Technical Memorandum 750

Sediment Deposition and Contamination Potential from Treated CSO Discharges

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King County

Department of Natural Resources and Parks
Wastewater Treatment Division

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Acronyms and Abbreviations

cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSO	combined sewer overflow
EFDC	Environmental Fluid Dynamics Code
HLKK	Hanford/Lander/King/Kingdome (CSO treatment scenario)
HPAH	high molecular weight polynuclear aromatic hydrocarbon
LDW FS	Lower Duwamish Waterway Feasibility Study
LDW RI	Lower Duwamish Waterway Remedial Investigation
LPAH	low molecular weight polynuclear aromatic hydrocarbon
MG	million gallons
MGD	million gallons per day
PCB	polychlorinated biphenyls
RWSP	Regional Wastewater Services Plan
SVOC	semi- volatile organic compounds
TSS	total suspended solids
USGS	U.S. Geological Survey

1 Executive Summary

King County's Wastewater Treatment Division is reviewing treatment technologies that can be used to treat combined sewer overflow (CSO) discharges. Historic CSO discharges have contributed to elevated contaminant levels in the sediments surround the discharge locations. A factor in the treatment technology review is the ability of the technologies to remove sufficient levels of contaminants to prevent exceedances of sediment quality standards. Long-term sediment contaminant levels are predicted for three potential treated CSO locations under three levels of treatment effectiveness. The resulting sediment quality is compared to the Washington State Sediment Quality Standards.

1.1 Background and History

As a component of King County's 2012 CSO Control Plan update, treatment technologies are being considered for CSO locations where storage and/or flow reduction are not expected to be cost-effective methods of achieving control, including the County's four Duwamish CSO treatment projects that were planned in the 1999 Regional Wastewater Services Plan (RWSP) (King/Kingdome, Hanford/Lander, Brandon and Michigan sites).

King County's RWSP recommended that the County use conventional clarification for CSO treatment, which was a proven technology and the more cost-effective at the time. The RWSP also recommended that the County continue to evaluate the development of new technologies, including alternative high-rate treatment technologies, based on the experience of other agencies. This was done as part of the *2000 CSO Plan Update* and the *2006 CSO Control Program Review*, and is being updated again as part of the *2012 CSO Control Program Review*. The 2006 Review identified several promising approaches which lacked operating data; thus, pilot testing was recommended. The County completed testing of high-rate clarification technologies at the West Point Wastewater Treatment Plant in 2009. The final report was issued in June 2010 (see http://www.kingcounty.gov/environment/wastewater/CSO/ProgramReview/EvalTech.aspx). The information from the pilot testing is included in the technology review for this *2012 CSO Control Program Review*, which can be found at http://www.kingcounty.gov/environment/wastewater/CSO/ProgramReview/Plan.aspx.

1.2 Purpose

The goal of modeling sediment deposition and contamination potential was to inform the treatment technology review on how the treatment technologies under consideration would affect sediment contamination. Technologies that produce an effluent quality sufficient that depositing sediment would meet Washington State's sediment quality standards would be preferred. The results of the treatment technology review can be found in the *Technical Memorandum 700, Treatment Technology Selection*.

1.3 Approach

The quality of accumulating sediments was estimated from a simple dilution relationship between the amount of sediment naturally accumulating and the sediment being deposited from the CSO discharge. The accumulation of sediment particles from CSO discharges was simulated with a three-dimensional hydrodynamic model. The amount of sediment that would naturally

accumulate was estimated from previous studies, typically studies using geochronological analysis.

Chemical concentrations associated with the CSO particles were assumed to behave as conservative substances and remain bound to the particulates. Samples of solid material from the CSO collection system were used to characterize the CSO chemical concentrations; concentrations for ambient sediment deposition were taken from existing characterizations of the Lower Duwamish Waterway and East Waterway.

Three potential treatment facilities were modeled to evaluate site-specific factors. A facility to treat Michigan and Brandon CSO flows was modeled with its discharge at the existing Michigan CSO. A facility treating the combined Hanford and Lander CSO flows was modeled with its discharge at the existing Hanford CSO. The third facility modeled would treat the combined flows from Hanford, Lander, King, and Kingdome and discharge at the existing Kingdome CSO.

1.4 Results

The level of treatment had the greatest effect on the predicted sediment quality. Site-specific factors caused minor variations in sediment quality, primarily a result of locations with higher deposition rates having higher ambient sedimentation rates. Thus, sediment quality was similar for the same level of CSO treatment at all of the simulated CSO discharge locations. Increasing the removal efficiency of the CSO treatment resulted in reduced concentrations in the sediment.

While the model predicted benzoic acid and 4-methylphenol would exceed sediment quality standards under several scenarios; physical-chemical data including solubility and organic-water partitioning coefficients indicate that these compounds are unlikely to accumulate in sediments. This is supported by the lack of sediment quality exceedances around existing CSO discharges.

Sediment quality exceedances of butyl benzyl phthalate and bis (2-ethylhexyl) phthalate were assessed for all three CSO locations with CSO treatment technology equivalent to 50% solids removal. With 70% solids removal efficiency bis (2-ethylhexyl) phthalate was predicted to exceed in one cell (300 square feet) at the Michigan/Brandon CSO. No other compounds were predicted to exceed sediment quality standards with a 70% solids removal and no compounds were predicted to exceed at 90% solids removal, aside from benzoic acid and 4-methylphenol mentioned above. Supported by these findings, the 2012 CSO Control Program Review recommended technologies capable of achieving these high removals - chemically enhanced primary clarification with lamella plates or ballasted sedimentation - for future CSO treatment projects.

2 Introduction

King County's Wastewater Treatment Division is reviewing treatment technologies that can be used to treat combined sewer overflow (CSO) discharges for CSO locations where storage and/or flow reduction are not expected to achieve control (defined as limiting untreated CSOs to no more than an average of one per year). These locations include the County's Duwamish/Elliott Bay CSO treatment projects that were planned in the 1999 Regional Wastewater Services Plan (RWSP; King County 1998).

This technical memorandum summarizes an evaluation of how treatment of CSOs could affect sediment quality in the waters surrounding the treatment facilities' discharge locations.

2.1 Background and History

The RWSP recommended that King County use conventional clarification for CSO treatment, which was a proven technology and more cost-effective at the time. The RWSP also recommended that the County continue to evaluate new technologies, including high-rate treatment technologies, based on the experience of other agencies. This was done as part of the 2000 CSO Plan Update (King County 2000) and the 2006 CSO Control Program Review (King County 2006). The evaluation of new technologies has been updated again for the 2012 CSO Control Program Review.

Sediment contamination near existing CSO discharges appears to have resulted from a combination of historical inputs and current practices (King County 1999). Details on existing exceedances of Washington State Sediment Quality Standards near CSO discharges are presented in the Comprehensive Sediment Quality Summary Report for CSO Discharge Locations (King County 2009a).

2.2 Purpose

King County wants to understand how different CSO treatment technologies would affect discharge quality and resulting sediment quality near the CSO discharge location. This technical memorandum documents estimates of sediment deposition around potential future treated CSO discharge locations. The estimates are based on CSO treatment efficiencies, discharge volumes and particulate chemical concentrations. Sediment quality resulting from treated CSO discharges was estimated by simulating the transport of particulate matter using the three-dimensional hydrodynamic model, Environmental Fluid Dynamics Code (EFDC).

2.3 Approach

The quality of accumulating sediments was estimated from a simple dilution relationship between the amount of sediment naturally accumulating and the sediment being deposited from the CSO discharge. The accumulation of sediment particles from CSO discharges was simulated with a three-dimensional hydrodynamic model. The amount of sediment that would naturally accumulate was estimated from previous studies, typically studies using geochronological analysis.

Chemical concentrations associated with the CSO particles were assumed to behave as conservative substances and remain bound to the particulates. Samples of solid material from the CSO collection system were used to characterize the CSO chemical concentrations;

concentrations for ambient sediment deposition were taken from existing characterizations of the Lower Duwamish Waterway and East Waterway.

Three potential treatment facilities were modeled to evaluate site-specific factors. A facility to treat Michigan and Brandon CSO flows was modeled with its discharge at the existing Michigan CSO. A facility treating the combined Hanford and Lander CSO flows was modeled with its discharge at the existing Hanford CSO. The third facility modeled would treat the combined flows from Hanford, Lander, King, and Kingdome CSOs and discharge at the existing Kingdome CSO location. These facilities simulate a discharge into the Lower Duwamish Waterway, East Waterway, and Elliott Bay, as shown in Figure 1.

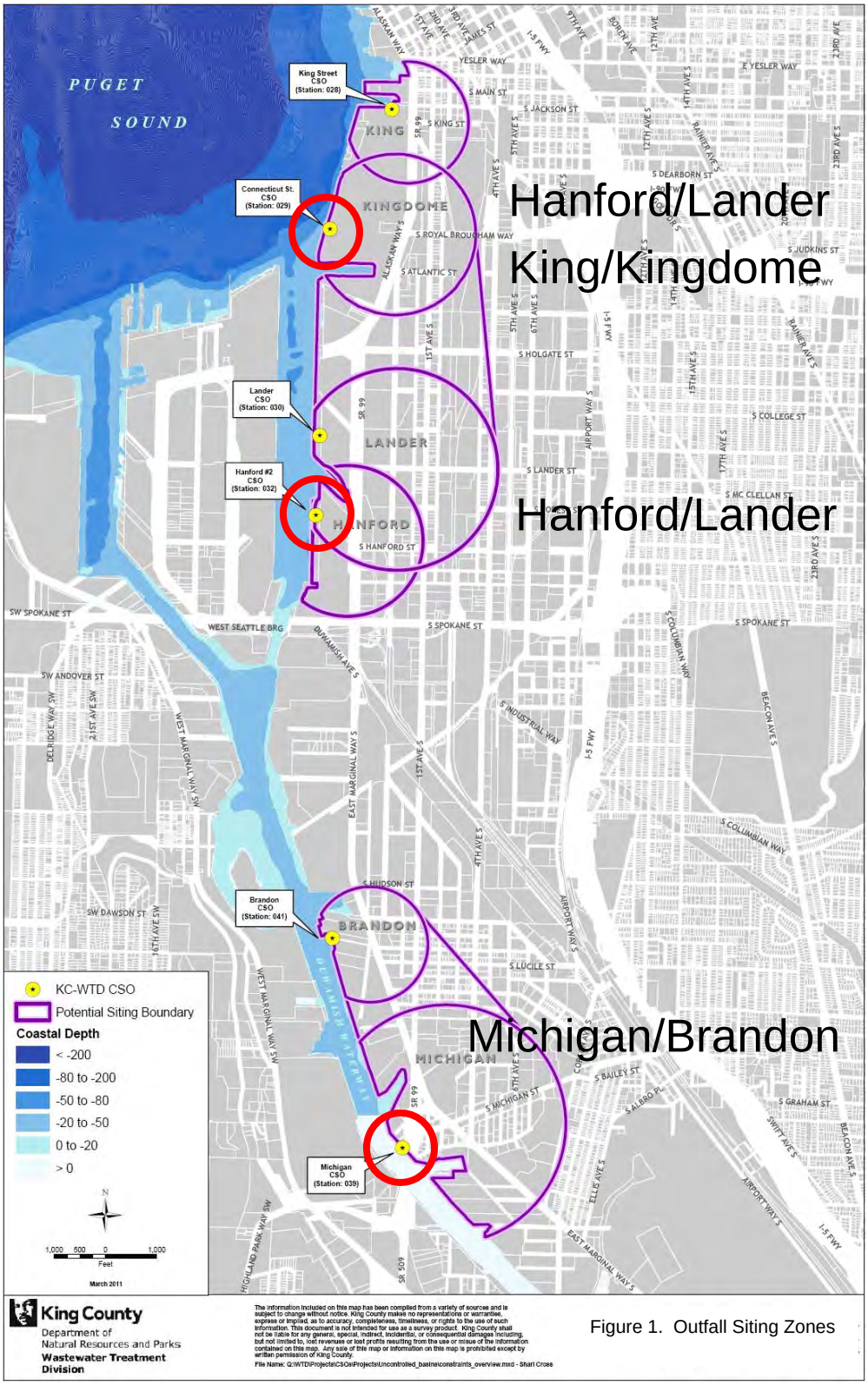

Figure 1. Outfall Siting Zones

Figure 1. Simulated CSO Treatment Facilities. Discharge locations circled in red. Potential siting areas in purple.

2.4 Modeling Workflow

Figure 2 shows the process used to evaluate sediment quality surrounding treated CSO discharge locations. The three-dimensional hydrodynamic model simulated the accumulation of sediment particles discharged from a CSO location. Chemical concentrations associated with the CSO particles were assumed to behave as conservative substances and remain bound to the particulates.

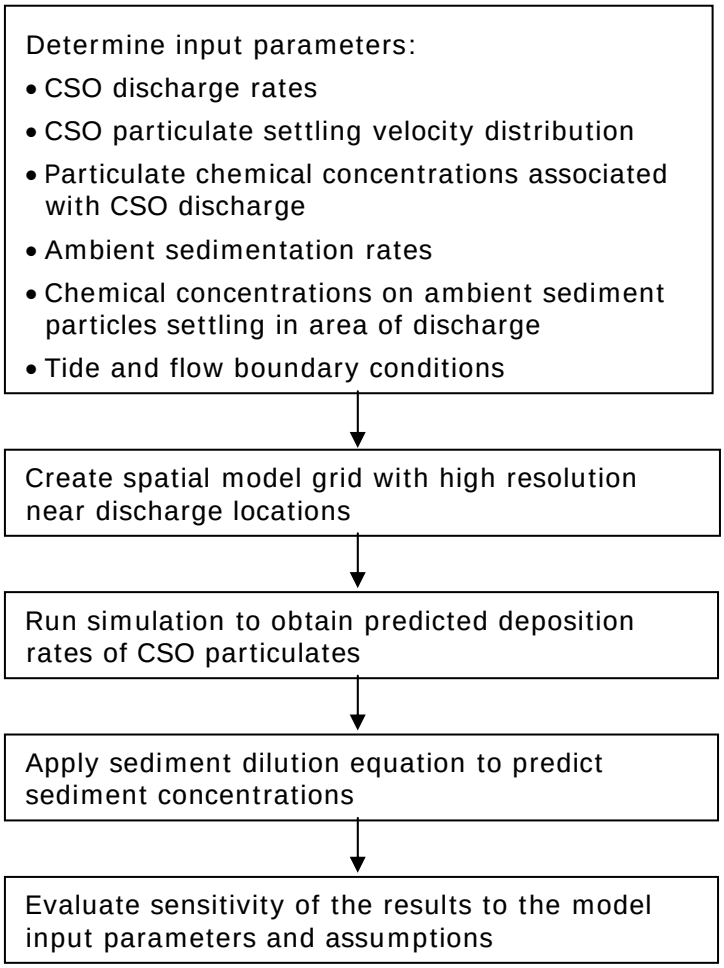

Figure 2. Modeling Process Used to Estimate Sediment Concentrations Near CSO Discharges

The quality of accumulating sediments was estimated from a simple dilution relationship between the amount of sediment naturally accumulating and the sediment being deposited from the CSO discharge. The amount of sediment that would naturally accumulate was estimated from previous studies, typically studies using geochronological analysis. The amount of sediment deposited from the CSO discharge was predicted by the EFDC model. These amounts, combined with the respective sediment quality were combined in the following dilution equation:

$$C = \frac{C_{CSO} D_{CSO} + C_A D_A}{D_{CSO} + D_A}$$

where:

C = predicted sediment chemical concentration in micrograms per kilogram (µg/kg)

C_{CSO} = chemical concentration on CSO particulates (µg/kg)

D_{CSO} = depositional rate of CSO particulates in millimeters per year (mm/year)

C_A = chemical concentration from ambient sedimentation (µg/kg)

D_A = rate of ambient sedimentation (mm/year)

This approach provides a conservative estimate of what treated CSOs deposit; it does not represent mixing of existing sediment bed concentrations into the newly deposited material. Only the depositional rate of CSO particulates was determined from the hydrodynamic model; other parameters are estimated from existing empirical data.

A spatially refined model grid was developed for the area around the CSO discharge locations that were evaluated. The hydrodynamic model was run for a simulated duration of three years; the annual sediment accumulation rate was calculated as the predicted sediment accumulation over the simulation period multiplied by the ratio of the annual CSO discharge volume to the simulation-period CSO discharge volume. The rate of sediment accumulation was used in the dilution equation to estimate sediment quality. This sediment quality was compared to the Washington State Sediment Quality Standards to identify which, if any, compounds could exceed the standards.

As many of the input parameters vary over a sizable range, a sensitivity analysis was conducted to assess how a higher or lower value of the following parameters would change the predictions:

- Ambient sediment concentrations
- Sedimentation rate
- Assumed concentration for compounds that were not detected in samples
- Organic carbon content of the sediment.

For chemicals that were predicted to exceed the sediment quality standards, an analysis was performed to evaluate the assumption that each contaminate behaves as a conservative substance

2.5 WA Sediment Quality Standards

The compounds of interest for this evaluation are those that have a sediment quality standard defined under Washington State Sediment Management Standard (Washington Administrative Code Chapter 173-204-320). Table 1 lists these chemicals and the sediment quality standard for each; for chemicals whose standard is expressed on an organic carbon (OC) basis, dry weight equivalents are provided.

Table 1. Washington State Sediment Quality Standards

Chemical	Sediment Quality Standards	Dry Weight Equivalent
Arsenic	57 mg/kg dry weight	
Cadmium	5.1 mg/kg dry weight	
Chromium	260 mg/kg dry weight	
Copper	390 mg/kg dry weight	
Lead	450 mg/kg dry weight	
Mercury	0.41 mg/kg dry weight	
Silver	6.1 mg/kg dry weight	
Zinc	410 mg/kg dry weight	
LPAH	370 mg/kg organic carbon	5200 µg/kg dry weight
Naphthalene	99 mg/kg organic carbon	2100 µg/kg dry weight
Acenaphthylene	66 mg/kg organic carbon	1300 µg/kg dry weight
Acenaphthene	16 mg/kg organic carbon	500 µg/kg dry weight
Fluorene	23 mg/kg organic carbon	540 µg/kg dry weight
Phenanthrene	100 mg/kg organic carbon	1500 µg/kg dry weight
Anthracene	220 mg/kg organic carbon	960 µg/kg dry weight
2-Methylnaphthalene	38 mg/kg organic carbon	670 µg/kg dry weight
HPAH	960 mg/kg organic carbon	12000 µg/kg dry weight
Fluoranthene	160 mg/kg organic carbon	1700 µg/kg dry weight
Pyrene	1,000 mg/kg organic carbon	2600 µg/kg dry weight
Benz(A)Anthracene	110 mg/kg organic carbon	1300 µg/kg dry weight
Chrysene	110 mg/kg organic carbon	1400 µg/kg dry weight
Total Benzofluoranthenes	230 mg/kg organic carbon	3200 µg/kg dry weight
Benzo(A)Pyrene	99 mg/kg organic carbon	1600 µg/kg dry weight
Indeno (1,2,3,-C,D) Pyrene	34 mg/kg organic carbon	600 µg/kg dry weight
Dibenzo (A,H) Anthracene	12 mg/kg organic carbon	230 µg/kg dry weight
Benzo(G,H,I)Perylene	31 mg/kg organic carbon	670 µg/kg dry weight
1,2-Dichlorobenzene	2.3 mg/kg organic carbon	35 µg/kg dry weight
1,4-Dichlorobenzene	3.1 mg/kg organic carbon	110 µg/kg dry weight
1,2,4-Trichlorobenzene	0.81 mg/kg organic carbon	31 µg/kg dry weight
Hexachlorobenzene	0.38 mg/kg organic carbon	22 µg/kg dry weight
Dimethyl Phthalate	53 mg/kg organic carbon	71 µg/kg dry weight
Diethyl Phthalate	61 mg/kg organic carbon	200 µg/kg dry weight
Di-N-Butyl Phthalate	220 mg/kg organic carbon	1400 µg/kg dry weight
Butyl Benzyl Phthalate	4.9 mg/kg organic carbon	63 µg/kg dry weight
Bis (2-Ethylhexyl) Phthalate	47 mg/kg organic carbon	1300 µg/kg dry weight
Di-N-Octyl Phthalate	58 mg/kg organic carbon	6200 µg/kg dry weight
Dibenzofuran	15 mg/kg organic carbon	540 µg/kg dry weight
Hexachlorobutadiene	3.9 mg/kg organic carbon	11 µg/kg dry weight
N-Nitrosodiphenylamine	11 mg/kg organic carbon	28 µg/kg dry weight
Total PCBs	12 mg/kg organic carbon	130,000 µg/kg dry weight
Phenol	420 µg/kg dry weight	
2-Methylphenol	63 µg/kg dry weight	
4-Methylphenol	670 µg/kg dry weight	
2,4-Dimethyl Phenol	29 µg/kg dry weight	
Pentachlorophenol	360 µg/kg dry weight	
Benzyl Alcohol	57 µg/kg dry weight	
Benzoic Acid	650 µg/kg dry weight	

Sediment Quality Standards: http://www.ecy.wa.gov/programs/tcp/smu/sed_chem.htm
Dry weight equivalent: http://www.ecy.wa.gov/programs/tcp/smu/SQS_CSL_DW-ForWebsite.pdf

3 Model Input Data

The input data required by the model includes the following:

- Characterization of the CSO discharges:
  - Discharge flow rates
  - Particle characteristics (size or settling velocity)
  - Suspended solids concentrations
  - Chemical concentrations associated with CSO particulates
- CSO treatment removal efficiency
- Characterization of the ambient water body:
  - Water body geometry and bathymetry (depth)
  - Temperature and salinity at model boundaries
  - Tidal conditions
  - River inflow rates
- Chemical concentrations associated with ambient particles expected to settle in the vicinity of the outfall
- Ambient sedimentation rates

Mean values were used for these parameters, as the objective was to predict the long-term average sediment accumulation and corresponding sediment quality.

3.1 CSO Characterization

Discharge rates of each CSO were obtained from existing King County models of the wastewater collection system. The composition of the CSO effluent was estimated based on past sampling of CSO effluent from several King County studies.

3.1.1 CSO Discharge Rates

CSO discharge rates were based on previous hydraulic modeling of the combined conveyance system (B. Crawford, personal communication, “Unsteady run 2010b”, October2010). Three CSO discharges were selected for simulation:

- Michigan (discharging to the Lower Duwamish Waterway)—Discharge rate taken from modeling of the combined Michigan/Brandon alternative
- Hanford (discharging to the East Waterway)—Discharge rate taken from modeling of the combined Hanford/Lander alternative
- Kingdome (discharging to Elliott Bay)—Discharge rate taken from modeling of the combined Hanford/Lander/King/Kingdome (HLKK) alternative

The CSO treatment process was characterized by an equalization storage tank volume in millions of gallons (MG) and a maximum treatment capacity in millions of gallons per day (MGD), as

listed in Table 2 (vales taken from the CSO Alternative Analysis; King County 2011). Inflows that exceed the storage and treatment capacity were assumed to overflow untreated (1 or fewer events per year). A 32-year simulation was provided, and from this the average annual discharge rate was calculated for both the treated discharge and the untreated discharge.

Table 2. CSO Treatment Process Parameters

Location	Equalization Storage Volume (MG)	Maximum Treatment Capacity (MGD)
Michigan/Brandon	0.89	66
Hanford/Lander	0.97	94
HLKK	1.71	151

3.1.2 Model Simulation Period

The model used for hydrodynamic simulation for this technical memorandum was too complex to run for the entire 32-year period of discharge record. An analysis of hydrographs showed that the three-year period January 1978 to January 1981 had a discharge volumes close to the long-term mean, as shown in Table 3; so this period was selected for the sediment evaluation. The time series used for each CSO location are shown in Appendix A.

Table 3. Discharge Volume Over 1978-1981 Simulation Period and 32-Year Average Annual Discharge Volumes

Location	Total Discharge Volume (January 1978-January 1981)	32-year Average Annual Discharge (1978 – 2010)	Equivalent Number of Years
Michigan/Brandon			
Treated overflow	1,440,000 m^3	449,000 m^3	3.2
Untreated overflow	46,400 m^3	19,600 m^3	2.4
Hanford/Lander			
Treated overflow	4,060,000 m^3	1,130,000 m^3	3.6
Untreated overflow	21,300 m^3	11,000 m^3	1.9
HLKK			
Treated overflow	6,570,000 m^3	1,900,000 m^3	3.5
Untreated overflow	49,500 m^3	26,700 m^3	1.9

The discharge records for the selected period were compressed to eliminate periods of time with no discharges and reduce the computational effort for the simulation to a manageable amount. This reduced the period of simulation to approximately 30 days for the Michigan/Brandon and Hanford/Lander discharges and 50 days for the HLKK discharge. The accumulation of ambient particles settling to the sediment bed was handled separately, by applying the empirical sedimentation rate over the 3-year period of simulation using the sediment dilution equation presented in Section 2.4.

3.1.3 Particle Size or Settling Velocity

The particulate size of solids in the CSO discharge is represented in the model by a fixed number of size classes described by a characteristic settling velocity. Each settling velocity represents a different sediment class in the EFDC model. Distributions were estimated based on past sampling of CSO effluent in several King County studies. The data were collected from four County CSO systems, and distributions were determined as a cumulative percentage of the total mass of solids (Battelle 2006). Table 4 and Figure 3 summarize the data.

Variations in settling velocities appear to have more relationship to the characteristics of the individual overflow event than the location of the CSO discharge. For example, the data from Norfolk CSO in Figure 3 nearly span the range of observed values. The average of all samples was used as the characteristic distribution for particles in the CSO discharge, as shown in Table 5.

Table 4. CSO Particulate Settling Velocity Distributions by Cumulative Mass Percentage

	Cumulative Mass Percentage					Mass Percentage < Minimum Settling Velocity (not cumulative)[a]
	Settling Velocity > 1.0 cm/s	Settling Velocity > 0.5 cm/s	Settling Velocity > 0.25 cm/s	Settling Velocity > 0.10 cm/s	Settling Velocity > Minimum[a]	
Denny Way						
Event 1	3	x	x	21	44	56[a]
Event 2	8	19	31	X	44	56
Event 3	3	11	22	X	46	54
Event 4	5	18	32	x	59	41
Norfolk Regulator (1997 Samples)						
30-Apr	6.4	26	51	74	89	11
31-May	1.8	9.4	25	43	72	28
19-Sep	0.7	5.3	21	40	65	35
30-Oct	0.1	0.8	5.3	19	38	62
Henderson Weir (1997 Samples)						
27-Apr	15	33	51	66	79	21
31-May	6.4	16	35	36	64	36
19-Sep	2.3	7.3	22	41	63	36
30-Oct	5.9	11	24	44	62	38
MLK CSO (1997 Samples)						
27-Apr	7.9	13	24	45	70	30
31-May	0.5	11	29	43	70	30
19-Sep	1.5	8.5	49	63	73	27
30-Oct	0.8	3.0	8.8	20	34	66

x = No data

a. For Denny Way Event 1, the minimum settling velocity class is 0.01 cm/second. For all other events, the minimum settling velocity class is 0.025 cm/second

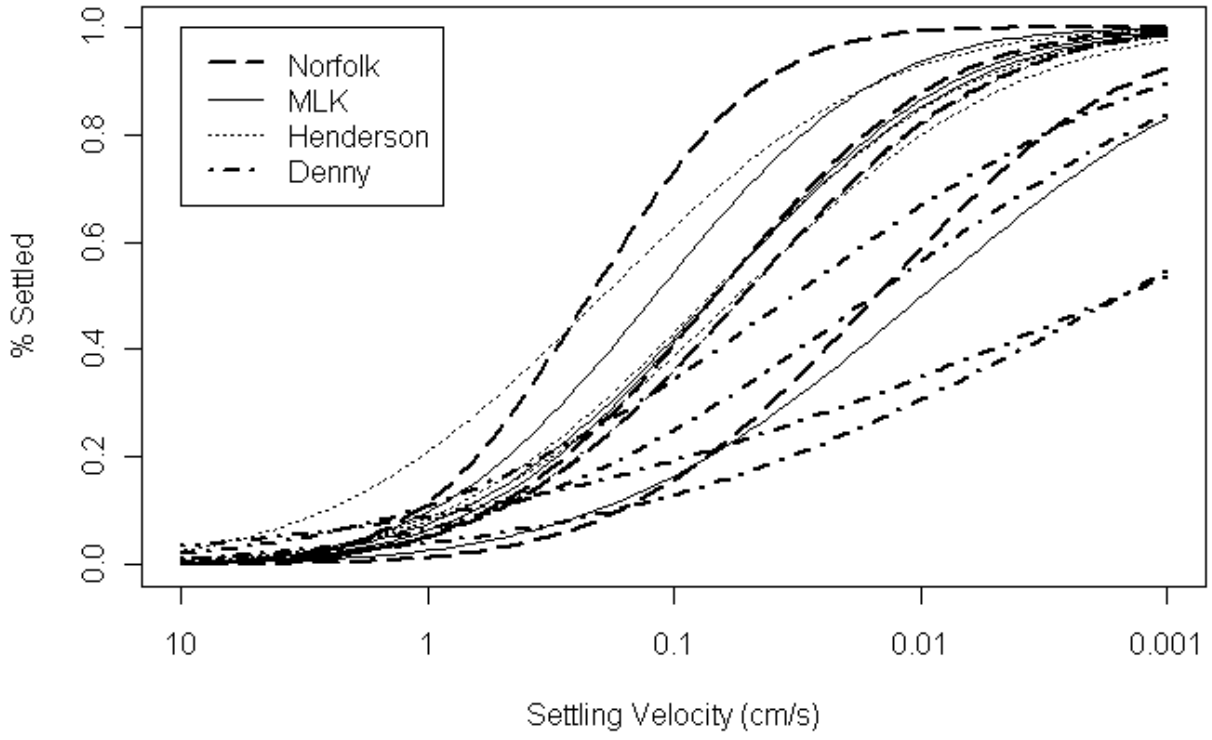

Figure 3. Settling Velocity of CSO Particulates

Table 5. Settling Velocities Representing Sediment Classes Used in the EFDC Model

Settling Velocity (m/s)	Cumulative Mean	Fraction in Range (%)
$1.5x10^{-2}$	4.7	4.7
$7.5x10^{-3}$	14.8	10.1
$3.75x10^{-3}$	32.5	17.7
$1.75x10^{-3}$	47.2	14.7
$6.25x10^{-4}$	66.3	19.1
$1.5x10^{-4}$	100.0	33.7
Total		**100.0**

3.1.4 Suspended Solids Concentration

Total suspended solids (TSS) concentrations of the CSO effluent were estimated based on past sampling of CSO effluent as summarized in the report, Duwamish River Basin Combined Sewer Overflow Data Report for Samples Collected from September 2007 to April 2009 (King County 2010a). In these samples, concentrations ranged from 34 to 640 mg/L, and the mean TSS concentration was 128 mg/L. The simulation used the mean value of 128 mg/L.

3.1.5 CSO Effluent Concentrations

The modeling requires an estimate of the chemical concentrations associated with particulates in the treated and untreated CSO discharges that will be deposited on the sediment bed. Concentrations were estimated based on limited sediment samples collected from the CSO facilities and pipelines:

- Six samples collected in sediment traps in the Hanford #2 CSO trunk line
- One sample collected from sediment in the bottom of the outfall structure at Brandon CSO
- Two samples collected from sediment in the outfall structure at Michigan CSO.

Additional samples of solids collected in the bottom of the conveyance lines leading to Hanford #2, Lander, and Brandon CSO regulator stations were considered for this analysis. However, these samples were not included because they appeared to be less characteristic of the solids that would be discharged from a treated CSO. The sediments in these samples were significantly coarser, with a higher fraction of sand and gravel. These samples also had lower chemical concentrations for almost all compounds than the samples used in this analysis, so excluding them resulted in a more conservative estimate of chemical concentration.

Table 6 summarizes the mean chemical concentrations of the samples used for the modeling. Individual sample results are included in Appendix C. It was assumed that the chemical concentration (per unit mass of solids) would remain constant (i.e. no desorption) during any treatment process and until the sediment particles come to rest on the sediment bed.

The samples were collected and analyzed following the sampling and analysis protocols outlined in King County 2009a and 2010a. Not every sample used for the analysis was analyzed for all parameters; about five to six samples were available for most parameters. All data were used, with the exception of results for one compound: 1,4-dichlorobenzene. Two samples from Brandon and Michigan are included for this compound, but samples from Hanford #2 sediment traps were not used because a source of that chemical identified in that system has since been eliminated.

Sample dilution was required to run many of the semi-volatile organic compound analyses; this, combined with the low solids content, resulted in unusually high detection limits in the Hanford sediment trap sample. This method increased uncertainty in the presence of some compounds, which is illustrated in Table 6 by different approaches to averaging the samples: the samples were averaged assuming non detected values were equal to the method detection level (MDL), half the MDL, or zero.

Table 6. Mean Concentrations of Chemicals with Washington State Sediment Quality Standards in Sediments Collected from CSO Systems

Chemical	Detects/ Samples	Mean Chemical Concentration		
		Non-Detects Set to 0	Non-Detects Set to ½ MDL	Non-Detects Set to MDL
Inorganics (concentration in mg/kg dry weight)				
Arsenic	5 / 6	7.1	8.0	8.9
Cadmium	6 / 6	2.4	2.4	2.4
Chromium	6 / 6	55.3	55.3	55.3
Copper	6 / 6	276.0	276.0	276.0
Lead	6 / 6	139.8	139.8	139.8
Mercury	9 / 9	1.4	1.4	1.4
Silver	6 / 6	4.3	4.3	4.3
Zinc	6 / 6	725.7	725.7	725.7
Organics (concentration in µg/kg dry weight)				
LPAH	5 / 5	2986	2986	2986
Naphthalene	1 / 5	80	287	494
Acenaphthylene	0 / 5	0	228	456
Acenaphthene	0 / 5	0	228	456
Fluorene	0 / 5	0	228	456
Phenanthrene	5 / 5	1898	1898	1898
Anthracene	0 / 5	0	228	456
2-Methylnaphthalene	2 / 5	1008	1199	1390
HPAH	5 / 5	5343.6	5343.6	5343.6
Fluoranthene	5 / 5	1366.4	1366.4	1366.4
Pyrene	5 / 5	1778	1778	1778
Benz(a)Anthracene	3 / 5	323.8	496.8	669.8
Chrysene	4 / 5	758.2	839.2	920.2
Total Benzofluoranthenes	4 / 5	397.4	591.4	785.4
Benzo(a)Pyrene	2 / 5	173.4	367.4	561.4
Indeno (1,2,3,-c,d) Pyrene	2 / 5	135.4	329.4	523.4
Dibenzo (a,h) Anthracene	0 / 5	0	228	456
BENZO(g,h,i)Perylene	3 / 5	411	513	615
1,2-Dichlorobenzene	0 / 5	0	22.8	45.6
1,4-Dichlorobenzene	1 / 2	81	86.25	91.5
1,2,4-Trichlorobenzene	0 / 5	0	11.53	23.06
Hexachlorobenzene	0 / 5	0	45.4	90.8
Dimethyl Phthalate	0 / 5	0	454	908
Diethyl Phthalate	0 / 5	0	454	908
Di-n-Butyl Phthalate	1 / 5	181	599	1017
Butyl Benzyl Phthalate	5 / 5	2188	2188	2188
Bis (2-Ethylhexyl) Phthalate	5 / 5	28540	28540	28540
Di-N-Octyl Phthalate	1 / 5	1318	1738	2158
Dibenzofuran	0 / 5	0	228	456
Hexachlorobutadiene	0 / 5	0	45.4	90.8
N-Nitrosodiphenylamine	0 / 5	0	454	908
Total PCBS	4 / 6	469	476	483
Phenol	2 / 5	286.4	662.4	1038.4
2-Methylphenol	0 / 5	0	228	456
4-Methylphenol	5 / 5	71660	71660	71660
2,4-Dimethyl phenol	0 / 5	0	115.3	230.6
Pentachlorophenol	0 / 5	0	1153	2306
Benzyl alcohol	0 / 5	0	228	456
Benzoic acid	4 / 5	13158	13268	13378

3.2 CSO Treatment Removal Efficiency

Preliminary screening of potential CSO treatment technologies suggests that the most likely type of treatment technology is a variation of a sedimentation process. These technologies range from primary sedimentation to high-rate sedimentation. For this modeling assessment, three levels of treatment effectiveness were assumed: 50%, 70%, and 90% TSS removal.

To simulate removal efficiencies of the treatment technology, an idealized plug-flow reactor was assumed. In an idealized plug-flow reactor, water enters a tank and flows through it without mixing. Particles are evenly distributed in the flow as they enter the tank and those that reach the bottom before exiting are captured. The design parameter for a plug-flow reactor is the surface overflow rate (v_o). If a particle's settling velocity (w_s) is greater than the overflow rate, all particles are removed. Otherwise the removal rate is proportional to the settling velocity:

$w_s > v_o$: capture = 100 %

$w_s < v_o$: capture = 100*(w_s / v_o) %

The approach was to determine the surface overflow rate that resulted in 50%, 70%, or 90% TSS removal for the CSO settling velocity distribution. This resulted in the relative fraction of particulate mass in each size class as shown in Table 7. This particulate fraction is applied to the average CSO TSS concentration, so removal of particulates by CSO treatment results in a total fraction less than 100 percent.

Table 7. Settling Velocity Distributions by Cumulative Mass Percentage for Three CSO Treatment Efficiencies

	Fraction in Range (%)			
Settling Velocity (m/s)	**No removal**	**50% removal**	**70% removal**	**90% removal**
$1.5x10^{-2}$	4.7	-	-	-
$7.5x10^{-3}$	10.1	-	-	-
$3.75x10^{-3}$	17.7	-	-	-
$1.75x10^{-3}$	14.7	4.2	-	-
$6.25x10^{-4}$	19.1	14.2	3.1	-
$1.5x10^{-4}$	33.7	31.6	26.9	10.0
Total	**100.0**	**50.0**	**30.0**	**10.0**

3.3 Water Body Characteristics

3.3.1 Bathymetry

The model domain includes the Green River downstream of Auburn through the Duwamish River to the western edge of Elliott Bay. The downstream boundary at Elliott Bay is along a shallow arc between Alki Point and Fourmile Rock. Bathymetric features for Elliott Bay and the Duwamish River was obtained from National Oceanic and Atmospheric Administration (NOAA) bathymetry records with shore boundaries digitized from the NOAA navigational charts. Bathymetric data for the Green River were surveyed by a consultant for King County and

boundary data were obtained from United States Geological Survey (USGS) maps. See King County (1999) for additional details.

3.3.2 Water level and flow boundary conditions

Boundary points for the model occur just outside of Elliott Bay and in the Green River near Auburn. Green River inflow to the model was based on observed daily flows at the U.S. Geological Survey gauge at Auburn (USGS Gauge #12113000) for the period of December 2003 through January 2004, during which time the Green River was flowing at typical winter flow rates of 700 to 3,000 cubic feet per second. CSO discharges happen most frequently from November through April, and this period provided typical wet-weather Green River flows.

The boundary at Elliott Bay was forced by a phased harmonic tidal series specifying water elevations. The amplitudes and phases were determined by back calculating the model predictions to the observations at the Seattle Tide Gauge (**Error! Reference source not found.**). The magnitude of the tidal components was constant over the open boundary, but the phase was shifted slightly to account for the propagation speed of the tide.

Table 8. Summary of Tidal parameters used in EFDC model.

Tidal Harmonic	Amplitude (m)	Phase (seconds)
M2	0.56160	-1956.5
S2	0.13500	18741.5
N2	0.1090	12041.3
K1	0.41700	36332.2
O1	0.23050	-1820.7
P1	0.13152	-46431.3
SSA	0.01661	1334394.6
SA	0.03856	1098157.4
Q1	0.04321	35787.5
L2	0.02914	11514.9
K2	0.04920	-3330.6

3.3.3 Temperature and Salinity

Temperature and salinity along the Elliott Bay boundary was obtained from CTD casts at King County sampling station LSTN01 (King County 2005, King County 2006b). The period of December 2003 through January 2004 was used, providing typical winter conditions typical of when most CSO discharges occur.

The Green River boundary was set to a constant temperature of 10 degrees Centigrade.

3.4 Ambient Sediment Concentrations

As discussed in Section 2.3, the compounds of interest are those that have applicable Washington State sediment quality standards. The Superfund cleanup investigations in the Lower Duwamish Waterway and East Waterway have compiled the most recent and extensive datasets of sediment quality for these waterways. Sediment transport modeling has shown that a large majority of the

sediments being deposited throughout the Lower Duwamish Waterway and the East Waterway and along the Seattle Waterfront are from the Green River. The sediment dilution relationship used to estimate sediment quality only considers what is settling and neglects any mixing with current sediment bed conditions. Thus, estimates of concentrations from the Green river input were given priority over other ambient concentrations. The following sources were used to develop characteristic ambient sediment concentrations:

- Lower Duwamish Waterway Feasibility Study (LDW FS; AECOM 2010):
  - Table 5-3, Chemical Input Values for Representative Sediment Management Standard Chemicals, Upstream Inflow
  - Table 5-1b, Recommended Bed Composition Model Upstream Input Parameters for Human Health Risk Drivers
  - Table J-1, Summary of Puget Sound Area Urban Water Body Total PCB, Arsenic, and cPAH Data - Inner and Outer Elliott Bay
- Department of Ecology Contaminant Loading to the Lower Duwamish Waterway from Suspended Sediment in the Green River (Gries and Sloan 2009)
- Lower Duwamish Waterway Remedial Investigation (LDW RI; Windward 2010a), Table 4-39. Summary of surface sediment data for selected SVOCs
- East Waterway Surface Sediment Data (Windward 2010b)

Lower Duwamish Waterway values are used for the East Waterway and Elliott Bay because ambient concentrations are typically higher in the Lower Duwamish Waterway (a more conservative assumption) and the East Waterway data report did not tabulate representative values. The representative chemical concentration was selected based on the following priority:

- If a value was included in the LDW FS Tables 5-3 or 5-1b, this value was used.
- Otherwise the value from Ecology's Suspended Sediment study was used.
- Finally if no other values were available, the Lower Duwamish Waterway average surface sediment concentration was used.

If no mean value was tabulated (usually because the frequency of detections was less than 25%), a zero value was used. This assumption can underestimate the predictions, and a sensitivity analysis of this assumption is included in Section 6.1

The values from these three sources and the value selected for this analysis is shown in Table 9.

Table 9. Chemical Concentrations Characterizing Ambient Sedimentation for Chemicals with WA State Sediment Quality Standards

Chemical	Ambient Chemical Concentration from Data Sources			Ambient Concentration Used for Analysis
	LDW FS Table 5-3 and Table 5-1b	Ecology Contaminant Loading Study	LDW RI, Summary of Data	
Inorganics (concentration in mg/kg dry weight)				
Arsenic	9	11	17	9
Cadmium			1	1
Chromium			40	40
Copper			100	100
Lead			100	100
Mercury	0.1		0.2	0.1
Silver			1	1
Zinc	64		190	64
Organics (concentration in µg/kg dry weight)				
LPAH		107	700	107
Naphthalene		11		11
Acenaphthylene	8	12		8
Acenaphthene		14	70	14
Fluorene		17	80	17
Phenanthrene	53	78	400	53
Anthracene		14	100	14
2-Methylnaphthalene		13		13
HPAH		930	4000	930
Fluoranthene	190	146	900	190
Pyrene		138	700	138
Benz(a)anthracene		56	320	56
Chrysene	49	114	500	49
Total Benzofluoranthenes			740	740
Benzo(A)Pyrene		69	310	69
Indeno (1,2,3,-C,D) Pyrene	31	116	200	31
Dibenzo (A,H) Anthracene		26	60	26
Benzo(G,H,I)Perylene		93	200	93
1,2-Dichlorobenzene				0
1,4-Dichlorobenzene				0
1,2,4-Trichlorobenzene				0
Hexachlorobenzene				0
Dimethyl Phthalate				0
Diethyl Phthalate				0
Di-N-Butyl Phthalate				0
Butyl Benzyl Phthalate	11		80	11
Bis (2-Ethylhexyl) Phthalate	120		600	120
Di-N-Octyl Phthalate				0
Dibenzofuran			50	50
Hexachlorobutadiene				0
N-Nitrosodiphenylamine				0
Total PCBs	35	16		35
Phenol	10		90	10
2-Methylphenol				0
4-Methylphenol				0
2,4-Dimethyl Phenol				0
Pentachlorophenol				0
Benzyl Alcohol				0
Benzoic Acid				0

3.5 Ambient Sedimentation Rates

Previous investigations in the Lower Duwamish Waterway (Windward and QEA, 2007) and the East Waterway (Windward 2010b) and along the Seattle Waterfront on Elliott Bay (Norton and Michelsen 1995) have analyzed core samples for radioactive isotopes in order to determine the geochronological history of each core. The resulting ambient sedimentation rates selected for each CSO location are summarized in Table 10 and discussed below.

Table 10. Summary of Ambient Sedimentation Rates

Location	Observed Range (cm/year)	Characteristic Rate (cm/year)
Michigan/Brandon	1.0 to > 2.0	1.5
Hanford/Lander	0.78 to 1.1	1.0
HLKK	0.08 to 0.88	0.22

Sedimentation rates in the Lower Duwamish Waterway were assessed from the following sources of data:

- 14 sediment cores collected from areas outside the maintained navigation channel
- Bathymetric analysis conducted in association with maintenance dredging of the channel
- Chemical markers and stratigraphy data from 56 subsurface sediment cores collected in 2006 and from historical subsurface sediment cores
- Grain size distribution data
- Dredging records
- Chemical spill, industrial, and regional discharge records
- Bathymetric data.

These data provided a set of time markers at different depths in the sediment bed at various locations in the Lower Duwamish Waterway. After assigning a date or time period and specific depth for a particular marker, the net sedimentation rate was estimated from that marker. The conclusion of this analysis was that net sedimentation rates were spatially variable, with the highest rates in the navigation channel (greater than 2 cm/year), moderate rates in the subtidal bench areas (less than 2 cm/year), and the lowest rates in the intertidal bench areas (less than 0.5 cm/year). In the vicinity of the Michigan and Brandon CSOs, the analysis shows areas with sedimentation rates of 1.0 to 1.5 cm/year, 1.5 to 2.0 cm/year, and > 2.0 cm/year (Figure 3.3 in Windward 2007). A net sedimentation rate of 1.5 cm/year was selected for this analysis.

In the East Waterway, sediment trap sampling and radionuclide dating of sediment cores were conducted at two locations for the Harbor Island Supplemental Remedial Investigation (HISWG 1996). One location was near Terminal 30 (Station 2500), and another was near the southern end (Station 5400), both along the centerline of the East Waterway. From the radionuclide dating, the mass net sedimentation rates of the two sites were 1.0 and 1.47 grams/cm^2/year. Assuming a bulk density of 1.3 grams per cubic centimeter (g/cm^3), the estimated net sedimentation rates are

0.78 and 1.1 cm/yr. The higher rate was at the more southern station, and the Hanford CSO is in the southern part of the East Waterway, so a value of 1.0 cm/year was selected for this analysis.

Along the Seattle waterfront, the estimated net mass accumulation rate ranges from 0.1 to 0.72 g/cm^2/year (Norton and Michelsen 1995). Assuming a bulk density of 1.3 g/cm^3, the net accumulation rate ranged from 0.08 to 0.55 cm/year, averaging 0.22 cm/yr. This is significantly lower than sedimentation rates in the East Waterway. Sediment accumulation rates in outer Elliott Bay were 0.78 g/cm^2/year and 1.15 g/cm^2/year (Lavelle, et al. 1985), or 0.6 and 0.88 cm/year assuming a bulk density of 1.3 g/cm^3. The study area of the Seattle Waterfront study is to the north of the Kingdome CSO. The relative proximity of the Kingdome CSO to the East Waterway suggests the accumulation rate could be higher than observed at the Seattle waterfront. To be conservative, an accumulation rate of 0.22 cm/year was selected for this analysis.

4 EFDC Model Configuration

The EFDC model is a state-of-the-art hydrodynamic model that solves three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motion for a variable-density fluid. Dynamically coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity and temperature are also solved. EFDC uses stretched or sigma vertical coordinates and Cartesian or curvilinear, orthogonal horizontal coordinates to represent the physical characteristics of a water body. The EFDC model allows for drying and wetting in shallow areas by a mass conservation scheme.

4.1 Model Grid

The model domain extends from the Green River at Auburn (River Mile 32.0) to a line between Magnolia and Alki in outer Elliott Bay (Figure 4).

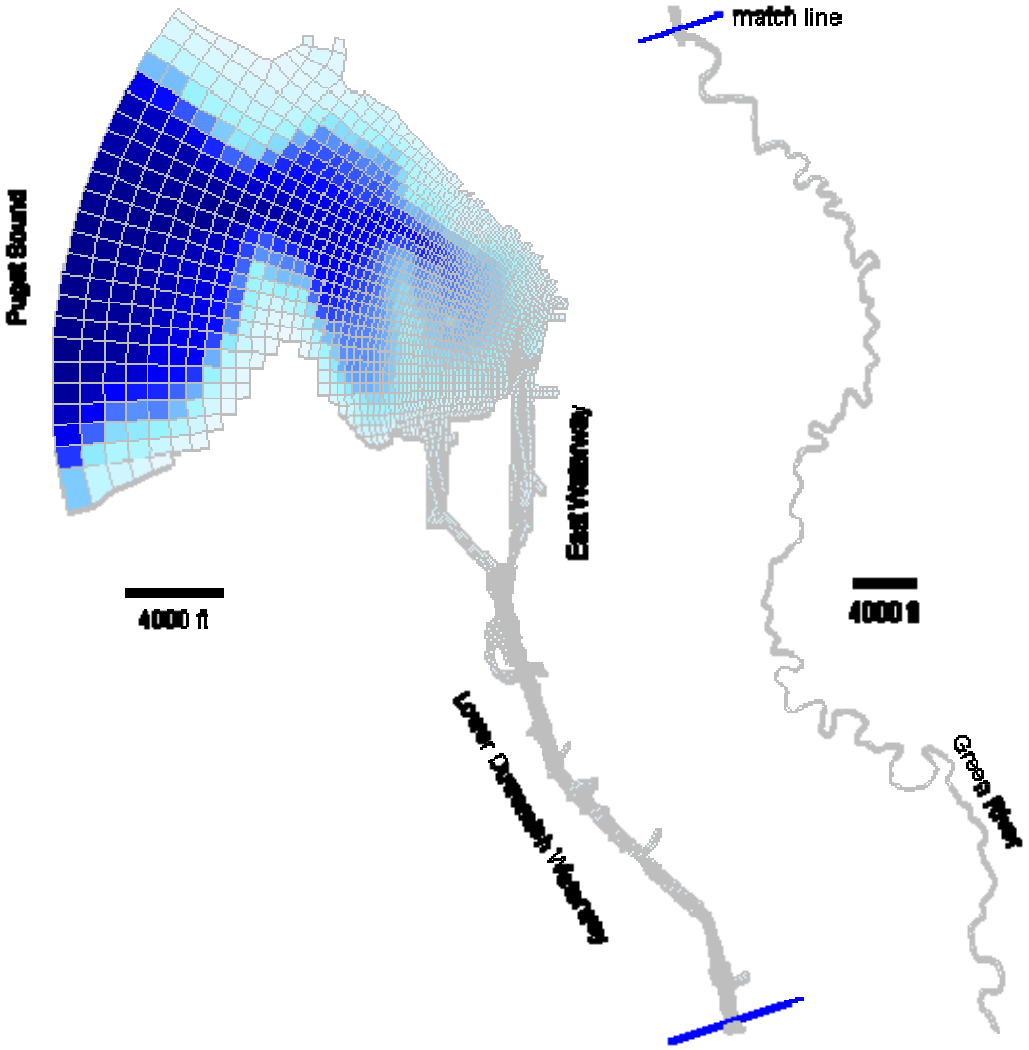

Figure 4. Extent of EFDC Model Grid

Previous work in simulating sediment accumulation from CSO discharges has shown that a model grid with a spatial scale similar to the size of the discharge outlet can result in realistic predictions of sediment accumulation rates (Battelle 2006; Schock 2011). To simulate both the overall transport through the Duwamish-Elliott Bay system and the dynamics at each CSO, the model grid was locally refined around each CSO discharge.

The basic grid structure consisted of 6,020 model cells that were 138 by 340 feet in the Lower Duwamish Waterway and 103 by 265 feet in the East Waterway. The grid cells progressively increased toward the boundaries in Elliott Bay and the Green River. At each CSO discharge location, the base grid was deformed to allow a hemispherical grid to be inset. This hemispherical insert was set to be eight model cells wide. A conformal mapping of a rectangle to the hemisphere provided a grid that matched the base grid along the edges of the hemisphere while having a model cell spacing of 6 feet at the point of discharge.

4.2 CSO Discharge Locations

State regulations require treated CSO discharges to be from a submerged outfall. Although outfalls constructed to convey these discharges may terminate offshore, the Michigan, Hanford and Kingdome CSO discharges were modeled at the edge of the waterway to provide conservative results for this analysis (Figure 5):

- The refined model grid around the Michigan CSO is illustrated in Figure 6. The extent of the model grid was not altered, resulting in model cells that would be above the water surface for part of the tidal cycle. Since the CSO discharge is required to be submerged, the model cells directly offshore from the discharge point were deepened to a depth of 3.0 meters below mean sea level (0.98 meters below mean lower low water (MLLW)).
- The refined model grid around the Hanford CSO is illustrated in Figure 7. The discharge location is slightly south of the existing Hanford CSO discharge in order to accommodate the grid refinements without excessively deforming the geometry of slip 27 to the north. The shoreline at this location consists of a pier face, so no adjustments were required to ensure sufficient water depth at all tidal conditions. Details of the refined model grid at the discharge location are illustrated in Figure 8.
- The refined model grid around the Kingdome CSO is illustrated in Figure 9. The discharge location is slightly north of the existing Kingdome CSO discharge in order to accommodate the grid refinements without excessively deforming the geometry of slip 36 to the south. The shoreline at this location consists of a riprapped embankment, so no adjustments were required to ensure sufficient water depth at all tidal conditions.

Modeling the CSO discharge at the shoreline creates the minimum distance for particles to settle before reaching the water bottom, thus minimizing the dispersion of particles and increasing sedimentation rates.

Treated and untreated overflows for each CSO were assumed to be discharged at the same location. A CSO treatment facility could have a new outfall and discharge point for treated flows, which would reduce sediment accumulation rates; assuming the same location for treated and untreated discharges results in a conservative prediction for sediment concentrations.

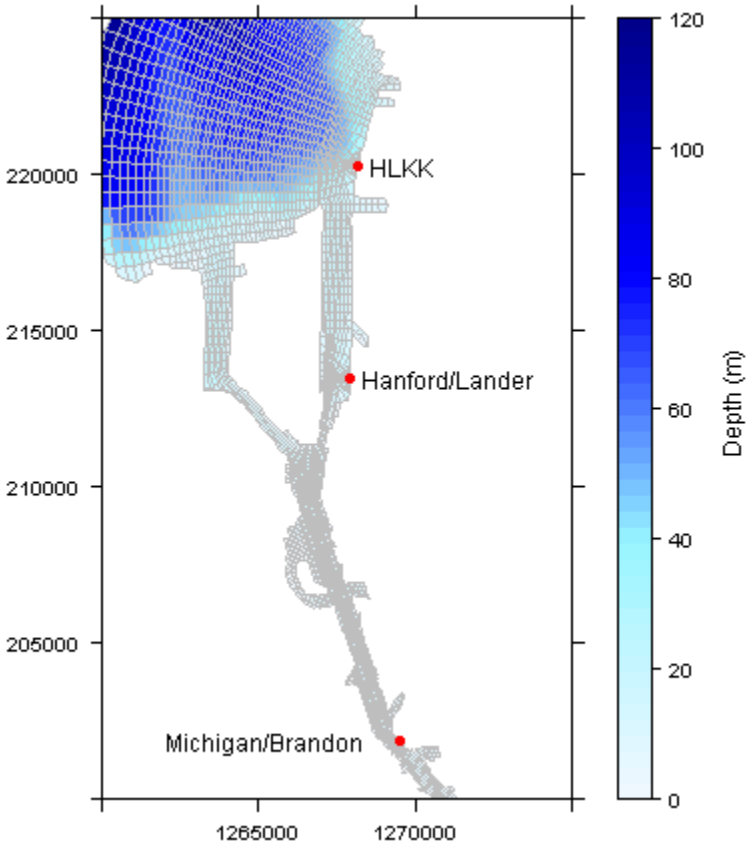

Figure 5. Location of Modeled CSO Discharges on EFDC Model Grid. Axes show coordinates in WA State Plane North (feet).

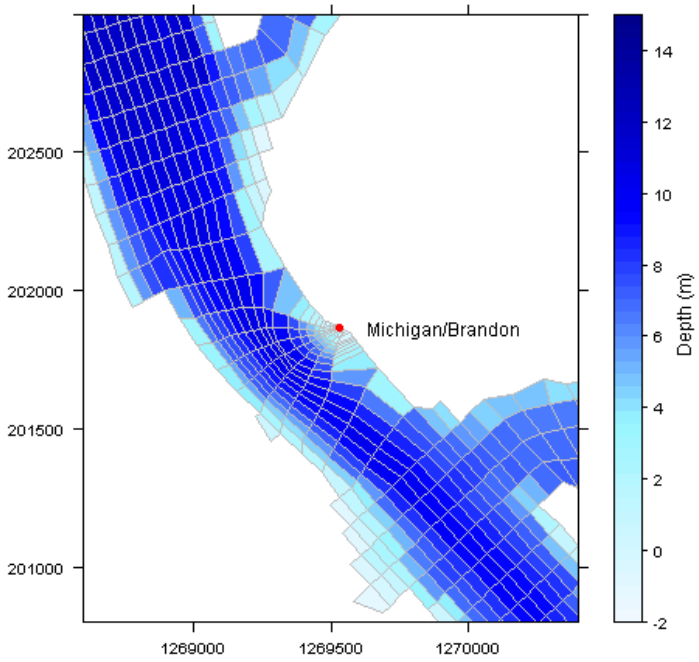

Figure 6. EFDC Model Grid Around the Michigan CSO Discharge. Axes show coordinates in WA State Plane North (feet).

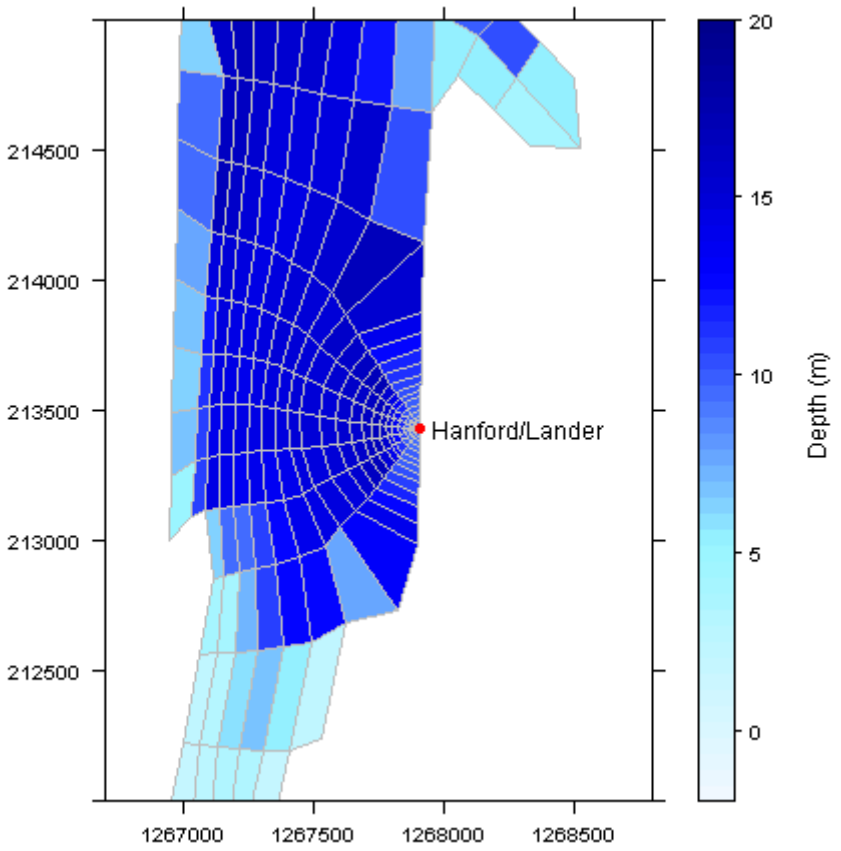

Figure 7. EFDC Model Grid Around the Hanford CSO Discharge. Axes show coordinates in WA State Plane North (feet).

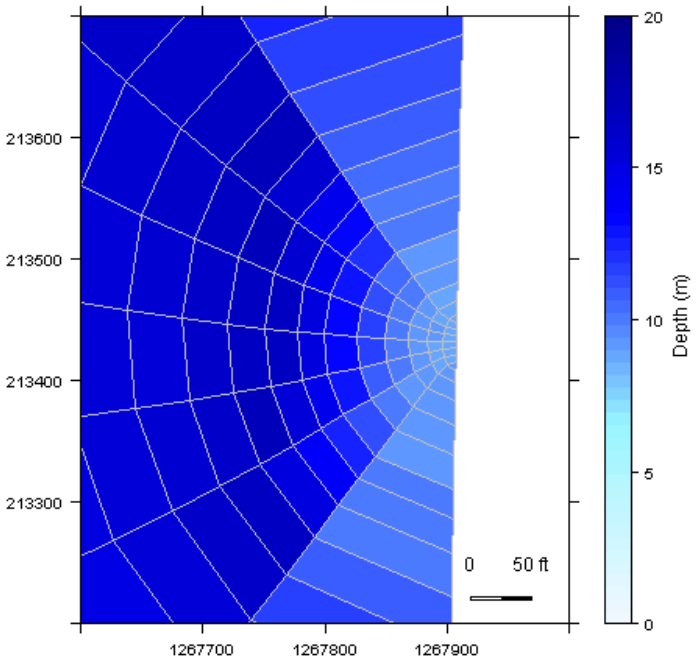

Figure 8. EFDC Model Grid Detail Around the Hanford CSO Discharge. Axes show coordinates in WA State Plane North (feet).

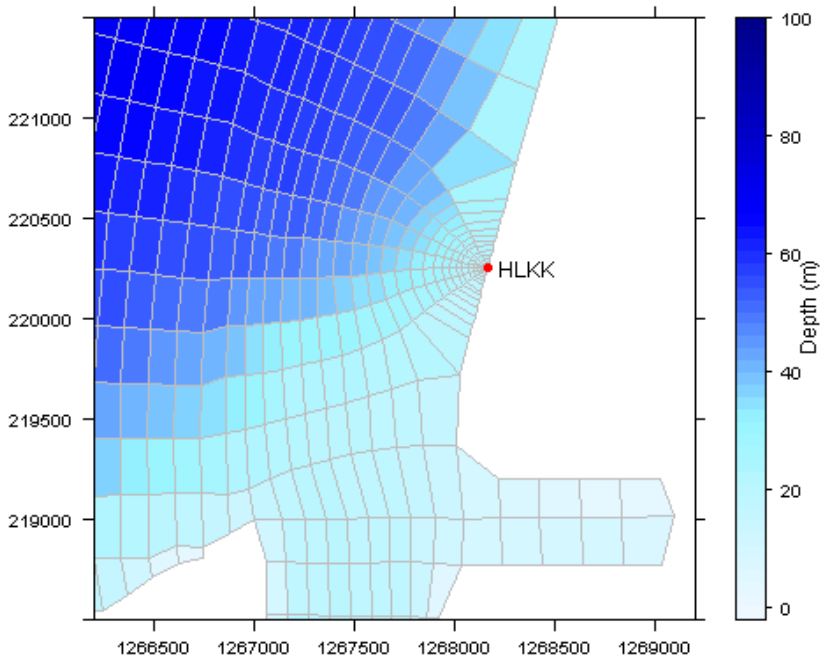

Figure 9. EFDC Model Grid Around the HLKK CSO Discharge. Axes show coordinates in WA State Plane North (feet).

4.3 Sediment Parameters

While the settling velocity of each particle size class has the greatest effect on the simulation results, a number of other parameters in EFDC can alter the simulation results. Six sediment classes were used for the simulation—four designated as cohesive sediment and two as non-cohesive sediment (Table 11).

Table 11. Summary Sediment classes and Resuspension stresses used in EFDC model.

Sediment Class	Characteristic Particle Diameter	Settling Velocity (m/s)	Resuspension stress $(m/s)^2$
Non-cohesive: Class 1	Medium sand 150 µm	0.015000	0.003
Non-cohesive: Class 2	Fine sand 100 µm	0.007500	0.003
Cohesive: Class 1	Silt 75 µm	0.003750	0.003
Cohesive: Class 2	Silt 50 µm	0.001750	0.003
Cohesive: Class 3	Silt 30 µm	0.000625	0.003
Cohesive: Class 4	Clay	0.000150	0.003

All sediment classes were assigned a resuspension stress of 0.003 m^2/s^2, which is used in the EFDC model to determine the water velocity required to initiate movement of that particle size class. The required water velocity is calculated based on the characteristics of the flow, but simplistically, a velocity of approximately 1.2 m/s is required to exceed this resuspension threshold. The resuspension stress was set higher than normal to minimize the secondary movement of sediment and provide a more conservative prediction of sediment accumulation.

5 Results

5.1 EFDC Simulation Results

The maximum modeled sedimentation accumulation in any model cell was averaged over the modeled period of discharge (Table 3) to obtain predicted maximum annual deposition rates, as shown in Table 12. The untreated overflow is predicted to provide a significant contribution to the sediment accumulation, using the assumption for this analysis that the untreated discharge is co-located with the treated discharge. This could result in an over-prediction of sediment concentrations should the two discharges not be co-located.

Table 12. Maximum Annual Sedimentation Rate Predicted from EFDC Model

	Maximum Annual Sedimentation Rate (mm/year)		
Treatment Level	**Michigan/Brandon**	**Hanford/Lander**	**HLKK**
50% solids removal	0.65	0.43	0.17
70% solids removal	0.17	0.12	0.034
90% solids removal	0.043	0.030	0.011
50% solids removal + untreated overflow	0.99	0.44	0.20
70% solids removal + untreated overflow	0.49	0.13	0.056
90% solids removal + untreated overflow	0.37	0.062	0.038

While CSOs are predicted to cause the greatest accumulation at Michigan, the ambient sedimentation rates are also the greatest at Michigan (Table 10). The long-term accumulated sediment concentration is dependent on the ratio of the ambient sedimentation rate to the CSO depositional rate. These ratios are tabulated in Table 13.

Table 13. Mixing Ratio of Ambient Sedimentation to Maximum CSO Deposition

	Mixing Ratio		
Treatment Level	**Michigan/Brandon**	**Hanford/Lander**	**HLKK**
50% solids removal + untreated overflow	15:1	23:1	11:1
70% solids removal + untreated overflow	31:1	77:1	39:1
90% solids removal + untreated overflow	41:1	160:1	58:1

The low ambient depositional rate assumed for the HLKK discharge results in the lowest dilution ratios and thus the highest predicted chemical concentrations, despite having the lowest predicted depositional rates from the CSO discharge. The mixing ratio increases significantly with increasing CSO treatment removal efficiency because the solids loading decreases and the coarse particle sizes are removed faster than the finest particle sizes.

5.1.1 Michigan/Brandon Depositional Pattern

The modeled depositional pattern surrounding the Michigan/Brandon CSO shows the highest levels of accumulation along the bank, just offshore of the discharge location. As described in Section 4.2, the model cells were deepened immediately offshore of the discharge point to simulate a submerged discharge. Relatively little sediment accumulates in these deepened cells. Instead, the sediment appears to settle on the surrounding shallower cells. Particulates begin to settle through the water column into the higher-salinity water underneath the CSO discharge. Tidal currents move the particulates north or south onto the shallower bank, where they settle out. The predicted depositional pattern for a 50% solids removal scenario is shown in Figure 10. The patterns for the 70% and 90% solids removal scenarios are similar, but with reduced sedimentation rates due to lower concentration of coarser size fractions in the discharge.

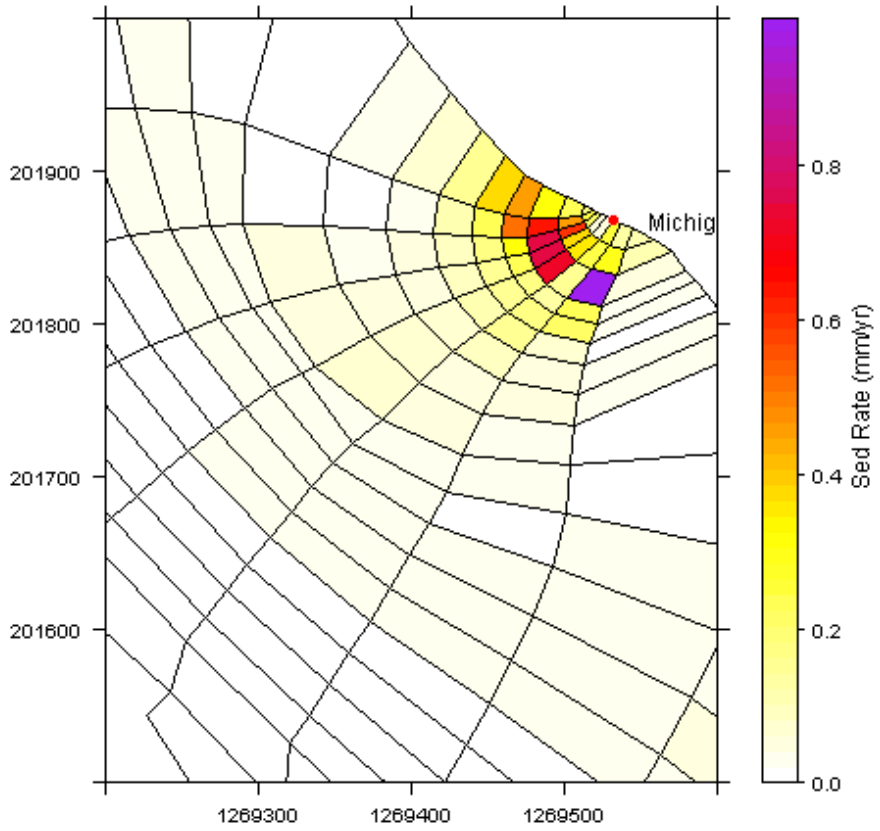

Figure 10. Predicted Sediment Accumulation Rates from CSO Discharges at Michigan with 50% Solids Removal. Axes show coordinates in WA State Plane North (feet).

5.1.2 Hanford/Lander Depositional Pattern

The modeled depositional pattern surrounding the Hanford/Lander CSO shows the highest levels of accumulation along the bank to the south of the discharge. Some sediment is deposited directly offshore of the outfall, as well as an appreciable amount at the bottom of the southern end of the East Waterway. The predicted depositional pattern for a 50% solids removal scenario is shown in Figure 11. The patterns for the 70% and 90% solids removal scenarios are similar, but with reduced sedimentation rates due to lower concentration of coarser size fractions in the discharge.

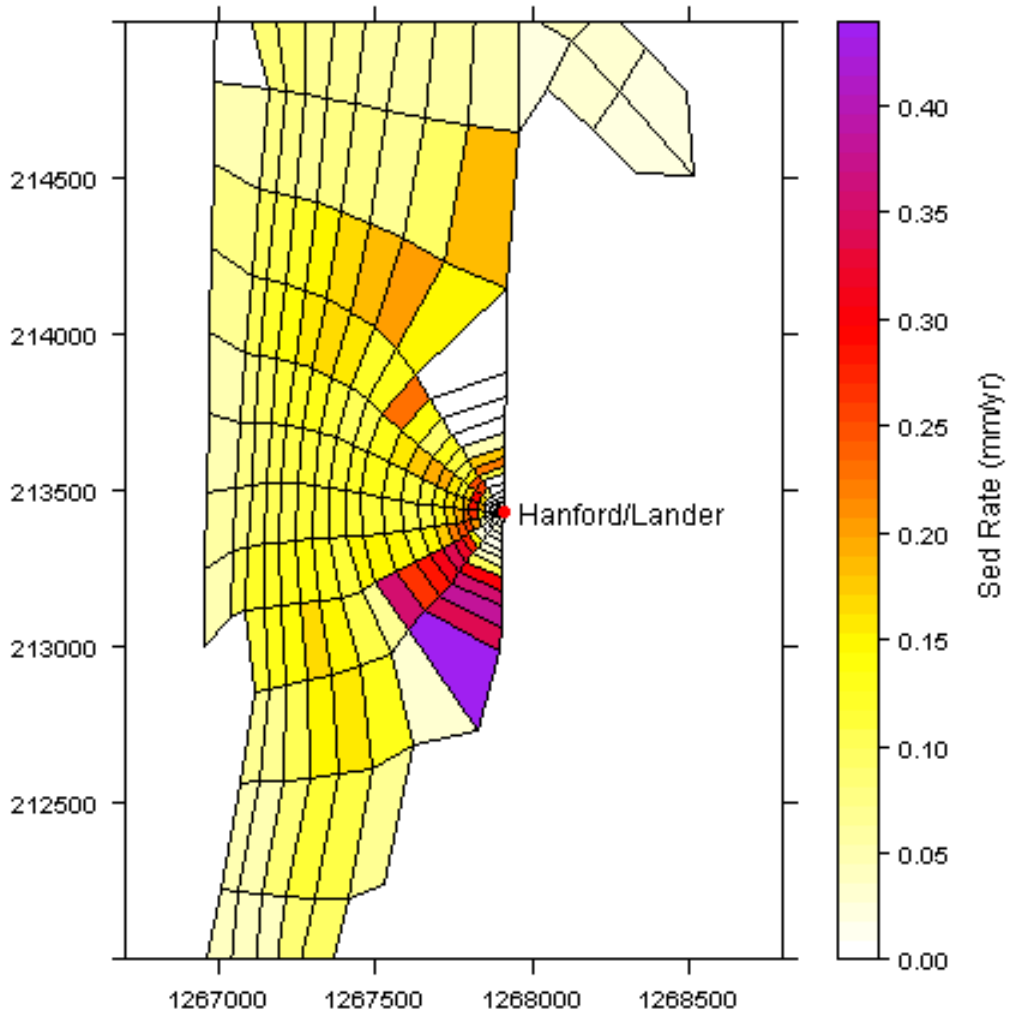

Figure 11. Predicted Sediment Accumulation Rates from CSO Discharges at Hanford With 50% Solids Removal. Axes show coordinates in WA State Plane North (feet).

5.1.3 HLKK Depositional Pattern

The HLKK CSO has a distinct depositional maximum about 70 meters (230 feet) offshore. The sediment accumulation rate is predicted to be significantly lower than at the Michigan and Hanford CSOs, reflecting the greater depth offshore of this discharge and the increased time for the sediment to be dispersed. The predicted depositional pattern for a 50% solids removal scenario is shown in Figure 12. The patterns for the 70% and 90% solids removal scenarios are similar, but with reduced sedimentation rates due to lower concentration of coarser size fractions in the discharge.

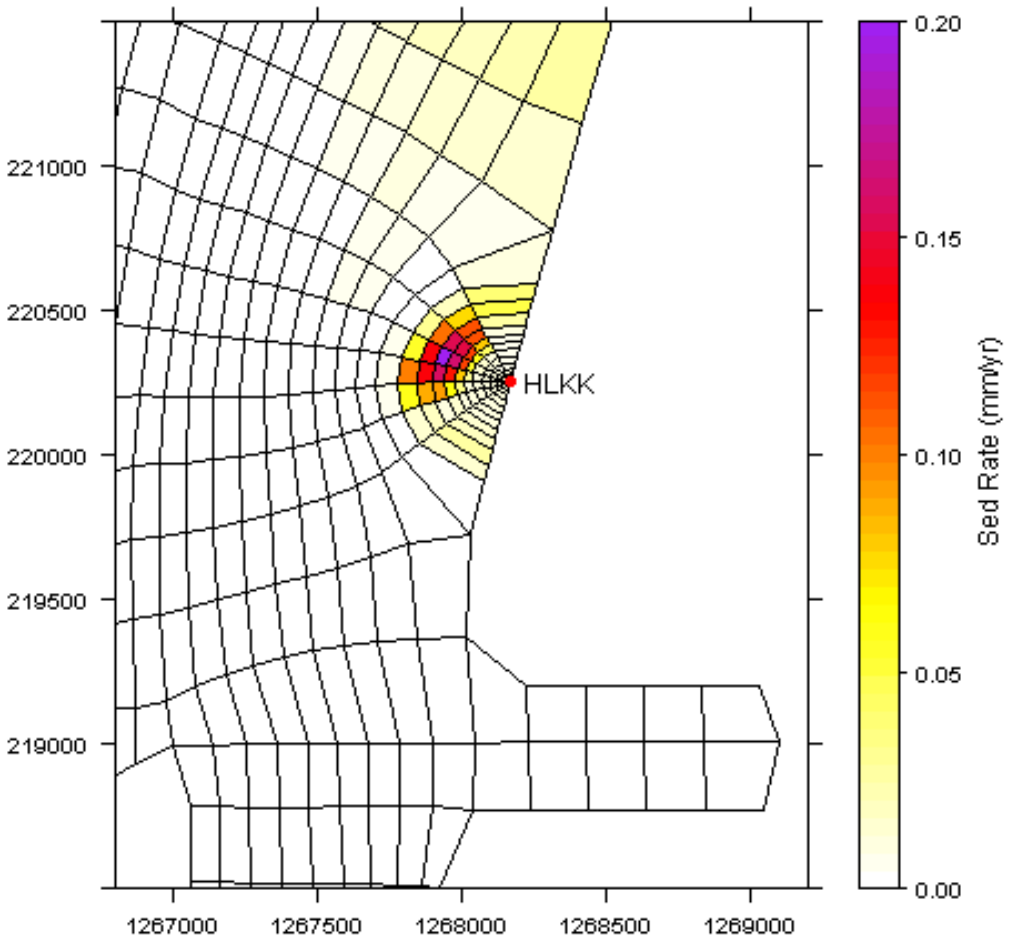

Figure 12. Predicted Sediment Accumulation Rates from CSO Discharges at HLKK With 50% Solids Removal. Axes show coordinates in WA State Plane North (feet).

5.2 Predicted Sediment Quality

Sediment quality in the vicinity of each CSO outfall was predicted by combining the sedimentation rate of CSO solids, the characteristic CSO solids quality, the ambient sedimentation rate and the ambient sediment quality in a simple dilution ratio (see Section 2.4). A sediment organic carbon concentration of 2 percent was used to evaluate chemicals with sediment quality standards based on organic carbon. Parameters that are predicted to exceed the sediment quality standards are summarized in Table 14 and discussed further below. The chemicals predicted to exceed the standards for a given level of treatment are generally similar for all three CSO locations, although the predicted areas are different.

The conservative assumptions used for this analysis may overestimate concentrations, so these results should be interpreted as a potential to exceed the sediment quality standards. Predicted sediment concentrations for all chemicals are included in Appendix B and compared to sediment quality standards on a dry weight basis, with varying assumptions on treating less than MDL parameters, and with varying assumptions on the organic carbon content of the sediments.

Table 14. Chemicals Predicted to Exceed Sediment Quality Standards

Treatment Level	Michigan/Brandon	Hanford/Lander	HLKK
50% solids removal	• butyl benzyl phthalate (5 cells, 0.025 ac) • bis (2-ethylhexyl) phthalate (9 cells, 0.056 ac) • 4-methylphenol (33 cells, 0.30 ac) • benzoic acid (1 cell, 0.007 ac)	• butyl benzyl phthalate (1 cell, 1.1 ac) • bis (2-ethylhexyl) phthalate (9 cells, 3.7 ac) • 4-methylphenol (123 cells, 33 ac)	• butyl benzyl phthalate (16 cells, 1.5 ac) • bis (2-ethylhexyl) phthalate (21 cells, 1.8 ac) • 4-methylphenol (43 cells, 6.7 ac) • Benzoic acid (10 cells, 0.78 ac)
70% solids removal	• bis (2-ethylhexyl) phthalate (1 cell, 0.007 ac) • 4-methylphenol (17 cells, 0.13 ac)	• 4-methylphenol (18 cells, 4.1 ac)	• 4-methylphenol (35 cells, 9.4 ac)
90% solids removal	• 4-methylphenol (14 cells, 0.09 ac)	• No exceedances	• 4-methylphenol (19 cells, 1.7 ac)

5.2.1 50% Solids removal

Butyl benzyl phthalate, bis (2-ethylhexyl) phthalate, and 4-methylphenol are predicted to exceed sediment quality standards under at all three CSO locations with a treatment technology providing 50% solids removal.

Benzoic acid was also predicted to exceed sediment quality standards at the Michigan/Brandon and HLKK CSO locations with a treatment technology equivalent to a 50% solids removal.

5.2.2 70% Solids removal

4-methylphenol was predicted to exceed sediment quality standards with a treatment technology equivalent to a 70% solids removal at all three CSO locations. Bis (2-ethylhexyl) phthalate was predicted to exceed sediment quality standards at Michigan/Brandon. Based on existing characterization of sediments around CSO discharges, it appears that it may not be appropriate to assume that 4-methylphenol remains associated with sediment particles. This is discussed further in Section 4.3.

5.2.3 90% Solids removal

Michigan/Brandon and HLKK were predicted to exceed sediment quality standards for 4-methylphenol with a treatment technology equivalent to a 90% solids removal. Based on existing characterization of sediments around CSO discharges, it appears that it may not be appropriate to assume that 4-methylphenol remains associated with sediment particles. This is discussed further in Section 4.3. No exceedances of the sediment quality standards were predicted for Hanford/Lander with treatment technology that removes 90% of the solids from the CSO discharge.

5.3 Environmental Fate

The results presented in Section 4.2 are based on the assumption that the chemicals behave as conservative substances and remain associated with the CSO sediment particles that deposit and accumulate on the water bottom. Some of the mass in the discharge will be in the dissolved form. Chemicals will have some partition from particulates to the water column, and that disassociation determines ultimate sediment concentrations.

5.3.1 4-Methylphenol

Current ambient sediment conditions in Lower Duwamish Waterway and East Waterway data do not indicate any existing sediment contamination for 4-methylphenol. The maximum observed sediment concentrations were 300 µg/kg dry weight in the Lower Duwamish Waterway (Windward 2007), and 180 µg/kg dry weight in the East Waterway (Windward 2010b). The data include locations near existing CSO discharges whose contribution to sediment contamination should be greater than the treated discharge scenarios modeled here.

4-methylphenol is a component of gasoline and diesel fuel products as well as occurring naturally in products such as coffee, tea, raspberries and blueberries (Montgomery 2007). It is slightly soluble in water, with a solubility of 19 g/L at 20ºC, and a fairly low octanol-water partitioning coefficient K_{ow} = 1.94 (Inchem 2008). Several degradation pathways have been documented for 4-methylphenol, including bacteriological (Montgomery 2007) and through oxidation with manganese (Schwarzenbach 1993).

Conservative-substance behavior appears to be a poor assumption for 4-methylphenol, which is predicted to exceed sediment quality standards under most treatment scenarios using that assumption. The predicted highest concentrations range from 210 to 5,100 µg/kg dry weight (Appendix B). The physical-chemical parameters of 4-methylphenol, combined with the low concentrations currently found in sediments suggest that 4-methylphenol does not behave conservatively in the environment. Thus it is unlikely that 4-methylphenol will cause exceedances of the sediment quality standards, despite the concentrations predicted from this modeling.

5.3.2 Benzoic Acid

Current ambient sediment conditions in Lower Duwamish Waterway and East Waterway data do not indicate significant sediment contamination for benzoic acid. Only two samples in the Lower Duwamish Waterway exceeded the sediment quality standards (26/208 detected; Windward 2007), and the maximum observed sediment concentration of 340 µg/kg dry weight in the East Waterway (3/120 detected) is below the sediment quality standard of 650 µg/kg dry weight (Windward 2010b). The data include locations near existing CSO discharges whose contribution to sediment contamination should be greater than the treated discharge scenarios modeled here.

Benzoic acid occurs naturally free and bound as benzoic acid esters in many plant and animal species. It is present as part of hippuric acid (N-benzoylglycine) in urine of mammals, especially herbivores. It is slightly soluble in water, with a solubility of 2.9 g/L at 25˚C, and a fairly low octanol-water partitioning coefficient log K_{ow} = 1.88 (Sigma-Aldrich 2011).

The physical-chemical parameters of benzoic acid indicate that it can easily transfer into the dissolved phase. It likely dissociates from CSO particulates during release into the environment, reducing the concentration accumulating in sediments and contravening the assumption of

conservative behavior with particulates used in this analysis. Thus predictions of benzoic acid concentrations are likely overestimated.

5.3.3 Butyl Benzyl Phthalate

Current ambient sediment conditions in Lower Duwamish Waterway and East Waterway data do not indicate significant sediment contamination for butyl benzyl phthalate. Nine samples (of 208) in the Lower Duwamish Waterway (Windward 2007) and five samples (of 120) in the East Waterway (Windward 2010b) exceeded the sediment quality standards. These samples include locations near existing CSO discharges whose contribution to sediment contamination should be greater than the treated discharge scenarios modeled here.

Butyl benzyl phthalate is mostly used as a plasticizer for PVC and vinyl foams. It is very slightly soluble in water, with a solubility of 0.71 mg/L at 25˚C, and a moderate octanol-water partitioning coefficient log K_{ow} = 4.77 (Inchem 2005).

The physical-chemical parameters of butyl benzyl phthalate indicate that it does not easily transfer into the dissolved phase. Much of the butyl benzyl phthalate likely remains with CSO particulates during release into the environment, so the assumption of conservative behavior with particulates used in this analysis is a reasonable, though conservative, assumption.

5.3.4 Bis (2-Ethylhexyl) Phthalate

Current ambient sediment conditions in Lower Duwamish Waterway and East Waterway data do not indicate significant sediment contamination for bis (2-ethylhexyl) phthalate. Ten samples (of 207) in the Lower Duwamish Waterway (Windward 2007) and four samples (of 120) in the East Waterway (Windward 2010b) exceeded the sediment quality standards. These samples include locations near existing CSO discharges whose contribution to sediment contamination should be greater than the treated discharge scenarios modeled here.

Bis (2-ethylhexyl) phthalate is widely used as a plasticizer in manufacturing of articles made of PVC. It is not soluble in water, and has a moderate octanol-water partitioning coefficient log K_{ow} = 5.03 (Inchem 2001).

The physical-chemical parameters of bis (2-ethylhexyl) phthalate indicate that it does not easily transfer into the dissolved phase. Much of the bis (2-ethylhexyl) phthalate likely remains with the CSO particulates during release into the environment, and the assumption of conservative behavior with particulates used in this analysis is a reasonable, though conservative, assumption.

6 Sensitivity Analysis

Estimating the future sediment quality around a CSO discharge involves estimating values for parameters that may be unknown or have spatial variability. This section evaluates the impact that variation of these parameters has on the predicted sediment quality.

6.1 Ambient Sediment Concentration

Ambient sediment concentrations used in the model included 16 chemicals assigned a zero concentration (Table 9) because the chemical was either not detected or detected in fewer than 25% of sediment samples, resulting in high uncertainty as to the concentrations of these chemicals. The detection level used for sampling typically varied by an order of magnitude, and a detailed analysis would be required to estimate a representative concentration. Sensitivity to use of zero-values was evaluated by assigning these chemicals an ambient sediment concentration equal to half the sediment quality standard.

The appropriateness of using half the sediment quality standard was checked by comparing it to the mean value of detected surface sediment samples from the Lower Duwamish Waterway (Windward 2007). The mean of detected samples is expected to be an overestimate of the actual mean because low concentration samples are non-detected and thus not included. One half of the sediment quality standard exceeded the mean of detected samples for all but three chemicals: hexachlorobenzene (5 detections/208 samples), pentachlorophenol (2/208), and benzyl alcohol (6/208). Given the low frequency of detections of these three chemicals, using half the sediment quality standard was thought to be a reasonable to overestimate the concentration of chemicals detected in fewer than 25% of samples. In addition, the quality of ambient sediment particles is more similar to the sediment entering from the Green River, which should have lower chemical concentrations than found in Lower Duwamish Waterway surface sediments. Thus using half the sediment quality standard for these ambient chemical concentrations should conservatively exceed actual sediment concentrations.

The results of the sensitivity analysis using higher ambient sediment concentrations indicated that the Michigan/Brandon CSO would exceed sediment quality standards for benzoic acid under the 70% solids removal scenario, in addition to the exceedances shown in Table 14. The Hanford/Lander CSO would exceed standards for benzoic acid under the 50% solids removal scenario, and 4-methylphenol under the 90% solids removal scenario. No changes were predicted from the exceedances shown in Table 14 for the HLKK CSO discharge.

6.2 Sediment Rates

The sensitivity of the sediment quality to different ambient sedimentation rates or to different sedimentation rates from the CSO discharge is evaluated by changing the ambient or CSO sedimentation rate (not both at the same time) to the increased or decreased values listed in Table 15. This sensitivity analysis did not predict any additional chemicals would exceed sediment quality standards other than the four already identified in Table 14. However, the treatment levels at which chemicals were predicted to exceed standards did change. The sensitivity to the chemicals predicted to exceed the standards is illustrated in Table 16, with predictions that are unchanged in grey, and changes to the base case in strike-out or bold.

Table 15. Sensitivity of Maximum Sedimentation Rate to Input Assumptions

	Revised Sedimentation Rates Used for Sensitivity Analysis (mm/year)		
	Michigan/Brandon	**Hanford/Lander**	**HLKK**
Ambient Sedimentation	Decreased: 10 Increased: 20	Decreased: 7.5 Increased: 12.5	Decreased: 1.0 Increased: 5.0
50% solids removal + untreated overflow	Decreased: 0.66 Increased: 1.32	Decreased: 0.33 Increased: 0.55	Decreased: 0.091 Increased: 0.45
70% solids removal + untreated overflow	Decreased: 0.33 Increased: 0.65	Decreased: 0.10 Increased: 0.16	Decreased: 0.025 Increased: 0.13
90% solids removal + untreated overflow	Decreased: 0.25 Increased: 0.49	Decreased: 0.047 Increased: 0.078	Decreased: 0.0017 Increased: 0.086

Table 16. Sensitivity Results for Chemicals Predicted to Exceed Sediment Quality Standards Under Higher or Lower Sedimentation Rates

Treatment Level	Michigan/Brandon	Hanford/Lander	HLKK
Increased ambient sedimentation rate/ decreased CSO deposition rate			
50% solids removal	• butyl benzyl phthalate • bis (2-ethylhexyl) phthalate • 4-methylphenol • benzoic acid	~~• butyl benzyl phthalate~~ • bis (2-ethylhexyl) phthalate • 4-methylphenol	~~• butyl benzyl phthalate~~ • bis (2-ethylhexyl) phthalate • 4-methylphenol ~~• benzoic acid~~
70% solids removal	~~• bis (2-ethylhexyl) phthalate~~ • 4-methylphenol	• 4-methylphenol	• 4-methylphenol
90% solids removal	• 4-methylphenol	• No exceedances	~~• 4-methylphenol~~
Decreased ambient sedimentation rate/ increased CSO deposition rate			
50% solids removal	• butyl benzyl phthalate • bis (2-ethylhexyl) phthalate • 4-methylphenol • benzoic acid	• butyl benzyl phthalate • bis (2-ethylhexyl) phthalate • 4-methylphenol • **benzoic acid**	• butyl benzyl phthalate • bis (2-ethylhexyl) phthalate • 4-methylphenol • benzoic acid
70% solids removal	• **butyl benzyl phthalate** • bis (2-ethylhexyl) phthalate • 4-methylphenol	• 4-methylphenol	• **butyl benzyl phthalate** • **bis (2-ethylhexyl) phthalate** • 4-methylphenol • **benzoic acid**
90% solids removal	• **bis (2-ethylhexyl) phthalate** • 4-methylphenol	• No exceedances	• **bis (2-ethylhexyl) phthalate** • 4-methylphenol

6.3 Non-Detected Compounds

A number of chemicals were not detected in one or more of the CSO characterization samples. The value of these compounds was set at half the MDL, but the actual value could be anywhere between 0 and the MDL. The sensitivity to the use of the half-MDL-value was evaluated by using values of 0 or the MDL for samples that were below detection limits.

No chemicals were predicted to exceed sediment quality standards by assuming a value equal to the MDL instead of half the MDL. No chemicals that were predicted to exceed the sediment quality standards in the initial modeling were predicted to accumulate at a concentration below the standards by assuming 0 instead of half the MDL.

6.4 Organic Carbon in Ambient Sediments

Washington State sediment quality standards for many organic compounds are based on organic carbon rather than dry weight. The amount of organic carbon in the sediment is determined primarily from sediment being deposited. The 2% organic carbon assumed in the analysis is typical of sediments in the region. The sensitivity to this assumption was evaluated by assigning a value of 1% and 4% organic carbon to the sediments.

Under a 4% organic carbon scenario and a 50% solids removal rate, butyl benzyl phthalate would not exceed sediment quality standards for any of the treatment facility scenarios. Bis (2-ethylhexyl) phthalate would only exceed the standards for the HLKK treatment scenario with a 50% solids removal.

Under a 1% organic carbon scenario bis (2-ethylhexyl) phthalate would exceed sediment quality standards with 70% solids removal for all three CSO discharge scenarios, and at the Michigan/Brandon and HLKK CSOs with 90% solids removal. Butyl benzyl phthalate would exceed the standard at the Michigan/Brandon and HLKK CSOs with 70% solids removal.

6.5 CSO Chemical Concentrations

The chemical concentrations used to characterize the CSO discharges were taken from sediment samples collected from the CSO conveyance lines, either from sediment traps or from material collected on the bottom. This data was thought to be the most representative of the particulate matter that would settle near the CSO. However, an alternative approach to characterizing the CSO discharges could be developed using whole water grab samples collected from the CSO conveyance lines. These samples are typically collected with an auto-sampler when the level in the conveyance line approaches the level that will trigger a CSO discharge. The particulates are typically finer in these samples than in the sediment samples. Finer particulates typically have higher chemical concentrations than larger particles due to their increased surface area. Chemical analysis of the entire water sample represents chemicals in the dissolved phase plus those associated with the particulates.

The chemical concentration associated with the particulate phase can be estimated by assuming a partitioning of each chemical between the dissolved and solid phases. The simplest may be to assume the entire chemical concentration is associated with particulate phase (this is known as the TSS normalized concentration). Other methods involve assuming an equilibrium partitioning between the solid phase and the dissolved phase, or between the solid, colloidal, and dissolved phases. The assumption of equilibrium may not be appropriate in CSO conditions, creating predictions that are high or low depending on the origin of the chemical.

An informal comparison showed TSS normalized concentrations were significantly higher than concentrations observed in the sediment samples. Concentrations predicted from a three-phase equilibrium model were typically within a factor of two, tending to be higher than the sediment samples. While using whole-water samples would result in higher concentrations and a more conservative analysis, the sediment samples were thought to be more representative of the material that would settle near a CSO discharge. A more detailed comparison of predictions beyond this informal analysis was not undertaken.

7 Summary

The potential for sediment quality exceedances near discharges from CSO treatment facilities was evaluated based on measured chemical concentrations in CSO solids, predicted sedimentation patterns around CSO discharges, assumed particulate removal efficiencies, ambient sedimentation rates and ambient sediment chemical concentrations.

The three evaluated CSO discharge locations (Michigan/Brandon, Hanford/Lander, HLKK) were predicted to have similar sediment quality for the same level of CSO treatment. Increasing the removal efficiency of the CSO treatment resulted in reduced concentrations in the sediment.

With a CSO treatment technology equivalent to 50% solids removal, sediment quality exceedances of butyl benzyl phthalate and bis (2-ethylhexyl) phthalate were predicted for all three CSO locations. Benzoic acid was predicted to exceed sediment quality standards at Michigan/Brandon and HLKK, and was just below the sediment quality standard at Hanford/Lander.

Physical-chemical data for 4-methylphenol and benzoic acid indicate that these compounds do not partition strongly to the solid phase, and some dissociation should be expected as the CSO particulates are discharged into the ambient environment. This suggests that assuming that these chemicals remain with the particulates will result in an over-prediction of sediment concentrations. Existing ambient sediment data indicate no sediment quality exceedances for 4-methylphenol and very limited exceedances for benzoic acid. Factoring in the reduction in loading compared to existing discharges, it appears unlikely that these compounds would accumulate in the sediments at levels that exceed sediment standards.

No other compounds were predicted to exceed sediment quality standards with a 70% or 90% solids removal, except bis (2-ethylhexyl) phthalate, which was predicted to exceed in one cell (300 square feet) at the Michigan/Brandon CSO under 70% solids removal.

Sensitivity analyses of the detection limits in CSO and ambient samples, the sedimentation rate, and the organic carbon content of the ambient sediment showed that assumptions about these parameters can alter which chemicals are predicted to exceed sediment quality standards. The sensitivity analysis showed that the reasonable uncertainty in parameters could alter the level of CSO treatment at which chemicals are predicted to meet sediment quality standards. Incorporating the expected environmental fate of the chemicals, the potential to exceed sediment quality standards appears limited to butyl benzyl phthalate and bis (2-ethylhexyl) phthalate. CSO treatment exceeding 70% solids removal is expected to prevent sediment contamination, but sufficient uncertainty exists in parameters at this level of analysis that contamination cannot be ruled out.

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Appendix A: Input Time Series

The CSO flow rates used for the model input are shown in Figures A1 through A3. Periods with zero discharge were removed from the model input time series to reduce the computational time. Flow hydrographs are the output of a hydraulic system model of the collection system using observed rainfall for the period 1978 – 1981.

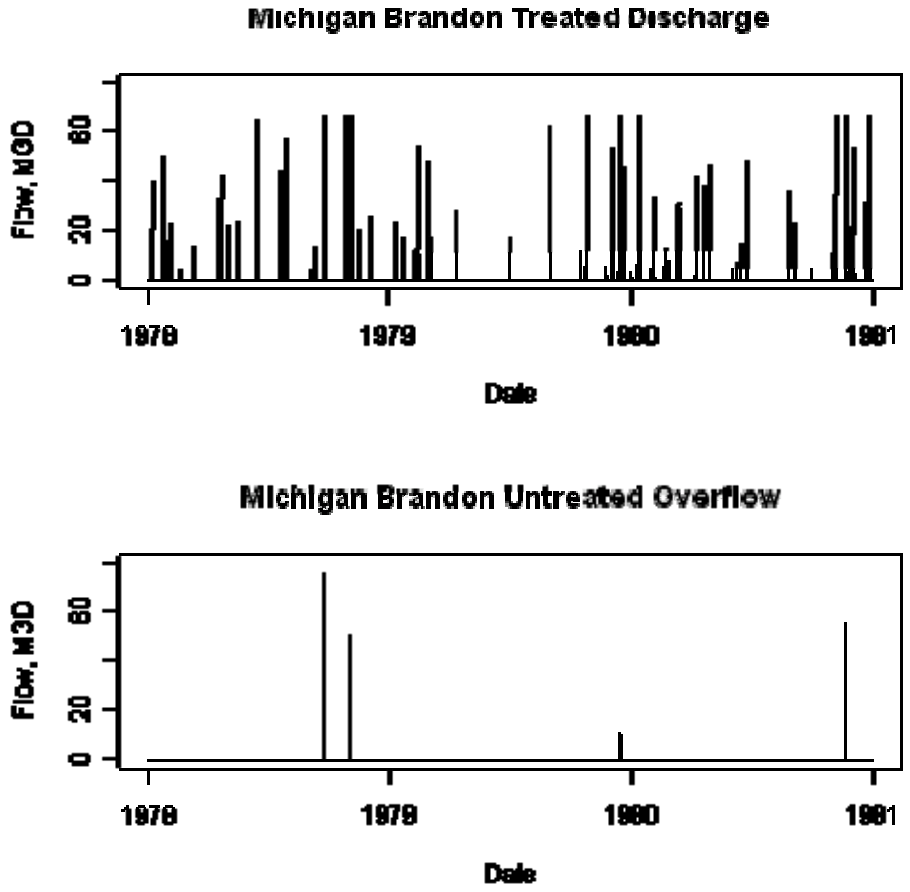

Figure A1. CSO Discharge Rates for a Combined Michigan/Brandon CSO Treatment Facility

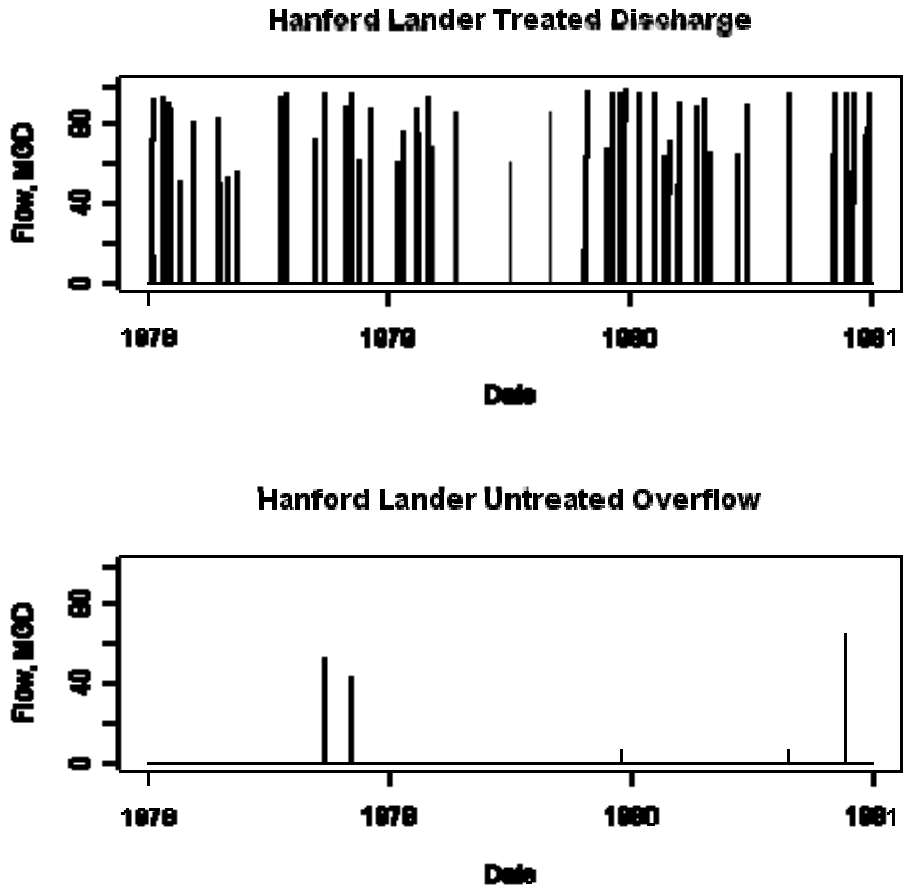

Figure A2. CSO Discharge Rates for a Combined Hanford/Lander CSO Treatment Facility

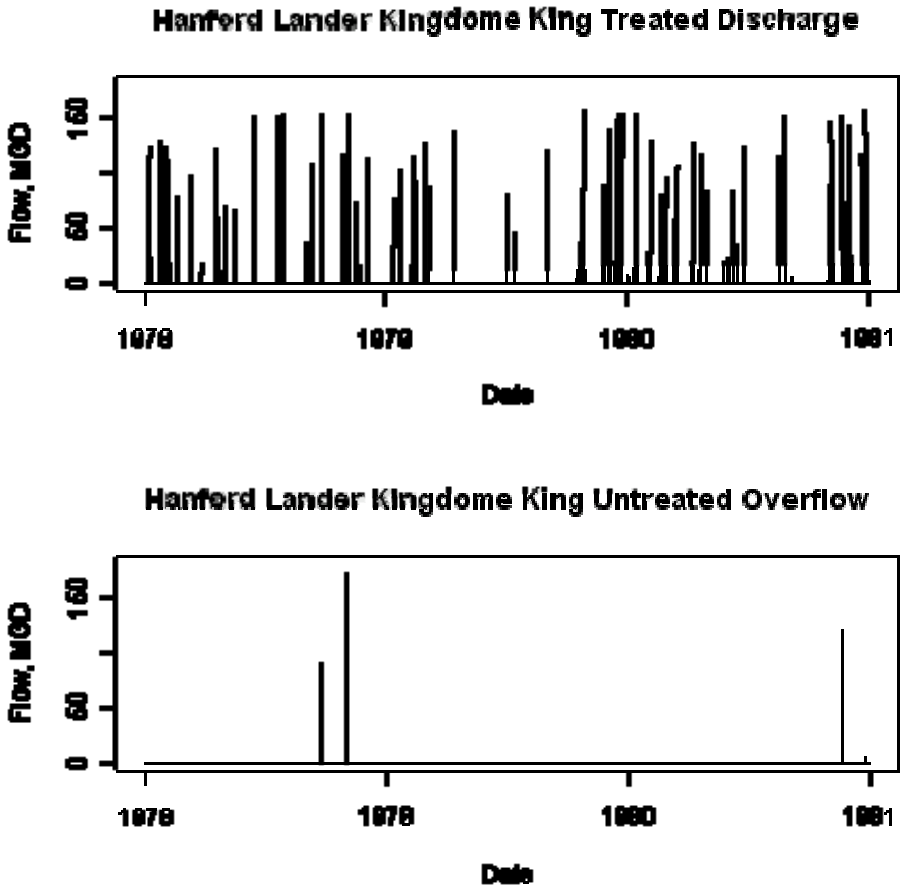

Figure A3. CSO Discharge Rates for a Combined Hanford/Lander/King/Kingdome CSO Treatment Facility

Appendix B: Predicted Chemical Concentrations

Tables B1 through B9 provide the model-predicted sediment concentrations for each CSO and treatment level for chemicals with Washington State Sediment Quality Standards. Three tables are provided for each CSO treatment facility scenario: Michigan/Brandon (Tables B1-B3), Hanford/Lander (Tables B4-B6), and HLKK (Tables B7-B9). Predicted sediment concentrations are tabulated for three treatment efficiencies: 50% solids removal (Tables B1, B4, B7), 70% solids removal (Tables B2, B5, B8), 90% solids removal (Tables B3, B6, B9). The sediment concentrations reflect the untreated overflows (≥ 1/year event) discharging at the same location as the treated discharge.

Each table presents the model-predicted sediment concentration using three assumed values for concentrations that were below the method detection limit (MDL) in the CSO samples: a value of zero, a value equal to half the MDL, and a value equal to the MDL.

Additionally, each table contains three columns presenting the organic carbon normalized concentrations, assuming a sediment organic carbon concentration of 1%, 2%, or 4%.

Values in the table without highlighting are less than half the sediment quality standard. Values highlighted in grey are predicted to be below the sediment quality standard, but have the potential to be more than half the standard. Values highlighted in yellow are predicted to have the potential to be above the sediment quality standard. Values are tabulated for the dry weight equivalent levels for informational purposes, but predicted exceedances were determined from the organic carbon normalized sediment quality standards.

Notes to Tables B1-B9:

- The LPAH criterion represents the sum of the following low molecular weight polynuclear aromatic hydrocarbon compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Note that the LPAH criterion is not the sum of criteria values for the individual LPAH compounds as listed.
- The HPAH criterion represents the sum of the following high molecular weight polynuclear aromatic hydrocarbon compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Note that the HPAH criterion is not the sum of criteria values for the individual HPAH compounds as listed.
- The total benzofluoranthenes criterion represents the sum of the concentrations of the “B,” “J,” and “K” isomers.

Table B1. Michigan/Brandon Predicted Sediment Concentrations 50% solids removal

Depositional Rate = 0.99 mm/year **Ambient Sedimentation = 15 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		8.9	8.9	9			
CADMIUM	5.1		1.1	1.1	1.1			
CHROMIUM	260		41	41	41			
COPPER	390		110	110	110			
LEAD	450		100	100	100			
MERCURY	0.41		0.18	0.18	0.18			
SILVER	6.1		1.2	1.2	1.2			
ZINC	410		100	100	100			
	µg /KG DRY WEIGHT	MG/KG OC		µg /KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	290	290	290	29	14	7.1
NAPHTHALENE	2100	99	15	28	41	2.8	1.4	0.7
ACENAPHTHYLENE	1300	66	7.5	22	36	2.2	1.1	0.54
ACENAPHTHENE	500	16	13	27	41	2.7	1.4	0.68
FLUORENE	540	23	16	30	44	3	1.5	0.75
PHENANTHRENE	1500	100	170	170	170	17	8.4	4.2
ANTHRACENE	960	220	13	27	41	2.7	1.4	0.68
2-METHYLNAPHTHALENE	670	38	75	86	98	8.6	4.3	2.2
HPAH	12000	960	1200	1200	1200	120	60	30
FLUORANTHENE	1700	160	260	260	260	26	13	6.6
PYRENE	2600	1,000	240	240	240	24	12	6
BENZ(A)ANTHRACENE	1300	110	73	83	94	8.3	4.2	2.1
CHRYSENE	1400	110	93	98	100	9.8	4.9	2.4
TOTAL BENZOFLUORANTHENES	3200	230	720	730	740	73	37	18
BENZO(A)PYRENE	1600	99	75	87	99	8.7	4.4	2.2
INDENO (1,2,3,-C,D) PYRENE	600	34	37	49	61	4.9	2.5	1.2
DIBENZO (A,H) ANTHRACENE	230	12	24	39	53	3.9	1.9	0.96
BENZO(G,H,I)PERYLENE	670	31	110	120	130	12	6	3
1,2-DICHLOROBENZENE	35	2.3	0	1.4	2.8	0.14	0.071	0.035
1,4-DICHLOROBENZENE	110	3.1	5	5.3	5.7	0.53	0.27	0.13
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.71	1.4	0.071	0.036	0.018
HEXACHLOROBENZENE	22	0.38	0	2.8	5.6	0.28	0.14	0.07
DIMETHYL PHTHALATE	71	53	0	28	56	2.8	1.4	0.7
DIETHYL PHTHALATE	200	61	0	28	56	2.8	1.4	0.7
DI-N-BUTYL PHTHALATE	1400	220	11	37	63	3.7	1.9	0.93
BUTYL BENZYL PHTHALATE	63	4.9	150	150	150	15	7.3	3.6
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	1900	1900	1900	190	94	47
DI-N-OCTYL PHTHALATE	6200	58	82	110	130	11	5.4	2.7
DIBENZOFURAN	540	15	47	61	75	6.1	3.1	1.5
HEXACHLOROBUTADIENE	11	3.9	0	2.8	5.6	0.28	0.14	0.07
N-NITROSODIPHENYLAMINE	28	11	0	28	56	2.8	1.4	0.7
TOTAL PCBs	130,000	12	62	62	63	6.2	3.1	1.6
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		27	50	74			
2-METHYLPHENOL	63		0	14	28			
4-METHYLPHENOL	670		4400	4400	4400			
2,4-DIMETHYL PHENOL	29		0	7.1	14			
PENTACHLOROPHENOL	360		0	71	140			
BENZYL ALCOHOL	57		0	14	28			
BENZOIC ACID	650		810	820	830			

Table B2. Michigan/Brandon Predicted Sediment Concentrations 70% solids removal

Depositional Rate = 0.49 mm/year **Ambient Sedimentation = 15 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		8.9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		110	110	110			
LEAD	450		100	100	100			
MERCURY	0.41		0.14	0.14	0.14			
SILVER	6.1		1.1	1.1	1.1			
ZINC	410		85	85	85			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	200	200	200	20	9.9	5
NAPHTHALENE	2100	99	13	20	26	2	0.99	0.49
ACENAPHTHYLENE	1300	66	7.7	15	22	1.5	0.75	0.37
ACENAPHTHENE	500	16	14	21	28	2.1	1	0.52
FLUORENE	540	23	16	24	31	2.4	1.2	0.59
PHENANTHRENE	1500	100	110	110	110	11	5.6	2.8
ANTHRACENE	960	220	14	21	28	2.1	1	0.52
2-METHYLNAPHTHALENE	670	38	44	51	57	5.1	2.5	1.3
HPAH	12000	960	1100	1100	1100	110	53	27
FLUORANTHENE	1700	160	230	230	230	23	11	5.7
PYRENE	2600	1,000	190	190	190	19	9.5	4.7
BENZ(A)ANTHRACENE	1300	110	64	70	75	7	3.5	1.7
CHRYSENE	1400	110	71	74	77	7.4	3.7	1.8
TOTAL BENZOFLUORANTHENES	3200	230	730	740	740	74	37	18
BENZO(A)PYRENE	1600	99	72	78	85	7.8	3.9	2
INDENO (1,2,3,-C,D) PYRENE	600	34	34	40	47	4	2	1
DIBENZO (A,H) ANTHRACENE	230	12	25	32	40	3.2	1.6	0.81
BENZO(G,H,I)PERYLENE	670	31	100	110	110	11	5.3	2.7
1,2-DICHLOROBENZENE	35	2.3	0	0.72	1.4	0.072	0.036	0.018
1,4-DICHLOROBENZENE	110	3.1	2.6	2.7	2.9	0.27	0.14	0.068
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.36	0.73	0.036	0.018	0.0091
HEXACHLOROBENZENE	22	0.38	0	1.4	2.9	0.14	0.072	0.036
DIMETHYL PHTHALATE	71	53	0	14	29	1.4	0.72	0.36
DIETHYL PHTHALATE	200	61	0	14	29	1.4	0.72	0.36
DI-N-BUTYL PHTHALATE	1400	220	5.7	19	32	1.9	0.95	0.47
BUTYL BENZYL PHTHALATE	63	4.9	80	80	80	8	4	2
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	1000	1000	1000	100	51	25
DI-N-OCTYL PHTHALATE	6200	58	42	55	68	5.5	2.7	1.4
DIBENZOFURAN	540	15	48	56	63	5.6	2.8	1.4
HEXACHLOROBUTADIENE	11	3.9	0	1.4	2.9	0.14	0.072	0.036
N-NITROSODIPHENYLAMINE	28	11	0	14	29	1.4	0.72	0.36
TOTAL PCBs	130,000	12	49	49	49	4.9	2.4	1.2
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		19	31	43			
2-METHYLPHENOL	63		0	7.2	14			
4-METHYLPHENOL	670		2300	2300	2300			
2,4-DIMETHYL PHENOL	29		0	3.6	7.3			
PENTACHLOROPHENOL	360		0	36	73			
BENZYL ALCOHOL	57		0	7.2	14			
BENZOIC ACID	650		420	420	420			

Table B3. Michigan/Brandon Predicted Sediment Concentrations 90% solids removal

Depositional Rate = 0.49 mm/year **Ambient Sedimentation = 15 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		100	100	100			
LEAD	450		100	100	100			
MERCURY	0.41		0.13	0.13	0.13			
SILVER	6.1		1.1	1.1	1.1			
ZINC	410		80	80	80			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	180	180	180	18	8.8	4.4
NAPHTHALENE	2100	99	13	18	23	1.8	0.88	0.44
ACENAPHTHYLENE	1300	66	7.8	13	19	1.3	0.66	0.33
ACENAPHTHENE	500	16	14	19	25	1.9	0.96	0.48
FLUORENE	540	23	17	22	28	2.2	1.1	0.55
PHENANTHRENE	1500	100	97	97	97	9.7	4.9	2.4
ANTHRACENE	960	220	14	19	25	1.9	0.96	0.48
2-METHYLNAPHTHALENE	670	38	37	42	46	4.2	2.1	1
HPAH	12000	960	1000	1000	1000	100	52	26
FLUORANTHENE	1700	160	220	220	220	22	11	5.5
PYRENE	2600	1,000	180	180	180	18	8.9	4.4
BENZ(A)ANTHRACENE	1300	110	62	67	71	6.7	3.3	1.7
CHRYSENE	1400	110	66	68	70	6.8	3.4	1.7
TOTAL BENZOFLUORANTHENES	3200	230	730	740	740	74	37	18
BENZO(A)PYRENE	1600	99	72	76	81	7.6	3.8	1.9
INDENO (1,2,3,-C,D) PYRENE	600	34	34	38	43	3.8	1.9	0.95
DIBENZO (A,H) ANTHRACENE	230	12	25	31	36	3.1	1.5	0.77
BENZO(G,H,I)PERYLENE	670	31	100	100	110	10	5.2	2.6
1,2-DICHLOROBENZENE	35	2.3	0	0.55	1.1	0.055	0.027	0.014
1,4-DICHLOROBENZENE	110	3.1	1.9	2.1	2.2	0.21	0.1	0.052
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.28	0.56	0.028	0.014	0.0069
HEXACHLOROBENZENE	22	0.38	0	1.1	2.2	0.11	0.055	0.027
DIMETHYL PHTHALATE	71	53	0	11	22	1.1	0.55	0.27
DIETHYL PHTHALATE	200	61	0	11	22	1.1	0.55	0.27
DI-N-BUTYL PHTHALATE	1400	220	4.4	14	24	1.4	0.72	0.36
BUTYL BENZYL PHTHALATE	63	4.9	63	63	63	6.3	3.2	1.6
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	800	800	800	80	40	20
DI-N-OCTYL PHTHALATE	6200	58	32	42	52	4.2	2.1	1
DIBENZOFURAN	540	15	49	54	60	5.4	2.7	1.4
HEXACHLOROBUTADIENE	11	3.9	0	1.1	2.2	0.11	0.055	0.027
N-NITROSODIPHENYLAMINE	28	11	0	11	22	1.1	0.55	0.27
TOTAL PCBs	130,000	12	45	46	46	4.6	2.3	1.1
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		17	26	35			
2-METHYLPHENOL	63		0	5.5	11			
4-METHYLPHENOL	670		1700	1700	1700			
2,4-DIMETHYL PHENOL	29		0	2.8	5.6			
PENTACHLOROPHENOL	360		0	28	56			
BENZYL ALCOHOL	57		0	5.5	11			
BENZOIC ACID	650		320	320	320			

Table B4. Hanford/Lander Predicted Sediment Concentrations 50% solids removal

Depositional Rate = 0.49 mm/year **Ambient Sedimentation = 15 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		8.9	9	9			
CADMIUM	5.1		1.1	1.1	1.1			
CHROMIUM	260		41	41	41			
COPPER	390		110	110	110			
LEAD	450		100	100	100			
MERCURY	0.41		0.15	0.15	0.15			
SILVER	6.1		1.1	1.1	1.1			
ZINC	410		92	92	92			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	230	230	230	23	11	5.7
NAPHTHALENE	2100	99	14	23	31	2.3	1.1	0.57
ACENAPHTHYLENE	1300	66	7.7	17	27	1.7	0.86	0.43
ACENAPHTHENE	500	16	13	23	33	2.3	1.2	0.58
FLUORENE	540	23	16	26	36	2.6	1.3	0.65
PHENANTHRENE	1500	100	130	130	130	13	6.5	3.3
ANTHRACENE	960	220	13	23	33	2.3	1.2	0.58
2-METHYLNAPHTHALENE	670	38	55	63	71	6.3	3.1	1.6
HPAH	12000	960	1100	1100	1100	110	56	28
FLUORANTHENE	1700	160	240	240	240	24	12	6
PYRENE	2600	1,000	210	210	210	21	10	5.2
BENZ(A)ANTHRACENE	1300	110	67	75	82	7.5	3.7	1.9
CHRYSENE	1400	110	79	82	86	8.2	4.1	2.1
TOTAL BENZOFLUORANTHENES	3200	230	730	730	740	73	37	18
BENZO(A)PYRENE	1600	99	73	82	90	8.2	4.1	2
INDENO (1,2,3,-C,D) PYRENE	600	34	35	44	52	4.4	2.2	1.1
DIBENZO (A,H) ANTHRACENE	230	12	25	35	44	3.5	1.7	0.86
BENZO(G,H,I)PERYLENE	670	31	110	110	120	11	5.5	2.8
1,2-DICHLOROBENZENE	35	2.3	0	0.96	1.9	0.096	0.048	0.024
1,4-DICHLOROBENZENE	110	3.1	3.4	3.6	3.9	0.36	0.18	0.091
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.49	0.97	0.049	0.024	0.012
HEXACHLOROBENZENE	22	0.38	0	1.9	3.8	0.19	0.096	0.048
DIMETHYL PHTHALATE	71	53	0	19	38	1.9	0.96	0.48
DIETHYL PHTHALATE	200	61	0	19	38	1.9	0.96	0.48
DI-N-BUTYL PHTHALATE	1400	220	7.6	25	43	2.5	1.3	0.63
BUTYL BENZYL PHTHALATE	63	4.9	100	100	100	10	5.1	2.6
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	1300	1300	1300	130	66	33
DI-N-OCTYL PHTHALATE	6200	58	56	73	91	7.3	3.7	1.8
DIBENZOFURAN	540	15	48	58	67	5.8	2.9	1.4
HEXACHLOROBUTADIENE	11	3.9	0	1.9	3.8	0.19	0.096	0.048
N-NITROSODIPHENYLAMINE	28	11	0	19	38	1.9	0.96	0.48
TOTAL PCBs	130,000	12	53	54	54	5.4	2.7	1.3
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		22	37	53			
2-METHYLPHENOL	63		0	9.6	19			
4-METHYLPHENOL	670		3000	3000	3000			
2,4-DIMETHYL PHENOL	29		0	4.9	9.7			
PENTACHLOROPHENOL	360		0	49	97			
BENZYL ALCOHOL	57		0	9.6	19			
BENZOIC ACID	650		550	560	560			

Table B5. Hanford/Lander Predicted Sediment Concentrations 70% solids removal

Depositional Rate = 0.13 mm/year **Ambient Sedimentation = 10 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		100	100	100			
LEAD	450		100	100	100			
MERCURY	0.41		0.12	0.12	0.12			
SILVER	6.1		1	1	1			
ZINC	410		72	72	72			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	140	140	140	14	7.2	3.6
NAPHTHALENE	2100	99	12	15	17	1.5	0.73	0.36
ACENAPHTHYLENE	1300	66	7.9	11	14	1.1	0.54	0.27
ACENAPHTHENE	500	16	14	17	20	1.7	0.84	0.42
FLUORENE	540	23	17	20	23	2	0.99	0.49
PHENANTHRENE	1500	100	77	77	77	7.7	3.8	1.9
ANTHRACENE	960	220	14	17	20	1.7	0.84	0.42
2-METHYLNAPHTHALENE	670	38	26	28	31	2.8	1.4	0.71
HPAH	12000	960	990	990	990	99	49	25
FLUORANTHENE	1700	160	210	210	210	21	10	5.1
PYRENE	2600	1,000	160	160	160	16	8	4
BENZ(A)ANTHRACENE	1300	110	59	62	64	6.2	3.1	1.5
CHRYSENE	1400	110	58	59	60	5.9	3	1.5
TOTAL BENZOFLUORANTHENES	3200	230	740	740	740	74	37	18
BENZO(A)PYRENE	1600	99	70	73	75	7.3	3.6	1.8
INDENO (1,2,3,-C,D) PYRENE	600	34	32	35	37	3.5	1.7	0.87
DIBENZO (A,H) ANTHRACENE	230	12	26	29	32	2.9	1.4	0.71
BENZO(G,H,I)PERYLENE	670	31	97	98	100	9.8	4.9	2.5
1,2-DICHLOROBENZENE	35	2.3	0	0.29	0.59	0.029	0.015	0.0073
1,4-DICHLOROBENZENE	110	3.1	1	1.1	1.2	0.11	0.055	0.028
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.15	0.3	0.015	0.0074	0.0037
HEXACHLOROBENZENE	22	0.38	0	0.58	1.2	0.058	0.029	0.015
DIMETHYL PHTHALATE	71	53	0	5.8	12	0.58	0.29	0.15
DIETHYL PHTHALATE	200	61	0	5.8	12	0.58	0.29	0.15
DI-N-BUTYL PHTHALATE	1400	220	2.3	7.7	13	0.77	0.38	0.19
BUTYL BENZYL PHTHALATE	63	4.9	39	39	39	3.9	1.9	0.97
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	480	480	480	48	24	12
DI-N-OCTYL PHTHALATE	6200	58	17	22	28	2.2	1.1	0.56
DIBENZOFURAN	540	15	49	52	55	5.2	2.6	1.3
HEXACHLOROBUTADIENE	11	3.9	0	0.58	1.2	0.058	0.029	0.015
N-NITROSODIPHENYLAMINE	28	11	0	5.8	12	0.58	0.29	0.15
TOTAL PCBs	130,000	12	41	41	41	4.1	2	1
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		14	18	23			
2-METHYLPHENOL	63		0	2.9	5.9			
4-METHYLPHENOL	670		920	920	920			
2,4-DIMETHYL PHENOL	29		0	1.5	3			
PENTACHLOROPHENOL	360		0	15	30			
BENZYL ALCOHOL	57		0	2.9	5.9			
BENZOIC ACID	650		170	170	170			

Table B6. Hanford/Lander Predicted Sediment Concentrations 90% solids removal

Depositional Rate = 0.062 mm/year **Ambient Sedimentation = 10 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		100	100	100			
LEAD	450		100	100	100			
MERCURY	0.41		0.11	0.11	0.11			
SILVER	6.1		1	1	1			
ZINC	410		68	68	68			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	120	120	120	12	6.2	3.1
NAPHTHALENE	2100	99	11	13	14	1.3	0.64	0.32
ACENAPHTHYLENE	1300	66	8	9.4	11	0.94	0.47	0.23
ACENAPHTHENE	500	16	14	15	17	1.5	0.77	0.38
FLUORENE	540	23	17	18	20	1.8	0.92	0.46
PHENANTHRENE	1500	100	64	64	64	6.4	3.2	1.6
ANTHRACENE	960	220	14	15	17	1.5	0.77	0.38
2-METHYLNAPHTHALENE	670	38	19	20	21	2	1	0.51
HPAH	12000	960	960	960	960	96	48	24
FLUORANTHENE	1700	160	200	200	200	20	9.9	4.9
PYRENE	2600	1,000	150	150	150	15	7.4	3.7
BENZ(A)ANTHRACENE	1300	110	58	59	60	5.9	2.9	1.5
CHRYSENE	1400	110	53	54	54	5.4	2.7	1.3
TOTAL BENZOFLUORANTHENES	3200	230	740	740	740	74	37	18
BENZO(A)PYRENE	1600	99	70	71	72	7.1	3.5	1.8
INDENO (1,2,3,-C,D) PYRENE	600	34	32	33	34	3.3	1.6	0.82
DIBENZO (A,H) ANTHRACENE	230	12	26	27	29	2.7	1.4	0.68
BENZO(G,H,I)PERYLENE	670	31	95	96	96	9.6	4.8	2.4
1,2-DICHLOROBENZENE	35	2.3	0	0.14	0.28	0.014	0.007	0.0035
1,4-DICHLOROBENZENE	110	3.1	0.5	0.53	0.56	0.053	0.027	0.013
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.071	0.14	0.0071	0.0036	0.0018
HEXACHLOROBENZENE	22	0.38	0	0.28	0.56	0.028	0.014	0.007
DIMETHYL PHTHALATE	71	53	0	2.8	5.6	0.28	0.14	0.07
DIETHYL PHTHALATE	200	61	0	2.8	5.6	0.28	0.14	0.07
DI-N-BUTYL PHTHALATE	1400	220	1.1	3.7	6.3	0.37	0.18	0.092
BUTYL BENZYL PHTHALATE	63	4.9	24	24	24	2.4	1.2	0.61
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	300	300	300	30	15	7.4
DI-N-OCTYL PHTHALATE	6200	58	8.1	11	13	1.1	0.54	0.27
DIBENZOFURAN	540	15	50	51	53	5.1	2.6	1.3
HEXACHLOROBUTADIENE	11	3.9	0	0.28	0.56	0.028	0.014	0.007
N-NITROSODIPHENYLAMINE	28	11	0	2.8	5.6	0.28	0.14	0.07
TOTAL PCBs	130,000	12	38	38	38	3.8	1.9	0.94
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		12	14	16			
2-METHYLPHENOL	63		0	1.4	2.8			
4-METHYLPHENOL	670		440	440	440			
2,4-DIMETHYL PHENOL	29		0	0.71	1.4			
PENTACHLOROPHENOL	360		0	7.1	14			
BENZYL ALCOHOL	57		0	1.4	2.8			
BENZOIC ACID	650		81	82	82			

Table B7. HLKK CSO Predicted Sediment Concentrations 50% solids removal

Depositional Rate = 0.20 mm/year **Ambient Sedimentation = 2.2 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		8.8	8.9	9			
CADMIUM	5.1		1.1	1.1	1.1			
CHROMIUM	260		41	41	41			
COPPER	390		110	110	110			
LEAD	450		100	100	100			
MERCURY	0.41		0.21	0.21	0.21			
SILVER	6.1		1.3	1.3	1.3			
ZINC	410		120	120	120			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	350	350	350	35	17	8.7
NAPHTHALENE	2100	99	17	34	51	3.4	1.7	0.85
ACENAPHTHYLENE	1300	66	7.3	26	45	2.6	1.3	0.66
ACENAPHTHENE	500	16	13	32	51	3.2	1.6	0.8
FLUORENE	540	23	16	35	54	3.5	1.7	0.86
PHENANTHRENE	1500	100	210	210	210	21	10	5.2
ANTHRACENE	960	220	13	32	51	3.2	1.6	0.8
2-METHYLNAPHTHALENE	670	38	96	110	130	11	5.6	2.8
HPAH	12000	960	1300	1300	1300	130	65	32
FLUORANTHENE	1700	160	290	290	290	29	14	7.2
PYRENE	2600	1,000	270	270	270	27	14	6.9
BENZ(A)ANTHRACENE	1300	110	78	93	110	9.3	4.6	2.3
CHRYSENE	1400	110	110	110	120	11	5.7	2.9
TOTAL BENZOFLUORANTHENES	3200	230	710	730	740	73	36	18
BENZO(A)PYRENE	1600	99	78	94	110	9.4	4.7	2.3
INDENO (1,2,3,-C,D) PYRENE	600	34	40	56	72	5.6	2.8	1.4
DIBENZO (A,H) ANTHRACENE	230	12	24	43	62	4.3	2.1	1.1
BENZO(G,H,I)PERYLENE	670	31	120	130	140	13	6.4	3.2
1,2-DICHLOROBENZENE	35	2.3	0	1.9	3.8	0.19	0.095	0.048
1,4-DICHLOROBENZENE	110	3.1	6.8	7.2	7.6	0.72	0.36	0.18
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.96	1.9	0.096	0.048	0.024
HEXACHLOROBENZENE	22	0.38	0	3.8	7.6	0.38	0.19	0.095
DIMETHYL PHTHALATE	71	53	0	38	76	3.8	1.9	0.95
DIETHYL PHTHALATE	200	61	0	38	76	3.8	1.9	0.95
DI-N-BUTYL PHTHALATE	1400	220	15	50	85	5	2.5	1.2
BUTYL BENZYL PHTHALATE	63	4.9	190	190	190	19	9.6	4.8
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	2500	2500	2500	250	120	62
DI-N-OCTYL PHTHALATE	6200	58	110	140	180	14	7.2	3.6
DIBENZOFURAN	540	15	46	65	84	6.5	3.2	1.6
HEXACHLOROBUTADIENE	11	3.9	0	3.8	7.6	0.38	0.19	0.095
N-NITROSODIPHENYLAMINE	28	11	0	38	76	3.8	1.9	0.95
TOTAL PCBs	130,000	12	71	72	72	7.2	3.6	1.8
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		33	64	96			
2-METHYLPHENOL	63		0	19	38			
4-METHYLPHENOL	670		6000	6000	6000			
2,4-DIMETHYL PHENOL	29		0	9.6	19			
PENTACHLOROPHENOL	360		0	96	190			
BENZYL ALCOHOL	57		0	19	38			
BENZOIC ACID	650		1100	1100	1100			

Table B8. HLKK CSO Predicted Sediment Concentrations 70% solids removal

Depositional Rate = 0.056 mm/year **Ambient Sedimentation = 2.2 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT			MG/KG DRY WEIGHT				
ARSENIC	57		9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		100	100	100			
LEAD	450		100	100	100			
MERCURY	0.41		0.13	0.13	0.13			
SILVER	6.1		1.1	1.1	1.1			
ZINC	410		80	80	80			
	µG/KG DRY WEIGHT	MG/KG OC		µG/KG DRY WEIGHT		MG/KG OC		
LPAH	5200	370	180	180	180	18	8.9	4.5
NAPHTHALENE	2100	99	13	18	23	1.8	0.89	0.45
ACENAPHTHYLENE	1300	66	7.8	13	19	1.3	0.67	0.34
ACENAPHTHENE	500	16	14	19	25	1.9	0.97	0.48
FLUORENE	540	23	17	22	28	2.2	1.1	0.56
PHENANTHRENE	1500	100	99	99	99	9.9	4.9	2.5
ANTHRACENE	960	220	14	19	25	1.9	0.97	0.48
2-METHYLNAPHTHALENE	670	38	38	42	47	4.2	2.1	1.1
HPAH	12000	960	1000	1000	1000	100	52	26
FLUORANTHENE	1700	160	220	220	220	22	11	5.5
PYRENE	2600	1,000	180	180	180	18	8.9	4.5
BENZ(A)ANTHRACENE	1300	110	63	67	71	6.7	3.3	1.7
CHRYSENE	1400	110	67	69	71	6.9	3.4	1.7
TOTAL BENZOFLUORANTHENES	3200	230	730	740	740	74	37	18
BENZO(A)PYRENE	1600	99	72	76	81	7.6	3.8	1.9
INDENO (1,2,3,-C,D) PYRENE	600	34	34	38	43	3.8	1.9	0.96
DIBENZO (A,H) ANTHRACENE	230	12	25	31	37	3.1	1.6	0.78
BENZO(G,H,I)PERYLENE	670	31	100	100	110	10	5.2	2.6
1,2-DICHLOROBENZENE	35	2.3	0	0.57	1.1	0.057	0.028	0.014
1,4-DICHLOROBENZENE	110	3.1	2	2.1	2.3	0.21	0.11	0.054
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.29	0.57	0.029	0.014	0.0072
HEXACHLOROBENZENE	22	0.38	0	1.1	2.3	0.11	0.056	0.028
DIMETHYL PHTHALATE	71	53	0	11	23	1.1	0.56	0.28
DIETHYL PHTHALATE	200	61	0	11	23	1.1	0.56	0.28
DI-N-BUTYL PHTHALATE	1400	220	4.5	15	25	1.5	0.74	0.37
BUTYL BENZYL PHTHALATE	63	4.9	65	65	65	6.5	3.3	1.6
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	830	830	830	83	41	21
DI-N-OCTYL PHTHALATE	6200	58	33	43	54	4.3	2.2	1.1
DIBENZOFURAN	540	15	49	54	60	5.4	2.7	1.4
HEXACHLOROBUTADIENE	11	3.9	0	1.1	2.3	0.11	0.056	0.028
N-NITROSODIPHENYLAMINE	28	11	0	11	23	1.1	0.56	0.28
TOTAL PCBs	130,000	12	46	46	46	4.6	2.3	1.1
	µG/KG DRY WEIGHT			µG/KG DRY WEIGHT				
PHENOL	420		17	26	36			
2-METHYLPHENOL	63		0	5.7	11			
4-METHYLPHENOL	670		1800	1800	1800			
2,4-DIMETHYL PHENOL	29		0	2.9	5.7			
PENTACHLOROPHENOL	360		0	29	57			
BENZYL ALCOHOL	57		0	5.7	11			
BENZOIC ACID	650		330	330	330			

Table B9. HLKK CSO Predicted Sediment Concentrations 90% solids removal

Depositional Rate = 0.038 mm/year **Ambient Sedimentation = 2.2 mm/year**						**ND=½ MDL**		
			ND=0	**ND=½ MDL**	**ND= MDL**	**1% OC**	**2% OC**	**4% OC**
CHEMICAL	MG/KG DRY WEIGHT		MG/KG DRY WEIGHT					
ARSENIC	57		9	9	9			
CADMIUM	5.1		1	1	1			
CHROMIUM	260		40	40	40			
COPPER	390		100	100	100			
LEAD	450		100	100	100			
MERCURY	0.41		0.12	0.12	0.12			
SILVER	6.1		1.1	1.1	1.1			
ZINC	410		75	75	75			
	µG/KG DRY WEIGHT	MG/KG OC	µG/KG DRY WEIGHT			MG/KG OC		
LPAH	5200	370	160	160	160	16	7.8	3.9
NAPHTHALENE	2100	99	12	16	19	1.6	0.78	0.39
ACENAPHTHYLENE	1300	66	7.9	12	16	1.2	0.59	0.29
ACENAPHTHENE	500	16	14	18	22	1.8	0.88	0.44
FLUORENE	540	23	17	21	24	2.1	1	0.51
PHENANTHRENE	1500	100	84	84	84	8.4	4.2	2.1
ANTHRACENE	960	220	14	18	22	1.8	0.88	0.44
2-METHYLNAPHTHALENE	670	38	30	33	36	3.3	1.7	0.83
HPAH	12000	960	1000	1000	1000	100	50	25
FLUORANTHENE	1700	160	210	210	210	21	10	5.2
PYRENE	2600	1,000	170	170	170	17	8.3	4.1
BENZ(A)ANTHRACENE	1300	110	61	63	66	6.3	3.2	1.6
CHRYSENE	1400	110	61	62	64	6.2	3.1	1.6
TOTAL BENZOFLUORANTHENES	3200	230	730	740	740	74	37	18
BENZO(A)PYRENE	1600	99	71	74	77	7.4	3.7	1.9
INDENO (1,2,3,-C,D) PYRENE	600	34	33	36	39	3.6	1.8	0.9
DIBENZO (A,H) ANTHRACENE	230	12	26	29	33	2.9	1.5	0.74
BENZO(G,H,I)PERYLENE	670	31	98	100	100	10	5	2.5
1,2-DICHLOROBENZENE	35	2.3	0	0.39	0.77	0.039	0.019	0.0097
1,4-DICHLOROBENZENE	110	3.1	1.4	1.5	1.6	0.15	0.073	0.037
1,2,4-TRICHLOROBENZENE	31	0.81	0	0.2	0.39	0.02	0.0098	0.0049
HEXACHLOROBENZENE	22	0.38	0	0.77	1.5	0.077	0.039	0.019
DIMETHYL PHTHALATE	71	53	0	7.7	15	0.77	0.39	0.19
DIETHYL PHTHALATE	200	61	0	7.7	15	0.77	0.39	0.19
DI-N-BUTYL PHTHALATE	1400	220	3.1	10	17	1	0.51	0.25
BUTYL BENZYL PHTHALATE	63	4.9	48	48	48	4.8	2.4	1.2
BIS (2-ETHYLHEXYL) PHTHALATE	1300	47	600	600	600	60	30	15
DI-N-OCTYL PHTHALATE	6200	58	22	30	37	3	1.5	0.74
DIBENZOFURAN	540	15	49	53	57	5.3	2.7	1.3
HEXACHLOROBUTADIENE	11	3.9	0	0.77	1.5	0.077	0.039	0.019
N-NITROSODIPHENYLAMINE	28	11	0	7.7	15	0.77	0.39	0.19
TOTAL PCBs	130,000	12	42	42	43	4.2	2.1	1.1
	µG/KG DRY WEIGHT		µG/KG DRY WEIGHT					
PHENOL	420		15	21	27			
2-METHYLPHENOL	63		0	3.9	7.7			
4-METHYLPHENOL	670		1200	1200	1200			
2,4-DIMETHYL PHENOL	29		0	2	3.9			
PENTACHLOROPHENOL	360		0	20	39			
BENZYL ALCOHOL	57		0	3.9	7.7			
BENZOIC ACID	650		220	230	230			

Appendix C: CSO Sediment Quality Data

Appendix C

	Project:	423589-090-1				Project:	423589-090-1				Project:	423589-090-4			
	Locator:	'063053				Locator:	S070196				Locator:	S070196			
	Descrip:	BRANDON ST OUTFALL				Descrip:	SMICHOF/WO39 S MIC				Descrip:	SMICHOF/WO39 S MIC			
	Sample:	L51108-1				Sample:	L51108-3				Sample:	L52290-1			
	Matrix:	SH IN-LINESED				Matrix:	SH IN-LINESED				Matrix:	SH IN-LINESED			
	ColDate:	6/29/10 14:20				ColDate:	6/29/10 15:30				ColDate:	12/7/10 9:45			
	TimeSpan:					TimeSpan:					TimeSpan:				
	TotalSolid:	32.3				TotalSolid:	25.1				TotalSolid:	11.3			
	ClientLoc:					ClientLoc:					ClientLoc:				
	SampDepth:					SampDepth:					SampDepth:				
	DRY Weight Basis					**DRY Weight Basis**					**DRY Weight Basis**				
Parameters	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**
CV ASTM D422															
Clay*		<MDL	1.8	3.55	%		<MDL	1.9	3.79	%					
Fines*	48		1.8	3.55	%	49.2		1.9	3.79	%					
Gravel*	5.5		0.36	3.55	%	4.2		0.38	3.79	%					
p+0.00*	19.6		0.36	3.55	%	10.2		0.38	3.79	%					
p+1.00*	8.8		0.36	3.55	%	9.1		0.38	3.79	%					
p+10.0(equal/more than)*		<MDL	1.8	3.55	%		<MDL	1.9	3.79	%					
p+2.00*	5.8		0.36	3.55	%	24.1		0.38	3.79	%					
p+3.00*	5.4		0.36	3.55	%	5.8		0.38	3.79	%					
p+4.00*	3.4	<RDL	0.36	3.55	%	2.5	<RDL	0.38	3.79	%					
p+5.00*	30.2		1.8	3.55	%	41.7		1.9	3.79	%					
p+6.00*	17.8		1.8	3.55	%	5.7		1.9	3.79	%					
p+7.00*		<MDL	1.8	3.55	%	1.9	<RDL	1.9	3.79	%					
p+8.00*		<MDL	1.8	3.55	%		<MDL	1.9	3.79	%					
p+9.00*		<MDL	1.8	3.55	%		<MDL	1.9	3.79	%					
p-1.00*	2.6	<RDL	0.36	3.55	%	2.5	<RDL	0.38	3.79	%					
p-2.00(less than)*	1.8	<RDL	0.36	3.55	%	1.3	<RDL	0.38	3.79	%					
p-2.00*	1	<RDL	0.36	3.55	%	0.5	<RDL	0.38	3.79	%					
Sand*	43		0.36	3.55	%	51.7		0.38	3.79	%					
Silt*	48		1.8	3.55	%	49.2		1.9	3.79	%					
CV SM2540-G															
Total Solids*	32.3		0.005	0.01	%	25.1		0.005	0.01	%	11.3	H	0.005	0.01	%
CV SW846 9060-PSEP96															
Total Organic Carbon	199000		18000	35900	mg/Kg	201000		18000	35100	mg/Kg					
MT SW846 3050B*SW846 6010C															
Antimony, Total, ICP		<MDL,JG	2.3	11.6	mg/Kg							<MDL	6.6	33.1	mg/Kg
Arsenic, Total, ICP	8	<RDL	4	19.4	mg/Kg							<MDL	11	55.2	mg/Kg
Cadmium, Total, ICP	2.44		0.31	1.55	mg/Kg						3.8	<RDL	0.88	4.42	mg/Kg
Chromium, Total, ICP	71.5		0.46	2.33	mg/Kg						54.2		1.3	6.62	mg/Kg
Cobalt, Total, ICP	10.6		0.46	2.33	mg/Kg						9.47		1.3	6.62	mg/Kg
Copper, Total, ICP	362		0.62	3.1	mg/Kg						265	J	1.8	8.83	mg/Kg
Lead, Total, ICP	133		3.1	15.5	mg/Kg						145		8.8	44.2	mg/Kg
Molybdenum, Total, ICP	29.1		0.46	2.33	mg/Kg						10.5		1.3	6.62	mg/Kg
Nickel, Total, ICP	82.7		0.77	3.87	mg/Kg						41.9		2.2	11.1	mg/Kg
Selenium, Total, ICP	11	<RDL	4	19.4	mg/Kg							<MDL	11	55.2	mg/Kg
Silver, Total, ICP	9.13		0.62	3.1	mg/Kg						3.3	<RDL	1.8	8.83	mg/Kg
Thallium, Total, ICP	11	<RDL	6.2	31	mg/Kg						35	<RDL	18	88.3	mg/Kg
Vanadium, Total, ICP	42.7		1.5	7.74	mg/Kg						42.6		4.4	22	mg/Kg
Zinc, Total, ICP	935		0.77	3.87	mg/Kg						965		2.2	11.1	mg/Kg
MT SW846 7471B															
Mercury, Total, CVAA	0.5	<RDL	0.062	0.613	mg/Kg	1.05		0.076	0.765	mg/Kg	1.93	J	0.044	0.442	mg/Kg
OR SW846 3550B*SW846 8082A															
Aroclor 1016		<MDL,TA	65	132	ug/Kg		<MDL,TA	1100	2120	ug/Kg					
Aroclor 1221		<MDL	16	33.1	ug/Kg		<MDL	110	212	ug/Kg					
Aroclor 1232		<MDL	16	33.1	ug/Kg		<MDL	110	212	ug/Kg					
Aroclor 1242		<MDL,TA	230	461	ug/Kg		<MDL,TA	1300	2550	ug/Kg					
Aroclor 1248	76.5		16	33.1	ug/Kg	1080		110	212	ug/Kg					
Aroclor 1254	172		16	33.1	ug/Kg	618		110	212	ug/Kg					
Aroclor 1260	96.6		16	33.1	ug/Kg	160	<RDL	110	212	ug/Kg					
Total PCBs *(sum detected aroclors)*	345.1				ug/Kg	1858				ug/Kg					
OR SW846 3550B*SW846 8270D															
1,2,4-Trichlorobenzene		<MDL	8.4	16.5	ug/Kg		<MDL	11	21.2	ug/Kg					
1,2-Dichlorobenzene		<MDL	16	33.1	ug/Kg		<MDL	21	42.6	ug/Kg					
1,2-Diphenylhydrazine		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg					
1,3-Dichlorobenzene		<MDL	16	33.1	ug/Kg		<MDL	21	42.6	ug/Kg					
1,4-Dichlorobenzene	162		16	33.1	ug/Kg		<MDL	21	42.6	ug/Kg					
2,4,5-Trichlorophenol		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg					
2,4,6-Trichlorophenol		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg					
2,4-Dichlorophenol		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg					
2,4-Dimethylphenol		<MDL	84	165	ug/Kg		<MDL	110	212	ug/Kg					
2,4-Dinitrotoluene		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg					

Appendix C

	Project:	423589-090-1				Project:	423589-090-1				Project:	423589-090-4								
	Locator:	'063053				Locator:	S070196				Locator:	S070196								
	Descrip:	BRANDON ST OUTFALL				Descrip:	SMICHOF/WO39 S MIC				Descrip:	SMICHOF/WO39 S MIC								
	Sample:	L51108-1				Sample:	L51108-3				Sample:	L52290-1								
	Matrix:	SH IN-LINESED				Matrix:	SH IN-LINESED				Matrix:	SH IN-LINESED								
	ColDate:	6/29/10 14:20				ColDate:	6/29/10 15:30				ColDate:	12/7/10 9:45								
	TimeSpan:					TimeSpan:					TimeSpan:									
	TotalSolid:	32.3				TotalSolid:	25.1				TotalSolid:	11.3								
	ClientLoc:					ClientLoc:					ClientLoc:									
	SampDepth:					SampDepth:					SampDepth:									
	DRY Weight Basis					**DRY Weight Basis**					**DRY Weight Basis**									
Parameters	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**					
2,6-Dinitrotoluene		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
2-Chloronaphthalene		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
2-Chlorophenol		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
2-Methylnaphthalene	180	<RDL	160	331	ug/Kg	4860		210	426	ug/Kg										
2-Methylphenol		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
2-Nitrophenol		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
4-Bromophenyl Phenyl Ether		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
4-Chlorophenyl Phenyl Ether		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
4-Methylphenol	63800		340	659	ug/Kg	64100		440	849	ug/Kg										
Acenaphthene		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Acenaphthylene		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Aniline		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
Anthracene		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzo(a)anthracene	458		160	331	ug/Kg	701		210	426	ug/Kg										
Benzo(a)pyrene	440		160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzo(b)fluoranthene	669		160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzo(g,h,i)perylene	616		160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzo(k)fluoranthene	250	<RDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzoic Acid	4490		840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
Benzyl Alcohol		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Benzyl Butyl Phthalate	3500		160	331	ug/Kg	2340		210	426	ug/Kg										
Bis(2-Chloroethoxy)Methane		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Bis(2-Chloroethyl)Ether		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Bis(2-Chloroisopropyl)Ether		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Bis(2-Ethylhexyl)Phthalate	21300		340	659	ug/Kg	33700		440	849	ug/Kg										
Caffeine		<MDL,JG	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Carbazole		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Chrysene	833		160	331	ug/Kg	1360		210	426	ug/Kg										
Coprostanol	97800		3400	6590	ug/Kg	566000		4400	8490	ug/Kg										
Dibenzo(a,h)anthracene		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Dibenzofuran		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Diethyl Phthalate		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Dimethyl Phthalate		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Di-N-Butyl Phthalate		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Di-N-Octyl Phthalate	6590		340	659	ug/Kg		<MDL	440	849	ug/Kg										
Fluoranthene	1380		160	331	ug/Kg	1980		210	426	ug/Kg										
Fluorene		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Hexachlorobenzene		<MDL	34	65.9	ug/Kg		<MDL	44	84.9	ug/Kg										
Hexachlorobutadiene		<MDL	34	65.9	ug/Kg		<MDL	44	84.9	ug/Kg										
Hexachloroethane		<MDL	160	331	ug/Kg		<MDL	210	426	ug/Kg										
Indeno(1,2,3-Cd)Pyrene	347		160	331	ug/Kg		<MDL	210	426	ug/Kg										
Isophorone		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Naphthalene		<MDL	160	331	ug/Kg	400	<RDL	210	426	ug/Kg										
Nitrobenzene		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
N-Nitrosodimethylamine		<MDL,JG	340	659	ug/Kg		<MDL	440	849	ug/Kg										
N-Nitrosodi-N-Propylamine		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
N-Nitrosodiphenylamine		<MDL	340	659	ug/Kg		<MDL	440	849	ug/Kg										
Pentachlorophenol		<MDL	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
Phenanthrene	1070		160	331	ug/Kg	4740		210	426	ug/Kg										
Phenol	500	<RDL	340	659	ug/Kg	932		440	849	ug/Kg										
Pyrene	2080		160	331	ug/Kg	3170		210	426	ug/Kg										
Pyridine		<MDL,JG	840	1650	ug/Kg		<MDL	1100	2120	ug/Kg										
* Not converted to dry weight basis																				
LPAH	1250				ug/Kg	10000				ug/Kg										
HPAH	7073				ug/Kg	7211				ug/Kg										
Total Benzofluoranthenes	919		160	331	ug/Kg		<MDL	210	426	ug/Kg										
Dioxin/furan TEQ	57.1				ng TEQ/kg	52.7				ng TEQ/kg										

Project:	423368-110-4				Project:	423368-110-4				
Locator:	ST805-L1-1				Locator:	ST805-L1-1				
Descrip:	Sed Trap at WW*HNFORD.04				Descrip:	Sed Trap at WW*HNFORD.04				
Sample:	L50498-1				Sample:	L50935-23				
Matrix:	SH IN-LINESED				Matrix:	SH IN-LINESED				
ColDate:	4/23/09 11:00				ColDate:	4/23/09 11:00				
TimeSpan:					TimeSpan:					
TotalSolid:	39.5				TotalSolid:	39.5				
ClientLoc:					ClientLoc:					
SampDepth:					SampDepth:					
DRY Weight Basis					**DRY Weight Basis**					
Parameters	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**
CV ASTM D422										
Clay										
Fines										
Gravel										
p+0.00										
p+1.00										
p+10.0(equal/more than)										
p+2.00										
p+3.00										
p+4.00										
p+5.00										
p+6.00										
p+7.00										
p+8.00										
p+9.00										
p-1.00										
p-2.00(less than)										
p-2.00										
Sand										
Silt										
CV SM2540-G										
Total Solids	39.5	H			%	39.5	H			%
CV SW846 9060-PSEP96										
Total Organic Carbon	161000	H		9600	19100 mg/kg dw					
MT SW846 3050B*SW846 6010C										
Antimony, Total, ICP										
Arsenic, Total, ICP	7.3	<RDL		3.3	16 mg/kg dw					
Cadmium, Total, ICP	1.32			0.25	1.28 mg/kg dw					
Chromium, Total, ICP	44.3			0.38	1.92 mg/kg dw					
Cobalt, Total, ICP	5.52			0.38	1.92 mg/kg dw					
Copper, Total, ICP	208			0.51	2.56 mg/kg dw					
Lead, Total, ICP	135			2.5	12.8 mg/kg dw					
Molybdenum, Total, ICP	4.3			0.38	1.92 mg/kg dw					
Nickel, Total, ICP	34.2			0.63	3.19 mg/kg dw					
Selenium, Total, ICP										
Silver, Total, ICP	3.06			0.51	2.56 mg/kg dw					
Thallium, Total, ICP										
Vanadium, Total, ICP	32.9			1.3	6.41 mg/kg dw					
Zinc, Total, ICP	582	J		0.63	3.19 mg/kg dw					
MT SW846 7471B										
Mercury, Total, CVAA	3.54	H		0.051	0.496 mg/kg dw	1.04	H,J	0.051	0.516	mg/kg dw
OR SW846 3550B*SW846 8082A										
Aroclor 1016		<MDL		20	40.5 µg/kg dw					
Aroclor 1221		<MDL		41	81 µg/kg dw					
Aroclor 1232		<MDL		41	81 µg/kg dw					
Aroclor 1242		<MDL		20	40.5 µg/kg dw					
Aroclor 1248		<MDL		20	40.5 µg/kg dw					
Aroclor 1254		<MDL		20	40.5 µg/kg dw					
Aroclor 1260	261			20	40.5 µg/kg dw					
Total PCBs *(sum detected aroclors)*	261			41	81 µg/kg dw					
OR SW846 3550B*SW846 8270D										
1,2,4-Trichlorobenzene		<MDL		41	81 µg/kg dw					
1,2-Dichlorobenzene		<MDL		81	162 µg/kg dw					
1,2-Diphenylhydrazine		<MDL		1600	3240 µg/kg dw					
1,3-Dichlorobenzene		<MDL		81	162 µg/kg dw					
1,4-Dichlorobenzene	628			81	162 µg/kg dw					
2,4,5-Trichlorophenol		<MDL		4100	8100 µg/kg dw					
2,4,6-Trichlorophenol		<MDL		4100	8100 µg/kg dw					
2,4-Dichlorophenol		<MDL		4100	8100 µg/kg dw					
2,4-Dimethylphenol		<MDL		410	810 µg/kg dw					
2,4-Dinitrotoluene		<MDL		4100	8100 µg/kg dw					
2,6-Dinitrotoluene		<MDL		4100	8100 µg/kg dw					
2-Chloronaphthalene		<MDL		1600	3240 µg/kg dw					
2-Chlorophenol		<MDL		1600	3240 µg/kg dw					
2-Methylnaphthalene		<MDL		810	1620 µg/kg dw					

2-Methylphenol		<MDL	810	1620	µg/kg dw			
2-Nitrophenol		<MDL	4100	8100	µg/kg dw			
4-Bromophenyl Phenyl Ether		<MDL	1600	3240	µg/kg dw			
4-Chlorophenyl Phenyl Ether		<MDL	1600	3240	µg/kg dw			
4-Methylphenol	106000		1600	3240	µg/kg dw			
Acenaphthene		<MDL	810	1620	µg/kg dw			
Acenaphthylene		<MDL	810	1620	µg/kg dw			
Aniline		<MDL	4100	8100	µg/kg dw			
Anthracene		<MDL	810	1620	µg/kg dw			
Benzo(a)anthracene		<MDL	810	1620	µg/kg dw			
Benzo(a)pyrene		<MDL	810	1620	µg/kg dw			
Benzo(b)fluoranthene		<MDL	810	1620	µg/kg dw			
Benzo(g,h,i)perylene		<MDL	810	1620	µg/kg dw			
Benzo(k)fluoranthene		<MDL	810	1620	µg/kg dw			
Benzoic Acid	20800		4100	8100	µg/kg dw			
Benzyl Alcohol		<MDL	810	1620	µg/kg dw			
Benzyl Butyl Phthalate	1300	<RDL	810	1620	µg/kg dw			
Bis(2-Chloroethoxy)Methane		<MDL	1600	3240	µg/kg dw			
Bis(2-Chloroethyl)Ether		<MDL	1600	3240	µg/kg dw			
Bis(2-Chloroisopropyl)Ether		<MDL	1600	3240	µg/kg dw			
Bis(2-Ethylhexyl)Phthalate	28100		1600	3240	µg/kg dw			
Caffeine		<MDL	810	1620	µg/kg dw			
Carbazole		<MDL	1600	3240	µg/kg dw			
Chrysene		<MDL	810	1620	µg/kg dw			
Coprostanol	177000		16000	32400	µg/kg dw			
Dibenzo(a,h)anthracene		<MDL	810	1620	µg/kg dw			
Dibenzofuran		<MDL	810	1620	µg/kg dw			
Diethyl Phthalate		<MDL	1600	3240	µg/kg dw			
Dimethyl Phthalate		<MDL	1600	3240	µg/kg dw			
Di-N-Butyl Phthalate		<MDL	1600	3240	µg/kg dw			
Di-N-Octyl Phthalate		<MDL	1600	3240	µg/kg dw			
Fluoranthene	1300	<RDL	810	1620	µg/kg dw			
Fluorene		<MDL	810	1620	µg/kg dw			
Hexachlorobenzene		<MDL	160	324	µg/kg dw			
Hexachlorobutadiene		<MDL	160	324	µg/kg dw			
Hexachloroethane		<MDL	810	1620	µg/kg dw			
Indeno(1,2,3-Cd)Pyrene		<MDL	810	1620	µg/kg dw			
Isophorone		<MDL	1600	3240	µg/kg dw			
Naphthalene		<MDL	810	1620	µg/kg dw			
Nitrobenzene		<MDL	1600	3240	µg/kg dw			
N-Nitrosodimethylamine		<MDL	1600	3240	µg/kg dw			
N-Nitrosodi-N-Propylamine		<MDL	1600	3240	µg/kg dw			
N-Nitrosodiphenylamine		<MDL	1600	3240	µg/kg dw			
Pentachlorophenol		<MDL	4100	8100	µg/kg dw			
Phenanthrene	1000	<RDL	810	1620	µg/kg dw			
Phenol		<MDL	1600	3240	µg/kg dw			
Pyrene	990	<RDL	810	1620	µg/kg dw			
Pyridine		<MDL	4100	8100	µg/kg dw			
LPAH	1000		810	1620	ug/Kg			
HPAH	2290		810	1620	ug/Kg			
Total Benzofluoranthenes		<MDL	810	1620	µg/kg dw			
Dioxin/furan TEQ	57.1				ng TEQ/kg	52.7		ng TEQ/kg

Project:	423368-110-4					Project:	423368-110-4			
Locator:	ST805-L1-1					Locator:	ST805-L1-2			
Descrip:	Sed Trap at WW*HNFORD.04					Descrip:	Sed Trap at WW*HNFORD.04			
Sample:	L50935-24					Sample:	L50498-2			
Matrix:	SH IN-LINESED					Matrix:	SH IN-LINESED			
ColDate:	4/23/09 11:00					ColDate:	11/23/09 14:00			
TimeSpan:						TimeSpan:				
TotalSolid:	39.5					TotalSolid:	0			
ClientLoc:						ClientLoc:				
SampDepth:						SampDepth:				
DRY Weight Basis						**DRY Weight Basis**				
Parameters	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**
CV ASTM D422										
Clay						15.8				%
Fines						55.4				%
Gravel						2.5				%
p+0.00						3.7				%
p+1.00						5.8				%
p+10.0(equal/more than)						15.8				%
p+2.00						7.5				%
p+3.00						13.3				%
p+4.00						11.2				%
p+5.00						23.7				%
p+6.00						7.9				%
p+7.00						7.9				%
p+8.00							<MDL			%
p+9.00							<MDL			%
p-1.00						2.5				%
p-2.00(less than)							<MDL			%
p-2.00							<MDL			%
Sand						41.4				%
Silt						39.5				%
CV SM2540-G										
Total Solids	39.5	H			%					
CV SW846 9060-PSEP96										
Total Organic Carbon										
MT SW846 3050B*SW846 6010C										
Antimony, Total, ICP										
Arsenic, Total, ICP										
Cadmium, Total, ICP										
Chromium, Total, ICP										
Cobalt, Total, ICP										
Copper, Total, ICP										
Lead, Total, ICP										
Molybdenum, Total, ICP										
Nickel, Total, ICP										
Selenium, Total, ICP										
Silver, Total, ICP										
Thallium, Total, ICP										
Vanadium, Total, ICP										
Zinc, Total, ICP										
MT SW846 7471B										
Mercury, Total, CVAA	1.31	H,J	0.051	0.506	mg/kg dw					
OR SW846 3550B*SW846 8082A										
Aroclor 1016										
Aroclor 1221										
Aroclor 1232										
Aroclor 1242										
Aroclor 1248										
Aroclor 1254										
Aroclor 1260										
Total PCBs *(sum detected aroclors)*										
OR SW846 3550B*SW846 8270D										
1,2,4-Trichlorobenzene										
1,2-Dichlorobenzene										
1,2-Diphenylhydrazine										
1,3-Dichlorobenzene										
1,4-Dichlorobenzene										
2,4,5-Trichlorophenol										
2,4,6-Trichlorophenol										
2,4-Dichlorophenol										
2,4-Dimethylphenol										
2,4-Dinitrotoluene										
2,6-Dinitrotoluene										
2-Chloronaphthalene										
2-Chlorophenol										
2-Methylnaphthalene										

2-Methylphenol				
2-Nitrophenol				
4-Bromophenyl Phenyl Ether				
4-Chlorophenyl Phenyl Ether				
4-Methylphenol				
Acenaphthene				
Acenaphthylene				
Aniline				
Anthracene				
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene				
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene				
Benzoic Acid				
Benzyl Alcohol				
Benzyl Butyl Phthalate				
Bis(2-Chloroethoxy)Methane				
Bis(2-Chloroethyl)Ether				
Bis(2-Chloroisopropyl)Ether				
Bis(2-Ethylhexyl)Phthalate				
Caffeine				
Carbazole				
Chrysene				
Coprostanol				
Dibenzo(a,h)anthracene				
Dibenzofuran				
Diethyl Phthalate				
Dimethyl Phthalate				
Di-N-Butyl Phthalate				
Di-N-Octyl Phthalate				
Fluoranthene				
Fluorene				
Hexachlorobenzene				
Hexachlorobutadiene				
Hexachloroethane				
Indeno(1,2,3-Cd)Pyrene				
Isophorone				
Naphthalene				
Nitrobenzene				
N-Nitrosodimethylamine				
N-Nitrosodi-N-Propylamine				
N-Nitrosodiphenylamine				
Pentachlorophenol				
Phenanthrene				
Phenol				
Pyrene				
Pyridine				
LPAH				
HPAH				
Total Benzofluoranthenes				
Dioxin/furan TEQ	5.38	ng TEQ/kg	1.01	ng TEQ/kg

	Project: 423368-110-4 Locator: ST805-L1-3 Descrip: Sed Trap at WW*HNFORD.04 Sample: L50498-3 Matrix: SH IN-LINESED ColDate: 2/19/10 11:00 TimeSpan: TotalSolid: 17.9 ClientLoc: SampDepth: **DRY Weight Basis**					Project: 423368-110-4 Locator: ST805-L2-1 Descrip: Sed Trap at WW*HNFORD.04 Sample: L50498-4 Matrix: SH IN-LINESED ColDate: 2/19/10 11:00 TimeSpan: TotalSolid: 34.8 ClientLoc: SampDepth: **DRY Weight Basis**				
Parameters	**Value**	**Qual**	**MDL**	**RDL**	**Units**	**Value**	**Qual**	**MDL**	**RDL**	**Units**
CV ASTM D422										
Clay										
Fines										
Gravel										
p+0.00										
p+1.00										
p+10.0(equal/more than)										
p+2.00										
p+3.00										
p+4.00										
p+5.00										
p+6.00										
p+7.00										
p+8.00										
p+9.00										
p-1.00										
p-2.00(less than)										
p-2.00										
Sand										
Silt										
CV SM2540-G										
Total Solids	17.9				%	34.8				%
CV SW846 9060-PSEP96										
Total Organic Carbon	193000		17000	34100	mg/kg dw	173000		17000	34200	mg/kg dw
MT SW846 3050B*SW846 6010C										
Antimony, Total, ICP										
Arsenic, Total, ICP	7.8	<RDL	7.3	36.1	mg/kg dw	9.8	<RDL	3.7	18.2	mg/kg dw
Cadmium, Total, ICP	1.7	<RDL	0.56	2.89	mg/kg dw	2.67		0.29	1.46	mg/kg dw
Chromium, Total, ICP	47.3		0.89	4.34	mg/kg dw	56.3		0.43	2.18	mg/kg dw
Cobalt, Total, ICP	5.75		0.89	4.34	mg/kg dw	7.67		0.43	2.18	mg/kg dw
Copper, Total, ICP	192		1.2	5.81	mg/kg dw	264		0.57	2.9	mg/kg dw
Lead, Total, ICP	108		5.6	28.9	mg/kg dw	148		2.9	14.6	mg/kg dw
Molybdenum, Total, ICP	6.87		0.89	4.34	mg/kg dw	10		0.43	2.18	mg/kg dw
Nickel, Total, ICP	38.9		1.5	7.21	mg/kg dw	46.6		0.72	3.65	mg/kg dw
Selenium, Total, ICP										
Silver, Total, ICP	3	<RDL	1.2	5.81	mg/kg dw	3.62		0.57	2.9	mg/kg dw
Thallium, Total, ICP										
Vanadium, Total, ICP	31.9		2.9	14.5	mg/kg dw	43.1		1.5	7.27	mg/kg dw
Zinc, Total, ICP	587	J	1.5	7.21	mg/kg dw	632	J	0.72	3.65	mg/kg dw
MT SW846 7471B										
Mercury, Total, CVAA	0.67	<RDL,H	0.11	1.1	mg/kg dw	1.24	H	0.057	0.563	mg/kg dw
OR SW846 3550B*SW846 8082A										
Aroclor 1016	103		45	89.4	µg/kg dw		<MDL	23	46	µg/kg dw
Aroclor 1221		<MDL	89	179	µg/kg dw		<MDL	46	92	µg/kg dw
Aroclor 1232		<MDL	89	179	µg/kg dw		<MDL	46	92	µg/kg dw
Aroclor 1242		<MDL	45	89.4	µg/kg dw		<MDL	23	46	µg/kg dw
Aroclor 1248		<MDL	45	89.4	µg/kg dw		<MDL	23	46	µg/kg dw
Aroclor 1254		<MDL	45	89.4	µg/kg dw		<MDL	23	46	µg/kg dw
Aroclor 1260	245		45	89.4	µg/kg dw		<MDL	23	46	µg/kg dw
Total PCBs *(sum detected aroclors)*	348		89	179	µg/kg dw		<MDL	46	92	µg/kg dw
OR SW846 3550B*SW846 8270D										
1,2,4-Trichlorobenzene		<MDL	8.9	17.9	µg/kg dw		<MDL	46	92	µg/kg dw
1,2-Dichlorobenzene		<MDL	18	35.8	µg/kg dw		<MDL	92	184	µg/kg dw
1,2-Diphenylhydrazine		<MDL	360	715	µg/kg dw		<MDL	1800	3680	µg/kg dw
1,3-Dichlorobenzene		<MDL	18	35.8	µg/kg dw		<MDL	92	184	µg/kg dw
1,4-Dichlorobenzene	60900		18	35.8	µg/kg dw	3680		92	184	µg/kg dw
2,4,5-Trichlorophenol		<MDL	890	1790	µg/kg dw		<MDL	4600	9200	µg/kg dw
2,4,6-Trichlorophenol		<MDL	890	1790	µg/kg dw		<MDL	4600	9200	µg/kg dw
2,4-Dichlorophenol		<MDL	890	1790	µg/kg dw		<MDL	4600	9200	µg/kg dw
2,4-Dimethylphenol		<MDL	89	179	µg/kg dw		<MDL	460	920	µg/kg dw
2,4-Dinitrotoluene		<MDL	890	1790	µg/kg dw		<MDL	4600	9200	µg/kg dw
2,6-Dinitrotoluene		<MDL	890	1790	µg/kg dw		<MDL	4600	9200	µg/kg dw
2-Chloronaphthalene		<MDL	360	715	µg/kg dw		<MDL	1800	3680	µg/kg dw
2-Chlorophenol		<MDL	360	715	µg/kg dw		<MDL	1800	3680	µg/kg dw
2-Methylnaphthalene		<MDL	180	358	µg/kg dw		<MDL	920	1840	µg/kg dw

2-Methylphenol		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
2-Nitrophenol		<MDL	890	1790	µg/kg dw		<MDL	4600	9200 µg/kg dw
4-Bromophenyl Phenyl Ether		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
4-Chlorophenyl Phenyl Ether		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
4-Methylphenol	103000		360	715	µg/kg dw	21400		1800	3680 µg/kg dw
Acenaphthene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Acenaphthylene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Aniline		<MDL	890	1790	µg/kg dw		<MDL	4600	9200 µg/kg dw
Anthracene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzo(a)anthracene	460		180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzo(a)pyrene	427		180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzo(b)fluoranthene	659		180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzo(g,h,i)perylene	439		180	358	µg/kg dw	1000	<RDL	920	1840 µg/kg dw
Benzo(k)fluoranthene	409		180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzoic Acid	30700		890	1790	µg/kg dw	9800		4600	9200 µg/kg dw
Benzyl Alcohol		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Benzyl Butyl Phthalate	2600		180	358	µg/kg dw	1200	<RDL	920	1840 µg/kg dw
Bis(2-Chloroethoxy)Methane		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Bis(2-Chloroethyl)Ether		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Bis(2-Chloroisopropyl)Ether		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Bis(2-Ethylhexyl)Phthalate	26800		360	715	µg/kg dw	32800		1800	3680 µg/kg dw
Caffeine		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Carbazole		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Chrysene	648		180	358	µg/kg dw	950	<RDL	920	1840 µg/kg dw
Coprostanol	95000		3600	7150	µg/kg dw	224000		18000	36800 µg/kg dw
Dibenzo(a,h)anthracene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Dibenzofuran		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Diethyl Phthalate		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Dimethyl Phthalate		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Di-N-Butyl Phthalate	905		360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Di-N-Octyl Phthalate		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Fluoranthene	972		180	358	µg/kg dw	1200	<RDL	920	1840 µg/kg dw
Fluorene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Hexachlorobenzene		<MDL	36	71.5	µg/kg dw		<MDL	180	368 µg/kg dw
Hexachlorobutadiene		<MDL	36	71.5	µg/kg dw		<MDL	180	368 µg/kg dw
Hexachloroethane		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Indeno(1,2,3-Cd)Pyrene	330	<RDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Isophorone		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Naphthalene		<MDL	180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Nitrobenzene		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
N-Nitrosodimethylamine		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
N-Nitrosodi-N-Propylamine		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
N-Nitrosodiphenylamine		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Pentachlorophenol		<MDL	890	1790	µg/kg dw		<MDL	4600	9200 µg/kg dw
Phenanthrene	1080		180	358	µg/kg dw	1600	<RDL	920	1840 µg/kg dw
Phenol		<MDL	360	715	µg/kg dw		<MDL	1800	3680 µg/kg dw
Pyrene	1150		180	358	µg/kg dw	1500	<RDL	920	1840 µg/kg dw
Pyridine		<MDL	890	1790	µg/kg dw		<MDL	4600	9200 µg/kg dw
LPAH	1080		180	358	µg/kg dw	1600		920	1840 ug/Kg
HPAH	5494		180	358	µg/kg dw	4650		920	1840 ug/Kg
Total Benzofluoranthenes	1068		180	358	µg/kg dw		<MDL	920	1840 µg/kg dw
Dioxin/furan TEQ						1.01			ng TEQ/kg

Project:	423368-110-4
Locator:	ST805-L3-1
Descrip:	Sed Trap at WW*HNFORD.04
Sample:	L50498-5
Matrix:	SH IN-LINESED
ColDate:	2/19/10 11:00
TimeSpan:	
TotalSolid:	37.8
ClientLoc:	
SampDepth:	

DRY Weight Basis

Parameters	Value	Qual	MDL	RDL	Units
CV ASTM D422					
Clay					
Fines					
Gravel					
p+0.00					
p+1.00					
p+10.0(equal/more than)					
p+2.00					
p+3.00					
p+4.00					
p+5.00					
p+6.00					
p+7.00					
p+8.00					
p+9.00					
p-1.00					
p-2.00(less than)					
p-2.00					
Sand					
Silt					
CV SM2540-G					
Total Solids	37.8				%
CV SW846 9060-PSEP96					
Total Organic Carbon	162000		18000	35700	mg/kg dw
MT SW846 3050B*SW846 6010C					
Antimony, Total, ICP					
Arsenic, Total, ICP	9.5	<RDL	3.2	16.4	mg/kg dw
Cadmium, Total, ICP	2.42		0.26	1.31	mg/kg dw
Chromium, Total, ICP	57.9		0.4	1.97	mg/kg dw
Cobalt, Total, ICP	8.44		0.4	1.97	mg/kg dw
Copper, Total, ICP	365		0.53	2.63	mg/kg dw
Lead, Total, ICP	170		2.6	13.1	mg/kg dw
Molybdenum, Total, ICP	12		0.4	1.97	mg/kg dw
Nickel, Total, ICP	47.6		0.66	3.28	mg/kg dw
Selenium, Total, ICP					
Silver, Total, ICP	3.65		0.53	2.63	mg/kg dw
Thallium, Total, ICP					
Vanadium, Total, ICP	47.1		1.3	6.56	mg/kg dw
Zinc, Total, ICP	653	J	0.66	3.28	mg/kg dw
MT SW846 7471B					
Mercury, Total, CVAA	1.2	H	0.05	0.513	mg/kg dw
OR SW846 3550B*SW846 8082A					
Aroclor 1016		<MDL	21	42.3	µg/kg dw
Aroclor 1221		<MDL	42	84.7	µg/kg dw
Aroclor 1232		<MDL	42	84.7	µg/kg dw
Aroclor 1242		<MDL	21	42.3	µg/kg dw
Aroclor 1248		<MDL	21	42.3	µg/kg dw
Aroclor 1254		<MDL	21	42.3	µg/kg dw
Aroclor 1260		<MDL	21	42.3	µg/kg dw
Total PCBs *(sum detected aroclors)*		<MDL	42	84.7	µg/kg dw
OR SW846 3550B*SW846 8270D					
1,2,4-Trichlorobenzene					
1,2-Dichlorobenzene					
1,2-Diphenylhydrazine					
1,3-Dichlorobenzene					
1,4-Dichlorobenzene					
2,4,5-Trichlorophenol					
2,4,6-Trichlorophenol					
2,4-Dichlorophenol					
2,4-Dimethylphenol					
2,4-Dinitrotoluene					
2,6-Dinitrotoluene					
2-Chloronaphthalene					
2-Chlorophenol					
2-Methylnaphthalene					

2-Methylphenol
2-Nitrophenol
4-Bromophenyl Phenyl Ether
4-Chlorophenyl Phenyl Ether
4-Methylphenol
Acenaphthene
Acenaphthylene
Aniline
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzoic Acid
Benzyl Alcohol
Benzyl Butyl Phthalate
Bis(2-Chloroethoxy)Methane
Bis(2-Chloroethyl)Ether
Bis(2-Chloroisopropyl)Ether
Bis(2-Ethylhexyl)Phthalate
Caffeine
Carbazole
Chrysene
Coprostanol
Dibenzo(a,h)anthracene
Dibenzofuran
Diethyl Phthalate
Dimethyl Phthalate
Di-N-Butyl Phthalate
Di-N-Octyl Phthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
Indeno(1,2,3-Cd)Pyrene
Isophorone
Naphthalene
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-N-Propylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
Pyridine
LPAH
HPAH
Total Benzofluoranthenes
Dioxin/furan TEQ