

ATTACHMENT 1

East Waterway
Storm Drain and Combined Sewer Solids Loading Analysis
August 2011 Update



City of Seattle
Seattle Public Utilities

Table of Contents

Tables

Table 1.	Summary of revisions to East Waterway drainage basin boundaries
Table 2.	Land use in the East Waterway separated storm drain basins
Table 3.	Summary of land use in the East Waterway separated storm drain basin (by ownership/jurisdiction)
Table 4.	Land use in the East Waterway combined sewer service area
Table 5.	Annual combined sewer overflow records for S Hinds St CSO (2000-2009)
Table 6.	Stormwater TSS concentrations by land use
Table 7.	Storm drain solids loading summary (base case)
Table 8.	Storm drain solids loading summary (low range)
Table 9.	Storm drain solids loading summary (high range)
Table 10.	Land use in CSOs monitored by SPU
Table 11.	Comparison of TSS in SPU and King County CSOs

Figures

Figure 1.	Updated East Waterway storm drain basins (2011)
Figure 2.	East Waterway storm drain basins from 2008 analysis
Figure 3.	Land use in East Waterway separated storm drain basins
Figure 4.	Outfalls in the East Waterway study area
Figure 5.	Location of SPU Rain Gage #15
Figure 6.	East Waterway combined sewer service area
Figure 7.	Land use in East Waterway combined sewer service area
Figure 8.	Box plot of TSS by land use
Figure 9.	TSS concentrations in Seattle CSOs
Figure 10.	Comparison of PSD in stormwater and storm drain solids samples

Appendices

Appendix A.	Stormwater volume calculations (NHC 2008)
Appendix B.	TSS data
Appendix C.	Surface geology
Appendix D.	S Hinds St CSO/SD CSO records
Appendix E.	Particle size distribution data

SUMMARY OF REVISIONS

This report is an update of the September 2008 East Waterway (EW) lateral load report (Northwest Hydraulic Consultants 2008). Changes from the 2008 report are summarized below:

- Drainage basin boundaries for Port-owned storm drains have been revised based on updated information on drainage infrastructure provided by the Port of Seattle (Port). Specific changes include:
 - Basin B-11. Previous mapping from Port did not include areas outside of Port property that are connected to this system. These areas have been added. In addition, the T18 portion of the basin has been modified to reflect changes received from the Port.
 - Basin B-38 has been removed from the study, because Port determined that outfall is located in the Lower Duwamish study area.
 - Basin B-1 delineation has been modified based on Port drainage system mapping.
 - The railroad bridge (BR-6) just south of the West Seattle Bridge and the Port's access road (BR-2) have been added.
 - The bridge at the head of Slip 27 has been added (BR-27).
 - Other bridge and apron basins not included in the 2008 loading analysis have now been incorporated, including: A-7, A-23, A-24, A-26, A-27, A-28, A-29, A-30, A-32, A-33, BR-39, BR-6.

Changes in drainage basin areas resulting from the revised basin delineations are summarized in Table 1. The updates to the drainage basin boundaries resulted in an overall reduction in basin area of about 6.4 acres (less than one percent change).

- Drainage basin boundaries for the S Lander St CSO/SD and S Hinds St CSO/SD have been revised based on updated information from recent field investigations and drainage maps compiled by Seattle Public Utilities (SPU).
- The S Connecticut St separated storm drain basin has been removed from the study because runoff from this basin enters Elliott Bay just outside of the EW study area boundary and information collected to date indicates that this basin would not contribute significant pollutant loads to the EW.
- Basins B-40, B-41, B-42, B-43 were identified as City-owned storm drain basins in the 2008 report. However, because these areas drain land entirely owned/occupied by the U.S. Coast Guard, these systems are now identified as Coast Guard drains. SPU is currently working to transfer ownership of these storm drain systems to the U.S. Coast Guard.
- Total suspended solids data have been updated to incorporate recent stormwater data from the Portland Harbor project and from SPU NPDES monitoring efforts. In addition, the method used to calculate land use representative TSS concentrations has been modified to improve accuracy.
- EW sediment trap results have been included in the particle size distribution (PSD) analysis, along with the data compiled for stormwater suspended solids samples to provide a range of inputs for the particle transport model.

- CSO volume estimates have been updated to include monitoring data from 2008 and 2009.

The methodology used to calculate annual stormwater volumes and TSS loads is unchanged from the 2008 report. For completeness, this information is repeated in this updated report (Appendix A).

INTRODUCTION

This report summarizes the analyses of stormwater and City combined sewer overflow (CSO) discharges to the East Waterway (EW) completed by SPU for use in the particle transport model for the EW remedial investigation. Annual discharge volume and TSS loads were estimated for all storm drain outfalls and the City CSO at S Hinds St. In addition, available data from SPU source sampling efforts were compiled to estimate the concentrations of chemicals of concern associated with the particulates discharged from these outfalls. Data used in the analyses include:

- King County parcel land use data from the City GIS system.
- Surficial geology data for the Seattle area (Goetz et.al., 2005).
- Rainfall data from Seattle rain gage #15 located at 4401 E Marginal Way S, for years 1978-2007.
- Total suspended solids concentrations in stormwater compiled from studies conducted in western Washington and Oregon (Appendix B).
- Particle size distribution (PSD) data from East Waterway source tracing/characterization samples and data compiled from stormwater samples collected throughout the U.S.

Methods used to calculate suspended solids loads are described in the following sections.

FLOW ESTIMATES

Flow is an important component of the solids load calculations. Neither SPU nor the Port routinely monitor flow from its storm drain outfalls, so a hydrologic model was used to estimate the volume of stormwater discharged to the EW.

In 1999, SPU initiated a flow monitoring program to measure the frequency and volume of overflows from City-owned CSOs. Data from 2000-2009 were used to estimate the volume of overflows from the City-owned CSO in the EW study area (S Hinds St CSO/SD).

Stormwater

The annual volume of stormwater discharged to the EW was estimated from land use, soil type, slope, and rainfall using a simplified Hydrologic Simulation Program-Fortran (HSPF) model (Northwest Hydraulic Consultants 2008). This model calculates runoff volumes per unit area for individual land use, slope, and soil combinations based on regional Puget Sound input parameters and local rainfall data. Runoff volumes have been updated to incorporate changes in basin boundaries. Assumptions and data used in the analysis have not changed from the 2008 analysis. A detailed description of the flow calculations is provided in Appendix A.

Drainage Basin Characteristics

Stormwater runoff from approximately 787 acres of land along the east side of Harbor Island and in the industrial area south of downtown Seattle drains to the EW via a combination of City, Port, and private storm drain systems, as well as direct discharges from apron areas immediately adjacent to the waterway. Drainage basin boundaries for City-owned storm drains were delineated using City GIS utility and topographic data supplemented with site-specific drainage plans where available. Drainage basin boundaries for Port-owned storm drains were provided by the Port.

Basin boundaries have been updated since the Final Initial Source Evaluation and Data Gaps Memorandum was completed (SEDGM; Anchor and Windward 2009). Figure 1 shows original basin delineations from the SEDGM. Updated basin delineations are shown in Figure 2.

Land use in the EW drainage area was determined based on parcel data from King County. Figure 3 shows the distribution of land use in the separated storm drain basin. The area west of I-5 is predominately industrial with a small number of commercial and vacant lots. The portion of the S Lander St drainage basin that lies east of I-5 contains a mixture of residential (single and multi-family) with a small amount of commercial property. Land use characteristics are summarized in Table 2.

Surficial geology maps developed by the University of Washington (Goetz et.al., 2005) were used to characterize soil conditions in the basin. Individual geologic deposits were grouped into the following categories (see Appendix C for details):

- Alluvium
- Till
- Outwash
- Wetland soil.

Using GIS, the soil and parcel information were then overlaid to break down the drainage basin into individual land use and soil types for the runoff analysis. All areas were modeled as moderate slope.

Stormwater Discharge Locations

Locations of the 38 storm drains discharging to the EW are shown in Figure 4. The majority of these outfalls serve nearshore areas along the waterway. The S Lander St system is the largest storm drain in the EW, serving approximately 442 acres. The Seattle municipal storm drain system accounts for approximately 66 percent of the EW drainage, while the POS property drains 32 percent of the basin (Table 3). The remaining outfalls are from small private waterfront storm drain systems.

Stormwater Flow Calculations

Annual stormwater runoff volumes were calculated for each individual outfall as well as for bridges and aprons that drain directly to the waterway. Flow estimates were completed for a typical wet year (2002), dry year (1993), and average year (1986) based on 1978-2007 rainfall records from SPU's rain gage #15 located at 4401 E Marginal Way S (Figure 5). Because the S Lander St CSO/SD system in the EW is partially and not fully separated, the runoff volumes estimated by the HSPF model had to be adjusted to account for areas that continue to drain to the

combined sewer system. For the purposes of this analysis, the S Lander St separated storm drain basin was divided into two subbasins:

- East of I-5 (east Lander)
- West of I-5 (west Lander).

The City of Seattle is served by combined, separated, and partially separated drainage/wastewater systems. In combined areas, stormwater runoff and sanitary sewage are collected and conveyed in a single pipe. In separated areas, stormwater and sanitary sewage are carried in totally separate pipes. However, partially separated areas are served by a combination of separated storm drains and combined sewer systems. In these areas, stormwater runoff can discharge to both systems. Depending on how the separation occurred, in areas that were initially combined and later separated (e.g., Lander system), the roadways are often connected to a new storm drain system, while drainage structures (e.g., inlets, catch basins, and sand boxes) outside the public right-of-way are left connected to the combined sewer system. Without dye testing the individual catch basins, it can be difficult to determine which areas are connected to which system.

Based on discussions with SPU staff familiar with historic separation projects and the City's drainage system, it was assumed that all of the right-of-way and varying percentages of the areas outside of the right-of-way are connected to the storm drain system. Available SPU GIS information was used to estimate the amount of land on private parcels outside of the right-of-way, is connected to the separated storm drain system. The layout of existing drainage systems for all of the private parcels is not available in the SPU GIS system. Therefore, to account for uncertainty, a range of values was developed. In the east Lander sub-basin, it was estimated that between 25 and 75 percent of the areas outside the ROW are connected to the storm drain system. In the west Lander sub-basin, it was estimated that between 15 and 65 percent are connected to the storm drain system.

CSOs

Figure 6 shows the combined sewer service area within the EW study area (approximately 4,840 acres). The City of Seattle operates one CSO in the EW, the S Hinds St CSO/SD outfall (NPDES #107). The S Hinds St combined sewer system serves an area of approximately 45 acres located on Terminals 30 and 104 (Figure 6). Land use in the combined sewer service area is shown in Figure 7 and summarized in Table 4. The combined sewer service area contains a larger proportion of residential development (35 percent) and lower proportion of industrial/commercial property (26 percent) than the separated storm drain basin (4 and 78 percent, respectively).

SPU has monitored overflow frequency and volumes in the S Hinds St CSO since 1998. Annual overflow volumes range from 0 to 34 million gallons (Table 5). The maximum overflow occurred in 2004, with the majority of the overflow occurring during two separate events (January 7 and January 29, 2004) with total rainfall amounts of 1.83 and 1.54 inches, respectively. These large overflow volumes are not consistent with the small service area contributing to the S Hinds St CSO. SPU is working with King County to model the combined sewer system in this area to determine whether the overflows recorded at this location could be caused by overflows from the Elliott Bay Interceptor. For this analysis, the January 2004 overflows were replaced with the average of overflow events occurring during storm events larger than 1 inch during 2007-2010. This three-year time period was used because since 2007,

Table 2. Yearly CSO Volume and Event Frequency Summary for Discharges to the EW and vicinity.

Station	Discharge Number	2005 (Jan-Dec)		2006 (Jan-Dec)		2007 (Jan-Dec)		2008 (Jan-Dec)		2009 (Jan-Dec)	
		Vol. (mg)	Events	Vol. (mg)	Events	Vol. (mg)	Events	Vol. (mg)	Events	Vol. (mg)	Events
Connecticut/Ki ngdome (a)	029	27.25	5	17.60	4	28.55	5	0.23	1	3.54	8
Hanford #2	031	91.33	15	183.06	26	65.60	12	23.94	8	36.34	17
Lander	030	15.53	2	43.73	13	41.51	4	4.07	3	111.67	16

Table 3. Monthly Average CSO Event Frequency and Volume Summary for Discharges to the EW and Vicinity.

June 2000-May 2009

Station	DSN	Year	June	July	August	September	October	November	December	January	February	March
CSO Discharge Frequency (# events)												
Connecticut	29	1999-2000	0	0	0	0	0	0	0	0	0	0
Connecticut	29	2000-2001	0	0	0	0	0	0	0	0	0	0
Connecticut	29	2001-2002	0	0	0	0	2	0	1	1	0	0
Connecticut	29	2002-2003	0	0	0	0	0	0	0	0	0	0
Kingdome		2003-2004	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Kingdome		2004-2005	NM	NM	NM	NM	NM	0	2	2	1	1
Kingdome		2005-2006	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Kingdome		2006-2007	NM	NM	NM	NM	NM	NM	4	3	0	0
Kingdome		2007-2008	0	0	0	0	0	0	1	0	0	0
Kingdome		2008-2009	0	0	0	0	0	1	0	1	0	0
Kingdome		2009	0	0	0	1	2	3	0			
Average			0	0	0	0.333333333	0.666666667	1	1.4	1.5	0.25	0.25
Hanford #2	31	1999-2000	1	0	0	0	0	5	3	2	3	3
Hanford #2	31	2000-2001	1	0	0	0	2	2	1	2	0	0
Hanford #2	31	2001-2002	0	0	0	0	1	3	2	3	2	1
Hanford #2	31	2002-2003	1	0	0	0	0	1	1	8	0	1
Hanford #2	31	2003-2004	0	0	0	0	0	2	1	3	1	1
Hanford #2	31	2004-2005	0	0	3	1	2	1	2	1	1	1
Hanford #2	31	2005-2006	1	0	0	0	1	5	2	6	2	1
Hanford #2	31	2006-2007	2	0	0	0	0	10	4	3	0	0
Hanford #2	31	2007-2008	0	0	0	2	0	3	2	1	0	2
Hanford #2	31	2008-2009	0	0	2	0	0	2	1	1	0	0
Hanford #2	31	2009	0	0	0	1	3	6	1			
Average			0.5	0	0.5	0.4	0.9	3.5	1.7	3.111111111	0.666666667	0.777777778
Lander St. #2	30	1999-2000	0	0	0	0	0	3	2	1	0	0
Lander St. #2	30	2000-2001	0	0	0	0	0	0	0	0	0	0
Lander St. #2	30	2001-2002	0	0	1	0	0	4	2	3	2	1
Lander St. #2	30	2002-2003	1	0	0	0	0	0	1	3	0	1
Lander St. #2	30	2003-2004	0	0	0	0	2	2	0	1	0	0
Lander St. #2	30	2004-2005	0	0	0	0	0	0	1	1	0	0
Lander St. #2	30	2005-2006	0	0	0	0	0	0	1	3	1	0
Lander St. #2	30	2006-2007	0	0	0	0	0	5	4	2	0	0
Lander St. #2	30	2007-2008	0	0	0	0	0	0	1	0	0	1
Lander St. #2	30	2008-2009	0	0	0	0	0	2	0	2	0	0
Lander St. #2	30	2009	0	0	0	1	3	5	1			
Average			0.1	0	0.1	0.1	0.5	1.8	1.1	1.666666667	0.333333333	0.333333333

Table 3. Monthly Average CSO Event Frequency and Volume Summary for Discharges to the EW and Vicinity.

June 2000-May 2009

Station	DSN	Year	April	May	Total	Baseline (1981-1983)
CSO Discharge Frequency (# events)						
Connecticut	29	1999-2000	0	0	0	34
Connecticut	29	2000-2001	0	0	0	
Connecticut	29	2001-2002	0	0	4	29
Connecticut	29	2002-2003	0	0	0	23
Kingdome		2003-2004	NM	NM	NM	
Kingdome		2004-2005	0	1	7	
Kingdome		2005-2006	NM	NM	0	
Kingdome		2006-2007	0	1	8	
Kingdome		2007-2008	0	0	1	
Kingdome		2008-2009	0	1	3	
Kingdome		2009			6	
Average			0	0.75	6.15	
Hanford #2	31	1999-2000	0	0	17	40
Hanford #2	31	2000-2001	0	0	8	
Hanford #2	31	2001-2002	1	0	13	
Hanford #2	31	2002-2003	0	0	12	
Hanford #2	31	2003-2004	0	2	10	
Hanford #2	31	2004-2005	2	1	15	28
Hanford #2	31	2005-2006	1	0	19	28
Hanford #2	31	2006-2007	0	2	21	
Hanford #2	31	2007-2008	0	0	10	
Hanford #2	31	2008-2009	2	3	11	
Hanford #2	31	2009			11	
Average			0.666666667	0.888888889	13.61	
Lander St. #2	30	1999-2000	0	0	6	29
Lander St. #2	30	2000-2001	0	0	0	
Lander St. #2	30	2001-2002	1	0	14	26
Lander St. #2	30	2002-2003	0	0	6	22
Lander St. #2	30	2003-2004	0	0	5	22
Lander St. #2	30	2004-2005	0	0	2	26
Lander St. #2	30	2005-2006	0	0	5	26
Lander St. #2	30	2006-2007	0	1	12	
Lander St. #2	30	2007-2008	0	0	2	
Lander St. #2	30	2008-2009	2	2	8	
Lander St. #2	30	2009			10	
Average			0.333333333	0.333333333	6.7	

Table 3. Monthly Average CSO Event Frequency and Volume Summary for Discharges to the EW and Vicinity.

June 2000-May 2009

Station	DSN	Year	June	July	August	September	October	November	December	January	February	March
CSO Discharge Volume (million gallons)												
Station	DSN	Year	June	July	August	September	October	November	December	January	February	March
Connecticut	29	1999-2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Connecticut	29	2000-2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Connecticut	29	2001-2002	<0.01	<0.01	<0.01	<0.01	1.34	<0.01	0.08	1.15	<0.01	<0.01
Connecticut	29	2002-2003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Kingdome		2003-2004	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Kingdome		2004-2005	NM	NM	NM	NM	NM	0.00	1.26	18.45	2.74	5.91
Kingdome		2005-2006	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Kingdome		2006-2007	NM	NM	NM	NM	NM	NM	17.60	0.84	0.00	0.00
Kingdome		2007-2008	0.00	0.00	0.00	0.00	0.00	0.00	27.62	0.00	0.00	0.00
Kingdome		2008-2009	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.27	0.00	0.00
Kingdome		2009	0.00	0.00	0.00	0.13	1.55	0.21	0.00			
Average			0.00	0.00	0.00	0.04	0.52	0.11	9.30	4.89	0.69	1.48
Hanford #2	31	1999-2000	9.34	0.00	0.00	0.00	0.00	17.70	5.61	0.41	11.21	2.21
Hanford #2	31	2000-2001	0.65	0.00	0.00	0.00	1.96	1.43	0.83	3.30	0.00	0.00
Hanford #2	31	2001-2002	0.00	0.00	0.00	0.00	0.66	49.11	38.08	28.79	22.79	5.48
Hanford #2	31	2002-2003	0.01	0.00	0.00	0.00	0.00	1.08	14.16	34.12	0.00	7.01
Hanford #2	31	2003-2004	0.00	0.00	0.00	0.00	0.00	16.03	0.77	38.04	3.19	1.31
Hanford #2	31	2004-2005	0.00	0.00	6.85	0.84	2.34	5.66	18.27	23.46	2.65	11.55
Hanford #2	31	2005-2006	0.46	0.00	0.00	0.00	1.82	13.64	30.58	67.50	3.69	0.01
Hanford #2	31	2006-2007	0.91	0.00	0.00	0.00	0.00	64.49	45.85	21.61	0.00	0.00
Hanford #2	31	2007-2008	0.00	0.00	0.00	3.58	0.00	2.80	35.64	0.73	0.00	1.79
Hanford #2	31	2008-2009	0.00	0.00	1.62	0.00	0.00	17.52	2.28	0.67	0.00	0.00
Hanford #2	31	2009	0.00	0.00	0.00	0.35	3.52	27.61	0.46			
Average			0.20	0.00	0.85	0.48	1.03	19.94	18.69	24.25	3.59	3.02
Lander St. #2	30	1999-2000	0.00	0.00	0.00	0.00	0.00	0.62	0.53	0.04	0.00	0.00
Lander St. #2	30	2000-2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lander St. #2	30	2001-2002	0.00	0.00	0.93	0.00	0.00	13.38	1.17	30.22	4.65	1.85
Lander St. #2	30	2002-2003	0.88	0.00	0.00	0.00	0.00	0.00	0.43	16.93	0.00	6.11
Lander St. #2	30	2003-2004	0.00	0.00	0.00	0.00	79.58	9.98	0.00	1.97	0.00	0.00
Lander St. #2	30	2004-2005	0.00	0.00	0.00	0.00	0.00	0.00	0.07	4.25	0.00	0.00
Lander St. #2	30	2005-2006	0.00	0.00	0.00	0.00	0.00	0.00	11.29	12.45	2.70	0.00
Lander St. #2	30	2006-2007	0.00	0.00	0.00	0.00	0.00	12.92	15.67	10.65	0.00	0.00
Lander St. #2	30	2007-2008	0.00	0.00	0.00	0.00	0.00	0.00	30.16	0.00	0.00	2.40
Lander St. #2	30	2008-2009	0	0	0	0	0	1.67	0	2.11	0	0
Lander St. #2	30	2009	0	0	0	0.01	5.52	84.38	6.38			
Average			0.09	0.00	0.09	0.00	8.51	12.23	6.52	8.73	0.82	1.15

DSN - Discharge Serial Number
 CSO - Combined Sewer Overflow
 NM - not measured

Table 3. Monthly Average CSO Event Frequency and Volume Summary for Discharges to the EW and Vicinity.

June 2000-May 2009

Station	DSN	Year	April	May	Total	Baseline (1981-1983)
CSO Discharge Volume (million gallons)						
Station	DSN	Year	April	May	Total	Baseline (1981-1983)
Connecticut	29	1999-2000	0.00	0.00	0.00	90
Connecticut	29	2000-2001	0.00	0.00	0.00	
Connecticut	29	2001-2002	<0.01	<0.01	2.57	90
Connecticut	29	2002-2003	<0.01	<0.01	0.00	90
Kingdome		2003-2004	NM	NM	0.00	
Kingdome		2004-2005	0.00	0.16	28.51	
Kingdome		2005-2006	NM	NM	0.00	
Kingdome		2006-2007	0.00	0.10	18.54	
Kingdome		2007-2008	0.00	0.00	27.62	
Kingdome		2008-2009	0.00	1.38	1.89	
Kingdome		2009			1.89	
Average			0.00	0.41	17.43	
Hanford #2	31	1999-2000	0.00	0.00	46.48	644
Hanford #2	31	2000-2001	0.00	0.00	8.17	
Hanford #2	31	2001-2002	4.79	0.00	149.70	
Hanford #2	31	2002-2003	0.00	0.00	56.38	
Hanford #2	31	2003-2004	0.00	1.73	61.07	
Hanford #2	31	2004-2005	5.33	1.84	78.78	
Hanford #2	31	2005-2006	0.61	0.00	118.33	
Hanford #2	31	2006-2007	0.00	1.97	134.83	
Hanford #2	31	2007-2008	0.00	0.00	44.55	
Hanford #2	31	2008-2009	1.31	2.42	25.82	
Hanford #2	31	2009			31.94	
Average			1.34	0.88	74.26	
Lander St. #2	30	1999-2000	0.00	0.00	1.19	143
Lander St. #2	30	2000-2001	0.00	0.00	0.00	
Lander St. #2	30	2001-2002	0.94	0.00	53.15	143
Lander St. #2	30	2002-2003	0.00	0.00	24.35	143
Lander St. #2	30	2003-2004	0.00	0.00	91.53	143
Lander St. #2	30	2004-2005	0.00	0.00	4.32	143
Lander St. #2	30	2005-2006	0.00	0.00	26.44	143
Lander St. #2	30	2006-2007	0.00	0.71	39.94	
Lander St. #2	30	2007-2008	0.00	0.00	32.56	
Lander St. #2	30	2008-2009	3.78	9.49	17.04	
Lander St. #2	30	2009			96.29	
Average			0.52	1.13	39.80	

DSN - Discharge Serial Number
 CSO - Combined Sewer Overflow
 NM - not measured

Attachment A: King County TSS Data (all 1.0 µ method) for Hanford #2 and Lander CSOs

SITE	LOCATOR	COLLECTDATE	TIMESPAN	SAMPLE		NUMVALUE	UNITS	MDL	RDL	Value with Dups averaged
				NUM	PARMNAME					
Hanford #2	CS030	12/2/2007 11:24	2	L44133-3	Total Suspended Solids	79	mg/L	5	10	67.85
Hanford #2	CS030	12/2/2007 11:24	2	L44133-4	Total Suspended Solids	56.7	mg/L	3.3	6.7	
Hanford #2	CS030	8/20/2008 1:35	1	L45811-3	Total Suspended Solids	53	mg/L	5	10	53
Hanford #2	CS030	11/4/2008 5:34	2	L46418-3	Total Suspended Solids	62.5	mg/L	2.5	5	62.5
Hanford #2	CS030	11/6/2008 16:05	2	L46918-3	Total Suspended Solids	156	mg/L	5	10	156
Hanford #2	CS030	4/2/2009 19:28	0.5	L47597-3	Total Suspended Solids	109	mg/L	7.1	14	94.5
Hanford #2	CS030	4/2/2009 19:28	0.5	L47597-4	Total Suspended Solids	80	mg/L	6.3	13	
Hanford #2	CS030	4/12/2009 17:13	2	L47834-1	Total Suspended Solids	34	mg/L	3.3	6.7	36.35
Hanford #2	CS030	4/12/2009 17:13	2	L47834-2	Total Suspended Solids	38.7	mg/L	3.3	6.7	
Hanford #2	CS030	5/5/2009 5:02	1	L48009-2	Total Suspended Solids	106	mg/L	5	10	108
Hanford #2	CS030	5/5/2009 5:02	1	L48009-3	Total Suspended Solids	110	mg/L	5	10	
Hanford #2	CS030	9/6/2009 12:02	1.75	L49003-1	Total Suspended Solids	108	mg/L	4.2	8.3	108
Hanford #2	CS030	11/6/2009 3:38	2	L49556-3	Total Suspended Solids	94.7	mg/L	3.3	6.7	94.7
Hanford #2	CS030	12/21/2009 9:04	1.5	L49832-1	Total Suspended Solids	46	mg/L	2.5	5	46
Lander	LANDER II REGI	6/3/2008 9:09	2	L44912-6	Total Suspended Solids	109	mg/L	5	10	109
Lander	LANDER II REGI	8/20/2008 1:01	2	L45811-6	Total Suspended Solids	38	mg/L	5	10	38
Lander	LANDER II REGI	11/4/2008 4:14	2	L46418-6	Total Suspended Solids	51.5	mg/L	2.5	5	51.5
Lander	LANDER II REGI	11/6/2008 15:42	2	L46918-6	Total Suspended Solids	84.2	mg/L	4.2	8.3	84.2
Lander	LANDER II REGI	4/12/2009 16:42	2	L47834-3	Total Suspended Solids	72.7	mg/L	3.3	6.7	72.7
Lander	LANDER II REGI	5/2/2009 22:12	1.5	L47992-2	Total Suspended Solids	80.8	mg/L	4.2	8.3	80.8
Lander	LANDER II REGI	5/4/2009 21:09	2	L48009-5	Total Suspended Solids	65	mg/L	5	10	65

Attachment A: King County TSS Data (all 1.0 µ method) for Hanford #2 and Lander CSOs

SITE	LOCATOR	COLLECTDATE	TIMESPAN	SAMPLE		NUMVALUE	UNITS	MDL	RDL	Value with Dups averaged
				NUM	PARMNAME					
Hanford #2	CS030	1/29/2004 8:08	2.5	L30881-2	Total Suspended Solids	122	mg/L	5	10	118
Hanford #2	CS030	1/29/2004 8:08	2.5	L30881-3	Total Suspended Solids	114	mg/L	5	10	
Hanford #2	CS030	5/26/2004 10:21	1.75	L31912-2	Total Suspended Solids	106	mg/L	5	10	104
Hanford #2	CS030	5/26/2004 10:21	1.75	L31912-3	Total Suspended Solids	102	mg/L	5	10	
Hanford #2	CS030	10/28/1996 12:00	2.5	L9820-1	Total Suspended Solids	84.7	mg/L	0.5	1	89.25
Hanford #2	CS030	10/28/1996 12:00	2.5	L9820-2	Total Suspended Solids	93.8	mg/L	0.5	1	
Hanford #2	CS030	12/4/1996 14:04	3	L10025-7	Total Suspended Solids	97	mg/L	0.5	1	99.5
Hanford #2	CS030	12/4/1996 14:04	3	L10025-8	Total Suspended Solids	102	mg/L	0.5	1	
Hanford #2	CS030	1/27/1997 20:55	1	L10292-3	Total Suspended Solids	97.3	mg/L	0.5	1	98.15
Hanford #2	CS030	1/27/1997 20:55	1	L10292-4	Total Suspended Solids	99	mg/L	0.5	1	
Hanford #2	CS030	1/30/1997 3:45	2.5	L10322-3	Total Suspended Solids	93.3	mg/L	0.5	1	95.35
Hanford #2	CS030	1/30/1997 3:45	2.5	L10322-4	Total Suspended Solids	97.4	mg/L	0.5	1	
Hanford #2	CS030	3/1/1997 10:24	3.5	L10524-3	Total Suspended Solids	128	mg/L	0.5	1	107.95
Hanford #2	CS030	3/1/1997 10:24	3.5	L10524-4	Total Suspended Solids	87.9	mg/L	0.5	1	
Hanford #2	CS030	3/7/1997 1:50	2	L10588-3	Total Suspended Solids	65.6	mg/L	0.5	1	65.6
Hanford #2	CS030	3/15/1997 10:59	3	L10645-3	Total Suspended Solids	114	mg/L	0.5	1	109.5
Hanford #2	CS030	3/15/1997 10:59	3	L10645-4	Total Suspended Solids	105	mg/L	0.5	1	
Hanford #2	CS030	4/19/1997 19:18	3	L10939-7	Total Suspended Solids	90.6	mg/L	0.5	1	95.8
Hanford #2	CS030	4/19/1997 19:18	3	L10939-8	Total Suspended Solids	101	mg/L	0.5	1	
Hanford #2	CS030	5/31/1997 7:40	3	L11233-7	Total Suspended Solids	143	mg/L	0.5	1	148
Hanford #2	CS030	5/31/1997 7:40	3	L11233-8	Total Suspended Solids	153	mg/L	0.5	1	

Attachment A: King County TSS Data (all 1.0 μ method) for Hanford #2 and Lander CSOs

Collect Date	All EW Data	TSS (mg/L) Summary Stats	
12/2/2007	67.8	86	average
8/20/2008	53	81	geomean
11/4/2008	62.5	36.4	min
11/6/2008	156	156	max
4/2/2009	94.5	94.5	median
4/12/2009	36.4	65.3	25th percentile
5/5/2009	108	106	75th percentile
9/6/2009	108	109.2	90th percentile
11/6/2009	94.7	27	count
12/21/2009	46		
6/3/2008	109		
8/20/2008	38		
11/4/2008	51.5		
11/6/2008	84.2		
4/12/2009	72.7		
5/2/2009	80.8		
5/4/2009	65		
1/29/2004	118		
5/26/2004	104		
10/28/1996	89.2		
12/4/1996	99.5		
1/27/1995	98.2		
1/30/1997	95.4		
3/1/1997	108		
3/7/1997	65.6		
3/15/1997	109.5		
4/19/1997	95.8		

TABLES F-1 TO F-3

Stormwater runoff and solids loading estimates for EWW storm drain basins (25th percentile estimate; TSS values updated 2/7/2011)

Runoff and TSS from SPU Basins (Low Runoff Assumption for Partially Separated Basins)¹

Basin	Area (Acres)	Outfall Coordinates ³		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-21	12.98	1,267,025.76	216,799.42	8.65	7.28	10.58	1,444.23	1,215.55	1,765.61	0.66	0.55	0.80
B-25	4.20	1,268,053.11	218,669.74	2.69	2.26	3.32	723.95	607.93	892.05	0.33	0.28	0.40
B-36	5.35	1,267,380.50	212,096.91	3.32	2.77	4.09	940.79	787.21	1,160.18	0.43	0.36	0.53
B-4	7.11	1,266,960.50	211,998.11	4.58	3.85	5.64	1,299.08	1,091.13	1,599.51	0.59	0.49	0.73
B-5	2.15	1,266,985.87	212,222.84	1.37	1.15	1.69	389.12	326.59	480.30	0.18	0.15	0.22
Lander ⁴ (SPU)	438.34	1,267,839.97	215,762.30	118.25	99.23	146.06	33,218.79	27,877.84	41,019.14	15.07	12.65	18.61
Hinds	39.50	1,267,870.96	212,912.61	24.99	20.99	30.57	7,090.27	5,956.38	8,674.67	3.22	2.70	3.93
total	509.62			163.84	137.53	201.95	45,106.24	37,862.64	55,591.47	20.46	17.17	25.22

1. Low and high values are provided to account for the uncertainty in how much area outside the right-of-way has been disconnected from the combined sewer and plumbed to the drainage system in partially separated areas. Low corresponds to 25 percent for Lander West and 15 percent for Lander East, and high corresponds to 75 percent for Lander West and 65 percent for Lander East.
2. Metric Ton = 2,204.62 lbs
3. Horizontal North American Datum of 1983,1991 adjustment
4. Lander drainage basin includes east and west sub-basins that discharge to the Lander St outfall; the Port Lander sub-basin is addressed in the POS Basins table below.

Runoff and TSS from SPU Basins (High Runoff Assumption for Partially Separated Basins)¹

Basin	Area (Acres)	Outfall Coordinates ³		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate ³	Y coordinate ³	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-21	12.98	1,267,025.76	216,799.42	8.65	7.28	10.58	1,444.23	1,215.55	1,765.61	0.66	0.55	0.80
B-25	4.20	1,268,053.11	218,669.74	2.69	2.26	3.32	723.95	607.93	892.05	0.33	0.28	0.40
B-36	5.35	1,267,380.50	212,096.91	3.32	2.77	4.09	940.79	787.21	1,160.18	0.43	0.36	0.53
B-4	7.11	1,266,960.50	211,998.11	4.58	3.85	5.64	1,299.08	1,091.13	1,599.51	0.59	0.49	0.73
B-5	2.15	1,266,985.87	212,222.84	1.37	1.15	1.69	389.12	326.59	480.30	0.18	0.15	0.22
Lander ⁴ (SPU)	438.34	1,267,839.97	215,762.30	222.70	186.98	274.59	62,056.74	52,113.65	76,455.34	28.15	23.64	34.68
Hinds	39.50	1,267,870.96	212,912.61	24.99	20.99	30.57	7,090.27	5,956.38	8,674.67	3.22	2.70	3.93
total	509.62			268.30	225.28	330.47	73,944.19	62,098.45	91,027.66	33.54	28.17	41.29

1. Low and high values are provided to account for the uncertainty in how much area outside the right-of-way has been disconnected from the combined sewer and plumbed to the drainage system in partially separated areas. Low corresponds to 25 percent for Lander West and 15 percent for Lander East, and high corresponds to 75 percent for Lander West and 65 percent for Lander East.
2. Metric Ton = 2,204.62 lbs
3. Horizontal North American Datum of 1983,1991 adjustment
4. Lander drainage basin includes east and west sub-basins that discharge to the Lander St outfall; the Port Lander sub-basin is addressed in the POS Basins table below.

Runoff and TSS from SPU Bridges

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
BR-34	0.95			0.59	0.49	0.73	166.74	139.71	207.00	0.08	0.06	0.09
BR-4	1.23			0.77	0.65	0.96	219.84	184.36	272.16	0.10	0.08	0.12
BR-5	1.61			1.00	0.84	1.24	283.81	237.80	352.33	0.13	0.11	0.16
total	3.80			2.36	1.98	2.93	670.40	561.88	831.49	0.30	0.25	0.38

1. Horizontal North American Datum of 1983,1991 adjustment; basins with no X, Y coordinates do not drain to an outfall
2. Metric Ton = 2,204.62 lbs

Stormwater runoff and solids loading estimates for EWW storm drain basins (25th percentile estimate; TSS values updated 2/7/2011)

Runoff and TSS from POS Basins

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-1	1.58	1,266,887.46	211,399.22	1.05	0.89	1.29	175.96	148.10	215.11	0.08	0.07	0.10
B-10	7.23	1,266,968.30	214,087.50	4.82	4.06	5.89	804.65	677.24	983.71	0.36	0.31	0.45
B-11	48.14	1,266,995.91	214,238.77	32.08	27.00	39.22	5,355.44	4,507.46	6,547.18	2.43	2.04	2.97
B-12	6.53	1,266,956.70	214,443.80	4.35	3.66	5.32	726.47	611.44	888.12	0.33	0.28	0.40
B-13	6.22	1,267,027.00	214,961.90	4.15	3.49	4.15	692.01	582.44	846.00	0.31	0.26	0.38
B-14	1.52	1,267,051.30	215,033.60	1.01	0.85	1.24	168.70	141.99	206.25	0.08	0.06	0.09
B-16	4.41	1,266,993.70	215,373.60	2.94	2.48	3.60	490.97	413.23	600.22	0.22	0.19	0.27
B-17	2.14	1,267,002.40	215,678.30	1.43	1.20	1.74	238.08	200.38	291.06	0.11	0.09	0.13
B-18	7.41	1,266,983.00	215,983.87	4.94	4.16	6.04	824.18	693.68	1,007.58	0.37	0.31	0.46
B-19	5.04	1,267,000.61	216,655.64	3.36	2.83	4.11	560.58	471.82	685.33	0.25	0.21	0.31
B-22	11.99	1,266,996.20	217,188.40	7.99	6.72	9.77	1,333.63	1,122.47	1,630.40	0.60	0.51	0.74
B-23	10.95	1,267,011.30	217,914.40	7.30	6.14	8.92	1,217.71	1,024.90	1,488.68	0.55	0.46	0.68
B-24	8.86	1,267,046.27	218,573.28	5.90	4.97	7.22	985.46	829.42	1,204.75	0.45	0.38	0.55
B-26	13.41	1,268,013.00	217,447.20	8.94	7.52	10.92	1,491.49	1,255.33	1,823.39	0.68	0.57	0.83
B-27	7.35	1,268,014.70	216,941.70	4.90	4.12	5.99	817.26	687.86	999.13	0.37	0.31	0.45
B-28	3.59	1,268,001.70	216,332.40	2.40	2.02	2.93	399.88	336.56	488.86	0.18	0.15	0.22
B-29	8.75	1,268,024.30	215,844.00	5.83	4.91	7.13	972.93	818.88	1,189.44	0.44	0.37	0.54
B-30	6.69	1,268,481.10	214,909.20	4.46	3.75	4.46	744.15	626.32	909.74	0.34	0.28	0.41
B-31 ³	9.81	1,267,827.60	214,382.65	6.54	5.51	8.00	1,091.90	919.01	1,334.88	0.50	0.42	0.61
B-32	3.73	1,267,816.51	214,084.19	2.48	2.09	3.04	414.63	348.98	506.90	0.19	0.16	0.23
B-33	12.11	1,267,802.40	213,205.40	8.06	6.79	9.86	1,345.93	1,132.83	1,645.31	0.61	0.51	0.75
B-34	13.33	1,267,445.56	212,282.86	8.77	7.38	10.71	2,488.66	2,093.33	3,038.01	1.13	0.95	1.38
B-37	6.41	1,267,196.82	211,561.15	4.23	3.56	5.17	706.74	594.29	863.35	0.32	0.27	0.39
B-39	2.08	1,267,224.50	211,803.70	1.38	1.16	1.69	231.01	194.38	282.40	0.10	0.09	0.13
B-7	13.93	1,266,941.40	212,971.90	9.29	7.81	11.35	1,549.86	1,304.46	1,894.75	0.70	0.59	0.86
Lander (POS) ⁴	3.62	1,267,839.97	215,762.30	2.41	2.03	2.95	402.29	338.59	491.81	0.18	0.15	0.22
total	226.80			151.01	127.09	184.59	26,230.58	22,075.38	32,062.35	11.90	10.01	14.54

1. Horizontal North American Datum of 1983,1991 adjustment
2. Metric Ton = 2,204.62 lbs
3. Basin B-31 includes basin BR-27
4. Lander (POS) sub-basin discharges to the Lander St outfall. Lander East and West (SPU) also discharge to this outfall, and are addressed in the SPU Basins table above

Runoff and TSS from POS Aprons

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
A-7	1.16			0.77	0.65	0.94	128.72	108.34	157.36	0.06	0.05	0.07
A-10	2.28			1.52	1.28	1.86	254.18	213.93	310.74	0.12	0.10	0.14
A-12	1.98			1.32	1.11	1.61	220.29	185.41	269.32	0.10	0.08	0.12
A-13	0.47			0.31	0.26	0.38	52.33	44.04	63.98	0.02	0.02	0.03
A-14	1.04			0.69	0.58	0.84	115.27	97.01	140.92	0.05	0.04	0.06
A-16	0.66			0.44	0.37	0.54	73.17	61.58	89.45	0.03	0.03	0.04
A-17	0.68			0.46	0.38	0.56	76.11	64.06	93.04	0.03	0.03	0.04
A-18	1.20			0.80	0.67	0.98	133.86	112.66	163.65	0.06	0.05	0.07
A-19	1.89			1.26	1.06	1.54	210.61	177.26	257.48	0.10	0.08	0.12
A-22	2.01			1.34	1.13	1.64	223.89	188.44	273.71	0.10	0.09	0.12
A-23	2.05			1.37	1.15	1.67	227.91	191.82	278.62	0.10	0.09	0.13
A-24	2.29			1.53	1.28	1.87	254.64	214.32	311.31	0.12	0.10	0.14
A-26	0.60			0.40	0.34	0.49	66.57	56.03	81.39	0.03	0.03	0.04
A-27	1.70			1.13	0.95	1.38	188.67	158.80	230.66	0.09	0.07	0.10
A-28	1.50			1.00	0.84	1.22	167.20	140.73	204.41	0.08	0.06	0.09
A-29	1.15			0.76	0.64	0.93	127.60	107.40	155.99	0.06	0.05	0.07
A-30	1.30			0.87	0.73	1.06	145.02	122.06	177.29	0.07	0.06	0.08
A-31	0.76			0.51	0.43	0.62	84.94	71.49	103.84	0.04	0.03	0.05
A-32	0.80			0.54	0.45	0.65	89.39	75.24	109.28	0.04	0.03	0.05
A-33	2.19			1.46	1.23	1.78	243.19	204.69	297.31	0.11	0.09	0.13
BR-39	1.25			0.83	0.83	1.02	236.69	199.21	289.39	0.11	0.09	0.13
BR-2	0.27	1,266,955.62	211,835.26	0.18	0.15	0.22	29.71	25.01	36.33	0.01	0.01	0.02
total	29.24			19.49	16.53	23.82	3,349.96	2,819.52	4,095.44	1.52	1.28	1.86

1. Horizontal North American Datum of 1983,1991 adjustment; basins with no X, Y coordinates do not drain to an outfall
2. Metric Ton = 2,204.62 lbs

Stormwater runoff and solids loading estimates for EWW storm drain basins (25th percentile estimate; TSS values updated 2/7/2011)

Runoff and TSS from Private Basins

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
A-6	3.16	1,267,133.00	212,871.00	2.10	1.77	2.57	597.30	502.72	730.22	0.27	0.23	0.33
B-40	3.26	1,268,082.43	218,293.18	2.04	1.71	2.53	528.33	442.97	654.46	0.24	0.20	0.30
B-41	5.46	1,268,032.50	218,704.86	3.64	3.06	4.45	869.02	869.02	1,262.46	0.39	0.39	0.57
B-42	0.46	1,268,376.87	218,781.63	0.31	0.26	0.38	87.30	73.48	106.73	0.04	0.03	0.05
B-43	5.74	1,268,824.23	218,875.21	3.83	3.22	4.68	1,085.50	913.62	1,327.05	0.49	0.41	0.60
total	18.08			11.92	10.02	14.60	3,167.45	2,801.81	4,080.92	1.44	1.27	1.85

1. Horizontal North American Datum of 1983,1991 adjustment

2. Metric Ton = 2,204.62 lbs

25th percentile estimate: TSS Concentrations in mg/L (All POS basins [except B-34], SPU basin: B-21)

Land Use	ROW	Industrial	MFR	Commercial	Open	SFR
Estimated Concentration (mg/L)	34	20	39	31	8	24

MFR= Multiple Family Residential, SFR= Single Family Residential

25th percentile estimate: TSS Concentrations in mg/L (All SPU basins [except B-21], POS basin B-34, all Private basins)

Land Use	ROW	Industrial	MFR	Commercial	Open	SFR
Estimated Concentration (mg/L)	34	34	39	31	8	24

Stormwater runoff and solids loading estimates for EWW storm drain basins (Base Case estimate; TSS values updated 2/7/2011)

Runoff and TSS from SPU Basins (Low Runoff Assumption for Partially Separated Basins)¹

Basin	Area (Acres)	Outfall Coordinates ³		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-21	12.98	1,267,025.76	216,799.42	8.65	7.28	10.58	3,105.09	2,613.43	3,796.06	1.41	1.19	1.72
B-25	4.20	1,268,053.11	218,669.74	2.69	2.26	3.32	1,449.33	1,217.23	1,785.00	0.66	0.55	0.81
B-36	5.35	1,267,380.50	212,096.91	3.32	2.77	4.09	1,992.07	1,666.98	2,456.30	0.90	0.76	1.11
B-4	7.11	1,266,960.50	211,998.11	4.58	3.85	5.64	2,774.44	2,330.43	3,415.52	1.26	1.06	1.55
B-5	2.15	1,266,985.87	212,222.84	1.37	1.15	1.69	825.47	692.86	1,018.75	0.37	0.31	0.46
Lander ⁴ (SPU)	438.34	1,267,839.97	215,762.30	118.25	99.23	146.06	69,548.30	58,369.41	85,863.49	31.55	26.48	38.95
Hinds	39.50	1,267,870.96	212,912.61	24.99	20.99	30.57	15,253.42	12,814.71	18,659.98	6.92	5.81	8.46
total	509.62			163.84	137.53	201.95	94,948.12	79,705.06	116,995.11	43.07	36.15	53.07

1. Low and high values are provided to account for the uncertainty in how much area outside the right-of-way has been disconnected from the combined sewer and plumbed to the drainage system in partially separated areas. Low corresponds to 25 percent for Lander West and 15 percent for Lander East, and high corresponds to 75 percent for Lander West and 65 percent for Lander East.
2. Metric Ton = 2,204.62 lbs
3. Horizontal North American Datum of 1983,1991 adjustment
4. Lander drainage basin includes east and west sub-basins that discharge to the Lander St outfall; the Port Lander sub-basin is addressed in the POS Basins table below.

Runoff and TSS from SPU Basins (High Runoff Assumption for Partially Separated Basins)¹

Basin	Area (Acres)	Outfall Coordinates ³		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate ³	Y coordinate ³	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-21	12.98	1,267,025.76	216,799.42	8.65	7.28	10.58	3,105.09	2,613.43	3,796.06	1.41	1.19	1.72
B-25	4.20	1,268,053.11	218,669.74	2.69	2.26	3.32	1,449.33	1,217.23	1,785.00	0.66	0.55	0.81
B-36	5.35	1,267,380.50	212,096.91	3.32	2.77	4.09	1,992.07	1,666.98	2,456.30	0.90	0.76	1.11
B-4	7.11	1,266,960.50	211,998.11	4.58	3.85	5.64	2,774.44	2,330.43	3,415.52	1.26	1.06	1.55
B-5	2.15	1,266,985.87	212,222.84	1.37	1.15	1.69	825.47	692.86	1,018.75	0.37	0.31	0.46
Lander ⁴ (SPU)	438.34	1,267,839.97	215,762.30	222.70	186.98	274.59	129,846.09	109,051.39	159,923.03	58.90	49.46	72.54
Hinds	39.50	1,267,870.96	212,912.61	24.99	20.99	30.57	15,253.42	12,814.71	18,659.98	6.92	5.81	8.46
total	509.62			268.30	225.28	330.47	155,245.91	130,387.03	191,054.65	70.42	59.14	86.66

1. Low and high values are provided to account for the uncertainty in how much area outside the right-of-way has been disconnected from the combined sewer and plumbed to the drainage system in partially separated areas. Low corresponds to 25 percent for Lander West and 15 percent for Lander East, and high corresponds to 75 percent for Lander West and 65 percent for Lander East.
2. Metric Ton = 2,204.62 lbs
3. Horizontal North American Datum of 1983,1991 adjustment
4. Lander drainage basin includes east and west sub-basins that discharge to the Lander St outfall; the Port Lander sub-basin is addressed in the POS Basins table below.

Runoff and TSS from SPU Bridges

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
BR-34	0.95			0.59	0.49	0.73	348.20	291.75	432.26	0.16	0.13	0.20
BR-4	1.23			0.77	0.65	0.96	462.62	387.96	572.66	0.21	0.18	0.26
BR-5	1.61			1.00	0.84	1.24	592.66	496.59	735.74	0.27	0.23	0.33
total	3.80			2.36	1.98	2.93	1,403.48	1,176.31	1,740.66	0.64	0.53	0.79

1. Horizontal North American Datum of 1983,1991 adjustment; basins with no X, Y coordinates do not drain to an outfall
2. Metric Ton = 2,204.62 lbs

Stormwater runoff and solids loading estimates for EWW storm drain basins (Base Case estimate; TSS values updated 2/7/2011)

Runoff and TSS from POS Basins

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
B-1	1.58	1,266,887.46	211,399.22	1.05	0.89	1.29	378.31	318.41	462.50	0.17	0.14	0.21
B-10	7.23	1,266,968.30	214,087.50	4.82	4.06	5.89	1,730.00	1,456.08	2,114.98	0.78	0.66	0.96
B-11	48.14	1,266,995.91	214,238.77	32.08	27.00	39.22	11,514.20	9,691.04	14,076.43	5.22	4.40	6.38
B-12	6.53	1,266,956.70	214,443.80	4.35	3.66	5.32	1,561.90	1,314.59	1,909.47	0.71	0.60	0.87
B-13	6.22	1,267,027.00	214,961.90	4.15	3.49	4.15	1,487.82	1,252.24	1,818.90	0.67	0.57	0.83
B-14	1.52	1,267,051.30	215,033.60	1.01	0.85	1.24	362.71	305.28	443.43	0.16	0.14	0.20
B-16	4.41	1,266,993.70	215,373.60	2.94	2.48	3.60	1,055.58	888.44	1,290.47	0.48	0.40	0.59
B-17	2.14	1,267,002.40	215,678.30	1.43	1.20	1.74	511.87	430.82	625.77	0.23	0.20	0.28
B-18	7.41	1,266,983.00	215,983.87	4.94	4.16	6.04	1,771.99	1,491.41	2,166.30	0.80	0.68	0.98
B-19	5.04	1,267,000.61	216,655.64	3.36	2.83	4.11	1,205.26	1,014.42	1,473.46	0.55	0.46	0.67
B-22	11.99	1,266,996.20	217,188.40	7.99	6.72	9.77	2,867.31	2,413.30	3,505.37	1.30	1.09	1.59
B-23	10.95	1,267,011.30	217,914.40	7.30	6.14	8.92	2,618.07	2,203.53	3,200.67	1.19	1.00	1.45
B-24	8.86	1,267,046.27	218,573.28	5.90	4.97	7.22	2,118.74	1,783.26	2,590.22	0.96	0.81	1.17
B-26	13.41	1,268,013.00	217,447.20	8.94	7.52	10.92	3,206.70	2,698.95	3,920.28	1.45	1.22	1.78
B-27	7.35	1,268,014.70	216,941.70	4.90	4.12	5.99	1,757.11	1,478.89	2,148.12	0.80	0.67	0.97
B-28	3.59	1,268,001.70	216,332.40	2.40	2.02	2.93	859.74	723.61	1,051.06	0.39	0.33	0.48
B-29	8.75	1,268,024.30	215,844.00	5.83	4.91	7.13	2,091.80	1,760.59	2,557.29	0.95	0.80	1.16
B-30	6.69	1,268,481.10	214,909.20	4.54	3.75	5.45	1,599.92	1,346.59	1,955.95	0.73	0.61	0.89
B-31 ³	9.81	1,267,827.60	214,382.65	6.54	5.51	8.00	2,347.59	1,975.87	2,869.99	1.06	0.90	1.30
B-32	3.73	1,267,816.51	214,084.19	2.48	2.09	3.04	891.45	750.30	1,089.83	0.40	0.34	0.49
B-33	12.11	1,267,802.40	213,205.40	8.06	6.79	9.86	2,893.76	2,435.58	3,537.41	1.31	1.10	1.60
B-34	13.33	1,267,445.56	212,282.86	8.77	7.38	10.71	5,416.50	4,556.07	6,612.13	2.46	2.07	3.00
B-37	6.41	1,267,196.82	211,561.15	4.23	3.56	5.17	1,519.48	1,277.72	1,856.20	0.69	0.58	0.84
B-39	2.08	1,267,224.50	211,803.70	1.38	1.16	1.69	496.68	417.92	607.15	0.23	0.19	0.28
B-7	13.93	1,266,941.40	212,971.90	9.29	7.81	11.35	3,332.20	2,804.58	4,073.71	1.51	1.27	1.85
Lander (POS) ⁴	3.62	1,267,839.97	215,762.30	2.41	2.03	2.95	864.93	727.98	1,057.40	0.39	0.33	0.48
total	226.80			151.01	127.09	184.59	56,461.63	47,517.48	69,014.48	25.61	21.55	31.30

1. Horizontal North American Datum of 1983,1991 adjustment
2. Metric Ton = 2,204.62 lbs
3. Basin B-31 includes basin BR-27
4. Lander (POS) sub-basin discharges to the Lander St outfall. Lander East and West (SPU) also discharge to this outfall, and are addressed in the SPU Basins table above

Runoff and TSS from POS Aprons

Basin	Area (Acres)	Outfall Coordinates ¹		Annual Runoff in Million gallons			Annual Average TSS in lbs			Annual Average TSS in metric tons ²		
		X coordinate	Y coordinate	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)	1986 (Average Water Year)	1993 (Dry Water Year)	2002 (Wet Water Year)
A-7	1.16			0.77	0.65	0.94	276.74	232.92	338.32	0.13	0.11	0.15
A-10	2.28			1.52	1.28	1.86	546.48	459.95	668.09	0.25	0.21	0.30
A-12	1.98			1.32	1.11	1.61	473.63	398.64	579.03	0.21	0.18	0.26
A-13	0.47			0.31	0.26	0.38	112.51	94.70	137.55	0.05	0.04	0.06
A-14	1.04			0.69	0.58	0.84	247.82	208.58	302.97	0.11	0.09	0.14
A-16	0.66			0.44	0.37	0.54	157.31	132.40	192.31	0.07	0.06	0.09
A-17	0.68			0.46	0.38	0.56	163.63	137.72	200.04	0.07	0.06	0.09
A-18	1.20			0.80	0.67	0.98	287.80	242.23	351.84	0.13	0.11	0.16
A-19	1.89			1.26	1.06	1.54	452.81	381.11	553.58	0.21	0.17	0.25
A-22	2.01			1.34	1.13	1.64	481.36	405.14	588.47	0.22	0.18	0.27
A-23	2.05			1.37	1.15	1.67	490.00	412.41	599.03	0.22	0.19	0.27
A-24	2.29			1.53	1.28	1.87	547.48	460.80	669.31	0.25	0.21	0.30
A-26	0.60			0.40	0.34	0.49	143.13	120.47	174.98	0.06	0.05	0.08
A-27	1.70			1.13	0.95	1.38	405.65	341.42	495.92	0.18	0.15	0.22
A-28	1.50			1.00	0.84	1.22	359.49	302.57	439.48	0.16	0.14	0.20
A-29	1.15			0.76	0.64	0.93	274.34	230.90	335.39	0.12	0.10	0.15
A-30	1.30			0.87	0.73	1.06	311.79	262.42	381.17	0.14	0.12	0.17
A-31	0.76			0.51	0.43	0.62	182.61	153.70	223.25	0.08	0.07	0.10
A-32	0.80			0.54	0.45	0.65	192.19	161.76	234.96	0.09	0.07	0.11
A-33	2.19			1.46	1.23	1.78	522.86	440.07	639.22	0.24	0.20	0.29
BR-39	1.25			0.83	0.83	1.02	515.04	433.48	629.71	0.23	0.20	0.29
BR-2	0.27	1,266,955.62	211,835.26	0.18	0.15	0.22	63.88	53.77	78.10	0.03	0.02	0.04
total	29.24			19.49	16.53	23.82	7,208.56	6,067.14	8,812.71	3.27	2.75	4.00

1. Horizontal North American Datum of 1983,1991 adjustment; basins with no X, Y coordinates do not drain to an outfall
2. Metric Ton = 2,204.62 lbs