5.1E-02	1.8E-01	3.8E-02	1.7E-03	2.7E-01	5.0E-02	8.8E-02	9.0E-02	2.1E-02	2.5E-01	5.2E-01
hexyl)-	50	2.0E-01	6.9E-01	1.5E-01	9.2E-03	1.0E+00	1.9E-01	3.4E-01	3.5E-01	1.1E-01	9.9E-01	2.0E+00
phthalate	25	7.6E-01	2.7E+00	5.7E-01	5.0E-02	4.0E+00	7.5E-01	1.3E+00	1.3E+00	6.1E-01	4.0E+00	8.0E+00
	5	5.1E+00	1.8E+01	3.9E+00	5.6E-01	2.8E+01	5.0E+00	8.8E+00	9.4E+00	6.9E+00	3.0E+01	5.8E+01
	95	7.3E-09	1.3E-08	2.7E-09	1.5E-10	2.3E-08	7.2E-09	6.3E-09	6.5E-09	1.8E-09	2.2E-08	4.5E-08
	75	5.1E-08	8.9E-08	1.9E-08	1.7E-09	1.6E-07	5.0E-08	4.4E-08	4.5E-08	2.1E-08	1.6E-07	3.2E-07
Total Dioxin	50	2.0E-07	3.5E-07	7.3E-08	9.2E-09	6.2E-07	1.9E-07	1.7E-07	1.7E-07	1.1E-07	6.5E-07	1.3E-06
TEQs	25	7.6E-07	1.3E-06	2.8E-07	5.0E-08	2.4E-06	7.5E-07	6.5E-07	6.7E-07	6.1E-07	2.7E-06	5.1E-06
	5	5.3E-06	9.3E-06	2.0E-06	5.6E-07	1.7E-05	5.2E-06	4.5E-06	4.7E-06	6.9E-06	2.1E-05	3.8E-05
	95	1.5E-07	2.6E-06	3.3E-06	1.0E-05	1.6E-05	1.4E-07	1.3E-06	7.8E-06	1.3E-04	1.4E-04	1.5E-04
	75	1.0E-06	1.8E-05	2.3E-05	7.1E-05	1.1E-04	1.0E-06	8.8E-06	5.4E-05	8.8E-04	9.4E-04	1.1E-03
Total DDT	50	3.9E-06	6.9E-05	8.8E-05	2.8E-04	4.4E-04	3.9E-06	3.4E-05	2.1E-04	3.4E-03	3.6E-03	4.1E-03
	25	1.5E-05	2.7E-04	3.4E-04	1.1E-03	1.7E-03	1.5E-05	1.3E-04	8.1E-04	1.3E-02	1.4E-02	1.6E-02
	5	1.1E-04	1.9E-03	2.4E-03	7.4E-03	1.2E-02	1.0E-04	9.1E-04	5.6E-03	9.1E-02	9.7E-02	1.1E-01

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																										
						Hood Canal (south)					Hood Canal (north)											Sinclair/Dyes Inlet										
						Non-Urban					Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	0.0E+00	1.3E-07	2.6E-08	1.2E-06	1.4E-06	5.7E-10	1.0E-08	1.4E-11	2.7E-09	1.3E-08	4.5E-09	2.5E-08	1.2E-09	6.7E-08	9.8E-08	1.1E-07	8.2E-09	1.4E-07	2.0E-09	1.9E-08	1.7E-07	1.0E-08	8.9E-08	7.1E-09	1.2E-07	2.2E-07	3.9E-07
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	0.0E+00	5.7E-07	1.8E-07	8.5E-06	9.2E-06	4.0E-09	4.4E-08	1.0E-10	1.9E-08	6.6E-08	3.1E-08	1.1E-07	8.3E-09	4.7E-07	6.1E-07	6.8E-07	5.7E-08	6.0E-07	1.4E-08	1.3E-07	8.0E-07	7.1E-08	3.8E-07	4.9E-08	8.1E-07	1.3E-06	2.1E-06
Total PBDEs	2.0E-05	4.0E-05	3.0E-05	8.0E-06	50	0.0E+00	1.6E-06	7.0E-07	3.3E-05	3.5E-05	1.5E-08	1.2E-07	3.9E-10	7.2E-08	2.1E-07	1.2E-07	3.0E-07	3.2E-08	1.8E-06	2.2E-06	2.5E-06	2.2E-07	1.6E-06	5.3E-08	5.1E-07	2.4E-06	2.7E-07	1.0E-06	1.9E-07	3.1E-06	4.6E-06	7.0E-06
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	0.0E+00	4.3E-06	2.7E-06	1.3E-04	1.3E-04	5.9E-08	3.3E-07	1.5E-09	2.8E-07	6.7E-07	4.6E-07	8.1E-07	1.2E-07	6.9E-06	8.3E-06	9.0E-06	8.4E-07	4.5E-06	2.0E-07	2.0E-06	7.5E-06	1.1E-06	2.9E-06	7.3E-07	1.2E-05	1.7E-05	2.4E-05
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	0.0E+00	1.8E-05	1.9E-05	8.8E-04	9.2E-04	4.1E-07	1.4E-06	1.0E-08	1.9E-06	3.8E-06	3.2E-06	3.5E-06	8.6E-07	4.8E-05	5.6E-05	6.0E-05	5.9E-06	1.9E-05	1.4E-06	1.4E-05	4.0E-05	7.3E-06	1.2E-05	5.1E-06	8.3E-05	1.1E-04	1.5E-04
	0.085	0.013	0.013	2.2E-04	95	0.0E+00	5.0E-04	3.0E-04	9.1E-04	1.7E-03	6.5E-05	3.8E-05	1.6E-07	2.0E-06	1.1E-04	5.1E-04	9.4E-05	1.4E-05	5.0E-05	6.7E-04	7.7E-04	9.3E-04	5.2E-04	2.2E-05	1.4E-05	1.5E-03	1.2E-03	3.3E-04	8.0E-05	8.7E-05	1.7E-03	3.1E-03
cPAHs	0.36	0.054	0.054	0.0016	75	0.0E+00	2.1E-03	1.3E-03	6.4E-03	9.8E-03	2.8E-04	1.6E-04	7.0E-07	1.4E-05	4.6E-04	2.2E-03	4.0E-04	5.8E-05	3.5E-04	3.0E-03	3.5E-03	4.0E-03	2.2E-03	9.6E-05	9.9E-05	6.4E-03	5.0E-03	1.4E-03	3.4E-04	6.0E-04	7.3E-03	1.4E-02
(carcinogenic	1	0.15	0.15	0.006	50	0.0E+00	5.9E-03	3.5E-03	2.5E-02	3.4E-02	7.7E-04	4.5E-04	1.9E-06	5.4E-05	1.3E-03	6.0E-03	1.1E-03	1.6E-04	1.3E-03	8.6E-03	9.9E-03	1.1E-02	6.2E-03	2.6E-04	3.8E-04	1.8E-02	1.4E-02	3.9E-03	9.5E-04	2.3E-03	2.1E-02	3.9E-02
PAHs)	2.8	0.41	0.41	0.023	25	0.0E+00	1.6E-02	9.6E-03	9.5E-02	1.2E-01	2.1E-03	1.2E-03	5.3E-06	2.1E-04	3.6E-03	1.7E-02	3.1E-03	4.4E-04	5.2E-03	2.5E-02	2.9E-02	3.0E-02	1.7E-02	7.3E-04	1.5E-03	4.9E-02	3.8E-02	1.1E-02	2.6E-03	9.0E-03	6.0E-02	1.1E-01
	12	1.8	1.8	0.16	5	0.0E+00	6.9E-02	4.1E-02	6.6E-01	7.7E-01	9.1E-03	5.3E-03	2.3E-05	1.4E-03	1.6E-02	7.1E-02	1.3E-02	1.9E-03	3.6E-02	1.2E-01	1.4E-01	1.3E-01	7.3E-02	3.1E-03	1.0E-02	2.1E-01	1.6E-01	4.6E-02	1.1E-02	6.3E-02	2.8E-01	5.0E-01
	0.068	0.0085	0.0085	1.9E-04	95	0.0E+00	3.3E-04	2.0E-04	7.6E-04	1.3E-03	5.2E-05	2.6E-05	1.1E-07	1.7E-06	7.9E-05	4.1E-04	6.3E-05	9.0E-06	4.2E-05	5.2E-04	6.0E-04	7.4E-04	3.5E-04	1.5E-05	1.2E-05	1.1E-03	9.2E-04	2.2E-04	5.4E-05	7.2E-05	1.3E-03	2.4E-03
HPAHs	0.29	0.036	0.036	0.0013	75	0.0E+00	1.4E-03	8.4E-04	5.3E-03	7.6E-03	2.2E-04	1.1E-04	4.7E-07	1.2E-05	3.4E-04	1.7E-03	2.7E-04	3.9E-05	2.9E-04	2.3E-03	2.7E-03	3.2E-03	1.5E-03	6.4E-05	8.2E-05	4.8E-03	4.0E-03	9.5E-04	2.3E-04	5.0E-04	5.6E-03	1.0E-02
(Other High	0.8	0.1	0.1	0.005	50	0.0E+00	3.9E-03	2.3E-03	2.0E-02	2.7E-02	6.1E-04	3.0E-04	1.3E-06	4.5E-05	9.6E-04	4.8E-03	7.4E-04	1.1E-04	1.1E-03	6.8E-03	7.7E-03	8.8E-03	4.1E-03	1.8E-04	3.2E-04	1.3E-02	1.1E-02	2.6E-03	6.3E-04	1.9E-03	1.6E-02	2.9E-02
Molecular	2.2	0.28	0.28	0.019	25	0.0E+00	1.1E-02	6.4E-03	7.9E-02	9.6E-02	1.7E-03	8.3E-04	3.5E-06	1.7E-04	2.7E-03	1.3E-02	2.0E-03	2.9E-04	4.3E-03	2.0E-02	2.3E-02	2.4E-02	1.1E-02	4.8E-04	1.2E-03	3.7E-02	3.0E-02	7.2E-03	1.7E-03	7.5E-03	4.6E-02	8.4E-02
Weight PAHs)	9.4	1.2	1.2	0.13	5	0.0E+00	4.6E-02	2.7E-02	5.5E-01	6.2E-01	7.2E-03	3.6E-03	1.5E-05	1.2E-03	1.2E-02	5.7E-02	8.7E-03	1.3E-03	3.0E-02	9.7E-02	1.1E-01	1.0E-01	4.8E-02	2.1E-03	8.5E-03	1.6E-01	1.3E-01	3.1E-02	7.4E-03	5.2E-02	2.2E-01	3.8E-01
	0.25	0.025	0.025	5.6E-04	95	0.0E+00	1.0E-03	5.9E-04	2.3E-03	3.9E-03	2.0E-04	7.7E-05	3.3E-07	5.0E-06	2.8E-04	1.5E-03	1.9E-04	2.7E-05	1.3E-04	1.9E-03	2.1E-03	2.8E-03	1.0E-03	4.5E-05	3.6E-05	3.9E-03	3.5E-03	6.7E-04	1.6E-04	2.2E-04	4.5E-03	8.4E-03
LPAHs	1.1	0.11	0.11	0.0039	75	0.0E+00	4.3E-03	2.5E-03	1.6E-02	2.3E-02	8.4E-04	3.3E-04	1.4E-06	3.5E-05	1.2E-03	6.5E-03	8.1E-04	1.2E-04	8.7E-04	8.3E-03	9.5E-03	1.2E-02	4.5E-03	1.9E-04	2.5E-04	1.7E-02	1.5E-02	2.9E-03	6.9E-04	1.5E-03	2.0E-02	3.7E-02
(Low Molecular	3	0.3	0.3	0.015	50	0.0E+00	1.2E-02	7.0E-03	6.1E-02	8.0E-02	2.3E-03	9.0E-04	3.9E-06	1.3E-04	3.3E-03	1.8E-02	2.2E-03	3.2E-04	3.4E-03	2.4E-02	2.7E-02	3.3E-02	1.2E-02	5.3E-04	9.5E-04	4.7E-02	4.1E-02	7.9E-03	1.9E-03	5.8E-03	5.6E-02	1.0E-01
Weight PAHs)	8.3	0.83	0.83	0.058	25	0.0E+00	3.2E-02	1.9E-02	2.4E-01	2.9E-01	6.3E-03	2.5E-03	1.1E-05	5.2E-04	9.4E-03	5.0E-02	6.1E-03	8.8E-04	1.3E-02	7.0E-02	7.9E-02	9.0E-02	3.4E-02	1.5E-03	3.7E-03	1.3E-01	1.1E-01	2.2E-02	5.2E-03	2.2E-02	1.6E-01	2.9E-01
	35	3.5	3.5	0.40	5	0.0E+00	1.4E-01	8.2E-02	1.6E+00	1.9E+00	2.7E-02	1.1E-02	4.6E-05	3.6E-03	4.1E-02	2.1E-01	2.6E-02	3.8E-03	9.0E-02	3.3E-01	3.7E-01	3.9E-01	1.5E-01	6.2E-03	2.6E-02	5.6E-01	4.8E-01	9.3E-02	2.2E-02	1.6E-01	7.5E-01	1.3E+00
	0.37	0.37	0.37	0.0016	95	0.0E+00	1.5E-02	8.7E-03	6.7E-03	3.0E-02	2.9E-04	1.1E-03	4.8E-06	1.5E-05	1.4E-03	2.2E-03	2.8E-03	4.0E-04	3.7E-04	5.8E-03	7.2E-03	4.1E-03	1.5E-02	6.6E-04	1.0E-04	2.0E-02	5.1E-03	9.8E-03	2.4E-03	6.4E-04	1.8E-02	3.8E-02
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	0.0E+00	1.0E-01	6.0E-02	7.6E-02	2.4E-01	2.0E-03	7.8E-03	3.3E-05	1.7E-04	1.0E-02	1.6E-02	1.9E-02	2.8E-03	4.2E-03	4.2E-02	5.2E-02	2.8E-02	1.1E-01	4.6E-03	1.2E-03	1.4E-01	3.5E-02	6.8E-02	1.6E-02	7.2E-03	1.3E-01	2.7E-01
hexyl)-	10	10	10	0.1	50	0.0E+00	3.9E-01	2.3E-01	4.1E-01	1.0E+00	7.7E-03	3.0E-02	1.3E-04	9.0E-04	3.9E-02	6.0E-02	7.4E-02	1.1E-02	2.2E-02	1.7E-01	2.1E-01	1.1E-01	4.1E-01	1.8E-02	6.4E-03	5.4E-01	1.4E-01	2.6E-01	6.3E-02	3.9E-02	5.0E-01	1.0E+00
phthalate	39	39	39	0.54	25	0.0E+00	1.5E+00	9.0E-01	2.2E+00	4.6E+00	3.0E-02	1.2E-01	5.0E-04	4.8E-03	1.5E-01	2.3E-01	2.9E-01	4.1E-02	1.2E-01	6.8E-01	8.3E-01	4.2E-01	1.6E+00	6.8E-02	3.4E-02	2.1E+00	5.3E-01	1.0E+00	2.4E-01	2.1E-01	2.0E+00	4.1E+00
	260	260	268	6.1	5	0.0E+00	1.0E+01	6.2E+00	2.5E+01	4.1E+01	2.0E-01	7.8E-01	3.5E-03	5.5E-02	1.0E+00	1.6E+00	1.9E+00	2.9E-01	1.4E+00	5.1E+00	6.2E+00	2.8E+00	1.1E+01	4.7E-01	3.9E-01	1.4E+01	3.5E+00	6.8E+00	1.7E+00	2.4E+00	1.4E+01	2.9E+01
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	0.0E+00	7.3E-09	4.3E-09	6.7E-09	1.8E-08	2.9E-10	5.6E-10	2.4E-12	1.5E-11	8.6E-10	2.2E-09	1.4E-09	2.0E-10	3.7E-10	4.2E-09	5.0E-09	4.1E-09	7.6E-09	3.3E-10	1.0E-10	1.2E-08	5.1E-09	4.9E-09	1.2E-09	6.4E-10	1.2E-08	2.4E-08
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	0.0E+00	5.1E-08	3.0E-08	7.6E-08	1.6E-07	2.0E-09	3.9E-09	1.7E-11	1.7E-10	6.1E-09	1.6E-08	9.6E-09	1.4E-09	4.2E-09	3.1E-08	3.7E-08	2.8E-08	5.3E-08	2.3E-09	1.2E-09	8.5E-08	3.5E-08	3.4E-08	8.2E-09	7.2E-09	8.5E-08	1.7E-07
Total Dioxin	1.0E-05	5.0E-06	5.0E-06	1.0E-07	50	0.0E+00	2.0E-07	1.2E-07	4.1E-07	7.2E-07	7.7E-09	1.5E-08	6.4E-11	9.0E-10	2.4E-08	6.0E-08	3.7E-08	5.3E-09	2.2E-08	1.2E-07	1.5E-07	1.1E-07	2.1E-07	8.8E-09	6.4E-09	3.3E-07	1.4E-07	1.3E-07	3.2E-08	3.9E-08	3.4E-07	6.7E-07
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	0.0E+00	7.6E-07	4.5E-07	2.2E-06	3.4E-06	3.0E-08	5.8E-08	2.5E-10	4.8E-09	9.3E-08	2.3E-07	1.4E-07	2.1E-08	1.2E-07	5.2E-07	6.1E-07	4.2E-07	7.9E-07	3.4E-08	3.4E-08	1.3E-06	5.3E-07	5.1E-07	1.2E-07	2.1E-07	1.4E-06	2.6E-06
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	0.0E+00	5.3E-06	3.1E-06	2.5E-05	3.3E-05	2.1E-07	4.0E-07	1.7E-09	5.5E-08	6.7E-07	1.6E-06	9.9E-07	1.4E-07	1.4E-06	4.1E-06	4.8E-06	2.9E-06	5.5E-06	2.4E-07	3.9E-07	9.1E-06	3.7E-06	3.5E-06	8.5E-07	2.4E-06	1.0E-05	1.9E-05
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	0.0E+00	1.5E-06	5.2E-06	4.6E-04	4.6E-04	5.7E-09	1.1E-07	2.9E-09	1.0E-06	1.1E-06	4.5E-08	2.8E-07	2.4E-07	2.5E-05	2.6E-05	2.7E-05	8.2E-08	1.5E-06	3.9E-07	7.1E-06	9.1E-06	1.0E-07	9.8E-07	1.4E-06	4.3E-05	4.6E-05	5.5E-05
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	0.0E+00	1.0E-05	3.6E-05	3.2E-03	3.2E-03	4.0E-08	7.8E-07	2.0E-08	7.0E-06	7.8E-06	3.1E-07	1.9E-06	1.7E-06	1.7E-04	1.8E-04	1.9E-04	5.7E-07	1.1E-05	2.7E-06	4.9E-05	6.3E-05	7.1E-07	6.8E-06	9.8E-06	3.0E-04	3.2E-04	3.8E-04
Total DDT	2.0E-04	0.001	0.006	0.003	50	0.0E+00	3.9E-05	1.4E-04	1.2E-02	1.2E-02	1.5E-07	3.0E-06	7.7E-08	2.7E-05	3.0E-05	1.2E-06	7.4E-06	6.4E-06	6.7E-04	6.9E-04	7.2E-04	2.2E-06	4.1E-05	1.1E-05	1.9E-04	2.4E-04	2.7E-06	2.6E-05	3.8E-05	1.2E-03	1.2E-03	1.5E-03
	7.7E-04	0.0039	0.023	0.012	25	0.0E+00	1.5E-04	5.4E-04	4.7E-02	4.8E-02	5.9E-07	1.2E-05	3.0E-07	1.0E-04	1.2E-04	4.6E-06	2.9E-05	2.5E-05	2.6E-03	2.7E-03	2.8E-03	8.4E-06	1.6E-04	4.1E-05	7.4E-04	9.4E-04	1.1E-05	1.0E-04	1.5E-04	4.5E-03	4.8E-03	5.7E-03
	0.0054	0.027	0.16	0.081	5	0.0E+00	1.1E-03	3.7E-03	3.3E-01	3.3E-01	4.1E-06	8.1E-05	2.1E-06	7.2E-04	8.1E-04	3.2E-05	2.0E-04	1.7E-04	1.8E-02	1.8E-02	1.9E-02	5.9E-05	1.1E-03	2.8E-04	5.1E-03	6.6E-03	7.3E-05	7.0E-04	1.0E-03	3.1E-02	3.3E-02	4.0E-02

Table B-2 - Box Model Surface Runoff Loadings

Surface Runoff Concentration (ug/L); Average Annual Mass Loading (metric tons / year) — Admiralty Inlet

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Admiralty Inlet: Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
Total PBDEs	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	0.0E+00	4.8E-08	1.2E-09	5.8E-09	5.5E-08	6.3E-09	6.1E-08	4.7E-08	1.1E-07	2.2E-07	2.8E-07
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	0.0E+00	2.1E-07	8.7E-09	4.1E-08	2.6E-07	4.4E-08	2.6E-07	3.2E-07	7.4E-07	1.4E-06	1.6E-06
	2.0E-05	**4.0E-05**	**3.0E-05**	**8.0E-06**	**50**	**0.0E+00**	**5.7E-07**	**3.3E-08**	**1.6E-07**	**7.6E-07**	**1.7E-07**	**7.2E-07**	**1.2E-06**	**2.9E-06**	**5.0E-06**	**5.8E-06**
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	0.0E+00	1.6E-06	1.3E-07	6.0E-07	2.3E-06	6.5E-07	2.0E-06	4.8E-06	1.1E-05	1.8E-05	2.1E-05
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	0.0E+00	6.7E-06	9.0E-07	4.2E-06	1.2E-05	4.5E-06	8.5E-06	3.4E-05	7.7E-05	1.2E-04	1.4E-04
cPAHs (carcinogenic PAHs)	0.085	0.013	0.013	2.2E-04	95	0.0E+00	1.8E-04	1.4E-05	4.4E-06	2.0E-04	7.2E-04	2.3E-04	5.3E-04	8.0E-05	1.6E-03	1.8E-03
	0.36	0.054	0.054	0.0016	75	0.0E+00	7.8E-04	6.1E-05	3.0E-05	8.7E-04	3.1E-03	9.8E-04	2.3E-03	5.6E-04	6.9E-03	7.7E-03
	1	**0.15**	**0.15**	**0.006**	**50**	**0.0E+00**	**2.1E-03**	**1.7E-04**	**1.2E-04**	**2.4E-03**	**8.4E-03**	**2.7E-03**	**6.2E-03**	**2.1E-03**	**2.0E-02**	**2.2E-02**
	2.8	0.41	0.41	0.023	25	0.0E+00	5.9E-03	4.6E-04	4.5E-04	6.8E-03	2.3E-02	7.4E-03	1.7E-02	8.3E-03	5.6E-02	6.3E-02
	12	1.8	1.8	0.16	5	0.0E+00	2.5E-02	2.0E-03	3.2E-03	3.0E-02	1.0E-01	3.2E-02	7.4E-02	5.8E-02	2.6E-01	2.9E-01
HPAHs (Other High Molecular Weight PAHs)	0.068	0.0085	0.0085	1.9E-04	95	0.0E+00	1.2E-04	9.5E-06	3.6E-06	1.3E-04	5.7E-04	1.5E-04	3.5E-04	6.7E-05	1.1E-03	1.3E-03
	0.29	0.036	0.036	0.0013	75	0.0E+00	5.2E-04	4.1E-05	2.5E-05	5.8E-04	2.5E-03	6.5E-04	1.5E-03	4.6E-04	5.1E-03	5.7E-03
	0.8	**0.1**	**0.1**	**0.005**	**50**	**0.0E+00**	**1.4E-03**	**1.1E-04**	**9.8E-05**	**1.6E-03**	**6.8E-03**	**1.8E-03**	**4.2E-03**	**1.8E-03**	**1.4E-02**	**1.6E-02**
	2.2	0.28	0.28	0.019	25	0.0E+00	3.9E-03	3.1E-04	3.8E-04	4.6E-03	1.9E-02	4.9E-03	1.1E-02	6.9E-03	4.2E-02	4.6E-02
	9.4	1.2	1.2	0.13	5	0.0E+00	1.7E-02	1.3E-03	2.6E-03	2.1E-02	8.0E-02	2.1E-02	4.9E-02	4.8E-02	2.0E-01	2.2E-01
LPAHs (Low Molecular Weight PAHs)	0.25	0.025	0.025	5.6E-04	95	0.0E+00	3.6E-04	2.8E-05	1.1E-05	4.0E-04	2.1E-03	4.6E-04	1.1E-03	2.0E-04	3.9E-03	4.3E-03
	1.1	0.11	0.11	0.0039	75	0.0E+00	1.6E-03	1.2E-04	7.6E-05	1.8E-03	9.2E-03	2.0E-03	4.5E-03	1.4E-03	1.7E-02	1.9E-02
	3	**0.3**	**0.3**	**0.015**	**50**	**0.0E+00**	**4.3E-03**	**3.3E-04**	**2.9E-04**	**4.9E-03**	**2.5E-02**	**5.4E-03**	**1.2E-02**	**5.4E-03**	**4.9E-02**	**5.3E-02**
	8.3	0.83	0.83	0.058	25	0.0E+00	1.2E-02	9.2E-04	1.1E-03	1.4E-02	7.0E-02	1.5E-02	3.4E-02	2.1E-02	1.4E-01	1.5E-01
	35	3.5	3.5	0.40	5	0.0E+00	5.0E-02	3.9E-03	7.9E-03	6.2E-02	3.0E-01	6.3E-02	1.5E-01	1.4E-01	6.5E-01	7.2E-01
Bis(2-ethyl-hexyl)-phthalate	0.37	0.37	0.37	0.0016	95	0.0E+00	5.3E-03	4.2E-04	3.2E-05	5.8E-03	3.1E-03	6.7E-03	1.6E-02	5.9E-04	2.6E-02	3.2E-02
	2.6	2.6	2.6	0.018	75	0.0E+00	3.7E-02	2.9E-03	3.6E-04	4.0E-02	2.2E-02	4.6E-02	1.1E-01	6.6E-03	1.8E-01	2.2E-01
	10	**10**	**10**	**0.1**	**50**	**0.0E+00**	**1.4E-01**	**1.1E-02**	**2.0E-03**	**1.6E-01**	**8.4E-02**	**1.8E-01**	**4.2E-01**	**3.6E-02**	**7.2E-01**	**8.7E-01**
	39	39	39	0.54	25	0.0E+00	5.5E-01	4.3E-02	1.1E-02	6.0E-01	3.3E-01	6.9E-01	1.6E+00	1.9E-01	2.8E+00	3.4E+00
	260	260	268	6.1	5	0.0E+00	3.7E+00	3.0E-01	1.2E-01	4.1E+00	2.2E+00	4.7E+00	1.1E+01	2.2E+00	2.0E+01	2.4E+01
Total Dioxin TEQs	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	0.0E+00	2.7E-09	2.1E-10	3.2E-11	2.9E-09	3.1E-09	3.3E-09	7.8E-09	5.9E-10	1.5E-08	1.8E-08
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	0.0E+00	1.8E-08	1.4E-09	3.6E-10	2.0E-08	2.2E-08	2.3E-08	5.4E-08	6.6E-09	1.1E-07	1.3E-07
	1.0E-05	**5.0E-06**	**5.0E-06**	**1.0E-07**	**50**	**0.0E+00**	**7.1E-08**	**5.6E-09**	**2.0E-09**	**7.9E-08**	**8.4E-08**	**9.0E-08**	**2.1E-07**	**3.6E-08**	**4.2E-07**	**5.0E-07**
	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	0.0E+00	2.8E-07	2.2E-08	1.1E-08	3.1E-07	3.3E-07	3.5E-07	8.0E-07	1.9E-07	1.7E-06	2.0E-06
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	0.0E+00	1.9E-06	1.5E-07	1.2E-07	2.2E-06	2.3E-06	2.4E-06	5.6E-06	2.2E-06	1.2E-05	1.5E-05
Total DDT	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	0.0E+00	5.3E-07	2.5E-07	2.2E-06	3.0E-06	6.3E-08	6.7E-07	9.3E-06	4.0E-05	5.0E-05	5.3E-05
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	0.0E+00	3.7E-06	1.7E-06	1.5E-05	2.1E-05	4.4E-07	4.6E-06	6.5E-05	2.8E-04	3.5E-04	3.7E-04
	2.0E-04	**0.001**	**0.006**	**0.003**	**50**	**0.0E+00**	**1.4E-05**	**6.7E-06**	**5.9E-05**	**8.0E-05**	**1.7E-06**	**1.8E-05**	**2.5E-04**	**1.1E-03**	**1.3E-03**	**1.4E-03**
	7.7E-04	0.0039	0.023	0.012	25	0.0E+00	5.5E-05	2.6E-05	2.3E-04	3.1E-04	6.5E-06	6.9E-05	9.6E-04	4.1E-03	5.2E-03	5.5E-03
	0.0054	0.027	0.16	0.081	5	0.0E+00	3.8E-04	1.8E-04	1.6E-03	2.1E-03	4.5E-05	4.8E-04	6.7E-03	2.9E-02	3.6E-02	3.8E-02

Average Annual Mass Loading (metric tons / year) — Strait of Juan de Fuca

Chemical of Concern	Probability of Exceedance	Strait of Juan de Fuca: Urban					Non-Urban					
	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
Total PBDEs	95	7.0E-10	1.2E-07	1.8E-08	1.2E-08	1.6E-07	1.8E-08	1.0E-07	2.0E-07	1.5E-06	1.8E-06	1.9E-06
	75	4.9E-09	5.3E-07	1.3E-07	8.5E-08	7.5E-07	1.2E-07	4.3E-07	1.4E-06	1.0E-05	1.2E-05	1.3E-05
	50	**1.9E-08**	**1.5E-06**	**4.9E-07**	**3.3E-07**	**2.3E-06**	**4.8E-07**	**1.2E-06**	**5.4E-06**	**3.9E-05**	**4.6E-05**	**4.8E-05**
	25	7.3E-08	4.0E-06	1.9E-06	1.3E-06	7.3E-06	1.8E-06	3.3E-06	2.1E-05	1.5E-04	1.8E-04	1.8E-04
	5	5.0E-07	1.7E-05	1.3E-05	8.8E-06	4.0E-05	1.3E-05	1.4E-05	1.5E-04	1.0E-03	1.2E-03	1.3E-03
cPAHs (carcinogenic PAHs)	95	8.0E-05	4.7E-04	2.1E-04	9.1E-06	7.6E-04	2.0E-03	3.8E-04	2.3E-03	1.1E-03	5.8E-03	6.6E-03
	75	3.4E-04	2.0E-03	8.8E-04	6.4E-05	3.3E-03	8.7E-03	1.6E-03	9.9E-03	7.6E-03	2.8E-02	3.1E-02
	50	**9.4E-04**	**5.5E-03**	**2.4E-03**	**2.5E-04**	**9.1E-03**	**2.4E-02**	**4.5E-03**	**2.7E-02**	**2.9E-02**	**8.5E-02**	**9.4E-02**
	25	2.6E-03	1.5E-02	6.7E-03	9.5E-04	2.5E-02	6.6E-02	1.2E-02	7.5E-02	1.1E-01	2.7E-01	2.9E-01
	5	1.1E-02	6.5E-02	2.9E-02	6.6E-03	1.1E-01	2.8E-01	5.3E-02	3.2E-01	7.8E-01	1.4E+00	1.6E+00
HPAHs (Other High Molecular Weight PAHs)	95	6.4E-05	3.1E-04	1.4E-04	7.6E-06	5.2E-04	1.6E-03	2.5E-04	1.5E-03	9.1E-04	4.3E-03	4.8E-03
	75	2.7E-04	1.3E-03	5.9E-04	5.3E-05	2.2E-03	6.9E-03	1.1E-03	6.6E-03	6.3E-03	2.1E-02	2.3E-02
	50	**7.5E-04**	**3.7E-03**	**1.6E-03**	**2.0E-04**	**6.3E-03**	**1.9E-02**	**3.0E-03**	**1.8E-02**	**2.4E-02**	**6.5E-02**	**7.1E-02**
	25	2.1E-03	1.0E-02	4.5E-03	7.9E-04	1.7E-02	5.3E-02	8.2E-03	5.0E-02	9.4E-02	2.0E-01	2.2E-01
	5	8.9E-03	4.3E-02	1.9E-02	5.5E-03	7.7E-02	2.2E-01	3.5E-02	2.1E-01	6.5E-01	1.1E+00	1.2E+00
LPAHs (Low Molecular Weight PAHs)	95	2.4E-04	9.3E-04	4.1E-04	2.3E-05	1.6E-03	6.1E-03	7.6E-04	4.6E-03	2.7E-03	1.4E-02	1.6E-02
	75	1.0E-03	4.0E-03	1.8E-03	1.6E-04	7.0E-03	2.6E-02	3.2E-03	2.0E-02	1.9E-02	6.8E-02	7.5E-02
	50	**2.8E-03**	**1.1E-02**	**4.9E-03**	**6.1E-04**	**1.9E-02**	**7.2E-02**	**8.9E-03**	**5.4E-02**	**7.3E-02**	**2.1E-01**	**2.3E-01**
	25	7.8E-03	3.0E-02	1.3E-02	2.4E-03	5.4E-02	2.0E-01	2.5E-02	1.5E-01	2.8E-01	6.5E-01	7.1E-01
	5	3.3E-02	1.3E-01	5.7E-02	1.6E-02	2.4E-01	8.4E-01	1.1E-01	6.4E-01	2.0E+00	3.6E+00	3.8E+00
Bis(2-ethyl-hexyl)-phthalate	95	3.5E-04	1.4E-02	6.0E-03	6.7E-05	2.0E-02	8.9E-03	1.1E-02	6.8E-02	8.0E-03	9.6E-02	1.2E-01
	75	2.4E-03	9.5E-02	4.2E-02	7.6E-04	1.4E-01	6.2E-02	7.7E-02	4.7E-01	9.0E-02	7.0E-01	8.4E-01
	50	**9.4E-03**	**3.7E-01**	**1.6E-01**	**4.1E-03**	**5.4E-01**	**2.4E-01**	**3.0E-01**	**1.8E+00**	**4.9E-01**	**2.8E+00**	**3.4E+00**
	25	3.6E-02	1.4E+00	6.3E-01	2.2E-02	2.1E+00	9.2E-01	1.1E+00	7.0E+00	2.6E+00	1.2E+01	1.4E+01
	5	2.4E-01	9.5E+00	4.4E+00	2.5E-01	1.4E+01	6.2E+00	7.7E+00	4.9E+01	3.0E+01	9.2E+01	1.1E+02
Total Dioxin TEQs	95	3.5E-10	6.8E-09	3.0E-09	6.7E-11	1.0E-08	8.9E-09	5.5E-09	3.4E-08	8.0E-09	5.6E-08	6.7E-08
	75	2.4E-09	4.8E-08	2.1E-08	7.6E-10	7.2E-08	6.2E-08	3.9E-08	2.4E-07	9.0E-08	4.3E-07	5.0E-07
	50	**9.4E-09**	**1.8E-07**	**8.1E-08**	**4.1E-09**	**2.8E-07**	**2.4E-07**	**1.5E-07**	**9.1E-07**	**4.9E-07**	**1.8E-06**	**2.1E-06**
	25	3.6E-08	7.1E-07	3.1E-07	2.2E-08	1.1E-06	9.2E-07	5.7E-07	3.5E-06	2.6E-06	7.6E-06	8.7E-06
	5	2.5E-07	4.9E-06	2.2E-06	2.5E-07	7.6E-06	6.4E-06	4.0E-06	2.4E-05	3.0E-05	6.5E-05	7.2E-05
Total DDT	95	7.0E-09	1.4E-06	3.6E-06	4.6E-06	9.6E-06	1.8E-07	1.1E-06	4.1E-05	5.4E-04	5.9E-04	6.0E-04
	75	4.9E-08	9.5E-06	2.5E-05	3.2E-05	6.7E-05	1.2E-06	7.7E-06	2.8E-04	3.8E-03	4.1E-03	4.1E-03
	50	**1.9E-07**	**3.7E-05**	**9.7E-05**	**1.2E-04**	**2.6E-04**	**4.8E-06**	**3.0E-05**	**1.1E-03**	**1.5E-02**	**1.6E-02**	**1.6E-02**
	25	7.3E-07	1.4E-04	3.8E-04	4.7E-04	9.9E-04	1.8E-05	1.1E-04	4.2E-03	5.6E-02	6.1E-02	6.2E-02
	5	5.0E-06	9.9E-04	2.6E-03	3.3E-03	6.9E-03	1.3E-04	8.0E-04	2.9E-02	3.9E-01	4.2E-01	4.3E-01

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Strait of Georgia											Whidbey Basin										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	2.1E-08	2.9E-07	5.5E-08	3.5E-08	4.1E-07	3.0E-08	2.1E-07	1.2E-06	1.4E-06	2.8E-06	3.3E-06	2.2E-08	3.3E-07	7.3E-08	5.6E-08	4.8E-07	4.4E-08	3.3E-07	7.3E-07	5.0E-06	6.1E-06	6.6E-06
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	1.5E-07	1.3E-06	3.9E-07	2.5E-07	2.0E-06	2.1E-07	9.1E-07	8.5E-06	9.7E-06	1.9E-05	2.1E-05	1.5E-07	1.4E-06	5.1E-07	3.9E-07	2.5E-06	3.0E-07	1.4E-06	5.1E-06	3.5E-05	4.2E-05	4.4E-05
Total PBDEs	2.0E-05	4.0E-05	3.0E-05	8.0E-06	50	5.6E-07	3.5E-06	1.5E-06	9.5E-07	6.5E-06	8.0E-07	2.5E-06	3.3E-05	3.7E-05	7.3E-05	8.0E-05	5.8E-07	3.9E-06	2.0E-06	1.5E-06	7.9E-06	1.2E-06	3.9E-06	2.0E-05	1.3E-04	1.6E-04	1.7E-04
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	2.2E-06	9.6E-06	5.7E-06	3.7E-06	2.1E-05	3.1E-06	6.9E-06	1.3E-04	1.4E-04	2.8E-04	3.0E-04	2.2E-06	1.1E-05	7.6E-06	5.8E-06	2.6E-05	4.5E-06	1.1E-05	7.6E-05	5.2E-04	6.1E-04	6.4E-04
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	1.5E-05	4.1E-05	4.0E-05	2.5E-05	1.2E-04	2.1E-05	2.9E-05	8.8E-04	1.0E-03	1.9E-03	2.0E-03	1.6E-05	4.6E-05	5.3E-05	4.0E-05	1.5E-04	3.1E-05	4.6E-05	5.3E-04	3.6E-03	4.2E-03	4.4E-03
	0.085	0.013	0.013	2.2E-04	95	2.4E-03	1.1E-03	6.3E-04	2.6E-05	4.1E-03	3.4E-03	7.9E-04	1.4E-02	1.0E-03	1.9E-02	2.3E-02	2.5E-03	1.2E-03	8.3E-04	4.2E-05	4.6E-03	5.0E-03	1.2E-03	8.3E-03	3.8E-03	1.8E-02	2.3E-02
cPAHs	0.36	0.054	0.054	0.0016	75	1.0E-02	4.7E-03	2.7E-03	1.8E-04	1.8E-02	1.5E-02	3.4E-03	5.9E-02	7.2E-03	8.5E-02	1.0E-01	1.1E-02	5.3E-03	3.6E-03	2.9E-04	2.0E-02	2.1E-02	5.3E-03	3.6E-02	2.6E-02	8.8E-02	1.1E-01
(carcinogenic	1	0.15	0.15	0.006	50	2.8E-02	1.3E-02	7.4E-03	7.1E-04	4.9E-02	4.0E-02	9.4E-03	1.6E-01	2.8E-02	2.4E-01	2.9E-01	2.9E-02	1.5E-02	9.8E-03	1.1E-03	5.5E-02	5.9E-02	1.5E-02	9.8E-02	1.0E-01	2.7E-01	3.3E-01
PAHs)	2.8	0.41	0.41	0.023	25	7.7E-02	3.6E-02	2.0E-02	2.7E-03	1.4E-01	1.1E-01	2.6E-02	4.5E-01	1.1E-01	6.9E-01	8.3E-01	8.0E-02	4.0E-02	2.7E-02	4.3E-03	1.5E-01	1.6E-01	4.0E-02	2.7E-01	3.9E-01	8.6E-01	1.0E+00
	12	1.8	1.8	0.16	5	3.3E-01	1.5E-01	8.8E-02	1.9E-02	5.9E-01	4.7E-01	1.1E-01	1.9E+00	7.5E-01	3.3E+00	3.8E+00	3.4E-01	1.7E-01	1.2E-01	3.0E-02	6.6E-01	6.9E-01	1.7E-01	1.2E+00	2.7E+00	4.7E+00	5.4E+00
	0.068	0.0085	0.0085	1.9E-04	95	1.9E-03	7.4E-04	4.2E-04	2.2E-05	3.1E-03	2.7E-03	5.3E-04	9.2E-03	8.7E-04	1.3E-02	1.6E-02	2.0E-03	8.2E-04	5.5E-04	3.5E-05	3.4E-03	4.0E-03	8.3E-04	5.5E-03	3.1E-03	1.3E-02	1.7E-02
HPAHs	0.29	0.036	0.036	0.0013	75	8.1E-03	3.2E-03	1.8E-03	1.5E-04	1.3E-02	1.2E-02	2.3E-03	4.0E-02	6.0E-03	6.0E-02	7.3E-02	8.5E-03	3.5E-03	2.4E-03	2.4E-04	1.5E-02	1.7E-02	3.6E-03	2.4E-02	2.2E-02	6.6E-02	8.1E-02
(Other High	0.8	0.1	0.1	0.005	50	2.2E-02	8.7E-03	5.0E-03	5.9E-04	3.7E-02	3.2E-02	6.2E-03	1.1E-01	2.3E-02	1.7E-01	2.1E-01	2.3E-02	9.7E-03	6.5E-03	9.4E-04	4.0E-02	4.7E-02	9.8E-03	6.5E-02	8.4E-02	2.1E-01	2.5E-01
Molecular	2.2	0.28	0.28	0.019	25	6.2E-02	2.4E-02	1.4E-02	2.3E-03	1.0E-01	8.8E-02	1.7E-02	3.0E-01	9.0E-02	4.9E-01	6.0E-01	6.4E-02	2.7E-02	1.8E-02	3.6E-03	1.1E-01	1.3E-01	2.7E-02	1.8E-01	3.3E-01	6.6E-01	7.7E-01
Weight PAHs)	9.4	1.2	1.2	0.13	5	2.6E-01	1.0E-01	5.9E-02	1.6E-02	4.4E-01	3.8E-01	7.4E-02	1.3E+00	6.2E-01	2.4E+00	2.8E+00	2.7E-01	1.1E-01	7.7E-02	2.5E-02	4.9E-01	5.5E-01	1.2E-01	7.7E-01	2.3E+00	3.7E+00	4.2E+00
	0.25	0.025	0.025	5.6E-04	95	7.1E-03	2.2E-03	1.3E-03	6.6E-05	1.1E-02	1.0E-02	1.6E-03	2.8E-02	2.6E-03	4.2E-02	5.3E-02	7.4E-03	2.5E-03	1.7E-03	1.0E-04	1.2E-02	1.5E-02	2.5E-03	1.7E-02	9.4E-03	4.3E-02	5.5E-02
LPAHs	1.1	0.11	0.11	0.0039	75	3.1E-02	9.5E-03	5.4E-03	4.6E-04	4.6E-02	4.4E-02	6.8E-03	1.2E-01	1.8E-02	1.9E-01	2.3E-01	3.2E-02	1.1E-02	7.1E-03	7.3E-04	5.0E-02	6.4E-02	1.1E-02	7.1E-02	6.6E-02	2.1E-01	2.6E-01
(Low Molecular	3	0.3	0.3	0.015	50	8.4E-02	2.6E-02	1.5E-02	1.8E-03	1.3E-01	1.2E-01	1.9E-02	3.3E-01	7.0E-02	5.4E-01	6.6E-01	8.7E-02	2.9E-02	2.0E-02	2.8E-03	1.4E-01	1.8E-01	2.9E-02	2.0E-01	2.5E-01	6.5E-01	7.9E-01
Weight PAHs)	8.3	0.83	0.83	0.058	25	2.3E-01	7.2E-02	4.1E-02	6.8E-03	3.5E-01	3.3E-01	5.2E-02	9.0E-01	2.7E-01	1.6E+00	1.9E+00	2.4E-01	8.0E-02	5.4E-02	1.1E-02	3.9E-01	4.8E-01	8.1E-02	5.4E-01	9.8E-01	2.1E+00	2.5E+00
	35	3.5	3.5	0.40	5	9.9E-01	3.1E-01	1.8E-01	4.8E-02	1.5E+00	1.4E+00	2.2E-01	3.9E+00	1.9E+00	7.4E+00	8.9E+00	1.0E+00	3.4E-01	2.3E-01	7.5E-02	1.7E+00	2.1E+00	3.5E-01	2.3E+00	6.8E+00	1.2E+01	1.3E+01
	0.37	0.37	0.37	0.0016	95	1.0E-02	3.2E-02	1.8E-02	1.9E-04	6.1E-02	1.5E-02	2.3E-02	4.1E-01	7.6E-03	4.5E-01	5.1E-01	1.1E-02	3.6E-02	2.4E-02	3.1E-04	7.2E-02	2.2E-02	3.6E-02	2.4E-01	2.8E-02	3.3E-01	4.0E-01
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	7.3E-02	2.3E-01	1.3E-01	2.2E-03	4.3E-01	1.0E-01	1.6E-01	2.8E+00	8.6E-02	3.2E+00	3.6E+00	7.6E-02	2.5E-01	1.7E-01	3.5E-03	5.0E-01	1.5E-01	2.5E-01	1.7E+00	3.1E-01	2.4E+00	2.9E+00
hexyl)-	10	10	10	0.1	50	2.8E-01	8.7E-01	5.0E-01	1.2E-02	1.7E+00	4.0E-01	6.2E-01	1.1E+01	4.7E-01	1.2E+01	1.4E+01	2.9E-01	9.7E-01	6.5E-01	1.9E-02	1.9E+00	5.9E-01	9.8E-01	6.5E+00	1.7E+00	9.8E+00	1.2E+01
phthalate	39	39	39	0.54	25	1.1E+00	3.4E+00	1.9E+00	6.4E-02	6.4E+00	1.5E+00	2.4E+00	4.2E+01	2.5E+00	4.8E+01	5.5E+01	1.1E+00	3.7E+00	2.5E+00	1.0E-01	7.5E+00	2.3E+00	3.8E+00	2.5E+01	9.1E+00	4.0E+01	4.8E+01
	260	260	268	6.1	5	7.3E+00	2.3E+01	1.3E+01	7.2E-01	4.4E+01	1.0E+01	1.6E+01	2.9E+02	2.8E+01	3.5E+02	3.9E+02	7.6E+00	2.5E+01	1.8E+01	1.1E+00	5.1E+01	1.5E+01	2.5E+01	1.8E+02	1.0E+02	3.2E+02	3.7E+02
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	1.0E-08	1.6E-08	9.2E-09	1.9E-10	3.6E-08	1.5E-08	1.2E-08	2.0E-07	7.6E-09	2.4E-07	2.7E-07	1.1E-08	1.8E-08	1.2E-08	3.1E-10	4.1E-08	2.2E-08	1.8E-08	1.2E-07	2.8E-08	1.9E-07	2.3E-07
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	7.3E-08	1.1E-07	6.4E-08	2.2E-09	2.5E-07	1.0E-07	8.1E-08	1.4E-06	8.6E-08	1.7E-06	1.9E-06	7.6E-08	1.3E-07	8.5E-08	3.5E-09	2.9E-07	1.5E-07	1.3E-07	8.5E-07	3.1E-07	1.4E-06	1.7E-06
Total Dioxin	1.0E-05	5.0E-06	5.0E-06	1.0E-07	50	2.8E-07	4.3E-07	2.5E-07	1.2E-08	9.7E-07	4.0E-07	3.1E-07	5.4E-06	4.7E-07	6.6E-06	7.6E-06	2.9E-07	4.8E-07	3.3E-07	1.9E-08	1.1E-06	5.9E-07	4.9E-07	3.3E-06	1.7E-06	6.0E-06	7.1E-06
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	1.1E-06	1.7E-06	9.6E-07	6.4E-08	3.8E-06	1.5E-06	1.2E-06	2.1E-05	2.5E-06	2.6E-05	3.0E-05	1.1E-06	1.9E-06	1.3E-06	1.0E-07	4.4E-06	2.3E-06	1.9E-06	1.3E-05	9.1E-06	2.6E-05	3.0E-05
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	7.5E-06	1.2E-05	6.7E-06	7.2E-07	2.7E-05	1.1E-05	8.4E-06	1.5E-04	2.8E-05	1.9E-04	2.2E-04	7.8E-06	1.3E-05	8.8E-06	1.1E-06	3.1E-05	1.6E-05	1.3E-05	8.8E-05	1.0E-04	2.2E-04	2.5E-04
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	2.1E-07	3.2E-06	1.1E-05	1.3E-05	2.8E-05	3.0E-07	2.3E-06	2.4E-04	5.2E-04	7.7E-04	7.9E-04	2.2E-07	3.6E-06	1.5E-05	2.1E-05	3.9E-05	4.4E-07	3.6E-06	1.5E-04	1.9E-03	2.0E-03	2.1E-03
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	1.5E-06	2.3E-05	7.7E-05	9.2E-05	1.9E-04	2.1E-06	1.6E-05	1.7E-03	3.6E-03	5.3E-03	5.5E-03	1.5E-06	2.5E-05	1.0E-04	1.5E-04	2.7E-04	3.0E-06	2.5E-05	1.0E-03	1.3E-02	1.4E-02	1.4E-02
Total DDT	2.0E-04	0.001	0.006	0.003	50	5.6E-06	8.7E-05	3.0E-04	3.5E-04	7.5E-04	8.0E-06	6.2E-05	6.5E-03	1.4E-02	2.1E-02	2.1E-02	5.8E-06	9.7E-05	3.9E-04	5.6E-04	1.1E-03	1.2E-05	9.8E-05	3.9E-03	5.1E-02	5.5E-02	5.6E-02
	7.7E-04	0.0039	0.023	0.012	25	2.2E-05	3.4E-04	1.1E-03	1.4E-03	2.9E-03	3.1E-05	2.4E-04	2.5E-02	5.4E-02	7.9E-02	8.2E-02	2.2E-05	3.7E-04	1.5E-03	2.2E-03	4.1E-03	4.5E-05	3.8E-04	1.5E-02	2.0E-01	2.1E-01	2.1E-01
	0.0054	0.027	0.16	0.081	5	1.5E-04	2.3E-03	8.0E-03	9.5E-03	2.0E-02	2.1E-04	1.7E-03	1.8E-01	3.7E-01	5.5E-01	5.7E-01	1.6E-04	2.6E-03	1.1E-02	1.5E-02	2.8E-02	3.1E-04	2.6E-03	1.1E-01	1.4E+00	1.5E+00	1.5E+00

Table B-2 - Box Model Surface Runoff Loadings

Average Annual Mass Loading (metric tons / year)

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	San Juan Islands Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	7.5E-07	3.4E-06	1.1E-06	3.0E-07	95	1.2E-08	8.2E-08	1.8E-08	1.9E-08	1.3E-07	7.1E-08	9.5E-07	1.2E-07	1.6E-07	1.3E-06	1.4E-06
	5.2E-06	1.5E-05	7.8E-06	2.1E-06	75	8.4E-08	3.5E-07	1.2E-07	1.3E-07	6.9E-07	4.9E-07	4.1E-06	8.4E-07	1.1E-06	6.5E-06	7.2E-06
Total PBDEs	2.0E-05	4.0E-05	3.0E-05	8.0E-06	50	3.3E-07	9.6E-07	4.8E-07	5.0E-07	2.3E-06	1.9E-06	1.1E-05	3.2E-06	4.2E-06	2.1E-05	2.3E-05
	7.7E-05	1.1E-04	1.2E-04	3.1E-05	25	1.3E-06	2.6E-06	1.8E-06	1.9E-06	7.7E-06	7.4E-06	3.1E-05	1.3E-05	1.6E-05	6.7E-05	7.5E-05
	5.4E-04	4.7E-04	8.1E-04	2.1E-04	5	8.7E-06	1.1E-05	1.3E-05	1.3E-05	4.6E-05	5.1E-05	1.3E-04	8.7E-05	1.1E-04	3.8E-04	4.3E-04
	0.085	0.013	0.013	2.2E-04	95	1.4E-03	3.1E-04	2.0E-04	1.4E-05	1.9E-03	8.1E-03	3.6E-03	1.4E-03	1.2E-04	1.3E-02	1.5E-02
cPAHs	0.36	0.054	0.054	0.0016	75	5.9E-03	1.3E-03	8.7E-04	9.8E-05	8.2E-03	3.5E-02	1.5E-02	5.9E-03	8.1E-04	5.7E-02	6.5E-02
(carcinogenic	1	0.15	0.15	0.006	50	1.6E-02	3.6E-03	2.4E-03	3.8E-04	2.3E-02	9.5E-02	4.2E-02	1.6E-02	3.1E-03	1.6E-01	1.8E-01
PAHs)	2.8	0.41	0.41	0.023	25	4.5E-02	9.9E-03	6.6E-03	1.5E-03	6.3E-02	2.6E-01	1.2E-01	4.5E-02	1.2E-02	4.4E-01	5.0E-01
	12	1.8	1.8	0.16	5	1.9E-01	4.3E-02	2.8E-02	1.0E-02	2.7E-01	1.1E+00	5.0E-01	1.9E-01	8.4E-02	1.9E+00	2.2E+00
	0.068	0.0085	0.0085	1.9E-04	95	1.1E-03	2.0E-04	1.3E-04	1.2E-05	1.5E-03	6.5E-03	2.4E-03	9.2E-04	9.7E-05	9.9E-03	1.1E-02
HPAHs	0.29	0.036	0.036	0.0013	75	4.7E-03	8.7E-04	5.8E-04	8.1E-05	6.3E-03	2.8E-02	1.0E-02	3.9E-03	6.8E-04	4.3E-02	4.9E-02
(Other High	0.8	0.1	0.1	0.005	50	1.3E-02	2.4E-03	1.6E-03	3.1E-04	1.7E-02	7.6E-02	2.8E-02	1.1E-02	2.6E-03	1.2E-01	1.4E-01
Molecular	2.2	0.28	0.28	0.019	25	3.6E-02	6.6E-03	4.4E-03	1.2E-03	4.8E-02	2.1E-01	7.7E-02	3.0E-02	1.0E-02	3.3E-01	3.8E-01
Weight PAHs)	9.4	1.2	1.2	0.13	5	1.5E-01	2.8E-02	1.9E-02	8.4E-03	2.1E-01	9.0E-01	3.3E-01	1.3E-01	7.0E-02	1.4E+00	1.6E+00
	0.25	0.025	0.025	5.6E-04	95	4.1E-03	6.1E-04	4.0E-04	3.5E-05	5.2E-03	2.4E-02	7.1E-03	2.8E-03	2.9E-04	3.4E-02	4.0E-02
LPAHs	1.1	0.11	0.11	0.0039	75	1.8E-02	2.6E-03	1.7E-03	2.4E-04	2.2E-02	1.0E-01	3.1E-02	1.2E-02	2.0E-03	1.5E-01	1.7E-01
(Low Molecular	3	0.3	0.3	0.015	50	4.9E-02	7.2E-03	4.8E-03	9.4E-04	6.2E-02	2.9E-01	8.4E-02	3.2E-02	7.8E-03	4.1E-01	4.7E-01
Weight PAHs)	8.3	0.83	0.83	0.058	25	1.3E-01	2.0E-02	1.3E-02	3.6E-03	1.7E-01	7.9E-01	2.3E-01	8.9E-02	3.0E-02	1.1E+00	1.3E+00
	35	3.5	3.5	0.40	5	5.8E-01	8.5E-02	5.6E-02	2.5E-02	7.4E-01	3.4E+00	9.9E-01	3.8E-01	2.1E-01	5.0E+00	5.7E+00
	0.37	0.37	0.37	0.0016	95	6.1E-03	9.0E-03	5.9E-03	1.0E-04	2.1E-02	3.6E-02	1.0E-01	4.0E-02	8.6E-04	1.8E-01	2.0E-01
Bis(2-ethyl-	2.6	2.6	2.6	0.018	75	4.2E-02	6.2E-02	4.1E-02	1.2E-03	1.5E-01	2.5E-01	7.3E-01	2.8E-01	9.7E-03	1.3E+00	1.4E+00
hexyl)-	10	10	10	0.1	50	1.6E-01	2.4E-01	1.6E-01	6.3E-03	5.7E-01	9.5E-01	2.8E+00	1.1E+00	5.2E-02	4.9E+00	5.5E+00
phthalate	39	39	39	0.54	25	6.3E-01	9.3E-01	6.1E-01	3.4E-02	2.2E+00	3.7E+00	1.1E+01	4.2E+00	2.8E-01	1.9E+01	2.1E+01
	260	260	268	6.1	5	4.2E+00	6.3E+00	4.3E+00	3.8E-01	1.5E+01	2.5E+01	7.3E+01	2.9E+01	3.2E+00	1.3E+02	1.5E+02
	3.7E-07	1.9E-07	1.9E-07	1.6E-09	95	6.1E-09	4.5E-09	3.0E-09	1.0E-10	1.4E-08	3.6E-08	5.2E-08	2.0E-08	8.6E-10	1.1E-07	1.2E-07
	2.6E-06	1.3E-06	1.3E-06	1.8E-08	75	4.2E-08	3.1E-08	2.1E-08	1.2E-09	9.5E-08	2.5E-07	3.6E-07	1.4E-07	9.7E-09	7.6E-07	8.6E-07
Total Dioxin	1.0E-05	5.0E-06	5.0E-06	1.0E-07	50	1.6E-07	1.2E-07	7.9E-08	6.3E-09	3.7E-07	9.5E-07	1.4E-06	5.4E-07	5.2E-08	2.9E-06	3.3E-06
TEQs	3.9E-05	1.9E-05	1.9E-05	5.4E-07	25	6.3E-07	4.6E-07	3.1E-07	3.4E-08	1.4E-06	3.7E-06	5.4E-06	2.1E-06	2.8E-07	1.1E-05	1.3E-05
	2.7E-04	1.3E-04	1.3E-04	6.1E-06	5	4.4E-06	3.2E-06	2.1E-06	3.8E-07	1.0E-05	2.6E-05	3.8E-05	1.5E-05	3.2E-06	8.1E-05	9.1E-05
	7.5E-06	3.7E-05	2.2E-04	1.1E-04	95	1.2E-07	9.0E-07	3.5E-06	7.0E-06	1.2E-05	7.1E-07	1.0E-05	2.4E-05	5.8E-05	9.4E-05	1.1E-04
	5.2E-05	2.6E-04	0.0016	7.8E-04	75	8.4E-07	6.2E-06	2.5E-05	4.9E-05	8.1E-05	4.9E-06	7.3E-05	1.7E-04	4.1E-04	6.5E-04	7.3E-04
Total DDT	2.0E-04	0.001	0.006	0.003	50	3.3E-06	2.4E-05	9.5E-05	1.9E-04	3.1E-04	1.9E-05	2.8E-04	6.5E-04	1.6E-03	2.5E-03	2.8E-03
	7.7E-04	0.0039	0.023	0.012	25	1.3E-05	9.3E-05	3.7E-04	7.3E-04	1.2E-03	7.4E-05	1.1E-03	2.5E-03	6.1E-03	9.7E-03	1.1E-02
	0.0054	0.027	0.16	0.081	5	8.7E-05	6.5E-04	2.6E-03	5.1E-03	8.3E-03	5.1E-04	7.5E-03	1.7E-02	4.2E-02	6.8E-02	7.6E-02

Chemical of Concern	Probability of Exceedance (%)	Totals by Land Use Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	95	4.4E-07	5.4E-06	4.1E-07	6.0E-07	6.9E-06	3.0E-07	2.6E-06	3.1E-06	1.4E-05	2.0E-05	2.7E-05
	75	3.1E-06	2.3E-05	2.8E-06	4.2E-06	3.3E-05	2.1E-06	1.1E-05	2.1E-05	9.9E-05	1.3E-04	1.7E-04
Total PBDEs	50	1.2E-05	6.4E-05	1.1E-05	1.6E-05	1.0E-04	8.0E-06	3.1E-05	8.2E-05	3.8E-04	5.0E-04	6.1E-04
	25	4.6E-05	1.8E-04	4.2E-05	6.2E-05	3.3E-04	3.1E-05	8.5E-05	3.2E-04	1.5E-03	1.9E-03	2.2E-03
	5	3.2E-04	7.5E-04	2.9E-04	4.3E-04	1.8E-03	2.1E-04	3.6E-04	2.2E-03	1.0E-02	1.3E-02	1.5E-02
	95	5.0E-02	2.0E-02	4.6E-03	4.5E-04	7.6E-02	3.4E-02	9.8E-03	3.5E-02	1.1E-02	8.9E-02	1.6E-01
cPAHs	75	2.2E-01	8.7E-02	2.0E-02	3.1E-03	3.3E-01	1.4E-01	4.2E-02	1.5E-01	7.4E-02	4.1E-01	7.4E-01
(carcinogenic	50	5.9E-01	2.4E-01	5.4E-02	1.2E-02	9.0E-01	4.0E-01	1.2E-01	4.1E-01	2.9E-01	1.2E+00	2.1E+00
PAHs)	25	1.6E+00	6.6E-01	1.5E-01	4.7E-02	2.5E+00	1.1E+00	3.2E-01	1.1E+00	1.1E+00	3.7E+00	6.1E+00
	5	7.0E+00	2.8E+00	6.4E-01	3.3E-01	1.1E+01	4.7E+00	1.4E+00	4.9E+00	7.7E+00	1.9E+01	2.9E+01
	95	4.0E-02	1.4E-02	3.1E-03	3.8E-04	5.7E-02	2.7E-02	6.5E-03	2.3E-02	8.9E-03	6.6E-02	1.2E-01
HPAHs	75	1.7E-01	5.8E-02	1.3E-02	2.6E-03	2.5E-01	1.2E-01	2.8E-02	1.0E-01	6.2E-02	3.1E-01	5.5E-01
(Other High	50	4.7E-01	1.6E-01	3.6E-02	1.0E-02	6.8E-01	3.2E-01	7.7E-02	2.7E-01	2.4E-01	9.1E-01	1.6E+00
Molecular	25	1.3E+00	4.4E-01	1.0E-01	3.9E-02	1.9E+00	8.8E-01	2.1E-01	7.6E-01	9.2E-01	2.8E+00	4.7E+00
Weight PAHs)	5	5.6E+00	1.9E+00	4.3E-01	2.7E-01	8.2E+00	3.8E+00	9.1E-01	3.2E+00	6.4E+00	1.4E+01	2.2E+01
	95	1.5E-01	4.1E-02	9.2E-03	1.1E-03	2.0E-01	1.0E-01	2.0E-02	7.0E-02	2.7E-02	2.2E-01	4.2E-01
LPAHs	75	6.5E-01	1.7E-01	4.0E-02	7.9E-03	8.7E-01	4.3E-01	8.4E-02	3.0E-01	1.9E-01	1.0E+00	1.9E+00
(Low Molecular	50	1.8E+00	4.8E-01	1.1E-01	3.0E-02	2.4E+00	1.2E+00	2.3E-01	8.2E-01	7.2E-01	3.0E+00	5.4E+00
Weight PAHs)	25	4.9E+00	1.3E+00	3.0E-01	1.2E-01	6.6E+00	3.3E+00	6.4E-01	2.3E+00	2.8E+00	9.0E+00	1.6E+01
	5	2.1E+01	5.6E+00	1.3E+00	8.1E-01	2.9E+01	1.4E+01	2.7E+00	9.7E+00	1.9E+01	4.6E+01	7.5E+01
	95	2.2E-01	5.9E-01	1.4E-01	3.3E-03	9.5E-01	1.5E-01	2.9E-01	1.0E+00	7.8E-02	1.5E+00	2.5E+00
Bis(2-ethyl-	75	1.5E+00	4.1E+00	9.4E-01	3.7E-02	6.6E+00	1.0E+00	2.0E+00	7.1E+00	8.8E-01	1.1E+01	1.8E+01
hexyl)-	50	5.9E+00	1.6E+01	3.6E+00	2.0E-01	2.6E+01	4.0E+00	7.7E+00	2.7E+01	4.8E+00	4.4E+01	7.0E+01
phthalate	25	2.3E+01	6.1E+01	1.4E+01	1.1E+00	9.9E+01	1.5E+01	3.0E+01	1.1E+02	2.6E+01	1.8E+02	2.8E+02
	5	1.5E+02	4.1E+02	9.7E+01	1.2E+01	6.8E+02	1.0E+02	2.0E+02	7.4E+02	2.9E+02	1.3E+03	2.0E+03
	95	2.2E-07	3.0E-07	6.8E-08	3.3E-09	5.9E-07	1.5E-07	1.4E-07	5.1E-07	7.8E-08	8.8E-07	1.5E-06
	75	1.5E-06	2.1E-06	4.7E-07	3.7E-08	4.1E-06	1.0E-06	1.0E-06	3.6E-06	8.8E-07	6.5E-06	1.1E-05
Total Dioxin	50	5.9E-06	8.0E-06	1.8E-06	2.0E-07	1.6E-05	4.0E-06	3.8E-06	1.4E-05	4.8E-06	2.6E-05	4.2E-05
TEQs	25	2.3E-05	3.1E-05	7.0E-06	1.1E-06	6.2E-05	1.5E-05	1.5E-05	5.3E-05	2.6E-05	1.1E-04	1.7E-04
	5	1.6E-04	2.1E-04	4.9E-05	1.2E-05	4.3E-04	1.1E-04	1.0E-04	3.7E-04	2.9E-04	8.7E-04	1.3E-03
	95	4.4E-06	5.9E-05	8.1E-05	2.3E-04	3.7E-04	3.0E-06	2.9E-05	6.1E-04	5.3E-03	6.0E-03	6.4E-03
	75	3.1E-05	4.1E-04	5.6E-04	1.6E-03	2.6E-03	2.1E-05	2.0E-04	4.3E-03	3.7E-02	4.2E-02	4.4E-02
Total DDT	50	1.2E-04	1.6E-03	2.2E-03	6.1E-03	9.9E-03	8.0E-05	7.7E-04	1.6E-02	1.4E-01	1.6E-01	1.7E-01
	25	4.6E-04	6.1E-03	8.4E-03	2.3E-02	3.8E-02	3.1E-04	3.0E-03	6.4E-02	5.5E-01	6.2E-01	6.6E-01
	5	3.2E-03	4.3E-02	5.8E-02	1.6E-01	2.7E-01	2.1E-03	2.1E-02	4.4E-01	3.8E+00	4.3E+00	4.6E+00

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Main Basin											Port Gardner										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	4.9E-04	0.0011	0.0022	1.5E-04	95	6.6E-05	5.6E-04	3.6E-05	5.8E-05	7.2E-04	5.9E-06	3.5E-05	1.9E-05	1.1E-04	1.7E-04	8.8E-04	3.8E-05	2.5E-04	1.9E-04	6.3E-05	5.5E-04	2.5E-05	9.3E-05	8.1E-04	1.3E-03	2.2E-03	2.7E-03
	0.0055	0.0078	0.016	0.0010	75	7.4E-04	3.9E-03	2.5E-04	4.0E-04	5.3E-03	6.6E-05	2.4E-04	1.3E-04	7.5E-04	1.2E-03	6.5E-03	4.2E-04	1.7E-03	1.4E-03	4.4E-04	4.0E-03	2.9E-04	6.5E-04	5.6E-03	8.9E-03	1.5E-02	1.9E-02
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**	**4.0E-03**	**1.5E-02**	**9.7E-04**	**1.6E-03**	**2.2E-02**	**3.6E-04**	**9.3E-04**	**5.1E-04**	**2.9E-03**	**4.7E-03**	**2.6E-02**	**2.3E-03**	**6.7E-03**	**5.2E-03**	**1.7E-03**	**1.6E-02**	**1.5E-03**	**2.5E-03**	**2.2E-02**	**3.4E-02**	**6.0E-02**	**7.6E-02**
	0.16	0.12	0.23	0.015	25	2.2E-02	5.8E-02	3.8E-03	6.0E-03	8.9E-02	1.9E-03	3.6E-03	2.0E-03	1.1E-02	1.9E-02	1.1E-01	1.2E-02	2.6E-02	2.0E-02	6.5E-03	6.5E-02	8.4E-03	9.6E-03	8.4E-02	1.3E-01	2.3E-01	3.0E-01
	1.8	0.81	1.6	0.11	5	2.5E-01	4.0E-01	2.6E-02	4.2E-02	7.2E-01	2.2E-02	2.5E-02	1.4E-02	7.8E-02	1.4E-01	8.5E-01	1.4E-01	1.8E-01	1.4E-01	4.5E-02	5.1E-01	9.5E-02	6.7E-02	5.8E-01	9.2E-01	1.7E+00	2.2E+00
	0.15	0.011	0.011	4.9E-04	95	2.0E-02	5.6E-03	1.8E-04	1.9E-04	2.6E-02	1.8E-03	3.5E-04	9.5E-05	3.5E-04	2.6E-03	2.8E-02	1.1E-02	2.5E-03	9.7E-04	2.1E-04	1.5E-02	7.7E-03	9.3E-04	4.0E-03	4.2E-03	1.7E-02	3.2E-02
	1.0	0.078	0.078	0.0055	75	1.4E-01	3.9E-02	1.3E-03	2.2E-03	1.8E-01	1.2E-02	2.4E-03	6.6E-04	4.0E-03	1.9E-02	2.0E-01	7.9E-02	1.7E-02	6.8E-03	2.3E-03	1.1E-01	5.4E-02	6.5E-03	2.8E-02	4.8E-02	1.4E-01	2.4E-01
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**	**5.4E-01**	**1.5E-01**	**4.9E-03**	**1.2E-02**	**7.0E-01**	**4.8E-02**	**9.3E-03**	**2.5E-03**	**2.2E-02**	**8.1E-02**	**7.8E-01**	**3.1E-01**	**6.7E-02**	**2.6E-02**	**1.3E-02**	**4.1E-01**	**2.1E-01**	**2.5E-02**	**1.1E-01**	**2.6E-01**	**6.0E-01**	**1.0E+00**
	15	1.2	1.2	0.16	25	2.1E+00	5.8E-01	1.9E-02	6.3E-02	2.7E+00	1.8E-01	3.6E-02	9.8E-03	1.2E-01	3.5E-01	3.1E+00	1.2E+00	2.6E-01	1.0E-01	6.8E-02	1.6E+00	8.0E-01	9.6E-02	4.2E-01	1.4E+00	2.7E+00	4.3E+00
	107	8.1	8.1	1.8	5	1.4E+01	4.0E+00	1.3E-01	7.1E-01	1.9E+01	1.3E+00	2.5E-01	6.8E-02	1.3E+00	2.9E+00	2.2E+01	8.2E+00	1.8E+00	7.0E-01	7.7E-01	1.1E+01	5.5E+00	6.7E-01	2.9E+00	1.6E+01	2.5E+01	3.6E+01
	1,365	417	85	3.7	95	1.8E+02	2.1E+02	1.4E+00	1.4E+00	3.9E+02	1.6E+01	1.3E+01	7.2E-01	2.7E+00	3.3E+01	4.3E+02	1.0E+02	9.4E+01	7.4E+00	1.6E+00	2.1E+02	7.0E+01	3.5E+01	3.1E+01	3.2E+01	1.7E+02	3.7E+02
Oil or	3,268	1,335	363	26	75	4.4E+02	6.7E+02	5.9E+00	1.0E+01	1.1E+03	3.9E+01	4.2E+01	3.1E+00	1.9E+01	1.0E+02	1.2E+03	2.5E+02	3.0E+02	3.2E+01	1.1E+01	5.9E+02	1.7E+02	1.1E+02	1.3E+02	2.2E+02	6.3E+02	1.2E+03
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**	**8.0E+02**	**1.5E+03**	**1.6E+01**	**3.9E+01**	**2.4E+03**	**7.2E+01**	**9.3E+01**	**8.5E+00**	**7.2E+01**	**2.5E+02**	**2.6E+03**	**4.6E+02**	**6.7E+02**	**8.7E+01**	**4.2E+01**	**1.3E+03**	**3.1E+02**	**2.5E+02**	**3.6E+02**	**8.6E+02**	**1.8E+03**	**3.0E+03**
Product	11,000	6,700	2,700	386	25	1.5E+03	3.3E+03	4.4E+01	1.5E+02	5.0E+03	1.3E+02	2.1E+02	2.3E+01	2.8E+02	6.4E+02	5.7E+03	8.4E+02	1.5E+03	2.3E+02	1.6E+02	2.7E+03	5.7E+02	5.6E+02	9.8E+02	3.3E+03	5.4E+03	8.2E+03
	26,300	21,500	11,700	2,600	5	3.5E+03	1.1E+04	1.9E+02	1.0E+03	1.5E+04	3.1E+02	6.7E+02	9.9E+01	1.9E+03	3.0E+03	1.8E+04	2.0E+03	4.8E+03	1.0E+03	1.1E+03	9.0E+03	1.4E+03	1.8E+03	4.2E+03	2.2E+04	3.0E+04	3.9E+04

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Proba-bility of Exceed-ance	Average Annual Mass Loading (metric tons / year)																					
						Elliot Bay											Commencement Bay										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	4.9E-04	0.0011	0.0022	1.5E-04	95	6.2E-05	1.5E-04	7.6E-05	2.2E-05	**3.1E-04**	3.3E-06	1.6E-05	1.5E-04	1.4E-04	**3.0E-04**	**6.1E-04**	4.9E-05	1.8E-04	8.5E-05	3.2E-05	**3.5E-04**	2.1E-05	1.6E-05	1.8E-04	3.7E-04	**5.8E-04**	**9.3E-04**
	0.0055	0.0078	0.016	0.0010	75	7.0E-04	1.1E-03	5.3E-04	1.5E-04	**2.4E-03**	3.7E-05	1.1E-04	1.0E-03	9.5E-04	**2.1E-03**	**4.5E-03**	5.6E-04	1.3E-03	5.9E-04	2.3E-04	**2.7E-03**	2.3E-04	1.1E-04	1.2E-03	2.6E-03	**4.1E-03**	**6.8E-03**
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**	**3.8E-03**	**4.1E-03**	**2.0E-03**	**5.9E-04**	**1.0E-02**	**2.0E-04**	**4.2E-04**	**3.9E-03**	**3.7E-03**	**8.2E-03**	**1.9E-02**	**3.0E-03**	**5.0E-03**	**2.3E-03**	**8.7E-04**	**1.1E-02**	**1.3E-03**	**4.3E-04**	**4.7E-03**	**9.9E-03**	**1.6E-02**	**2.7E-02**
	0.16	0.12	0.23	0.015	25	2.0E-02	1.6E-02	7.8E-03	2.3E-03	**4.6E-02**	1.1E-03	1.6E-03	1.5E-02	1.4E-02	**3.2E-02**	**7.8E-02**	1.6E-02	1.9E-02	8.8E-03	3.4E-03	**4.8E-02**	6.8E-03	1.6E-03	1.8E-02	3.8E-02	**6.5E-02**	**1.1E-01**
	1.8	0.81	1.6	0.11	5	2.3E-01	1.1E-01	5.5E-02	1.6E-02	**4.1E-01**	1.2E-02	1.1E-02	1.0E-01	9.9E-02	**2.3E-01**	**6.4E-01**	1.8E-01	1.3E-01	6.1E-02	2.3E-02	**4.0E-01**	7.7E-02	1.1E-02	1.3E-01	2.7E-01	**4.8E-01**	**8.8E-01**
	0.15	0.011	0.011	4.9E-04	95	1.9E-02	1.5E-03	3.8E-04	7.2E-05	**2.1E-02**	1.0E-03	1.6E-04	7.3E-04	4.5E-04	**2.3E-03**	**2.3E-02**	1.5E-02	1.8E-03	4.2E-04	1.1E-04	**1.7E-02**	6.2E-03	1.6E-04	8.8E-04	1.2E-03	**8.5E-03**	**2.6E-02**
	1.0	0.078	0.078	0.0055	75	1.3E-01	1.1E-02	2.6E-03	8.2E-04	**1.4E-01**	7.0E-03	1.1E-03	5.0E-03	5.1E-03	**1.8E-02**	**1.6E-01**	1.0E-01	1.3E-02	2.9E-03	1.2E-03	**1.2E-01**	4.3E-02	1.1E-03	6.1E-03	1.4E-02	**6.4E-02**	**1.9E-01**
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**	**5.1E-01**	**4.1E-02**	**1.0E-02**	**4.4E-03**	**5.6E-01**	**2.7E-02**	**4.2E-03**	**1.9E-02**	**2.8E-02**	**7.8E-02**	**6.4E-01**	**4.0E-01**	**5.0E-02**	**1.1E-02**	**6.5E-03**	**4.7E-01**	**1.7E-01**	**4.3E-03**	**2.4E-02**	**7.4E-02**	**2.7E-01**	**7.4E-01**
	15	1.2	1.2	0.16	25	1.9E+00	1.6E-01	3.9E-02	2.4E-02	**2.2E+00**	1.0E-01	1.6E-02	7.5E-02	1.5E-01	**3.4E-01**	**2.5E+00**	1.6E+00	1.9E-01	4.4E-02	3.5E-02	**1.8E+00**	6.5E-01	1.6E-02	9.1E-02	4.0E-01	**1.2E+00**	**3.0E+00**
	107	8.1	8.1	1.8	5	1.4E+01	1.1E+00	2.7E-01	2.7E-01	**1.5E+01**	7.2E-01	1.1E-01	5.2E-01	1.7E+00	**3.0E+00**	**1.8E+01**	1.1E+01	1.3E+00	3.0E-01	4.0E-01	**1.3E+01**	4.5E+00	1.1E-01	6.3E-01	4.6E+00	**9.8E+00**	**2.3E+01**
	1,365	417	85	3.7	95	1.7E+02	5.7E+01	2.9E+00	5.5E-01	**2.3E+02**	9.2E+00	5.8E+00	5.5E+00	3.4E+00	**2.4E+01**	**2.6E+02**	1.4E+02	6.9E+01	3.2E+00	8.1E-01	**2.1E+02**	5.7E+01	5.9E+00	6.7E+00	9.3E+00	**7.9E+01**	**2.9E+02**
Oil or	3,268	1,335	363	26	75	4.1E+02	1.8E+02	1.2E+01	3.8E+00	**6.1E+02**	2.2E+01	1.9E+01	2.4E+01	2.4E+01	**8.8E+01**	**7.0E+02**	3.3E+02	2.2E+02	1.4E+01	5.6E+00	**5.7E+02**	1.4E+02	1.9E+01	2.9E+01	6.4E+01	**2.5E+02**	**8.2E+02**
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**	**7.6E+02**	**4.1E+02**	**3.4E+01**	**1.5E+01**	**1.2E+03**	**4.0E+01**	**4.2E+01**	**6.5E+01**	**9.2E+01**	**2.4E+02**	**1.5E+03**	**6.0E+02**	**5.0E+02**	**3.8E+01**	**2.2E+01**	**1.2E+03**	**2.5E+02**	**4.3E+01**	**7.9E+01**	**2.5E+02**	**6.2E+02**	**1.8E+03**
Product	11,000	6,700	2,700	386	25	1.4E+03	9.1E+02	9.2E+01	5.7E+01	**2.4E+03**	7.4E+01	9.4E+01	1.8E+02	3.6E+02	**7.0E+02**	**3.1E+03**	1.1E+03	1.1E+03	1.0E+02	8.4E+01	**2.4E+03**	4.6E+02	9.5E+01	2.1E+02	9.6E+02	**1.7E+03**	**4.1E+03**
	26,300	21,500	11,700	2,600	5	3.3E+03	2.9E+03	4.0E+02	3.8E+02	**7.0E+03**	1.8E+02	3.0E+02	7.6E+02	2.4E+03	**3.6E+03**	**1.1E+04**	2.6E+03	3.6E+03	4.4E+02	5.6E+02	**7.2E+03**	1.1E+03	3.0E+02	9.2E+02	6.5E+03	**8.8E+03**	**1.6E+04**

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)
	4.9E-04	0.0011	0.0022	1.5E-04	95
	0.0055	0.0078	0.016	0.0010	75
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**
	0.16	0.12	0.23	0.015	25
	1.8	0.81	1.6	0.11	5
	0.15	0.011	0.011	4.9E-04	95
	1.0	0.078	0.078	0.0055	75
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**
	15	1.2	1.2	0.16	25
	107	8.1	8.1	1.8	5
	1,365	417	85	3.7	95
Oil or	3,268	1,335	363	26	75
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**
Product	11,000	6,700	2,700	386	25
	26,300	21,500	11,700	2,600	5

Average Annual Mass Loading (metric tons / year)

South Sound (east)

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	2.5E-05	2.2E-04	5.2E-05	3.8E-05	**3.3E-04**	1.0E-05	3.6E-05	2.1E-04	3.0E-04	**5.6E-04**	**8.9E-04**
	75	2.8E-04	1.5E-03	3.6E-04	2.6E-04	**2.4E-03**	1.2E-04	2.5E-04	1.5E-03	2.1E-03	**3.9E-03**	**6.4E-03**
Triclopyr	**50**	**1.5E-03**	**5.9E-03**	**1.4E-03**	**1.0E-03**	**9.8E-03**	**6.3E-04**	**9.7E-04**	**5.7E-03**	**8.0E-03**	**1.5E-02**	**2.5E-02**
	25	8.2E-03	2.3E-02	5.4E-03	3.9E-03	**4.0E-02**	3.4E-03	3.7E-03	2.2E-02	3.1E-02	**6.0E-02**	**1.0E-01**
	5	9.3E-02	1.6E-01	3.7E-02	2.7E-02	**3.2E-01**	3.8E-02	2.6E-02	1.5E-01	2.1E-01	**4.3E-01**	**7.5E-01**
	95	7.5E-03	2.2E-03	2.6E-04	1.2E-04	**1.0E-02**	3.1E-03	3.6E-04	1.1E-03	9.8E-04	**5.5E-03**	**1.6E-02**
	75	5.2E-02	1.5E-02	1.8E-03	1.4E-03	**7.1E-02**	2.2E-02	2.5E-03	7.4E-03	1.1E-02	**4.3E-02**	**1.1E-01**
Nonylphenol	**50**	**2.0E-01**	**5.9E-02**	**6.9E-03**	**7.6E-03**	**2.8E-01**	**8.4E-02**	**9.7E-03**	**2.9E-02**	**6.0E-02**	**1.8E-01**	**4.6E-01**
	25	7.8E-01	2.3E-01	2.7E-02	4.1E-02	**1.1E+00**	3.2E-01	3.7E-02	1.1E-01	3.2E-01	**7.9E-01**	**1.9E+00**
	5	5.4E+00	1.6E+00	1.9E-01	4.6E-01	**7.7E+00**	2.2E+00	2.6E-01	7.7E-01	3.7E+00	**6.9E+00**	**1.5E+01**
	95	6.9E+01	8.2E+01	2.0E+00	9.4E-01	**1.5E+02**	2.9E+01	1.3E+01	8.1E+00	7.4E+00	**5.8E+01**	**2.1E+02**
Oil or	75	1.7E+02	2.6E+02	8.4E+00	6.6E+00	**4.4E+02**	6.8E+01	4.3E+01	3.5E+01	5.2E+01	**2.0E+02**	**6.4E+02**
Petroleum	**50**	**3.0E+02**	**5.9E+02**	**2.3E+01**	**2.5E+01**	**9.4E+02**	**1.3E+02**	**9.7E+01**	**9.5E+01**	**2.0E+02**	**5.2E+02**	**1.5E+03**
Product	25	5.6E+02	1.3E+03	6.2E+01	9.8E+01	**2.0E+03**	2.3E+02	2.2E+02	2.6E+02	7.7E+02	**1.5E+03**	**3.5E+03**
	5	1.3E+03	4.2E+03	2.7E+02	6.6E+02	**6.5E+03**	5.5E+02	6.9E+02	1.1E+03	5.2E+03	**7.6E+03**	**1.4E+04**

South Sound (west)

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	9.6E-06	7.7E-05	3.3E-05	1.4E-05	**1.3E-04**	9.5E-06	3.8E-05	7.8E-05	1.7E-04	**2.9E-04**	**4.3E-04**
	75	1.1E-04	5.4E-04	2.3E-04	9.5E-05	**9.7E-04**	1.1E-04	2.6E-04	5.4E-04	1.2E-03	**2.1E-03**	**3.1E-03**
Triclopyr	**50**	**5.9E-04**	**2.1E-03**	**8.8E-04**	**3.7E-04**	**3.9E-03**	**5.8E-04**	**1.0E-03**	**2.1E-03**	**4.5E-03**	**8.2E-03**	**1.2E-02**
	25	3.2E-03	8.0E-03	3.4E-03	1.4E-03	**1.6E-02**	3.1E-03	3.9E-03	8.1E-03	1.7E-02	**3.3E-02**	**4.8E-02**
	5	3.6E-02	5.6E-02	2.4E-02	9.8E-03	**1.3E-01**	3.6E-02	2.7E-02	5.6E-02	1.2E-01	**2.4E-01**	**3.6E-01**
	95	2.9E-03	7.7E-04	1.6E-04	4.5E-05	**3.9E-03**	2.9E-03	3.8E-04	3.9E-04	5.5E-04	**4.2E-03**	**8.1E-03**
	75	2.0E-02	5.4E-03	1.1E-03	5.1E-04	**2.7E-02**	2.0E-02	2.6E-03	2.7E-03	6.3E-03	**3.2E-02**	**5.9E-02**
Nonylphenol	**50**	**7.9E-02**	**2.1E-02**	**4.4E-03**	**2.8E-03**	**1.1E-01**	**7.8E-02**	**1.0E-02**	**1.0E-02**	**3.4E-02**	**1.3E-01**	**2.4E-01**
	25	3.0E-01	8.0E-02	1.7E-02	1.5E-02	**4.1E-01**	3.0E-01	3.9E-02	4.0E-02	1.8E-01	**5.6E-01**	**9.8E-01**
	5	2.1E+00	5.6E-01	1.2E-01	1.7E-01	**3.0E+00**	2.1E+00	2.7E-01	2.8E-01	2.1E+00	**4.7E+00**	**7.7E+00**
	95	2.7E+01	2.9E+01	1.2E+00	3.4E-01	**5.7E+01**	2.7E+01	1.4E+01	3.0E+00	4.2E+00	**4.8E+01**	**1.0E+02**
Oil or	75	6.4E+01	9.2E+01	5.3E+00	2.4E+00	**1.6E+02**	6.3E+01	4.5E+01	1.3E+01	2.9E+01	**1.5E+02**	**3.1E+02**
Petroleum	**50**	**1.2E+02**	**2.1E+02**	**1.5E+01**	**9.2E+00**	**3.5E+02**	**1.2E+02**	**1.0E+02**	**3.5E+01**	**1.1E+02**	**3.7E+02**	**7.1E+02**
Product	25	2.2E+02	4.6E+02	4.0E+01	3.5E+01	**7.5E+02**	2.1E+02	2.3E+02	9.4E+01	4.3E+02	**9.7E+02**	**1.7E+03**
	5	5.2E+02	1.5E+03	1.7E+02	2.4E+02	**2.4E+03**	5.1E+02	7.3E+02	4.1E+02	2.9E+03	**4.6E+03**	**7.0E+03**

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																										
						Hood Canal (south)					Hood Canal (north)											Sinclair/Dyes Inlet										
						Non-Urban					Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	4.9E-04	0.0011	0.0022	1.5E-04	95	0.0E+00	4.4E-05	5.2E-05	6.1E-04	7.1E-04	3.8E-07	3.4E-06	2.9E-08	1.3E-06	5.1E-06	2.9E-06	8.3E-06	2.4E-06	3.3E-05	4.7E-05	5.2E-05	5.4E-06	4.6E-05	3.9E-06	9.5E-06	6.5E-05	6.7E-06	2.9E-05	1.4E-05	5.8E-05	1.1E-04	1.7E-04
	0.0055	0.0078	0.016	0.0010	75	0.0E+00	3.0E-04	3.6E-04	4.2E-03	4.9E-03	4.3E-06	2.3E-05	2.0E-07	9.3E-06	3.7E-05	3.3E-05	5.7E-05	1.7E-05	2.3E-04	3.4E-04	3.8E-04	6.1E-05	3.2E-04	2.7E-05	6.6E-05	4.7E-04	7.6E-05	2.0E-04	9.8E-05	4.0E-04	7.8E-04	1.3E-03
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**	**0.0E+00**	**1.2E-03**	**1.4E-03**	**1.6E-02**	**1.9E-02**	**2.3E-05**	**9.0E-05**	**7.7E-07**	**3.6E-05**	**1.5E-04**	**1.8E-04**	**2.2E-04**	**6.4E-05**	**9.0E-04**	**1.4E-03**	**1.5E-03**	**3.3E-04**	**1.2E-03**	**1.1E-04**	**2.5E-04**	**1.9E-03**	**4.1E-04**	**7.9E-04**	**3.8E-04**	**1.6E-03**	**3.1E-03**	**5.0E-03**
	0.16	0.12	0.23	0.015	25	0.0E+00	4.5E-03	5.4E-03	6.3E-02	7.3E-02	1.2E-04	3.5E-04	3.0E-06	1.4E-04	6.1E-04	9.7E-04	8.6E-04	2.5E-04	3.5E-03	5.5E-03	6.2E-03	1.8E-03	4.7E-03	4.1E-04	9.8E-04	7.9E-03	2.2E-03	3.0E-03	1.5E-03	6.0E-03	1.3E-02	2.1E-02
	1.8	0.81	1.6	0.11	5	0.0E+00	3.2E-02	3.7E-02	4.4E-01	5.1E-01	1.4E-03	2.4E-03	2.1E-05	9.6E-04	4.8E-03	1.1E-02	6.0E-03	1.7E-03	2.4E-02	4.3E-02	4.8E-02	2.0E-02	3.3E-02	2.8E-03	6.8E-03	6.3E-02	2.5E-02	2.1E-02	1.0E-02	4.2E-02	9.8E-02	1.6E-01
	0.15	0.011	0.011	4.9E-04	95	0.0E+00	4.4E-04	2.6E-04	2.0E-03	2.7E-03	1.1E-04	3.4E-05	1.4E-07	4.4E-06	1.5E-04	9.0E-04	8.3E-05	1.2E-05	1.1E-04	1.1E-03	1.3E-03	1.6E-03	4.6E-04	2.0E-05	3.1E-05	2.1E-03	2.0E-03	2.9E-04	7.1E-05	1.9E-04	2.6E-03	4.7E-03
	1.0	0.078	0.078	0.0055	75	0.0E+00	3.0E-03	1.8E-03	2.3E-02	2.8E-02	8.0E-04	2.3E-04	1.0E-06	5.0E-05	1.1E-03	6.2E-03	5.7E-04	8.3E-05	1.2E-03	8.1E-03	9.2E-03	1.1E-02	3.2E-03	1.4E-04	3.5E-04	1.5E-02	1.4E-02	2.0E-03	4.9E-04	2.2E-03	1.9E-02	3.4E-02
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**	**0.0E+00**	**1.2E-02**	**7.0E-03**	**1.2E-01**	**1.4E-01**	**3.1E-03**	**9.0E-04**	**3.9E-06**	**2.7E-04**	**4.3E-03**	**2.4E-02**	**2.2E-03**	**3.2E-04**	**6.7E-03**	**3.3E-02**	**3.8E-02**	**4.4E-02**	**1.2E-02**	**5.3E-04**	**1.9E-03**	**5.9E-02**	**5.5E-02**	**7.9E-03**	**1.9E-03**	**1.2E-02**	**7.6E-02**	**1.3E-01**
	15	1.2	1.2	0.16	25	0.0E+00	4.5E-02	2.7E-02	6.6E-01	7.4E-01	1.2E-02	3.5E-03	1.5E-05	1.5E-03	1.7E-02	9.3E-02	8.6E-03	1.2E-03	3.6E-02	1.4E-01	1.6E-01	1.7E-01	4.7E-02	2.0E-03	1.0E-02	2.3E-01	2.1E-01	3.0E-02	7.3E-03	6.3E-02	3.1E-01	5.4E-01
	107	8.1	8.1	1.8	5	0.0E+00	3.2E-01	1.9E-01	7.5E+00	8.0E+00	8.3E-02	2.4E-02	1.0E-04	1.6E-02	1.2E-01	6.4E-01	6.0E-02	8.6E-03	4.1E-01	1.1E+00	1.2E+00	1.2E+00	3.3E-01	1.4E-02	1.2E-01	1.6E+00	1.5E+00	2.1E-01	5.1E-02	7.1E-01	2.4E+00	4.1E+00
	1,365	417	85	3.7	95	0.0E+00	1.6E+01	2.0E+00	1.5E+01	3.4E+01	1.0E+00	1.3E+00	1.1E-03	3.3E-02	2.3E+00	8.2E+00	3.1E+00	9.0E-02	8.4E-01	1.2E+01	1.5E+01	1.5E+01	1.7E+01	1.5E-01	2.4E-01	3.2E+01	1.9E+01	1.1E+01	5.4E-01	1.4E+00	3.2E+01	6.4E+01
Oil or	3,268	1,335	363	26	75	0.0E+00	5.2E+01	8.4E+00	1.1E+02	1.7E+02	2.5E+00	4.0E+00	4.7E-03	2.3E-01	6.8E+00	2.0E+01	9.9E+00	3.9E-01	5.8E+00	3.6E+01	4.2E+01	3.6E+01	5.5E+01	6.4E-01	1.6E+00	9.3E+01	4.5E+01	3.5E+01	2.3E+00	1.0E+01	9.2E+01	1.8E+02
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**	**0.0E+00**	**1.2E+02**	**2.3E+01**	**4.1E+02**	**5.5E+02**	**4.6E+00**	**9.0E+00**	**1.3E-02**	**9.0E-01**	**1.5E+01**	**3.6E+01**	**2.2E+01**	**1.1E+00**	**2.2E+01**	**8.2E+01**	**9.6E+01**	**6.6E+01**	**1.2E+02**	**1.8E+00**	**6.4E+00**	**2.0E+02**	**8.2E+01**	**7.9E+01**	**6.3E+00**	**3.9E+01**	**2.1E+02**	**4.0E+02**
Product	11,000	6,700	2,700	386	25	0.0E+00	2.6E+02	6.3E+01	1.6E+03	1.9E+03	8.5E+00	2.0E+01	3.5E-02	3.5E+00	3.2E+01	6.6E+01	5.0E+01	2.9E+00	8.7E+01	2.1E+02	2.4E+02	1.2E+02	2.7E+02	4.8E+00	2.5E+01	4.2E+02	1.5E+02	1.8E+02	1.7E+01	1.5E+02	4.9E+02	9.2E+02
	26,300	21,500	11,700	2,600	5	0.0E+00	8.4E+02	2.7E+02	1.1E+04	1.2E+04	2.0E+01	6.5E+01	1.5E-01	2.3E+01	1.1E+02	1.6E+02	1.6E+02	1.2E+01	5.8E+02	9.1E+02	1.0E+03	2.9E+02	8.8E+02	2.1E+01	1.7E+02	1.4E+03	3.6E+02	5.6E+02	7.4E+01	1.0E+03	2.0E+03	3.4E+03

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)
	4.9E-04	0.0011	0.0022	1.5E-04	95
	0.0055	0.0078	0.016	0.0010	75
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**
	0.16	0.12	0.23	0.015	25
	1.8	0.81	1.6	0.11	5
	0.15	0.011	0.011	4.9E-04	95
	1.0	0.078	0.078	0.0055	75
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**
	15	1.2	1.2	0.16	25
	107	8.1	8.1	1.8	5
	1,365	417	85	3.7	95
Oil or	3,268	1,335	363	26	75
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**
Product	11,000	6,700	2,700	386	25
	26,300	21,500	11,700	2,600	5

Average Annual Mass Loading (metric tons / year)

Admiralty Inlet

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	0.0E+00	1.6E-05	2.5E-06	2.9E-06	**2.1E-05**	4.1E-06	2.0E-05	9.3E-05	5.3E-05	**1.7E-04**	**1.9E-04**
	75	0.0E+00	1.1E-04	1.7E-05	2.0E-05	**1.5E-04**	4.7E-05	1.4E-04	6.5E-04	3.7E-04	**1.2E-03**	**1.4E-03**
Triclopyr	**50**	**0.0E+00**	**4.3E-04**	**6.7E-05**	**7.8E-05**	**5.7E-04**	**2.5E-04**	**5.4E-04**	**2.5E-03**	**1.4E-03**	**4.7E-03**	**5.3E-03**
	25	0.0E+00	1.7E-03	2.6E-04	3.0E-04	**2.2E-03**	1.4E-03	2.1E-03	9.6E-03	5.5E-03	**1.9E-02**	**2.1E-02**
	5	0.0E+00	1.1E-02	1.8E-03	2.1E-03	**1.5E-02**	1.5E-02	1.4E-02	6.7E-02	3.8E-02	**1.4E-01**	**1.5E-01**
	95	0.0E+00	1.6E-04	1.2E-05	9.6E-06	**1.8E-04**	1.3E-03	2.0E-04	4.7E-04	1.8E-04	**2.1E-03**	**2.3E-03**
	75	0.0E+00	1.1E-03	8.7E-05	1.1E-04	**1.3E-03**	8.8E-03	1.4E-03	3.2E-03	2.0E-03	**1.5E-02**	**1.7E-02**
Nonylphenol	**50**	**0.0E+00**	**4.3E-03**	**3.3E-04**	**5.9E-04**	**5.2E-03**	**3.4E-02**	**5.4E-03**	**1.2E-02**	**1.1E-02**	**6.2E-02**	**6.8E-02**
	25	0.0E+00	1.7E-02	1.3E-03	3.2E-03	**2.1E-02**	1.3E-01	2.1E-02	4.8E-02	5.8E-02	**2.6E-01**	**2.8E-01**
	5	0.0E+00	1.1E-01	9.0E-03	3.6E-02	**1.6E-01**	9.1E-01	1.4E-01	3.4E-01	6.6E-01	**2.0E+00**	**2.2E+00**
	95	0.0E+00	5.9E+00	9.5E-02	7.3E-02	**6.1E+00**	1.2E+01	7.5E+00	3.5E+00	1.3E+00	**2.4E+01**	**3.0E+01**
Oil or	75	0.0E+00	1.9E+01	4.1E-01	5.1E-01	**2.0E+01**	2.8E+01	2.4E+01	1.5E+01	9.3E+00	**7.6E+01**	**9.6E+01**
Petroleum	**50**	**0.0E+00**	**4.3E+01**	**1.1E+00**	**2.0E+00**	**4.6E+01**	**5.1E+01**	**5.4E+01**	**4.2E+01**	**3.6E+01**	**1.8E+02**	**2.3E+02**
Product	25	0.0E+00	9.6E+01	3.0E+00	7.6E+00	**1.1E+02**	9.3E+01	1.2E+02	1.1E+02	1.4E+02	**4.6E+02**	**5.7E+02**
	5	0.0E+00	3.1E+02	1.3E+01	5.1E+01	**3.7E+02**	2.2E+02	3.9E+02	4.9E+02	9.3E+02	**2.0E+03**	**2.4E+03**

Strait of Juan de Fuca

Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	Urban RES	Urban AGR	Urban FOR	Urban Subtotal	Non-Urban CO/IN	Non-Urban RES	Non-Urban AGR	Non-Urban FOR	Non-Urban Subtotal	TOTAL
	95	4.6E-07	4.1E-05	3.6E-05	6.1E-06	**8.4E-05**	1.2E-05	3.3E-05	4.1E-04	7.3E-04	**1.2E-03**	**1.3E-03**
	75	5.2E-06	2.9E-04	2.5E-04	4.2E-05	**5.9E-04**	1.3E-04	2.3E-04	2.8E-03	5.0E-03	**8.2E-03**	**8.8E-03**
Triclopyr	**50**	**2.8E-05**	**1.1E-03**	**9.7E-04**	**1.6E-04**	**2.3E-03**	**7.2E-04**	**8.9E-04**	**1.1E-02**	**1.9E-02**	**3.2E-02**	**3.4E-02**
	25	1.5E-04	4.3E-03	3.8E-03	6.3E-04	**8.8E-03**	3.9E-03	3.4E-03	4.2E-02	7.5E-02	**1.2E-01**	**1.3E-01**
	5	1.7E-03	3.0E-02	2.6E-02	4.4E-03	**6.2E-02**	4.4E-02	2.4E-02	2.9E-01	5.2E-01	**8.8E-01**	**9.4E-01**
	95	1.4E-04	4.1E-04	1.8E-04	2.0E-05	**7.5E-04**	3.6E-03	3.3E-04	2.0E-03	2.4E-03	**8.3E-03**	**9.1E-03**
	75	9.8E-04	2.9E-03	1.3E-03	2.3E-04	**5.3E-03**	2.5E-02	2.3E-03	1.4E-02	2.7E-02	**6.8E-02**	**7.4E-02**
Nonylphenol	**50**	**3.8E-03**	**1.1E-02**	**4.9E-03**	**1.2E-03**	**2.1E-02**	**9.5E-02**	**8.9E-03**	**5.4E-02**	**1.5E-01**	**3.0E-01**	**3.3E-01**
	25	1.5E-02	4.3E-02	1.9E-02	6.6E-03	**8.2E-02**	3.7E-01	3.4E-02	2.1E-01	7.9E-01	**1.4E+00**	**1.5E+00**
	5	1.0E-01	3.0E-01	1.3E-01	7.5E-02	**6.0E-01**	2.6E+00	2.4E-01	1.5E+00	8.9E+00	**1.3E+01**	**1.4E+01**
	95	1.3E+00	1.5E+01	1.4E+00	1.5E-01	**1.8E+01**	3.3E+01	1.2E+01	1.5E+01	1.8E+01	**7.8E+01**	**9.7E+01**
Oil or	75	3.1E+00	4.9E+01	5.9E+00	1.1E+00	**5.9E+01**	7.8E+01	4.0E+01	6.6E+01	1.3E+02	**3.1E+02**	**3.7E+02**
Petroleum	**50**	**5.6E+00**	**1.1E+02**	**1.6E+01**	**4.1E+00**	**1.4E+02**	**1.4E+02**	**8.9E+01**	**1.8E+02**	**4.9E+02**	**9.0E+02**	**1.0E+03**
Product	25	1.0E+01	2.5E+02	4.4E+01	1.6E+01	**3.2E+02**	2.6E+02	2.0E+02	4.9E+02	1.9E+03	**2.8E+03**	**3.1E+03**
	5	2.5E+01	7.9E+02	1.9E+02	1.1E+02	**1.1E+03**	6.3E+02	6.4E+02	2.1E+03	1.3E+04	**1.6E+04**	**1.7E+04**

Table B-2 - Box Model Surface Runoff Loadings

Chemical of Concern	Surface Runoff Concentration (ug/L)				Probability of Exceedance	Average Annual Mass Loading (metric tons / year)																					
						Strait of Georgia											Whidbey Basin										
						Urban					Non-Urban						Urban					Non-Urban					
	CO/IN	RES	AGR	FOR	(%)	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL	CO/IN	RES	AGR	FOR	Subtotal	CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	4.9E-04	0.0011	0.0022	1.5E-04	95	1.4E-05	9.7E-05	1.1E-04	1.8E-05	**2.4E-04**	2.0E-05	7.0E-05	2.4E-03	6.9E-04	**3.2E-03**	**3.5E-03**	1.4E-05	1.1E-04	1.5E-04	2.8E-05	**3.0E-04**	2.9E-05	1.1E-04	1.5E-03	2.5E-03	**4.1E-03**	**4.4E-03**
	0.0055	0.0078	0.016	0.0010	75	1.6E-04	6.8E-04	7.7E-04	1.2E-04	**1.7E-03**	2.2E-04	4.9E-04	1.7E-02	4.8E-03	**2.2E-02**	**2.4E-02**	1.6E-04	7.5E-04	1.0E-03	1.9E-04	**2.1E-03**	3.2E-04	7.6E-04	1.0E-02	1.7E-02	**2.9E-02**	**3.1E-02**
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**	**8.4E-04**	**2.6E-03**	**3.0E-03**	**4.7E-04**	**6.9E-03**	**1.2E-03**	**1.9E-03**	**6.5E-02**	**1.9E-02**	**8.7E-02**	**9.4E-02**	**8.7E-04**	**2.9E-03**	**3.9E-03**	**7.5E-04**	**8.4E-03**	**1.8E-03**	**2.9E-03**	**3.9E-02**	**6.7E-02**	**1.1E-01**	**1.2E-01**
	0.16	0.12	0.23	0.015	25	4.5E-03	1.0E-02	1.1E-02	1.8E-03	**2.8E-02**	6.5E-03	7.2E-03	2.5E-01	7.2E-02	**3.4E-01**	**3.7E-01**	4.7E-03	1.1E-02	1.5E-02	2.9E-03	**3.4E-02**	9.5E-03	1.1E-02	1.5E-01	2.6E-01	**4.3E-01**	**4.7E-01**
	1.8	0.81	1.6	0.11	5	5.1E-02	7.0E-02	8.0E-02	1.3E-02	**2.1E-01**	7.3E-02	5.0E-02	1.8E+00	5.0E-01	**2.4E+00**	**2.6E+00**	5.3E-02	7.8E-02	1.1E-01	2.0E-02	**2.6E-01**	1.1E-01	7.9E-02	1.1E+00	1.8E+00	**3.0E+00**	**3.3E+00**
	0.15	0.011	0.011	4.9E-04	95	4.2E-03	9.7E-04	5.5E-04	5.8E-05	**5.8E-03**	6.0E-03	7.0E-04	1.2E-02	2.3E-03	**2.1E-02**	**2.7E-02**	4.3E-03	1.1E-03	7.3E-04	9.2E-05	**6.2E-03**	8.7E-03	1.1E-03	7.3E-03	8.3E-03	**2.5E-02**	**3.2E-02**
	1.0	0.078	0.078	0.0055	75	2.9E-02	6.8E-03	3.9E-03	6.6E-04	**4.0E-02**	4.1E-02	4.9E-03	8.5E-02	2.6E-02	**1.6E-01**	**2.0E-01**	3.0E-02	7.5E-03	5.1E-03	1.0E-03	**4.4E-02**	6.1E-02	7.6E-03	5.1E-02	9.4E-02	**2.1E-01**	**2.6E-01**
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**	**1.1E-01**	**2.6E-02**	**1.5E-02**	**3.5E-03**	**1.6E-01**	**1.6E-01**	**1.9E-02**	**3.3E-01**	**1.4E-01**	**6.5E-01**	**8.0E-01**	**1.2E-01**	**2.9E-02**	**2.0E-02**	**5.6E-03**	**1.7E-01**	**2.3E-01**	**2.9E-02**	**2.0E-01**	**5.1E-01**	**9.7E-01**	**1.1E+00**
	15	1.2	1.2	0.16	25	4.3E-01	1.0E-01	5.7E-02	1.9E-02	**6.1E-01**	6.2E-01	7.2E-02	1.3E+00	7.5E-01	**2.7E+00**	**3.3E+00**	4.5E-01	1.1E-01	7.6E-02	3.0E-02	**6.7E-01**	9.0E-01	1.1E-01	7.6E-01	2.7E+00	**4.5E+00**	**5.2E+00**
	107	8.1	8.1	1.8	5	3.0E+00	7.0E-01	4.0E-01	2.2E-01	**4.3E+00**	4.3E+00	5.0E-01	8.8E+00	8.5E+00	**2.2E+01**	**2.6E+01**	3.1E+00	7.8E-01	5.3E-01	3.4E-01	**4.8E+00**	6.3E+00	7.9E-01	5.3E+00	3.1E+01	**4.3E+01**	**4.8E+01**
	1,365	417	85	3.7	95	3.8E+01	3.6E+01	4.2E+00	4.4E-01	**7.9E+01**	5.5E+01	2.6E+01	9.2E+01	1.7E+01	**1.9E+02**	**2.7E+02**	4.0E+01	4.0E+01	5.5E+00	7.0E-01	**8.6E+01**	8.0E+01	4.1E+01	5.5E+01	6.3E+01	**2.4E+02**	**3.3E+02**
Oil or	3,268	1,335	363	26	75	9.2E+01	1.2E+02	1.8E+01	3.1E+00	**2.3E+02**	1.3E+02	8.3E+01	4.0E+02	1.2E+02	**7.3E+02**	**9.6E+02**	9.5E+01	1.3E+02	2.4E+01	4.9E+00	**2.5E+02**	1.9E+02	1.3E+02	2.4E+02	4.4E+02	**1.0E+03**	**1.2E+03**
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**	**1.7E+02**	**2.6E+02**	**5.0E+01**	**1.2E+01**	**4.9E+02**	**2.4E+02**	**1.9E+02**	**1.1E+03**	**4.7E+02**	**2.0E+03**	**2.5E+03**	**1.7E+02**	**2.9E+02**	**6.5E+01**	**1.9E+01**	**5.5E+02**	**3.5E+02**	**2.9E+02**	**6.5E+02**	**1.7E+03**	**3.0E+03**	**3.5E+03**
Product	11,000	6,700	2,700	386	25	3.1E+02	5.8E+02	1.3E+02	4.6E+01	**1.1E+03**	4.4E+02	4.2E+02	2.9E+03	1.8E+03	**5.6E+03**	**6.7E+03**	3.2E+02	6.5E+02	1.8E+02	7.2E+01	**1.2E+03**	6.4E+02	6.5E+02	1.8E+03	6.5E+03	**9.6E+03**	**1.1E+04**
	26,300	21,500	11,700	2,600	5	7.4E+02	1.9E+03	5.8E+02	3.1E+02	**3.5E+03**	1.1E+03	1.3E+03	1.3E+04	1.2E+04	**2.7E+04**	**3.1E+04**	7.7E+02	2.1E+03	7.6E+02	4.9E+02	**4.1E+03**	1.5E+03	2.1E+03	7.6E+03	4.4E+04	**5.5E+04**	**5.9E+04**

Table B-2 - Box Model Surface Runoff Loadings

Average Annual Mass Loading (metric tons / year) — San Juan Islands

Chemical of Concern	Surface Runoff Concentration (ug/L) CO/IN	RES	AGR	FOR	Probability of Exceedance (%)	San Juan Islands Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	4.9E-04	0.0011	0.0022	1.5E-04	95	8.0E-06	2.7E-05	3.5E-05	9.4E-06	**8.0E-05**	4.7E-05	3.1E-04	2.4E-04	7.8E-05	**6.8E-04**	**7.6E-04**
	0.0055	0.0078	0.016	0.0010	75	9.0E-05	1.9E-04	2.5E-04	6.5E-05	**5.9E-04**	5.3E-04	2.2E-03	1.7E-03	5.4E-04	**4.9E-03**	**5.5E-03**
Triclopyr	**0.03**	**0.03**	**0.06**	**0.004**	**50**	**4.9E-04**	**7.2E-04**	**9.5E-04**	**2.5E-04**	**2.4E-03**	**2.9E-03**	**8.4E-03**	**6.5E-03**	**2.1E-03**	**2.0E-02**	**2.2E-02**
	0.16	0.12	0.23	0.015	25	2.6E-03	2.8E-03	3.7E-03	9.7E-04	**1.0E-02**	1.5E-02	3.2E-02	2.5E-02	8.1E-03	**8.1E-02**	**9.1E-02**
	1.8	0.81	1.6	0.11	5	3.0E-02	1.9E-02	2.6E-02	6.7E-03	**8.2E-02**	1.7E-01	2.3E-01	1.7E-01	5.6E-02	**6.3E-01**	**7.1E-01**
	0.15	0.011	0.011	4.9E-04	95	2.4E-03	2.7E-04	1.8E-04	3.1E-05	**2.9E-03**	1.4E-02	3.1E-03	1.2E-03	2.6E-04	**1.9E-02**	**2.2E-02**
	1.0	0.078	0.078	0.0055	75	1.7E-02	1.9E-03	1.2E-03	3.5E-04	**2.0E-02**	9.9E-02	2.2E-02	8.4E-03	2.9E-03	**1.3E-01**	**1.5E-01**
Nonylphenol	**4**	**0.3**	**0.3**	**0.03**	**50**	**6.5E-02**	**7.2E-03**	**4.8E-03**	**1.9E-03**	**7.9E-02**	**3.8E-01**	**8.4E-02**	**3.2E-02**	**1.6E-02**	**5.1E-01**	**5.9E-01**
	15	1.2	1.2	0.16	25	2.5E-01	2.8E-02	1.8E-02	1.0E-02	**3.1E-01**	1.5E+00	3.2E-01	1.3E-01	8.5E-02	**2.0E+00**	**2.3E+00**
	107	8.1	8.1	1.8	5	1.7E+00	1.9E-01	1.3E-01	1.2E-01	**2.2E+00**	1.0E+01	2.3E+00	8.7E-01	9.6E-01	**1.4E+01**	**1.7E+01**
	1,365	417	85	3.7	95	2.2E+01	1.0E+01	1.3E+00	2.3E-01	**3.4E+01**	1.3E+02	1.2E+02	9.2E+00	1.9E+00	**2.6E+02**	**2.9E+02**
Oil or	3,268	1,335	363	26	75	5.3E+01	3.2E+01	5.8E+00	1.6E+00	**9.3E+01**	3.1E+02	3.7E+02	3.9E+01	1.4E+01	**7.4E+02**	**8.3E+02**
Petroleum	**6,000**	**3,000**	**1,000**	**100**	**50**	**9.8E+01**	**7.2E+01**	**1.6E+01**	**6.3E+00**	**1.9E+02**	**5.7E+02**	**8.4E+02**	**1.1E+02**	**5.2E+01**	**1.6E+03**	**1.8E+03**
Product	11,000	6,700	2,700	386	25	1.8E+02	1.6E+02	4.3E+01	2.4E+01	**4.1E+02**	1.0E+03	1.9E+03	2.9E+02	2.0E+02	**3.4E+03**	**3.8E+03**
	26,300	21,500	11,700	2,600	5	4.3E+02	5.2E+02	1.9E+02	1.6E+02	**1.3E+03**	2.5E+03	6.0E+03	1.3E+03	1.4E+03	**1.1E+04**	**1.2E+04**

Average Annual Mass Loading (metric tons / year) — Totals by Land Use

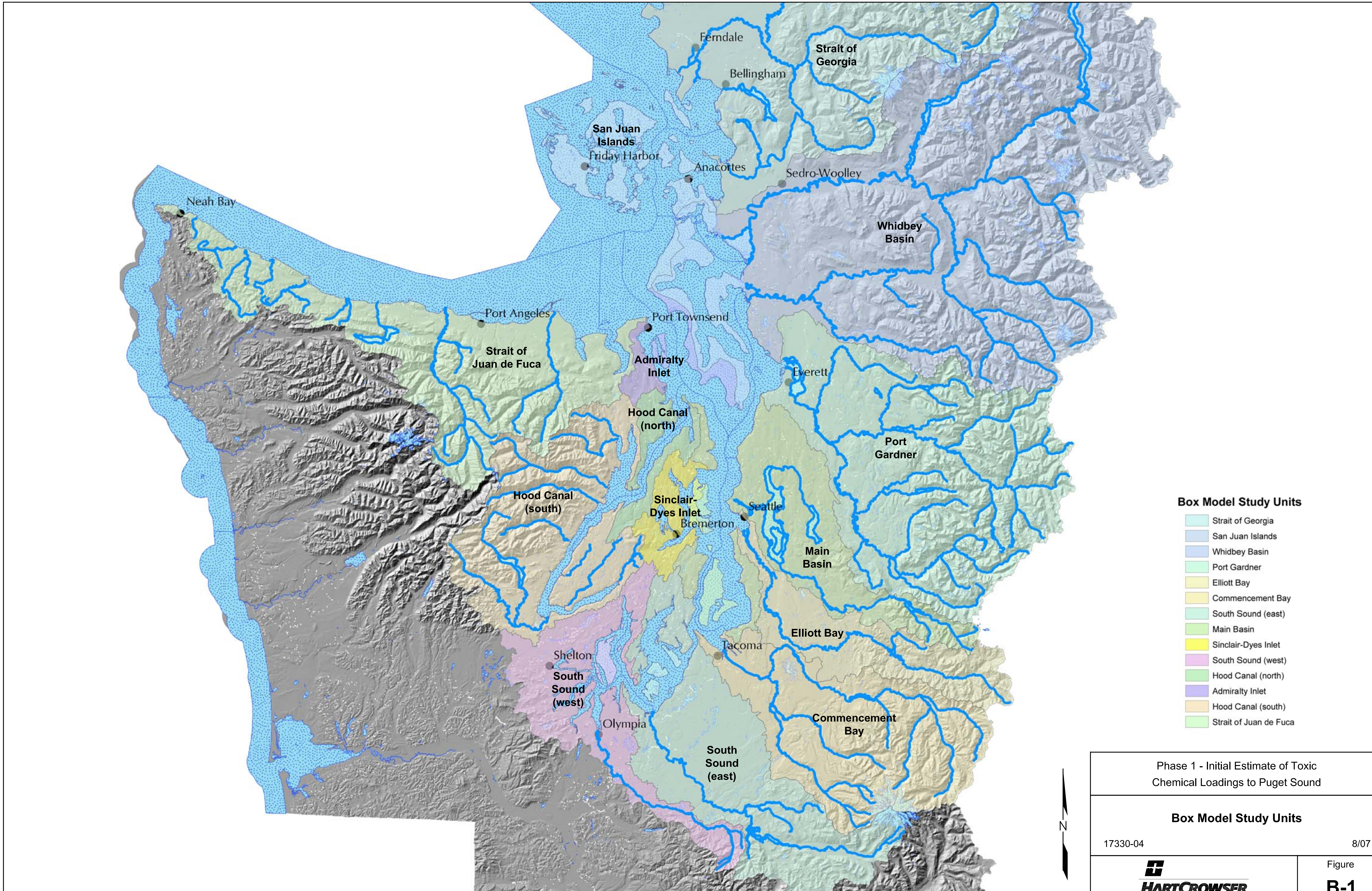
Chemical of Concern	Probability of Exceedance (%)	Urban CO/IN	RES	AGR	FOR	Subtotal	Non-Urban CO/IN	RES	AGR	FOR	Subtotal	TOTAL
	95	2.9E-04	1.8E-03	8.1E-04	3.0E-04	3.2E-03	2.0E-04	8.6E-04	6.1E-03	7.1E-03	1.4E-02	1.8E-02
	75	3.3E-03	1.2E-02	5.6E-03	2.1E-03	2.3E-02	2.2E-03	6.0E-03	4.3E-02	5.0E-02	1.0E-01	1.2E-01
Triclopyr	**50**	**1.8E-02**	**4.8E-02**	**2.2E-02**	**8.1E-03**	**9.5E-02**	**1.2E-02**	**2.3E-02**	**1.6E-01**	**1.9E-01**	**3.9E-01**	**4.9E-01**
	25	9.6E-02	1.8E-01	8.4E-02	3.1E-02	4.0E-01	6.5E-02	8.9E-02	6.4E-01	7.4E-01	1.5E+00	1.9E+00
	5	1.1E+00	1.3E+00	5.8E-01	2.2E-01	3.2E+00	7.3E-01	6.2E-01	4.4E+00	5.1E+00	1.1E+01	1.4E+01
	95	8.8E-02	1.8E-02	4.1E-03	9.9E-04	1.1E-01	5.9E-02	8.6E-03	3.1E-02	2.3E-02	1.2E-01	2.3E-01
	75	6.2E-01	1.2E-01	2.8E-02	1.1E-02	7.8E-01	4.1E-01	6.0E-02	2.1E-01	2.7E-01	9.5E-01	1.7E+00
Nonylphenol	**50**	**2.4E+00**	**4.8E-01**	**1.1E-01**	**6.1E-02**	**3.0E+00**	**1.6E+00**	**2.3E-01**	**8.2E-01**	**1.4E+00**	**4.1E+00**	**7.1E+00**
	25	9.2E+00	1.8E+00	4.2E-01	3.3E-01	1.2E+01	6.1E+00	8.9E-01	3.2E+00	7.8E+00	1.8E+01	3.0E+01
	5	6.4E+01	1.3E+01	2.9E+00	3.7E+00	8.3E+01	4.3E+01	6.2E+00	2.2E+01	8.8E+01	1.6E+02	2.4E+02
	95	8.1E+02	6.6E+02	3.1E+01	7.5E+00	1.5E+03	5.4E+02	3.2E+02	2.3E+02	1.8E+02	1.3E+03	2.8E+03
Oil or	75	1.9E+03	2.1E+03	1.3E+02	5.2E+01	4.3E+03	1.3E+03	1.0E+03	1.0E+03	1.2E+03	4.6E+03	8.8E+03
Petroleum	**50**	**3.6E+03**	**4.8E+03**	**3.6E+02**	**2.0E+02**	**8.9E+03**	**2.4E+03**	**2.3E+03**	**2.7E+03**	**4.8E+03**	**1.2E+04**	**2.1E+04**
Product	25	6.5E+03	1.1E+04	9.8E+02	7.8E+02	1.9E+04	4.4E+03	5.2E+03	7.4E+03	1.8E+04	3.5E+04	5.4E+04
	5	1.6E+04	3.4E+04	4.2E+03	5.3E+03	5.9E+04	1.0E+04	1.7E+04	3.2E+04	1.2E+05	1.8E+05	2.4E+05

Table B-3 - Loadings from Wastewater for Box Model Study Areas

Chemical of Concern	Treatment of Non-detects (ND)	Average Annual Effluent Mass Loading (metric tons / year)															
		Main Basin		Port Gardner		Elliott Bay		Commencement Bay		South Sound (East)		South Sound (West)		Hood Canal (South)		Hood Canal (North)	
		Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial
	ND = 0	-	0.026	-	0.0014	-	-	-	0.17	0.0000	-	-	-	-	-	-	-
Arsenic	ND = 1/2 DL	-	7.2	-	0.0014	-	-	-	0.17	0.0005	-	-	-	-	-	-	-
	ND = DL	-	14.4	-	0.0014	-	-	-	0.17	0.0010	-	-	-	-	-	-	-
	ND = 0	-	0.010	0.00052	0.000074	-	-	-	0.00000	0.00030	-	0.00000	-	-	-	-	0.00020
Cadmium	ND = 1/2 DL	-	0.44	0.0016	0.000081	-	-	-	0.00021	0.00033	-	0.00030	-	-	-	-	0.00024
	ND = DL	-	0.87	0.0028	0.000088	-	-	-	0.00043	0.00035	-	0.00060	-	-	-	-	0.00028
	ND = 0	0.14	5.2	0.10	0.0067	-	0.0019	0.27	0.51	0.0072	-	0.58	0.0056	-	0.0038	-	0.037
Copper	ND = 1/2 DL	0.14	5.2	0.10	0.0067	-	0.0019	0.27	0.51	0.0080	-	0.58	0.0056	-	0.0038	-	0.037
	ND = DL	0.14	5.2	0.10	0.0067	-	0.0019	0.27	0.52	0.0089	-	0.58	0.0057	-	0.0038	-	0.037
	ND = 0	-	0.25	0.021	0.0016	-	0.0016	0.0022	0.012	0.000075	-	0.077	0.00015	-	-	-	0.0039
Lead	ND = 1/2 DL	-	4.6	0.023	0.0016	-	0.0017	0.0022	0.014	0.00032	-	0.082	0.021	-	-	-	0.0046
	ND = DL	-	8.9	0.026	0.0016	-	0.0017	0.0022	0.017	0.00056	-	0.087	0.041	-	-	-	0.0054
	ND = 0	-	14.7	0.31	0.0074	-	0.056	0.41	0.26	0.014	-	1.9	0.016	-	0.013	-	0.047
Zinc	ND = 1/2 DL	-	14.7	0.31	0.0074	-	0.056	0.41	0.26	0.016	-	1.9	0.016	-	0.013	-	0.047
	ND = DL	-	14.7	0.32	0.0074	-	0.056	0.41	0.26	0.018	-	1.9	0.016	-	0.013	-	0.047
	ND = 0	-	0.0000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	ND = 1/2 DL	-	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = DL	-	0.029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = 0	-	0.00018	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	ND = 1/2 DL	-	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Carcinogenic)	ND = DL	-	0.048	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = 0	-	0.00079	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs (Other High	ND = 1/2 DL	-	0.0070	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molecular Weight)	ND = DL	-	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = 0	-	0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs (Low	ND = 1/2 DL	-	0.014	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molecular Weight)	ND = DL	-	0.026	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = 0	-	0.082	-	-	-	-	-	-	-	-	-	-	-	-	-	-
bis(2-Ethylhexyl)phthalate	ND = 1/2 DL	-	0.082	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = DL	-	0.082	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND = 0	-	14.8	-	0.23	-	20.8	-	1.3	-	-	-	-	-	-	-	-
Oil or Petroleum Product	ND = 1/2 DL	-	23.7	-	0.30	-	20.9	-	2.7	-	-	-	-	-	-	-	-
	ND = DL	-	32.7	-	0.38	-	20.9	-	4.1	-	-	-	-	-	-	-	-

Table B-3 - Loadings from Wastewater for Box Model Study Areas

Chemical of Concern	Treatment of Non-detects (ND)	Average Annual Effluent Mass Loading (metric tons / year)														
		Sinclair/Dyes Inlet		Admiralty Inlet		Strait of Juan de Fuca		Strait of Georgia		Whidbey Basin		San Juan Islands		Total		
		Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial	Municipal + Industrial
Arsenic	ND = 0	-	0.0023	-	-	-	-	-	0.0043	-	-	-	-	**0.0000**	**0.20**	**0.20**
	ND = 1/2 DL	-	0.0023	-	-	-	-	-	0.0043	-	-	-	-	**0.0005**	**7.4**	**7.4**
	ND = DL	-	0.0024	-	-	-	-	-	0.0043	-	-	-	-	**0.0010**	**14.6**	**14.6**
Cadmium	ND = 0	-	0.0069	-	-	-	-	-	0.00092	-	0.000071	-	-	**0.00083**	**0.019**	**0.019**
	ND = 1/2 DL	-	0.0078	-	-	-	-	-	0.0014	-	0.000071	-	-	**0.0023**	**0.45**	**0.45**
	ND = DL	-	0.0087	-	-	-	-	-	0.0018	-	0.000071	-	-	**0.0037**	**0.88**	**0.89**
Copper	ND = 0	-	0.14	-	-	-	-	0.051	0.051	-	0.0064	-	-	**1.2**	**6.0**	**7.1**
	ND = 1/2 DL	-	0.14	-	-	-	-	0.066	0.051	-	0.0064	-	-	**1.2**	**6.0**	**7.1**
	ND = DL	-	0.15	-	-	-	-	0.081	0.052	-	0.0064	-	-	**1.2**	**6.0**	**7.2**
Lead	ND = 0	-	0.013	-	-	-	-	-	0.0038	-	0.00082	-	-	**0.10**	**0.28**	**0.38**
	ND = 1/2 DL	-	0.029	-	-	-	-	-	0.0040	-	0.00082	-	-	**0.11**	**4.6**	**4.7**
	ND = DL	-	0.045	-	-	-	-	-	0.0042	-	0.00082	-	-	**0.12**	**9.0**	**9.1**
Zinc	ND = 0	-	0.28	-	-	-	0.045	-	0.021	-	0.023	-	0.0000	**2.6**	**15.5**	**18.1**
	ND = 1/2 DL	-	0.29	-	-	-	0.045	-	0.025	-	0.023	-	0.0000	**2.6**	**15.5**	**18.1**
	ND = DL	-	0.29	-	-	-	0.045	-	0.028	-	0.023	-	0.0000	**2.6**	**15.5**	**18.2**
Mercury	ND = 0	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.0000**	**0.0000**
	ND = 1/2 DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.015**	**0.015**
	ND = DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.029**	**0.029**
PAHs (Carcinogenic)	ND = 0	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.00018**	**0.00018**
	ND = 1/2 DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.024**	**0.024**
	ND = DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.048**	**0.048**
PAHs (Other High Molecular Weight)	ND = 0	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.00079**	**0.00079**
	ND = 1/2 DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.0070**	**0.0070**
	ND = DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.013**	**0.013**
PAHs (Low Molecular Weight)	ND = 0	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.00099**	**0.00099**
	ND = 1/2 DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.014**	**0.014**
	ND = DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.026**	**0.026**
bis(2-Ethylhexyl)phthalate	ND = 0	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.082**	**0.082**
	ND = 1/2 DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.082**	**0.082**
	ND = DL	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**0.082**	**0.082**
Oil or Petroleum Product	ND = 0	-	-	-	-	-	0.00	6.1	1.5	-	-	-	-	**6.1**	**38.6**	**44.7**
	ND = 1/2 DL	-	-	-	-	-	0.29	6.1	2.1	-	-	-	-	**6.1**	**50.0**	**56.1**
	ND = DL	-	-	-	-	-	0.57	6.1	2.8	-	-	-	-	**6.1**	**61.5**	**67.5**



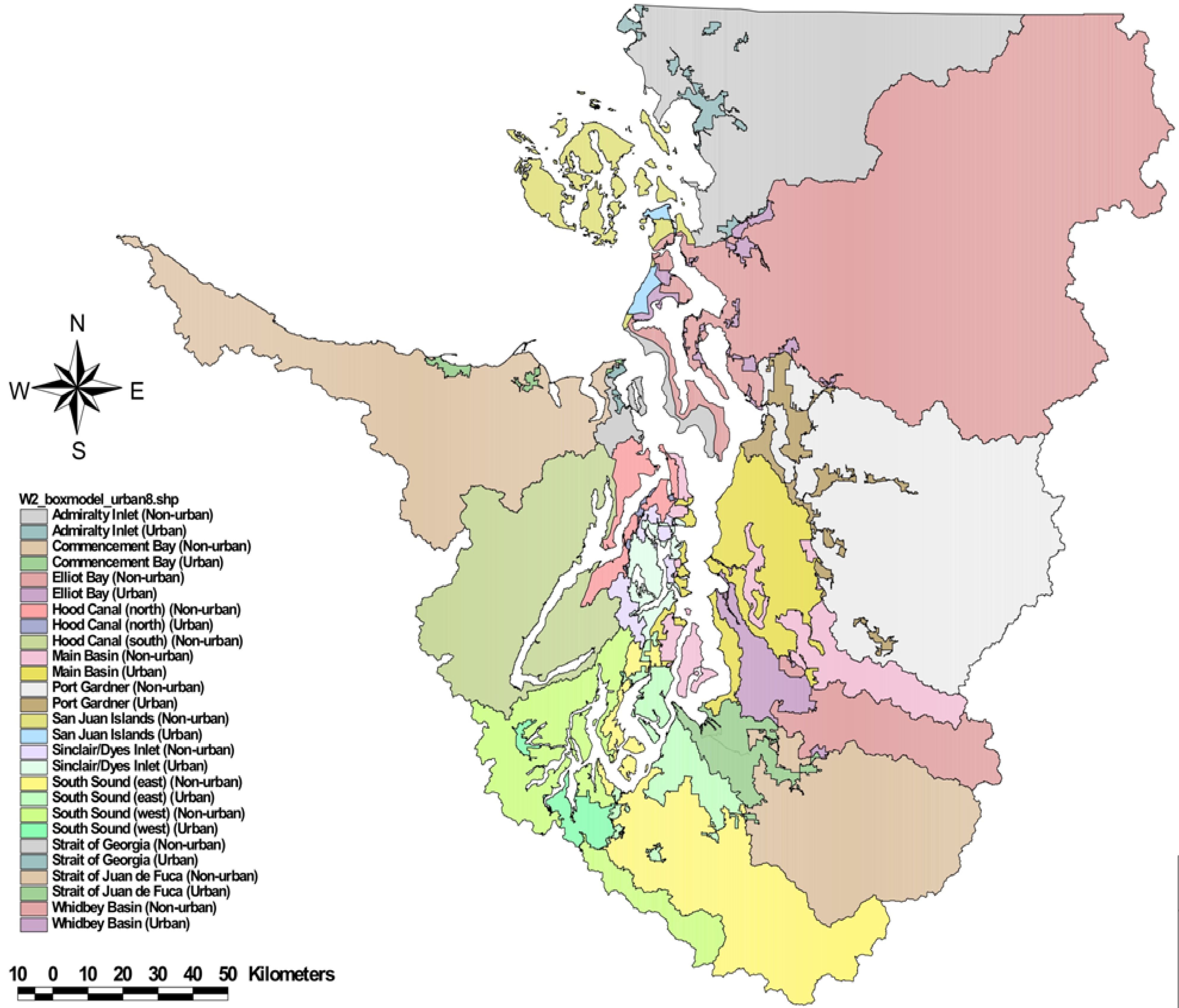
Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Box Model Study Units

17330-04 8/07

Figure **B-1**

EAL 08/14/07 1733004-002.dwg



Phase 1 - Initial Estimate of Toxic
Chemical Loadings to Puget Sound

Watershed Areas Discharging into the Puget Sound Box Model with Urban and Non-Urban Delineation According to the GIS Coverage of the Year 2000 Census Urban Areas

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Figure

B-2

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Appendix C

Atmospheric Deposition Flux Measurements from Various Studies

Appendix C – Atmospheric Deposition Flux Measurements from Various Studies

As part of this Phase 1 study, Hart Crowser performed an extensive literature survey to obtain atmospheric deposition flux measurements that could be used for the loading calculations. This appendix summarizes the results of this literature review.

Arsenic

Crecelius (1991) conducted a 6-month atmospheric deposition sampling program in an industrial area adjacent to Commencement Bay in Tacoma, Washington. The mean total (wet + dry) arsenic deposition rates ranged from 1.8 ug/m2/day (rural and marine sites) to 9.8 to 18 ug/m2/day (industrial sites). The average arsenic deposition rate for the five sites was 7.4 ug/m2/day.

The average wet deposition rate of arsenic in a Vancouver, British Columbia (Brunette River Watershed) study was 2.1 ug/m2/day (Hall et al. 1996). Thirty-six weekly measurements were made between January 31 and December 5, 1995. The land use distribution in the Brunette River Watershed in 1993 was: Residential 46 percent; Industrial 13 percent; Commercial 4 percent; Institutional 6 percent; Agricultural 0 percent; Forest and Field 31 percent.

The results of a 1997-2000 Great Lakes investigation indicate total arsenic wet and dry deposition rates ranging from 0.1 to 0.3 ug/m2/day (IADN 2000).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional arsenic total deposition (wet + dry) rate of 0.4 ug/m2/day (Chesapeake Bay Program 1999).

Cadmium

The average wet deposition rate of cadmium in the Vancouver, British Columbia, study was 1.4 ug/m2/day (Hall et al. 1996). Thirty-six weekly measurements were made between January 31 and December 5, 1995.

The average cadmium deposition rates used in the San Francisco Bay project (Davis et al. 2000) were 0.077 (dry) and 0.0071 (wet) ug/m2/day.

The results of a 1997-2000 Great Lakes investigation indicate total cadmium wet and dry deposition rates ranging from 0.1 to 0.3 ug/m2/day (IADN 2000).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional cadmium total deposition (wet + dry) rate of 0.2 ug/m2/day.

Copper

In the Crecelius (1991) study, the mean total copper deposition rates ranged from 20 to 44 ug/m2/day (rural and marine sites) to 68 to 149 ug/m2/day (industrial sites). The average copper deposition rate for the five sites was 80 ug/m2/day.

Crecelius et al. (2003) used the deposition rate measurements of Crecelius (1981, 1991) at several locations in Western Washington as part of a copper mass balance for Sinclair and Dyes Inlets. They report total copper deposition rates in the range of 3 to 150 ug/m2/day and use 20 ug/m2/day in their mass balance calculations.

The average wet deposition rate of copper in the Vancouver, British Columbia, study was 6.6 ug/m2/day (Hall et al. 1996).

The average copper deposition rates used in the San Francisco Bay project were 2.1 (dry) and 0.30 (wet) ug/m2/day.

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional copper total deposition (wet + dry) rate of 2 ug/m2/day.

Lead

In the Crecelius (1991) study, the mean total lead deposition rates ranged from 22 to 38 ug/m2/day (rural and marine sites) to 55 to 653 ug/m2/day (industrial sites). The average lead deposition rate for the five sites was 180 ug/m2/day.

The average wet deposition rate of lead in the Vancouver, British Columbia, study was 0.58 ug/m2/day (Hall et al. 1996).

The results of a 1997-2000 Great Lakes investigation indicate total lead wet and dry deposition rates ranging from 1 to 4 ug/m2/day (IADN 2000).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional lead total deposition (wet + dry) rate of 3 ug/m2/day.

Doskey and Talbot (2000) measured a total lead deposition rate equal to 27 ug/m2/day for a Wisconsin lake that is primarily recharged by precipitation.

Zinc

In the Crecelius (1991) study, the mean total zinc deposition rates ranged from 36 to 116 ug/m2/day (rural and marine sites) to 230 to 872 ug/m2/day (industrial sites). The average zinc deposition rate for the five sites was 300 ug/m2/day.

The average wet deposition rate of zinc in the Vancouver, British Columbia, study was 68 ug/m2/day (Hall et al. 1996).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional zinc total deposition (wet + dry) rate of 10 ug/m2/day.

Mercury

Data from the National Atmospheric Deposition Program for the Seattle/King County area (Station WA18) indicate an average mercury wet deposition rate of 0.017 ug/m2/day for the period 2002-2005.

The average wet deposition rate of mercury in the Vancouver, British Columbia, study was 0.010 ug/m2/day (Hall et al. 1996).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional mercury total deposition (wet + dry + net gas exchange) rate of 0.02 ug/m2/day.

The average wet deposition rate for mercury that was used in the San Francisco Bay project was 0.0067 ug/m2/day (range for three stations = 0.0031 to 0.0089 ug/m2/day).

PCBs

King County provided data from the Lower Duwamish Waterway Passive Deposition Sampling Program - Phase 2, which was conducted in 2006. The average total PCB deposition flux for 15 sampling rounds at five stations was 0.010 ug/m2/day assuming zero for values below the detection limit. The average total PCB deposition flux for 15 sampling rounds at five stations was 0.11 ug/m2/day assuming one-half of the detection limit for values below the detection limit.

Analyses by King County presented at the 2007 Georgia Basin Puget Sound Research Conference (Nairn 2007) indicate an average total PCB deposition flux of approximately 0.024 ug/m2/day for the Green-Duwamish Watershed. This value is based on a reported 11 kg/yr total deposition rate onto the Green-Duwamish Watershed (Nairn 2007) and an estimated watershed area of 125,400 hectares (King County 2007).

Georgia Basin Action Plan estimates of PCB deposition rates in southern British Columbia range from 0.0021 to 0.0047 ug/m2/day (Shaw 2007).

The results of a 1997-2000 Great Lakes investigation indicate PCB wet deposition rates ranging from 0.0018 to 0.0030 ug/m2/day and a net loss from gas exchange equal to –0.007 to –0.050 ug/m2/day (IADN 2000). Gas exchange, which was dominated by volatilization out of the lakes (but tending toward equilibrium), was the main atmospheric loading process for PCBs.

Total PBDEs

Georgia Basin Action Plan estimates of total PBDE deposition rates in southern British Columbia range from 0.0022 to 0.0058 ug/m2/day (Shaw 2007).

Vives et al. (2007) report total PBDE deposition rates varying from 0.0007 to 0.032 ug/m2/day for Lake Maggiore in Italy and Switzerland. Moon et al. (2007) measured total PBDE deposition rates equal to 0.028 to 0.24 ug/m2/day in coastal areas of Korea.

PAHs

Carcinogenic PAHs (cPAH)

The average cPAH deposition flux for 15 sampling rounds at five stations during the Lower Duwamish Waterway Passive Deposition Sampling Program (Phase 2) was 2.4 ug/m2/day (range = 0 to 13 ug/m2/day). In the Crecelius (1991) study, the mean cPAH deposition rates ranged from 2.1 to 5.6 ug/m2/day (rural and marine sites) to 5.5 to 29 ug/m2/day (industrial sites). The average cPAH deposition rate for the five sites was 10 ug/m2/day.

The results of a 1997-2000 Great Lakes investigation indicate cPAH wet deposition rates ranging from 0.014 to 0.078 ug/m2/day, dry deposition equal to 0.0085 to 0.074 ug/m2/day, and a total gas absorption rate (net air-water exchange into water) equal to 0.00013 to 0.0096 ug/m2/day (IADN 2000). Wet and dry depositions were the main atmospheric pathways into the lakes for the heavier PAHs.

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional carcinogenic PAHs total deposition (wet + dry + net gas exchange) rate equal to about 0.05 ug/m2/day.

Other High Molecular Weight PAHs (HPAH)

The average HPAH deposition flux for 15 sampling rounds at five stations during the Lower Duwamish Waterway Passive Deposition Sampling Program (Phase 2) was 1.1 ug/m^2/day (range of 0 to 6.0 ug/m^2/day). In the Crecelius (1991) study, the mean HPAH deposition rates ranged from 1.4 to 3.4 ug/m^2/day (rural and marine sites) to 3.8 to 12 ug/m^2/day (industrial sites). The average HPAH deposition rate for the five sites was 5.2 ug/m^2/day.

The results of a 1997-2000 Great Lakes investigation indicate HPAH wet deposition rates ranging from 0.0052 to 0.050 ug/m2/day, dry deposition equal to 0.0026 to 0.020 ug/m2/day, and a total gas absorption rate (net air-water exchange into water) equal to 0.016 to 0.11 ug/m2/day (IADN 2000).

The average HPAH wet deposition rate in the Vancouver, British Columbia, study was 0.20 ug/m2/day (Hall et al. 1996).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional HPAH total deposition (wet + dry + net gas exchange) rate equal to about 0.3 ug/m2/day.

Low Molecular Weight PAHs (LPAH)

In the Crecelius (1991) study, the mean LPAH deposition rates ranged from 0.45 to 0.68 ug/m2/day (rural and marine sites) to 1.1 to 3.8 ug/m2/day (industrial sites). The average LPAH deposition rate for the five sites was 1.5 ug/m2/day.

The results of a 1997-2000 Great Lakes investigation indicate LPAH wet deposition rates ranging from 0.0080 to 0.082 ug/m2/day, dry deposition equal to 0.0031 to 0.016 ug/m2/day, and a total gas absorption rate (net air-water exchange into water) equal to 0.089 to 1.2 ug/m2/day (IADN 2000). Gas absorption (net gain into water) dominated wet and dry deposition for the lighter PAHs.

The average LPAH wet deposition rate in the Vancouver, British Columbia, study was 0.92 ug/m2/day (Hall et al. 1996).

Measurements from the 1999 Chesapeake Bay toxics loading study indicated an average regional LPAH total deposition (wet + dry + net gas exchange) rate equal to about 1 ug/m2/day.

bis(2-Ethylhexyl)phthalate (BEHP)

The BEHP deposition flux for 15 sampling rounds at five stations during the Lower Duwamish Waterway Passive Deposition Sampling Program (Phase 2) was 2.6 ug/m2/day (range of 0.26 to 12 ug/m2/day).

Triclopyr

No measurements of the atmospheric deposition rate of triclopyr were available.

Nonylphenol

No measurements of the atmospheric deposition rate of nonylphenol were available. As discussed earlier, water-to-air volatilization of nonylphenols from estuarine waters can be a source of nonylphenols to the estuarine atmosphere (Dachs et al. 1999). Dachs et al. (1999) report 2.2 to 70 ng/m3 in the coastal atmosphere of the New York - New Jersey Bight (attributed to treated sewage effluents). Van Ry et al. (2000) detected up to 56 ng/m3 in the atmosphere of a coastal site in the Lower Hudson River Estuary. Van Ry et al. (2000) also report 0.13 to 81 ng/m3 in the air at a suburban site (New Brunswick) in the Hudson River Estuary.

Dioxins and Furans

Previous studies in the U.S. (Gill and Mongar 2004) and data from the National Dioxin Air Monitoring Network and Europe (NERI 2006) provide the following information regarding dioxin fluxes and air concentrations (fg = femtogram; 1 pg = 1,000 fg):

Location	*Sampling Period*	*Flux (pg TEQ/m²/day)* Mean	*Flux* Range	*Air Concentration (fg TEQ/m³)* Mean	*Air Concentration* Range
Rural Northwest Oregon[1]	2001	-	-	13 to 25	-
Remote NW Washington[1]	2001	-	-	0.8	-
California	2002-2003	-	-	23 to 26	-
Rural U.S.[1]	2000-2001	-	-	13	-
Denmark	2002-2005	2.9	0.3 to 14	-	-
Denmark	2002-2005	4.4	0.5 to 17	20	3 to 87
Denmark	2003-2005	6.1	0.5 to 32	-	-
Denmark	2003-2004	8.0	1.7 to 32	20	3 to 56
Italy	1998-1999	-	0.03 to 6.2	85	50 to 280
Belgium	1992-1999	-	0.68 to 25	110	20 to 380
Germany	1987-1992	-	2.7 to 82	-	50 to 280
Germany	1993-1997	-	0.7 to 11	-	80 to 150
Spain	1995	-	-	50 to 250	-
England	1991-1993	-	-	190 to 410	-

[1]Data from the National Dioxin Air Monitoring Network (NDAMN)

Total dioxins/furans atmospheric deposition rate measurements in the Baltic Sea region (HELCOM 2004) generally ranged from 0.03 to 0.1 pg TEQ/m^2/day above water surfaces and 0.1 to 1 pg TEQ/m^2/day over land. An atmospheric study in Denmark estimated an average deposition rate of 4.4 pg TEQ/m^2/day for the entire country and 1 to 2 pg TEQ/L in rain (NERI 2006).

Total DDT

Measured total DDT wet and dry deposition fluxes from the New Jersey Atmospheric Deposition Network (NJADN 2001) for multiple sites throughout the state during the period 1998 to 2001 varied as follows [mean and (range)]: dry = 0.0012 ug/m2/day (0.00025 to 0.0021); wet - 0.00061 ug/m2/day (0.00017 to 0.0011).

The results of a 1997-2000 Great Lakes investigation indicate total DDT wet deposition rates ranging from 0.00015 to 0.0021 ug/m2/day (mean of 0.00085 ug/m2/day) and a total gas absorption rate (net air-water exchange into water) equal to 0.00047 to 0.0057 ug/m2/day (mean of 0.0024 ug/m2/day) (IADN 2000).

Oil or Petroleum Product

No measurements of the atmospheric deposition rate for oil or petroleum product were available.

Appendix D

Details of Point Source Loading Calculations

Table D-1 - Details of Wastewater Loading Calculations

WQMA_ID	User_Location	Chemical	Y	X	First Data Point	Last Data Point	No. Data Points	Months of Data	Avg Flow (cfs)	Min Flow (cfs)	Max Flow (cfs)	Facility Type	Avg Mass Load (ND=0) (mt/yr)	Avg Mass Load (ND=1/2 DL) (mt/yr)	Avg Mass Load (ND=DL) (mt/yr)
South Sound	Arkema Inc	**Arsenic**	710744	1174465	1/1/02	7/1/03	14	18.2	**0.025**	0.025	0.025	Industrial	**0.00151**	**0.00151**	**0.00151**
Main Basin	Bnsf Skykomish Remediation Site	**Arsenic**	867963	1428297	8/1/06	11/1/06	4	3.1	**0.782**	0.388	1.044	Industrial	**0.00136**	**0.00136**	**0.00136**
South Sound	Carbonado Coalbed Methane Project	**Arsenic**	619150	1252155	10/1/02	1/1/04	15	15.2	**0.058**	0.023	0.076	Industrial	**0.00005**	**0.00033**	**0.00061**
Bellingham	Chemco	**Arsenic**	1305435	1109140	1/1/02	5/1/05	35	40.5	**0.457**	0.194	1.807	Industrial	**0.00321**	**0.00321**	**0.00321**
South Sound	Exide Technologies	**Arsenic**	690002	1207704	10/1/04	10/1/06	7	24.3	**0.003**	0.003	0.004	Industrial	**0.00001**	**0.00001**	**0.00001**
Whidbey Island	Inman Landfill	**Arsenic**	1164786	1171276	3/1/02	3/1/03	3	12.2	**0.066**	0.046	0.097	Industrial	**0.00081**	**0.00081**	**0.00081**
South Sound	Manke Lumber Co Superior Wood	**Arsenic**	712064	1175259	3/1/05	12/1/06	11	21.3	**0.505**	0.323	0.947	Industrial	**0.03634**	**0.03634**	**0.03634**
South Sound	Mcfarland Cascade Pole & Lumber Co	**Arsenic**	704778	1166507	4/1/02	12/1/06	87	56.8	**5.889**	1.035	11.318	Industrial	**0.12625**	**0.12657**	**0.12689**
Main Basin	METRO- KING ST REG STATION	**Arsenic**	222124	1269353	3/1/97	8/16/05	34	103.0	**12.834**	6.514	23.410	Industrial	**0.02647**	**0.02647**	**0.02647**
South Sound	Pacific Functional Fluids Llc	**Arsenic**	709851	1170308	10/1/03	11/1/06	17	37.6	**0.045**	0.017	0.094	Industrial	**0.00001**	**0.00023**	**0.00046**
Bellingham	Recomp Of Wa	**Arsenic**	1277106	1146735	1/1/02	1/1/02	1	0.0	**0.073**	0.073	0.073	Industrial	**0.00033**	**0.00033**	**0.00033**
Main Basin	RENTON INPLANT	**Arsenic**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**0.00000**	**3.53220**	**7.06441**
Main Basin	Usn Undersea Warfare Center	**Arsenic**	869459	1117180	1/1/03	12/1/06	47	47.7	**0.223**	0.000	1.725	Industrial	**0.00231**	**0.00233**	**0.00236**
Main Basin	WEST PT INPLANT	**Arsenic**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**0.00000**	**3.64028**	**7.28056**
South Sound	Western Wood Preserving Co	**Arsenic**	688326	1208432	1/1/02	10/1/04	39	33.5	**0.242**	0.041	0.805	Industrial	**0.00234**	**0.00406**	**0.00578**
South Sound	Yelm Stp	**Arsenic**	599289	1121721	3/1/02	12/1/02	4	9.2	**0.140**	0.082	0.204	Municipal	**0.00000**	**0.00050**	**0.00101**
Whidbey Island	Alpha Technologies - Arlington	**Cadmium**	1050953	1242609	10/1/02	7/1/05	6	33.5	**0.016**	0.014	0.018	Industrial	**0.00007**	**0.00007**	**0.00007**
Main Basin	Artisan Finishing Systems Inc	**Cadmium**	992296	1230656	2/1/02	8/1/06	9	54.7	**0.010**	0.007	0.013	Industrial	**0.00002**	**0.00002**	**0.00002**
South Sound	Atlas Castings & Technology	**Cadmium**	698677	1153225	1/1/02	5/1/02	15	4.0	**0.042**	0.003	0.126	Industrial	**0.00000**	**0.00006**	**0.00011**
South Sound	Carbonado Coalbed Methane Project	**Cadmium**	619150	1252155	10/1/02	1/1/04	15	15.2	**0.058**	0.023	0.076	Industrial	**0.00000**	**0.00016**	**0.00031**
Main Basin	Coastal Manufacturing	**Cadmium**	939143	1197588	3/1/02	7/1/04	10	28.4	**0.003**	0.001	0.005	Industrial	**0.00000**	**0.00001**	**0.00001**
Main Basin	Everett Stp	**Cadmium**	967933	1225118	1/1/02	6/1/04	30	29.4	**12.056**	6.807	18.564	Municipal	**0.00000**	**0.00112**	**0.00224**
South Sound	Exide Technologies	**Cadmium**	690002	1207704	10/1/04	10/1/06	7	24.3	**0.003**	0.003	0.004	Industrial	**0.00000**	**0.00000**	**0.00000**
Main Basin	Goodrich Aviation Tech Services	**Cadmium**	941699	1207907	1/1/02	12/1/06	51	59.8	**0.051**	0.030	0.071	Industrial	**0.00510**	**0.00510**	**0.00510**
Main Basin	Granite Falls Stp	**Cadmium**	1004725	1278621	11/1/03	11/1/03	1	0.0	**0.568**	0.568	0.568	Municipal	**0.00052**	**0.00052**	**0.00052**
Whidbey Island	Inman Landfill	**Cadmium**	1164786	1171276	3/1/02	3/1/03	3	12.2	**0.066**	0.046	0.097	Industrial	**0.00000**	**0.00009**	**0.00018**
Main Basin	Metal Finishing Inc	**Cadmium**	995106	1230341	3/1/02	11/1/06	6	56.9	**0.010**	0.008	0.012	Industrial	**0.00005**	**0.00005**	**0.00006**
Main Basin	METRO- KING ST REG STATION	**Cadmium**	222124	1269353	3/1/97	8/16/05	34	103.0	**12.834**	6.514	23.410	Industrial	**0.00404**	**0.00415**	**0.00425**
Main Basin	Powder Fab Inc	**Cadmium**	1038544	1238040	3/1/02	12/1/06	19	57.9	**0.002**	0.001	0.003	Industrial	**0.00001**	**0.00001**	**0.00002**
Main Basin	Production Plating	**Cadmium**	939204	1200375	1/1/02	1/1/06	8	48.7	**0.056**	0.034	0.097	Industrial	**0.00132**	**0.00134**	**0.00137**
Bellingham	Recomp Of Wa	**Cadmium**	1277106	1146735	10/1/03	10/1/03	1	0.0	**0.075**	0.075	0.075	Industrial	**0.00013**	**0.00013**	**0.00013**
Main Basin	RENTON INPLANT	**Cadmium**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**0.00000**	**0.21193**	**0.42386**
South Sound	Rustlewood Stp	**Cadmium**	719870	1038606	12/1/02	12/1/06	4	48.7	**0.041**	0.031	0.068	Municipal	**0.00030**	**0.00033**	**0.00035**
Whidbey Island	Ttm Technologies	**Cadmium**	1151192	1175617	1/1/02	4/1/02	2	3.0	**0.170**	0.166	0.175	Industrial	**0.00078**	**0.00115**	**0.00152**
Main Basin	Usn Undersea Warfare Center	**Cadmium**	869459	1117180	1/1/02	12/1/06	107	59.8	**0.272**	0.027	1.809	Industrial	**0.00233**	**0.00263**	**0.00292**
Main Basin	Usnav Puget Sound Shipyard	**Cadmium**	818979	1113160	1/1/02	12/1/06	52	59.8	**0.099**	0.052	0.161	Industrial	**0.00453**	**0.00518**	**0.00582**
Hood Canal	Usnav Submarine Base Bangor	**Cadmium**	879683	1093806	1/1/02	12/1/06	69	59.8	**0.090**	0.043	0.162	Industrial	**0.00020**	**0.00024**	**0.00028**
Main Basin	WEST PT INPLANT	**Cadmium**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**0.00000**	**0.21842**	**0.43683**
Bellingham	Yamato Engine Specialist	**Cadmium**	1265039	1150220	12/1/03	10/1/06	9	34.5	**0.002**	0.002	0.003	Industrial	**0.00001**	**0.00001**	**0.00001**

Table D-1 - Details of Wastewater Loading Calculations

WQMA_ID	User_Location	Chemical	Y	X	First Data Point	Last Data Point	No. Data Points	Months of Data	Avg Flow (cfs)	Min Flow (cfs)	Max Flow (cfs)	Facility Type	Avg Mass Load (ND=0) (mt/yr)	Avg Mass Load (ND=1/2 DL) (mt/yr)	Avg Mass Load (ND=DL) (mt/yr)
South Sound	Yelm Stp	**Cadmium**	599289	1121721	3/1/02	12/1/02	8	9.2	**0.337**	0.237	0.449	Municipal	**0.00000**	**0.00030**	**0.00060**
Main Basin	METRO- KING ST REG STATION	**carcinogenic PAHs**	222124	1269353	3/1/97	5/31/97	70	3.0	**72.598**	37.474	138.090	Industrial	**0.00018**	**0.02393**	**0.04767**
Whidbey Island	Alpha Technologies - Arlington	**Copper**	1050953	1242609	1/1/02	10/1/05	12	45.6	**0.027**	0.014	0.040	Industrial	**0.00086**	**0.00086**	**0.00086**
Main Basin	Artisan Finishing Systems Inc	**Copper**	992296	1230656	3/1/02	3/1/06	7	48.7	**0.008**	0.007	0.009	Industrial	**0.00025**	**0.00025**	**0.00025**
South Sound	Atlas Castings & Technology	**Copper**	698677	1153225	1/1/02	5/1/02	15	4.0	**0.042**	0.003	0.126	Industrial	**0.00361**	**0.00362**	**0.00363**
South Sound	Buckley Stp	**Copper**	673490	1257901	1/1/02	12/1/06	52	59.8	**1.823**	1.012	3.346	Municipal	**0.01523**	**0.01523**	**0.01523**
South Sound	Carbonado Coalbed Methane Project	**Copper**	619150	1252155	1/1/03	1/1/04	12	12.2	**0.067**	0.037	0.076	Industrial	**0.00046**	**0.00061**	**0.00077**
Bellingham	Chemco	**Copper**	1305435	1109140	1/1/02	5/1/05	35	40.5	**0.457**	0.194	1.807	Industrial	**0.00392**	**0.00392**	**0.00392**
Main Basin	Coastal Manufacturing	**Copper**	939143	1197588	1/1/02	9/1/04	31	32.5	**0.003**	0.001	0.005	Industrial	**0.00006**	**0.00006**	**0.00006**
South Sound	Conocophillips Tacoma Terminal Sout	**Copper**	706778	1160247	9/1/04	12/1/06	22	27.4	**0.206**	0.002	1.093	Industrial	**0.00031**	**0.00045**	**0.00060**
Main Basin	Duvall Stp	**Copper**	874588	1272144	1/1/02	4/1/02	4	3.0	**0.854**	0.733	1.036	Municipal	**0.01247**	**0.01247**	**0.01247**
South Sound	Enumclaw Stp	**Copper**	679924	1265901	2/1/02	12/1/06	52	58.8	**4.652**	2.166	8.509	Municipal	**0.13631**	**0.13631**	**0.13631**
Main Basin	Everett Stp	**Copper**	967933	1225118	1/1/02	6/1/04	30	29.4	**12.056**	6.807	18.564	Municipal	**0.06460**	**0.06460**	**0.06460**
South Sound	Exide Technologies	**Copper**	690002	1207704	7/1/04	12/1/06	27	29.4	**0.003**	0.002	0.004	Industrial	**0.00049**	**0.00049**	**0.00049**
Main Basin	Goodrich Aviation Tech Services	**Copper**	941699	1207907	1/1/02	11/1/06	25	58.8	**0.051**	0.036	0.071	Industrial	**0.00613**	**0.00613**	**0.00613**
Main Basin	Granite Falls Stp	**Copper**	1004725	1278621	1/1/02	10/1/04	34	33.5	**0.367**	0.229	0.591	Industrial	**0.00491**	**0.00491**	**0.00491**
Whidbey Island	Inman Landfill	**Copper**	1164786	1171276	3/1/02	3/1/03	3	12.2	**0.066**	0.046	0.097	Industrial	**0.00092**	**0.00130**	**0.00168**
Bellingham	Intalco Ferndale	**Copper**	1289304	1107312	1/1/02	12/1/06	119	59.8	**6.715**	3.075	14.806	Municipal	**0.05084**	**0.06611**	**0.08137**
South Sound	J M Martinac	**Copper**	704713	1161192	5/1/06	11/1/06	5	6.1	**0.000**	0.000	0.000	Industrial	**0.00000**	**0.00000**	**0.00000**
Main Basin	Jh Baxter Arlington	**Copper**	1037493	1238955	12/1/05	9/1/06	4	9.1	**0.106**	0.072	0.147	Industrial	**0.00052**	**0.00052**	**0.00052**
Bellingham	Lehigh Northwest Cement Co	**Copper**	1259178	1152682	3/1/02	3/1/06	3	48.7	**0.095**	0.085	0.106	Industrial	**0.00056**	**0.00056**	**0.00056**
South Sound	Lott	**Copper**	630997	1045285	1/1/02	12/1/06	57	59.8	**35.036**	25.974	54.454	Municipal	**0.57049**	**0.57049**	**0.57049**
South Sound	Manke Lumber Co Superior Wood	**Copper**	712064	1175259	3/1/05	12/1/06	28	21.3	**0.507**	0.219	1.284	Industrial	**0.08238**	**0.08238**	**0.08238**
South Sound	Marine Industries Nw-State	**Copper**	708374	1161293	2/1/04	11/1/04	11	9.1	**0.032**	0.002	0.092	Industrial	**0.00520**	**0.00520**	**0.00520**
South Sound	Mcfarland Cascade Pole & Lumber Co	**Copper**	704778	1166507	4/1/02	12/1/06	87	56.8	**5.889**	1.035	11.318	Industrial	**0.36294**	**0.36294**	**0.36294**
Main Basin	Metal Finishing Inc	**Copper**	995106	1230341	1/1/02	12/1/06	54	59.8	**0.010**	0.007	0.014	Industrial	**0.00071**	**0.00071**	**0.00071**
Main Basin	METRO- KING ST REG STATION	**Copper**	222124	1269353	3/1/97	8/16/05	34	103.0	**12.834**	6.514	23.410	Industrial	**0.66644**	**0.66644**	**0.66644**
Main Basin	Miller Creek Wwtp	**Copper**	776846	1182983	2/1/02	1/1/03	5	11.1	**5.616**	4.393	7.441	Industrial	**0.05209**	**0.05209**	**0.05209**
Whidbey Island	Nichols Bros Boat Builders Inc	**Copper**	983376	1140093	3/1/02	11/1/06	26	56.9	**0.057**	0.006	0.125	Industrial	**0.00554**	**0.00554**	**0.00554**
South Sound	North Bay/Case Inlet	**Copper**	754218	1054742	3/1/03	3/1/03	1	0.0	**0.275**	0.275	0.275	Industrial	**0.00000**	**0.00000**	**0.00000**
Main Basin	North Bend Stp	**Copper**	791889	1322612	1/1/02	12/1/06	59	59.8	**1.431**	1.013	2.283	Municipal	**0.01699**	**0.01699**	**0.01699**
Main Basin	Nucor Steel Seattle Inc	**Copper**	820560	1180140	1/1/02	11/1/06	48	58.8	**0.248**	0.025	0.561	Industrial	**0.00085**	**0.00085**	**0.00085**
South Sound	Occidental Chemical Corp	**Copper**	711718	1176346	1/1/02	12/1/06	20	59.8	**5.146**	1.392	19.709	Industrial	**0.01124**	**0.01147**	**0.01170**
Bellingham	Olivine Corp	**Copper**	1272358	1150301	4/1/06	4/1/06	1	0.0	**0.023**	0.023	0.023	Industrial	**0.00015**	**0.00015**	**0.00015**
Hood Canal	Olympic View Sanitary Landfill	**Copper**	799939	1077698	6/1/02	12/1/06	5	54.8	**0.403**	0.403	0.403	Industrial	**0.00382**	**0.00382**	**0.00382**
South Sound	Orting Stp	**Copper**	651544	1214606	1/1/02	12/1/06	40	59.8	**1.638**	1.105	3.427	Municipal	**0.00000**	**0.00002**	**0.00003**
South Sound	Pacific Functional Fluids Llc	**Copper**	709851	1170308	1/1/02	11/1/06	25	58.8	**0.162**	0.011	0.364	Industrial	**0.00424**	**0.00425**	**0.00427**
South Sound	Port Of Olympia Budd Inlet	**Copper**	638179	10417005	1/1/02	12/1/06	59	59.8	**0.056**	0.013	0.118	Industrial	**0.00000**	**0.00003**	**0.00006**

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WQMA_ID	User_Location	Chemical	Y	X	First Data Point	Last Data Point	No. Data Points	Months of Data	Avg Flow (cfs)	Min Flow (cfs)	Max Flow (cfs)	Facility Type	Avg Mass Load (ND=0) (mt/yr)	Avg Mass Load (ND=1/2 DL) (mt/yr)	Avg Mass Load (ND=DL) (mt/yr)
Main Basin	Powder Fab Inc	**Copper**	1038544	1238040	3/1/02	12/1/06	19	57.9	**0.002**	0.001	0.003	Industrial	**0.00009**	**0.00009**	**0.00009**
Main Basin	Production Plating	**Copper**	939204	1200375	1/1/02	9/1/06	57	56.8	**0.055**	0.032	0.101	Industrial	**0.01135**	**0.01141**	**0.01148**
South Sound	Puglia Engineering Inc	**Copper**	710396	1165892	12/1/06	12/1/06	1	0.0	**0.042**	0.042	0.042	Industrial	**0.01577**	**0.01577**	**0.01577**
South Sound	Puyallup Stp	**Copper**	685790	1193396	8/1/03	12/1/06	38	40.6	**6.431**	4.440	13.629	Municipal	**0.07718**	**0.07718**	**0.07718**
Bellingham	Recomp Of Wa	**Copper**	1277106	1146735	1/1/02	1/1/02	1	0.0	**0.073**	0.073	0.073	Industrial	**0.00182**	**0.00182**	**0.00182**
Main Basin	Redondo Stp	**Copper**	735460	1190813	4/1/02	5/1/03	6	13.2	**3.928**	3.236	4.604	Municipal	**0.14200**	**0.14200**	**0.14200**
Main Basin	RENTON INPLANT	**Copper**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**2.62771**	**2.62771**	**2.62771**
South Sound	Rustlewood Stp	**Copper**	719870	1038606	12/1/02	12/1/06	6	48.7	**0.045**	0.031	0.071	Municipal	**0.00030**	**0.00045**	**0.00059**
South Sound	Schnitzer Steel Industries Tac	**Copper**	710006	1176589	1/1/02	12/1/06	58	59.8	**0.011**	0.003	0.023	Industrial	**0.00005**	**0.00013**	**0.00021**
Main Basin	Seacast Inc	**Copper**	995858	1227035	7/1/04	6/1/05	4	11.2	**0.000**	0.000	0.000	Industrial	**0.00026**	**0.00026**	**0.00026**
South Sound	Seashore Villa Stp	**Copper**	653042	1044857	3/1/03	10/1/06	44	43.7	**0.731**	0.011	30.940	Municipal	**0.01300**	**0.01301**	**0.01302**
Main Basin	Shell Oil Product Seattle Terminal	**Copper**	823723	1183551	7/8/03	9/1/06	14	38.4	**0.118**	0.004	0.661	Industrial	**0.00107**	**0.00107**	**0.00107**
Main Basin	Snoqualmie Wwtp	**Copper**	807567	1311327	1/1/02	12/1/02	12	11.1	**0.540**	0.014	1.032	Municipal	**0.00600**	**0.00600**	**0.00600**
Main Basin	Sultan Wwtp	**Copper**	927422	1315827	9/1/06	10/1/06	2	1.0	**0.449**	0.444	0.453	Municipal	**0.00000**	**0.00000**	**0.00000**
South Sound	Sumner Stp	**Copper**	685681	1204323	1/1/02	12/1/06	60	59.8	**2.716**	2.027	5.275	Municipal	**0.04312**	**0.04312**	**0.04312**
Main Basin	Synrad Inc	**Copper**	894849	1226208	1/1/02	9/1/06	57	56.8	**0.001**	0.000	0.001	Industrial	**0.00001**	**0.00001**	**0.00001**
Whidbey Island	Ttm Technologies	**Copper**	1151192	1175617	1/1/02	6/1/03	18	17.2	**0.074**	0.003	0.185	Industrial	**0.04336**	**0.04336**	**0.04336**
Main Basin	Usn Undersea Warfare Center	**Copper**	869459	1117180	1/1/02	9/1/06	101	56.8	**0.276**	0.027	1.809	Industrial	**0.00925**	**0.00925**	**0.00925**
Main Basin	Usnav Puget Sound Shipyard	**Copper**	818979	1113160	1/1/02	12/1/06	318	59.8	**0.710**	0.328	1.181	Industrial	**0.13107**	**0.13411**	**0.13715**
Hood Canal	Usnav Submarine Base Bangor	**Copper**	879683	1093806	1/1/02	12/1/06	126	59.8	**0.150**	0.081	0.278	Industrial	**0.03664**	**0.03665**	**0.03666**
South Sound	Washington Corrections Center	**Copper**	708992	973086	10/1/02	10/1/06	5	48.7	**0.253**	0.217	0.316	Industrial	**0.00562**	**0.00562**	**0.00562**
Main Basin	WEST PT INPLANT	**Copper**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**1.83556**	**1.83556**	**1.83556**
South Sound	Western Wood Preserving Co	**Copper**	688326	1208432	1/1/02	12/1/06	58	59.8	**1.635**	0.195	3.658	Industrial	**0.02584**	**0.02671**	**0.02758**
Bellingham	Yamato Engine Specialist	**Copper**	1265039	1150220	12/1/03	10/1/06	14	34.5	**0.002**	0.002	0.003	Industrial	**0.00029**	**0.00029**	**0.00029**
South Sound	Yelm Stp	**Copper**	599289	1121721	3/1/02	12/1/06	30	57.9	**0.561**	0.299	0.970	Municipal	**0.00719**	**0.00802**	**0.00885**
Whidbey Island	Alpha Technologies - Arlington	**Lead**	1050953	1242609	6/1/02	7/1/05	7	37.5	**0.018**	0.014	0.025	Industrial	**0.00015**	**0.00015**	**0.00015**
Main Basin	Artisan Finishing Systems Inc	**Lead**	992296	1230656	1/1/02	7/1/06	10	54.7	**0.009**	0.007	0.014	Industrial	**0.00081**	**0.00081**	**0.00081**
South Sound	Atlas Castings & Technology	**Lead**	698677	1153225	1/1/02	5/1/02	15	4.0	**0.042**	0.003	0.126	Industrial	**0.00014**	**0.00015**	**0.00016**
Main Basin	Bnsf Skykomish Remediation Site	**Lead**	867963	1428297	9/1/06	9/1/06	1	0.0	**0.967**	0.967	0.967	Industrial	**0.00024**	**0.00024**	**0.00024**
Main Basin	Bp Oil Service Station #11093	**Lead**	923090	1217161	1/1/02	8/1/06	45	55.8	**0.013**	0.000	0.039	Industrial	**0.00000**	**0.00001**	**0.00001**
South Sound	Carbonado Coalbed Methane Project	**Lead**	619150	1252155	10/1/02	1/1/04	15	15.2	**0.058**	0.023	0.076	Industrial	**0.00000**	**0.00045**	**0.00089**
Main Basin	Coastal Manufacturing	**Lead**	939143	1197588	3/1/02	7/1/04	10	28.4	**0.003**	0.001	0.005	Industrial	**0.00005**	**0.00007**	**0.00009**
Main Basin	Concophillips Co Renton Terminal	**Lead**	780163	1214025	1/1/02	2/1/06	5	49.7	**0.186**	0.062	0.402	Industrial	**0.00032**	**0.00032**	**0.00033**
South Sound	Conocophillips Tacoma Terminal Sout	**Lead**	706778	1160247	9/1/04	12/1/06	22	27.4	**0.206**	0.002	1.093	Industrial	**0.00000**	**0.00128**	**0.00255**
Main Basin	Everett Stp	**Lead**	967933	1225118	1/1/02	6/1/04	30	29.4	**12.056**	6.807	18.564	Municipal	**0.02117**	**0.02334**	**0.02550**
South Sound	Exide Technologies	**Lead**	690002	1207704	7/1/04	12/1/06	27	29.4	**0.003**	0.002	0.004	Industrial	**0.00017**	**0.00018**	**0.00019**
Bellingham	Gb Enterprises Alpha West Facility	**Lead**	1261049	1150972	1/1/04	6/1/06	11	29.4	**0.000**	0.000	0.000	Industrial	**0.00007**	**0.00007**	**0.00007**
Main Basin	Goodrich Aviation Tech Services	**Lead**	941699	1207907	1/1/02	11/1/06	25	58.8	**0.051**	0.036	0.071	Industrial	**0.00219**	**0.00220**	**0.00221**
Whidbey Island	Inman Landfill	**Lead**	1164786	1171276	3/1/02	3/1/03	3	12.2	**0.066**	0.046	0.097	Industrial	**0.00000**	**0.00015**	**0.00030**

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South Sound	J M Martinac	**Lead**	704713	1161192	5/1/06	11/1/06	5	6.1	**0.000**	0.000	0.000	Industrial	**0.00000**	**0.00000**	**0.00000**
South Sound	Lott	**Lead**	630997	1045285	1/1/02	12/1/06	57	59.8	**35.036**	25.974	54.454	Municipal	**0.07593**	**0.08101**	**0.08609**
Bellingham	Mcevoy Texaco	**Lead**	1243732	1156206	3/1/04	8/1/05	15	17.3	**0.007**	0.001	0.012	Industrial	**0.00002**	**0.00002**	**0.00002**
Main Basin	Metal Finishing Inc	**Lead**	995106	1230341	1/1/02	5/1/06	7	52.7	**0.011**	0.008	0.012	Industrial	**0.00052**	**0.00052**	**0.00052**
Main Basin	METRO- KING ST REG STATION	**Lead**	222124	1269353	3/1/97	8/16/05	34	103.0	**12.834**	6.514	23.410	Industrial	**0.23801**	**0.23801**	**0.23801**
Whidbey Island	Nichols Bros Boat Builders Inc	**Lead**	983376	1140093	3/1/02	11/1/06	26	56.9	**0.057**	0.006	0.125	Industrial	**0.00067**	**0.00067**	**0.00067**
South Sound	North Bay/Case Inlet	**Lead**	754218	1054742	12/1/02	8/1/05	10	32.5	**0.287**	0.229	0.325	Industrial	**0.00015**	**0.02080**	**0.04146**
South Sound	Occidental Chemical Corp	**Lead**	711718	1176346	5/1/02	5/1/04	9	24.4	**2.832**	1.244	3.187	Industrial	**0.00878**	**0.00878**	**0.00878**
Bellingham	Olivine Corp	**Lead**	1272358	1150301	4/1/02	7/1/06	5	51.7	**0.048**	0.046	0.049	Industrial	**0.00017**	**0.00017**	**0.00017**
South Sound	Pacific Functional Fluids Llc	**Lead**	709851	1170308	1/1/02	11/1/06	25	58.8	**0.162**	0.011	0.364	Industrial	**0.00102**	**0.00107**	**0.00113**
Main Basin	Paramount Petroleum Corp Lust Site	**Lead**	897130	1174930	1/1/02	10/1/06	25	57.8	**0.143**	0.084	0.184	Industrial	**0.00049**	**0.00050**	**0.00051**
Main Basin	Powder Fab Inc	**Lead**	1038544	1238040	3/1/02	12/1/06	19	57.9	**0.002**	0.001	0.003	Industrial	**0.00001**	**0.00002**	**0.00002**
Main Basin	Production Plating	**Lead**	939204	1200375	1/1/02	1/1/06	9	48.7	**0.057**	0.034	0.097	Industrial	**0.00589**	**0.00632**	**0.00675**
South Sound	Puglia Engineering Inc	**Lead**	710396	1165892	12/1/06	12/1/06	1	0.0	**0.042**	0.042	0.042	Industrial	**0.00143**	**0.00143**	**0.00143**
South Sound	Puyallup Stp	**Lead**	685790	1193396	8/1/03	12/1/06	38	40.6	**6.431**	4.440	13.629	Municipal	**0.00223**	**0.00223**	**0.00223**
Bellingham	Recomp Of Wa	**Lead**	1277106	1146735	1/1/02	12/1/06	57	59.8	**0.056**	0.013	0.119	Industrial	**0.00020**	**0.00020**	**0.00020**
Main Basin	RENTON INPLANT	**Lead**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**0.00000**	**2.11932**	**4.23865**
South Sound	Rustlewood Stp	**Lead**	719870	1038606	12/1/02	12/1/06	5	48.7	**0.047**	0.031	0.071	Municipal	**0.00061**	**0.00064**	**0.00067**
South Sound	Schnitzer Steel Industries Tac	**Lead**	710006	1176589	1/1/02	12/1/06	58	59.8	**0.011**	0.003	0.023	Industrial	**0.00007**	**0.00076**	**0.00146**
Main Basin	Shell Oil Product Seattle Terminal	**Lead**	823723	1183551	7/8/03	4/1/04	5	8.9	**0.138**	0.004	0.661	Industrial	**0.00133**	**0.00133**	**0.00133**
Main Basin	Synrad Inc	**Lead**	894849	1226208	1/1/02	9/1/06	53	56.8	**0.001**	0.000	0.001	Industrial	**0.00000**	**0.00000**	**0.00000**
Main Basin	Time Oil Co	**Lead**	854869	1173980	3/1/02	6/1/05	7	39.6	**0.000**	0.000	0.001	Industrial	**0.00000**	**0.00000**	**0.00000**
Whidbey Island	Ttm Technologies	**Lead**	1151192	1175617	1/1/02	6/1/03	18	17.2	**0.074**	0.003	0.185	Industrial	**0.00270**	**0.00274**	**0.00279**
Main Basin	Usn Undersea Warfare Center	**Lead**	869459	1117180	1/1/02	9/1/06	101	56.8	**0.276**	0.027	1.809	Industrial	**0.00236**	**0.00257**	**0.00278**
Main Basin	Usnav Puget Sound Shipyard	**Lead**	818979	1113160	1/1/02	12/1/06	139	59.8	**0.563**	0.289	0.853	Industrial	**0.01050**	**0.02623**	**0.04196**
Hood Canal	Usnav Submarine Base Bangor	**Lead**	879683	1093806	1/1/02	12/1/06	126	59.8	**0.150**	0.081	0.278	Industrial	**0.00390**	**0.00464**	**0.00539**
Main Basin	WEST PT INPLANT	**Lead**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**0.00000**	**2.18417**	**4.36834**
Bellingham	Yamato Engine Specialist	**Lead**	1265039	1150220	12/1/03	11/1/06	28	35.5	**0.002**	0.002	0.003	Industrial	**0.00062**	**0.00062**	**0.00062**
South Sound	Yelm Stp	**Lead**	599289	1121721	3/1/02	6/1/05	10	39.6	**0.362**	0.237	0.541	Municipal	**0.00007**	**0.00032**	**0.00056**
Main Basin	METRO- KING ST REG STATION	**low molecular weight PAHs**	222124	1269353	3/1/97	5/31/97	60	3.0	**62.226**	32.120	118.363	Industrial	**0.00099**	**0.01360**	**0.02621**
Main Basin	METRO- KING ST REG STATION	**Mercury**	222124	1269353	3/1/97	5/31/97	10	3.0	**10.371**	5.353	19.727	Industrial	**0.00000**	**0.00092**	**0.00185**
Main Basin	RENTON INPLANT	**Mercury**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**0.00000**	**0.00353**	**0.00706**
Main Basin	WEST PT INPLANT	**Mercury**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**0.00000**	**0.01009**	**0.02018**
Main Basin	Bnsf Skykomish Remediation Site	**oil or petroleum product**	867963	1428297	8/1/06	11/1/06	6	3.1	**0.786**	0.388	1.044	Industrial	**0.22914**	**0.22914**	**0.22914**
Main Basin	Bp Oil Service Station #11093	**oil or petroleum product**	923090	1217161	1/1/02	8/1/06	41	55.8	**0.013**	0.000	0.039	Industrial	**0.01707**	**0.01832**	**0.01958**

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Bellingham	Brooks Mfg	**oil or petroleum product**	1255275	1168299	4/1/06	4/1/06	1	0.0	**0.001**	0.001	0.001	Industrial	**0.00384**	**0.00384**	**0.00384**
Bellingham	Chemco	**oil or petroleum product**	1305435	1109140	1/1/02	5/1/05	35	40.5	**0.457**	0.194	1.807	Industrial	**1.25556**	**1.64819**	**2.04082**
Main Basin	Concophillips Co Renton Terminal	**oil or petroleum product**	780163	1214025	1/1/02	2/1/06	12	49.7	**0.418**	0.155	0.866	Industrial	**0.24383**	**0.27215**	**0.30047**
South Sound	Conocophillips Tacoma North Termina	**oil or petroleum product**	707942	1160465	1/1/02	12/1/06	37	59.8	**0.060**	0.016	0.132	Industrial	**0.03383**	**0.07408**	**0.11434**
South Sound	Conocophillips Tacoma Terminal Sout	**oil or petroleum product**	706778	1160247	9/1/04	12/1/06	22	27.4	**0.206**	0.002	1.093	Industrial	**0.06952**	**0.22852**	**0.38753**
Bellingham	Intalco Ferndale	**oil or petroleum product**	1289304	1107312	3/1/02	12/1/06	27	57.9	**5.522**	3.048	6.875	Municipal	**6.05433**	**6.05433**	**6.05433**
Eastern Olympic	K Ply Inc	**oil or petroleum product**	1030378	922069	4/1/02	9/1/02	6	5.1	**0.128**	0.118	0.152	Industrial	**0.00000**	**0.28573**	**0.57147**
Bellingham	Lehigh Northwest Cement Co	**oil or petroleum product**	1259178	1152682	1/1/02	3/1/06	46	50.7	**0.091**	0.070	0.127	Industrial	**0.08721**	**0.08721**	**0.08721**
South Sound	Mcfarland Cascade Pole & Lumber Co	**oil or petroleum product**	704778	1166507	12/14/02	1/1/06	14	37.1	**0.462**	0.223	0.936	Industrial	**0.93254**	**1.56609**	**2.19965**
Bellingham	Oeser Co	**oil or petroleum product**	1259183	1153206	11/1/05	12/1/06	2	13.2	**0.004**	0.004	0.004	Industrial	**0.00777**	**0.00777**	**0.00777**
Main Basin	Pacific Coast Coal Co	**oil or petroleum product**	730509	1270313	2/1/02	6/1/06	15	52.7	**0.371**	0.030	1.000	Industrial	**0.62995**	**0.63560**	**0.64126**
South Sound	Pacific Functional Fluids Llc	**oil or petroleum product**	709851	1170308	1/1/02	11/1/06	20	58.8	**0.049**	0.011	0.132	Industrial	**0.12511**	**0.14540**	**0.16569**
Main Basin	Paramount Petroleum Corp Lust Site	**oil or petroleum product**	897130	1174930	1/1/02	12/1/06	114	59.8	**0.278**	0.162	0.379	Industrial	**0.01742**	**0.02823**	**0.03904**
South Sound	Port Of Tacoma	**oil or petroleum product**	708744	1176524	1/1/02	2/1/06	37	49.7	**0.214**	0.005	1.301	Industrial	**0.03047**	**0.36893**	**0.70739**
Bellingham	Puget Sound Energy Whitehorn	**oil or petroleum product**	1300816	1093816	12/1/04	12/1/04	1	0.0	**0.013**	0.013	0.013	Industrial	**0.05676**	**0.05676**	**0.05676**
South Sound	Schnitzer Steel Industries Tac	**oil or petroleum product**	710006	1176589	1/1/02	12/1/06	57	59.8	**0.011**	0.003	0.023	Industrial	**0.00227**	**0.02570**	**0.04913**
Main Basin	Sea Tac Airport	**oil or petroleum product**	773903	1193930	1/1/02	12/1/06	64	59.8	**10.493**	0.038	17.059	Industrial	**14.73300**	**23.69643**	**32.65985**
Main Basin	Seattle Steam	**oil or petroleum product**	832602	1187442	1/1/02	12/1/06	22	59.8	**0.066**	0.038	0.113	Industrial	**0.12481**	**0.13126**	**0.13771**
Main Basin	Shell Oil Product Seattle Terminal	**oil or petroleum product**	823723	1183551	1/1/02	11/1/05	12	46.7	**0.466**	0.318	0.626	Industrial	**19.84486**	**19.84486**	**19.84486**
South Sound	St Services	**oil or petroleum product**	708911	1160065	11/1/04	12/1/06	22	25.3	**0.029**	0.009	0.064	Industrial	**0.01071**	**0.03323**	**0.05574**

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Bellingham	Tenaska Cogeneration Plant	**oil or petroleum product**	1281302	1114379	2/1/02	12/1/05	21	46.6	**0.181**	0.014	0.317	Industrial	**0.06554**	**0.31312**	**0.56070**
South Sound	Western Wood Preserving Co	**oil or petroleum product**	688326	1208432	1/1/02	9/1/04	27	32.5	**0.226**	0.057	0.367	Industrial	**0.08895**	**0.26204**	**0.43514**
Main Basin	Weyerhaeuser Snoqualmie	**oil or petroleum product**	805613	1312954	1/1/02	3/1/04	19	26.3	**0.034**	0.000	0.365	Industrial	**0.00000**	**0.07489**	**0.14979**
Main Basin	METRO- KING ST REG STATION	**other high molecular weight PAHs**	222124	1269353	3/1/97	5/31/97	30	3.0	**31.113**	16.060	59.181	Industrial	**0.00079**	**0.00701**	**0.01322**
Main Basin	METRO- KING ST REG STATION	**phthalate**	222124	1269353	3/1/97	5/31/97	10	3.0	**10.371**	5.353	19.727	Industrial	**0.08189**	**0.08189**	**0.08189**
Whidbey Island	Alpha Technologies - Arlington	**Zinc**	1050953	1242609	1/1/02	10/1/05	13	45.6	**0.024**	0.007	0.040	Industrial	**0.00400**	**0.00400**	**0.00400**
Main Basin	Artisan Finishing Systems Inc	**Zinc**	992296	1230656	1/1/02	7/1/06	10	54.7	**0.009**	0.007	0.014	Industrial	**0.00038**	**0.00038**	**0.00038**
Whidbey Island	Associated Petroleum Products Inc	**Zinc**	1161904	1217337	1/1/04	12/1/06	19	35.5	**0.001**	0.000	0.011	Industrial	**0.00001**	**0.00001**	**0.00001**
South Sound	Atlas Castings & Technology	**Zinc**	698677	1153225	1/1/02	5/1/02	15	4.0	**0.042**	0.003	0.126	Industrial	**0.02348**	**0.02348**	**0.02348**
South Sound	Buckley Stp	**Zinc**	673490	1257901	1/1/02	3/1/03	8	14.1	**0.915**	0.511	1.364	Municipal	**0.03714**	**0.03714**	**0.03714**
South Sound	Carbonado Coalbed Methane Project	**Zinc**	619150	1252155	10/1/02	1/1/04	15	15.2	**0.058**	0.023	0.076	Industrial	**0.00022**	**0.00046**	**0.00070**
Main Basin	Coastal Manufacturing	**Zinc**	939143	1197588	1/1/02	9/1/04	31	32.5	**0.003**	0.001	0.005	Industrial	**0.00076**	**0.00076**	**0.00076**
South Sound	Conocophillips Tacoma Terminal Sout	**Zinc**	706778	1160247	9/1/04	12/1/06	22	27.4	**0.206**	0.002	1.093	Industrial	**0.01496**	**0.01496**	**0.01496**
Main Basin	Duvall Stp	**Zinc**	874588	1272144	1/1/02	4/1/02	4	3.0	**0.854**	0.733	1.036	Municipal	**0.03451**	**0.03451**	**0.03451**
Main Basin	Everett Stp	**Zinc**	967933	1225118	1/1/02	6/1/04	30	29.4	**12.056**	6.807	18.564	Municipal	**0.18484**	**0.18877**	**0.19271**
South Sound	Exide Technologies	**Zinc**	690002	1207704	10/1/04	10/1/06	7	24.3	**0.003**	0.003	0.004	Industrial	**0.00025**	**0.00025**	**0.00025**
Main Basin	Goodrich Aviation Tech Services	**Zinc**	941699	1207907	1/1/02	12/1/06	51	59.8	**0.051**	0.030	0.071	Industrial	**0.02228**	**0.02228**	**0.02228**
Main Basin	Granite Falls Stp	**Zinc**	1004725	1278621	1/1/02	10/1/04	34	33.5	**0.367**	0.229	0.591	Municipal	**0.02837**	**0.02837**	**0.02837**
Whidbey Island	Inman Landfill	**Zinc**	1164786	1171276	3/1/02	3/1/03	3	12.2	**0.066**	0.046	0.097	Industrial	**0.00165**	**0.00165**	**0.00165**
South Sound	J M Martinac	**Zinc**	704713	1161192	5/1/06	11/1/06	5	6.1	**0.000**	0.000	0.000	Industrial	**0.00003**	**0.00003**	**0.00003**
Eastern Olympic	Lafarge Corporation	**Zinc**	1050293	797299	12/1/06	12/1/06	1	0.0	**0.200**	0.200	0.200	Industrial	**0.04476**	**0.04476**	**0.04476**
South Sound	Lott	**Zinc**	630997	1045285	1/1/02	12/1/06	57	59.8	**35.036**	25.974	54.454	Municipal	**1.88520**	**1.88520**	**1.88520**
South Sound	Marine Industries Nw-State	**Zinc**	708374	1161293	2/1/04	11/1/04	11	9.1	**0.032**	0.002	0.092	Industrial	**0.01389**	**0.01389**	**0.01389**
Main Basin	Metal Finishing Inc	**Zinc**	995106	1230341	1/1/02	12/1/06	58	59.8	**0.010**	0.007	0.014	Industrial	**0.00679**	**0.00679**	**0.00679**
Main Basin	METRO- KING ST REG STATION	**Zinc**	222124	1269353	3/1/97	8/16/05	34	103.0	**12.834**	6.514	23.410	Industrial	**1.97369**	**1.97369**	**1.97369**
Whidbey Island	Nichols Bros Boat Builders Inc	**Zinc**	983376	1140093	3/1/02	12/1/06	27	57.9	**0.059**	0.006	0.133	Industrial	**0.01864**	**0.01864**	**0.01864**
Main Basin	North Bend Stp	**Zinc**	791889	1322612	1/1/02	12/1/06	60	59.8	**1.431**	1.013	2.283	Municipal	**0.06227**	**0.06227**	**0.06227**
South Sound	Occidental Chemical Corp	**Zinc**	711718	1176346	8/1/05	12/1/06	6	16.2	**1.606**	1.392	1.764	Industrial	**0.13036**	**0.13098**	**0.13161**
Bellingham	Olivine Corp	**Zinc**	1272358	1150301	1/1/02	10/1/06	10	57.8	**0.030**	0.014	0.039	Industrial	**0.00034**	**0.00034**	**0.00034**
Hood Canal	Olympic View Sanitary Landfill	**Zinc**	799939	1077698	3/1/02	12/1/06	6	57.9	**0.418**	0.403	0.433	Industrial	**0.01342**	**0.01342**	**0.01342**
Main Basin	Pacific Coast Coal Co	**Zinc**	730509	1270313	3/1/02	3/1/02	2	0.0	**2.680**	2.680	2.680	Industrial	**0.02202**	**0.02202**	**0.02202**
South Sound	Pacific Functional Fluids Llc	**Zinc**	709851	1170308	1/1/02	11/1/06	25	58.8	**0.162**	0.011	0.364	Industrial	**0.01625**	**0.01625**	**0.01625**
Main Basin	Powder Fab Inc	**Zinc**	1038544	1238040	3/1/02	12/1/06	19	57.9	**0.002**	0.001	0.003	Industrial	**0.00022**	**0.00022**	**0.00022**
Main Basin	Production Plating	**Zinc**	939204	1200375	1/1/02	12/1/06	60	59.8	**0.055**	0.032	0.101	Industrial	**0.13569**	**0.13569**	**0.13569**

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South Sound	Puglia Engineering Inc	**Zinc**	710396	1165892	12/1/06	12/1/06	1	0.0	**0.042**	0.042	0.042	Industrial	**0.06047**	**0.06047**	**0.06047**
South Sound	Puyallup Stp	**Zinc**	685790	1193396	8/1/03	12/1/06	38	40.6	**6.431**	4.440	13.629	Municipal	**0.23349**	**0.23349**	**0.23349**
Bellingham	Recomp Of Wa	**Zinc**	1277106	1146735	1/1/02	12/1/06	60	59.8	**0.056**	0.013	0.119	Industrial	**0.00396**	**0.00396**	**0.00396**
Main Basin	RENTON INPLANT	**Zinc**	224095	1247306	3/6/02	3/20/02	2	0.5	**158.444**	127.306	189.582	Industrial	**5.84063**	**5.84063**	**5.84063**
South Sound	Schnitzer Steel Industries Tac	**Zinc**	710006	1176589	1/1/02	12/1/06	58	59.8	**0.011**	0.003	0.023	Industrial	**0.00333**	**0.00334**	**0.00336**
Main Basin	Shell Oil Product Seattle Terminal	**Zinc**	823723	1183551	1/1/02	12/1/06	52	59.8	**0.230**	0.005	0.966	Industrial	**0.03393**	**0.03393**	**0.03393**
South Sound	Sumner Stp	**Zinc**	685681	1204323	1/1/02	12/1/06	60	59.8	**2.716**	2.027	5.275	Municipal	**0.13798**	**0.13798**	**0.13798**
Bellingham	Tenaska Cogeneration Plant	**Zinc**	1281302	1114379	8/1/06	8/1/06	1	0.0	**0.277**	0.277	0.277	Industrial	**0.00000**	**0.00310**	**0.00619**
Whidbey Island	Ttm Technologies	**Zinc**	1151192	1175617	1/1/02	4/1/02	2	3.0	**0.170**	0.166	0.175	Industrial	**0.00616**	**0.00616**	**0.00616**
Main Basin	Usn Undersea Warfare Center	**Zinc**	869459	1117180	1/1/02	12/1/06	107	59.8	**0.272**	0.027	1.809	Industrial	**0.02496**	**0.02496**	**0.02496**
Whidbey Island	Usnav Naval Air Station Whidbey	**Zinc**	1101395	1112921	12/1/06	12/1/06	1	0.0	**0.000**	0.000	0.000	Industrial	**0.00000**	**0.00000**	**0.00000**
Main Basin	Usnav Puget Sound Shipyard	**Zinc**	818979	1113160	1/1/02	12/1/06	318	59.8	**0.710**	0.328	1.181	Industrial	**0.25676**	**0.26020**	**0.26364**
Hood Canal	Usnav Submarine Base Bangor	**Zinc**	879683	1093806	1/1/02	12/1/06	126	59.8	**0.150**	0.081	0.278	Industrial	**0.04675**	**0.04676**	**0.04677**
South Sound	Washington Corrections Center	**Zinc**	708992	973086	10/1/02	10/1/06	5	48.7	**0.253**	0.217	0.316	Industrial	**0.01626**	**0.01626**	**0.01626**
Main Basin	WEST PT INPLANT	**Zinc**	245209	1242390	3/7/02	12/9/03	6	21.4	**163.292**	126.501	247.247	Industrial	**6.76339**	**6.76339**	**6.76339**
Bellingham	Yamato Engine Specialist	**Zinc**	1265039	1150220	12/1/03	10/1/06	14	34.5	**0.002**	0.002	0.003	Industrial	**0.00931**	**0.00931**	**0.00931**
South Sound	Yelm Stp	**Zinc**	599289	1121721	3/1/02	12/1/06	33	57.9	**0.543**	0.299	0.970	Municipal	**0.01384**	**0.01606**	**0.01828**