2013 Monitoring Report for King County Stormwater Monitoring Under S8.D of the NPDES Phase 1 Municipal Permit WAR04-4501 (Issued February 2007)

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Department of Natural Resources and Parks
Water and Land Resources Division
Science Section
King Street Center, KSC-NR-0600
201 South Jackson Street, Suite 600
Seattle, WA 98104
dnr.metrokc.gov/wlr

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Prepared by

Cardno TEC

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Submitted by:

Eric Ferguson
King County Water and Land Resources Division
Department of Natural Resources and Parks

King County
Department of
Natural Resources and Parks
Water and Land Resources Division

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1.0. INTRODUCTION

The Washington State Phase I Municipal Stormwater Permit (Permit) applies to all entities in Washington State required to have permit coverage under current (Phase I) U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) stormwater regulations. This includes cities and unincorporated portions of counties whose populations exceed 100,000. The Permit includes requirements to conduct stormwater-related monitoring in Special Condition 8 (S8). The required monitoring program detailed in S8 includes three components:

- S8.D Stormwater Monitoring
- S8.E Targeted Stormwater Management Program Effectiveness Monitoring
- S8.F Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring.

Reporting for all three monitoring components is required as part of Special Condition S8.H and S9. These sections require permittees to complete an annual stormwater monitoring report for each component detailing monitoring that occurred during the previous water year. A water year is a 12 month period that ends on September 30 and starts on previous October 1; example: water year 2012 starts on October 1, 2011 and ends on September 30, 2012.

For Water Year 2012 (WY12) storms were initially targeted for sampling between October 1 and December 31, 2011. In January 2012, after completing two and one-quarter years of sampling, King County stopped collecting stormwater samples. King County officials believed that other ongoing sampling and testing could substitute for the NPDES S8.D permit-required monitoring. Ecology and King County worked together and signed an agreement to resume the WY12 stormwater monitoring program on June 15, 2012 and continue through September 30, 2012. Ecology and King County also agreed to extend the monitoring through the partial wet season of Water Year 2013 (WY13), with monitoring being completed in March 2013.

This document serves as King County's WY13 Stormwater Monitoring Report and documents the stormwater characterization monitoring conducted under S8.D of the Permit during the time period between October 1, 2012 through March 15, 2013. Previous water year data are available in separate reports. The stormwater characterization monitoring is intended to characterize stormwater runoff based on land use type and to detect trends from these same land uses in stormwater quality and quantity over time.

2.0. SUMMARY OF MONITORING STATIONS

Stormwater monitoring, to fulfill requirements of the Permit (per Permit §S8.D), was performed by King County in accordance with their project Quality Assurance Project Plan (QAPP) entitled Quality Assurance Project Plan for King County Stormwater Monitoring Under the NPDES Phase 1 Municipal Permit WAR04-4501 (Issued February 2007) (King County, 2010). This QAPP was issued in February 2007, approved by Ecology on March 9, 2009 and updated November 2010. A QAPP addendum was approved that provided an update to the monitoring program schedule. The updated QAPP and addendum are included as Appendix A.

The Permit requires each permittee to monitor stormwater and sediment from three different land use types: commercial, high density residential and low density residential. A description of the monitoring sites selected to represent these land uses are provided below.

2.1 Site Descriptions

Monitoring site locations for the commercial (COM), high density residential (HDR) and low density residential (LDR) land use types were selected based on a number of factors. An attempt was made to locate sites both outside of incorporated areas and outside of the potential annexation areas identified in King County. Other factors included logistics, such as proximity to where sampling crews are based (to reduce hold-time violations, transit time and costs, etc.), proximity of power for sample refrigeration and site access. Attributes of the three monitoring sites that were proposed by King County, and approved by Ecology, are presented in Table 1 and described below. There have been no changes in land use within any of the monitored drainage basins as compared to land use defined in the QAPP, or reported in King County's Water Years 2010, 2011 and 2012 Stormwater Monitoring Reports.

Table 1. King County NPDES S8.D Monitoring Site Characteristics

Site Characteristics	Monitoring Site Name		
	COM	HDR	LDR
Location	Fall City	Fall City	Near Renton
Drainage Area (acres)	5	5.25	42.7
% Commercial	80	0	0
% Low Density Residential	0	0	100
% High Density Residential	20	100	0
% Impervious Area	80	50	17
Rain Gage Location (State Plane NAD83)	1,378,430E 208,006N	1,378,430E 208,006N	1,308,856E 178,651N

2.1.1 Commercial Site (COM)

The COM site selected and monitored by King County is located in Fall City. The 5-acre drainage area is situated near the intersection of Highway 202 (which parallels the Snoqualmie River) and Preston-Fall City Road (Figure 1). This site was selected because the area includes several different types of businesses and is an older development, with a few structures built as early as the 1920s. Businesses along Highway 202 and Preston-Fall City Road consist of commercial areas that include a gas station, taverns, restaurants and various other small shops. This site is intended to represent an older commercial development that has a storm drain system without mitigation BMPs or stormwater treatment of any kind.

The COM drainage basin is 80 percent impervious surfaces, which consist predominantly of roads, parking lots and rooftops. The pervious surfaces within the basin are mostly lawn. Separate storm drain systems collect runoff from along Highway 202 and from along Preston-Fall City Road through a series of ditches, culverts and catch basins. The two storm drain systems combine at a catch basin near the corner of Highway 202 and Preston-Fall City Road. This catch basin serves as the monitoring location for the COM site (Figure 1). A photo of the catch basin and sampler housing is presented in Figure 2. Stormwater from this system drains from the bottom of the monitoring catch basin, flows under Highway 202 and discharges directly to the Snoqualmie River.

The catch basin selected for monitoring does not store water between storm events or provide any water quality treatment or attenuation. The autosampler intake tubing is installed in the catch basin in a location that is downstream of the inlet pipes from the Highway 202 and Preston-Fall City Road drainage systems. This location ensures that if both drainage systems are flowing, sampled stormwater will represent runoff from both the Highway 202 and Preston-Fall City Road systems. The primary rain gage for COM is located approximately 0.35 miles away at the HDR monitoring site, as described in Section 2.1.2.

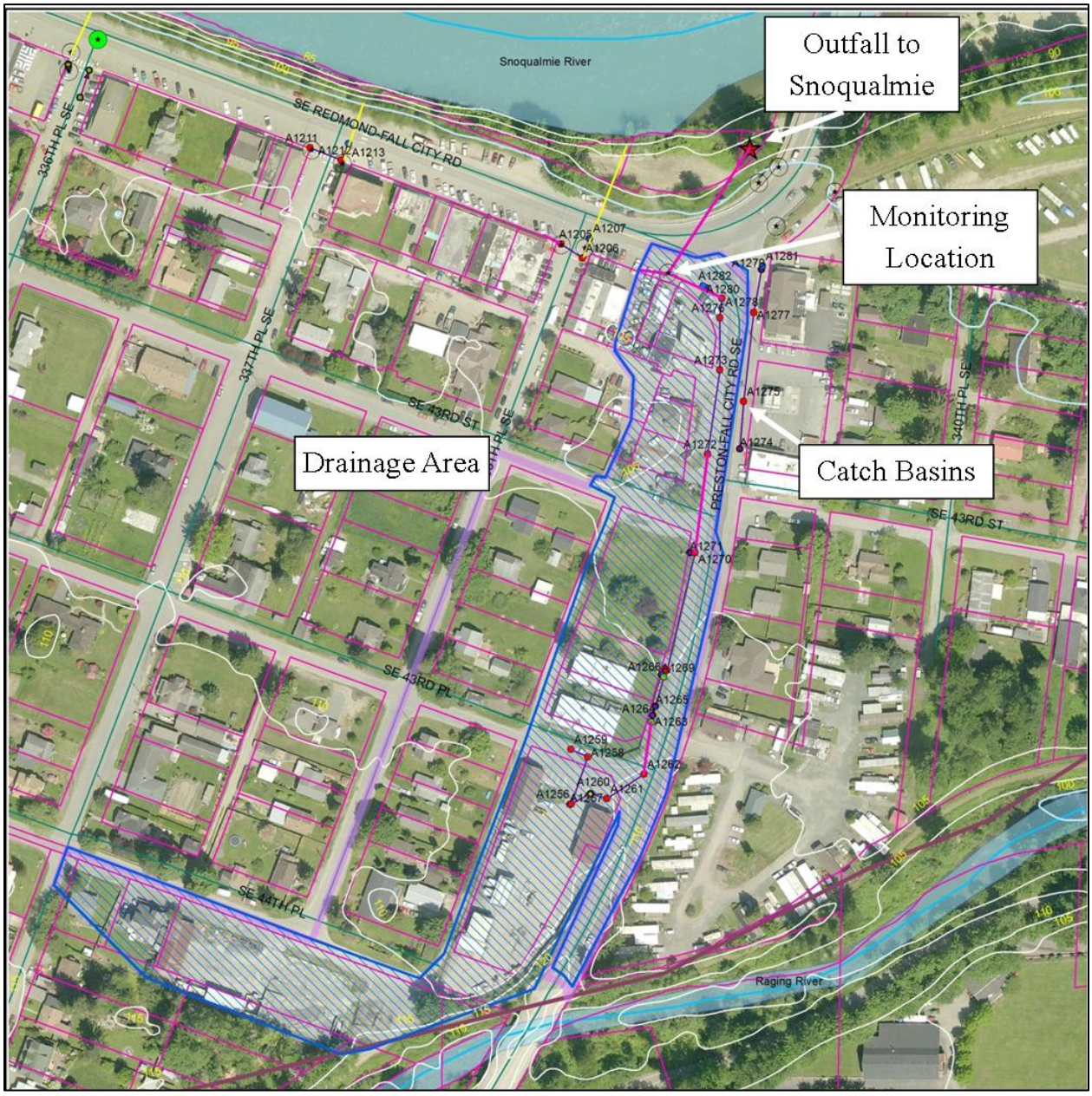

Figure 1. Drainage area and drainage system for the Fall City commercial (COM) monitoring site.

Figure 2. Catch basin monitoring site and sampler housing at COM site.

2.1.2 High Density Residential (HDR)

The HDR site selected and monitored by King County is located in Fall City (Figure 3). For this study high density is defined as four houses or more per acre. Density in the HDR drainage basin is approximately four houses to an acre.

The HDR drainage basin is 5.25 acres consisting of a neighborhood of 21 single family homes. The neighborhood is accessed by 335th Place SE and 44th Lane. Approximately 50 percent of the drainage basin is impervious surfaces, which are predominantly streets and rooftops. The pervious surfaces are predominantly lawns.

The neighborhood was developed in the early 1970s and the street, drainage and house construction are all typical of this time period. The storm drain system serving the neighborhood is a curb and catch basin system that flows into an infiltration vault. The monitoring location (Figure 4) is set up to collect stormwater immediately prior to flowing into the infiltration vault. This site also includes the primary rain gage for the HDR and COM monitoring sites.

Figure 3. Drainage area and drainage system for the Fall City high density residential (HDR) monitoring site.

Figure 4. Automated sampler and downstream vault at HDR monitoring site.

2.1.3 Low Density Residential (LDR)

The LDR site selected and monitored by King County is located in a neighborhood near Renton (Figure 5). Density in the drainage basin is approximately one house per 1 to 5 acres, which is the definition of low density for this study. The nearly 43 acre drainage basin is 17 percent impervious and 83 percent pervious. The majority of the impervious areas are roads and rooftops while the pervious surfaces are predominantly lawns and forested areas.

Drainage within the basin consists of an open ditch that runs along the east shoulder of 148th Avenue SE. The ditch, which transitions to a 12-inch culvert when bisected by residential driveways, flows north from State Route (SR) 900 and drains into May Creek. Runoff is primarily from the rural residential properties on the east side of 148th Ave SE with additional runoff from SR 900.

The monitoring site is located at the southwest corner of a lot at 10222 148th Avenue SE. Flow is measured by a trapezoidal flume placed in the ditch, as shown in Figure 6. The monitoring station is located within King County road right-of-way on the east side of the ditch. The primary rain gage used for this site is located at the King County Roads Renton Maintenance Facility.

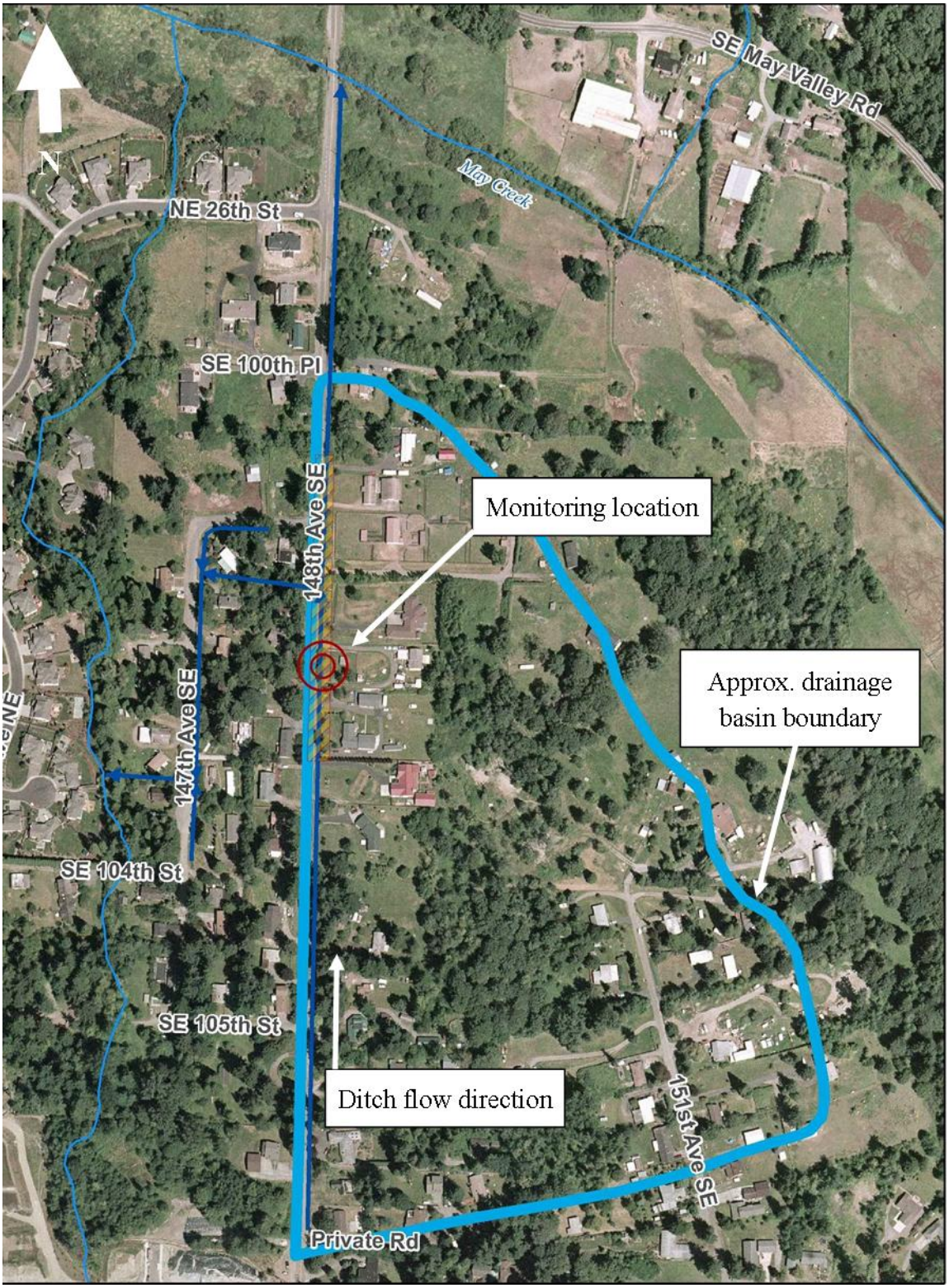

Figure 5. Drainage area and drainage system for the low density residential (LDR) monitoring site.

Figure 6. Flume and autosampler suction line at LDR monitoring site.

3.0. COMPREHENSIVE DATA REPORT

This section presents information about the storm and base flow events sampled at the COM, HDR and LDR sites during WY13. No sediment samples were collected during WY13. All stormwater and base flow samples were collected following procedures outlined in the project QAPP.

3.1 Summary of Storm Events

As agreed upon with Ecology, storms were targeted for sampling for a portion of the WY13 wet season between October 1, 2012 and March 15, 2013. The Permit states that 67 percent of the forecasted qualifying storms should be sampled at each monitoring site, up to a maximum of 11 storm events per water year. The Permit also allows up to 3 samples to be collected from non-qualifying storm events at each site. Qualifying storm event criteria are presented in Table 2.

Table 2. NPDES S8.D storm criteria for stormwater sampling.

	Wet Season	Dry Season
Seasonal Period	October 1 through April 30	May 1 through September 30
Minimum Amount of Rainfall	0.20” min. no fixed max.	0.20” min. no fixed max.
Rainfall Duration	No fixed min. or max.	No fixed min. or max.
Antecedent Dry Period	≤0.02” rain in previous 24-hours	≤0.02 rain” in previous 72-hours
Interevent Dry Period	6 hours	6 hours

As outlined in Table 3, archived weather forecasts show that during the abbreviated WY13 there were 13 events at COM, 13 at HDR and 7 at LDR that were forecasted qualifying storms. For each monitoring site, all forecasted qualifying events were targeted for sampling. In addition to the qualifying events, 4 events at COM and HDR and 3 events at LDR were targeted that were forecasted to be qualifying but did not end up meeting the storm size criterion.

Of the storms targeted for sampling, a total of 10 qualifying composite samples were collected at COM. These 10 samples represented 76 percent of the forecasted qualifying storms at COM and met the Permit requirements. At HDR 4 qualifying composite samples were collected while 3 qualifying composite samples were collected at LDR. One additional sample from COM and one from LDR did not meet the storm size criterion; however, the samples were submitted as one of the three allowed from non-qualifying storm events. Storms that were targeted but for which no samples were submitted were unsuccessful were due to:

- Storms being larger or smaller than forecasted and therefore the flow pacing resulted in samples that did not meet one of the sampling criterion listed in Permit §S8.D.2.b[1],

[1] Permit §S8.D.2.b lists as one criterion “For storm events lasting less than 24 hours, samples shall be collected for at least seventy-five percent (75%) of the storm event hydrograph. For storm events lasting longer than 24 hours, samples shall be collected for at least seventy-five percent of the hydrograph of the first 24 hours of the storm.”

- Storms did not produce a large enough rise in level or flow to enable the auto-sampler, or
- "False starts" relating to equipment issues.

Qualifying grab samples were collected from 3 storms at COM, 3 storms at HDR and 6 storms at LDR. Another 7 grab samples were collected at COM and 3 at HDR that did not meet the Permit criterion stating samples must be collected early in the storm event. Several grab samples were collected at LDR from storms that did not meet the storm size criterion; however, these samples were collected early in the storm and it was not possible to know if rainfall totals would meet the storm criterion. Therefore, these samples were considered qualifying since they were collected during active runoff from a storm that met all the other criteria. More details of the sample events and how they compared to Permit criteria are provided in Section 3.2.

Table 3. Number of targeted and sampled storm events at COM, HDR and LDR.

	COM		HDR		LDR	
Total # of forecasted qualifying events	13		13		7	
Total # of targeted storms	17		17		10	
	Grab	Composite	Grab	Composite	Grab	Composite
Total # of samples collected	10	11	6	4	6	4
Total # of samples that met storm and sampling criteria	3	10	3	4	6	3

At the COM monitoring qualifying samples were collected from 76 percent of the forecasted qualifying storms, meeting the Permit criterion. At HDR and LDR, King County targeted all of the forecasted qualifying storms within the active sampling period. At HDR qualifying composite samples were collected from 4 out of 13 qualifying events; however, rainfall from 6 of the remaining 9 events did not produce enough runoff to enable the auto-sampler. At LDR qualifying composite samples were collected from 3 out the 7 qualifying events, with 3 additional storms targeted. These attempts show while the Permit criterion was not met at HDR and LDR, King County made good faith efforts with good professional practice to fulfill the established sampling objectives within the abbreviated water year. A table providing a list of the targeted and sampled storm events for each site is included in Appendix B.

Base flow was present at LDR from mid-November through the end of the monitoring period in March. One base flow grab sample was collected on March 6, 2013 and one base flow composite sample was collected on March 8, 2013. Details on the base flow sampling event are provided in Section 3.2.3. Base flow was not present at COM or HDR during WY13.

3.2 Characteristics of Individual Sampled Events

Continuous precipitation and flow data were collected between October 1, 2012 and March 15, 2013. Sample event information was documented for all sampled storm events. A summary of the event data for each site, including precipitation, flow and sample information are included in the following sections. Sample event files presenting the storm hydrographs for each sampled event are included in Appendix C.

3.2.1 Sampled Events at Commercial (COM) Site

During the abbreviated WY13 wet season there were 13 forecasted qualifying storm events measured by the Fall City rain gage, which serves as the gage for the COM monitoring site. These forecasted qualifying events, plus 4 storms that were forecasted and targeted but did not meet the storm size criterion, are outlined in Table 4. Details of each successfully sampled event are presented in Table 5.

Sufficient volume of stormwater was collected to complete the full analysis of all of the grab samples and 9 of the 11 composite samples. Rainfall intensities for the 1/23/13 and 2/25/13 events were lighter than forecasted, resulting in low sample volumes. Because of the lower sample volumes, not all parameters could be analyzed. Therefore, parameters were analyzed in the order of priority listed in the project QAPP. Table 6 and Table 7 indicate the analyses completed and laboratory methods for the grab and composite samples.

Table 4. Details of targeted storms and forecasted qualifying storms at COM monitoring site.

Event Date	Description of sampling attempts
10/13/12	Forecast called for 0.29-inches and the event was targeted for composite samples. Actual rainfall totaled 0.16-inches followed by a 7 hour break so the sample was discarded.
10/18/12	A 0.81-inch event was preceded by an over 49 hour antecedent dry period. The event was successfully targeted for grab and composite samples. The composite sample included 14 aliquots and represented 98 percent of the first 24 hours of the storm runoff.
10/27/12	Forecast called for 0.6-inches and event was targeted for a composite sample. Actual rainfall totaled 0.13-inches. The composite sample consisted of only 3 aliquots so the sample was discarded.
11/11/12	The 0.3-inch event was targeted for a composite sample; however, the storm resulted in very little runoff at the site. Only 1 aliquot was collected therefore the sample was discarded.
11/23/12	A grab and composite sample were collected from the 1.43-inch event, which was preceded by a 35 hour antecedent dry period. The composite sample represented 83 percent of the first 24 hours of runoff, and consisted of 35 aliquots.
12/6/12	The targeted event was forecast to be a 0.9-inch storm. Actual rainfall totaled 0.13-inches, which was not intense enough for grab or composite sample collection.
12/9/12	The storm event totaled 0.37-inches and was preceded by an antecedent dry period of 43.75 hours. Both a grab and composite sample were collected. The composite sample included 35 aliquots and represented 99 percent of the first 24 hours of runoff.
12/11/12	A 0.28-inch event was followed by a 9 hour break in the rain and then another 0.28-inch storm. The event was targeted for a composite sample, with 23 aliquots collected during the first 0.28-inches and 2 aliquots collected during the second 0.28-inches. Since the final 2 aliquots represented runoff from a separate storm, the sample was discarded.
12/13/12	The 0.26-inch event was successfully targeted for a grab and composite sample. The composite sample consisted of 26 aliquots and represented 99 percent of the first 24 hours of the storm runoff.
12/15/12	Rainfall totaled 0.26-inches after an almost 32 hour antecedent dry period. Both a grab and composite sample were collected, with the composite sample composed of 20 aliquots and representing 98 percent of the first 24 hours of the storm runoff.

Table 4. Details of targeted storms and forecasted qualifying storms at COM monitoring site.

Event Date	Description of sampling attempts
1/23/13	A 0.20-inch event was preceded by an over 300 hour antecedent dry period. The event was successfully targeted for both a grab and composite sample, with the composite sample composed of 9 aliquots representing 99 percent of the first 24 hours of the storm runoff.
2/5/13	The event totaled 0.45-inches after a 32 hour antecedent dry period. A grab and composite sample were collected. The composite sample represented 98 percent of the runoff from the first 24 hours of the event, and was composed of 24 aliquots.
2/16/13	The targeted event was forecasted to total 0.4-inches. Actual rainfall was 0.84-inches. As a result, the flow pacing was off and the composite sample only represented 53 percent of the first 24 hours of storm runoff. The composite sample was discarded.
2/25/13	Event was forecast for 0.4-inches of rain and was targeted for a composite sample. Actual rainfall was 0.19-inches, which did not meet the storm size criterion. The composite sample was composed of 24 aliquots and represented 100 percent of the runoff from the first 24 hours of the storm. Therefore, the composite sample was submitted as 1 of 3 allowed from storms not meeting the storm size criterion.
3/2/13	The event was preceded by a 36 hour dry antecedent period and totaled 0.43-inches. The event was successfully targeted for grab and composite samples, with the composite sample representing 99 percent of the first 24 hours of the storm runoff and composed of 22 aliquots.
3/6/13	The event totaled 0.56-inches after an 85 hour antecedent dry period. Both a grab and composite sample were collected, with the composite sample composed of 35 aliquots representing 100 percent of the first 24 hours of the storm runoff.
3/13/13	The 0.31-inch event, preceded by a 30 hour antecedent dry period, was successfully targeted for grab and composite samples. The composite sample represented 99 percent of the first 24 hours of storm runoff and included 24 aliquots.

Notes:

Dates in bold represent storms that were successfully sampled for grab and/or composite samples.

Table 5. Characteristics of sampled storms at COM.

	Rainfall total (in)	Storm duration (hrs)	Interevent Dry Period <6 hrs?	Antecedent period w/ ≤ 0.02" rain (hrs)	Grab sample analyzed?	Composite sample analyzed?	Number of aliquots in composite	Average flow rate (cfs)	Runoff volume 1st 24 hours (cf)	Runoff volume sampled (cf)	Percent runoff sampled
Permit Criteria	**≥ 0.2**	**NA**	**Y**	**≥ 24[a]**	**Samples must be collected early in storm**	**NA**	**10[b]**	**NA**	**NA**	**NA**	**≥ 75**
10/18/12	0.81	13.5	Y	49.75	Y, j	Y	14	0.127	6,606	6,462	98
11/23/12	1.43	27.25	Y	35.25	Y	Y	36	0.255	13,302	11,079	83
12/9/12	0.37	15.75	Y	43.75	Y, j	Y	35	0.049	2,316	2,298	99
12/13/12	0.26	10.75	Y	32	Y, j	Y	21	0.031	1,341	1,332	99
12/15/12	0.26	4.5	Y	31.75	Y, j	Y	20	0.089	1,992	1,950	98
1/23/13	0.2	10.5	Y	312.5	Y, j	Y	9	0.012	360	357	99
2/5/13	0.45	26.5	Y	32.25	Y	Y	24	0.015	1,305	1,284	98
2/25/13	0.19, j	2.75	Y	26.75	N	Y	24	0.058	1,056	1,056	100
3/2/13	0.43	10.75	Y	36	Y, j	Y	22	0.064	2,367	2,334	99
3/6/13	0.56	19	Y	85.25	Y, j	Y	35	0.013	2,169	2,169	100
3/13/13	0.31	17.25	Y	30	Y	Y	24	0.068	1,998	1,980	99

Notes:
(a) applies to wet season (October 1 through April 30).
(b) 10 aliquots is the goal, but 7 to 9 aliquots are acceptable if other sampling criteria are met.
NA – not applicable.
j – did not meet Permit criterion.

Table 6. Parameters analyzed in composite stormwater samples at COM monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date										
			10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
COMPOSITE SAMPLE PARAMETERS													
Conventionals													
TSS	mg/L	SM2540D	x	x	x	x	x	x	x	-	x	x	x
Turbidity	NTU	SM2130B	x	x	x	x	x	x	x	x	x	x	x
Conductivity	µmhos/cm	SM2510B	x	x	x	x	x	x	x	x	x	x	x
Chloride	mg/L	SM4110B	x	x	x	x	x	x	x	-	x	x	x
BOD	mg/L	SM5210B	x	x	x	x	x	x	x	-	x	x	x
Hardness as $CaCO_3$	mg $CaC0_3$/L	EPA 200.8/ SM2340B. ED19	x	x	x	x	x	x	x	-	x	x	x
Methylene Blue Activated Substances	mg/L	SM5540C	x	x	x	x	x	-	x	-	x	x	x
Nutrients													
Nitrite + Nitrate Nitrogen	mg/L	SM4500-NO3-F	x	x	x	x	x	x	x	-	x	x	x
Total Kjeldahl Nitrogen	mg/L	EPA 351.2	x	x	x	x	x	x	x	-	x	x	x
Total Phosphorus	mg/L	SM4500-P-B,F	x	x	x	x	x	x	x	-	x	x	x
Orthophosphate Phosphorus	mg/L	SM4500-P-F	x	x	x	x	x	x	x	-	x	x	x
Metals													
Cadmium, Dissolved	µg/L	EPA 200.8	x	x	x	x	x	x	x	x	x	x	x
Cadmium, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Calcium, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Copper, Dissolved	µg/L		x	x	x	x	x	x	x	x	x	x	x
Copper, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Lead, Dissolved	µg/L		x	x	x	x	x	x	x	x	x	x	x
Lead, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Magnesium, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Mercury, Dissolved	µg/L	EPA 245.1	x	x	x	x	x	x	x	x	x	x	x
Mercury, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x
Zinc, Dissolved	µg/L	EPA 200.8	x	x	x	x	x	x	x	x	x	x	x
Zinc, Total	µg/L		x	x	x	x	x	x	x	x	x	x	x

Table 6. Parameters analyzed in composite stormwater samples at COM monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date										
			10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
Organics													
PAHs													
Acenaphthene	µg/L	SW846-8270D	x	x	x	x	x	-	x	x	x	x	x
Acenaphthylene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Anthracene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Benzo(a)anthracene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Benzo(a)pyrene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Benzo(b,j,k)fluoranthene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Benzo(g,h,i)perylene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Chrysene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Dibenzo(a,h)anthracene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Fluoranthene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Fluorene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Indeno(1,2,3-Cd)Pyrene	µg/L		x	x	x	x	x	-	x	x	x	x	x
2-Methylnaphthalene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Naphthalene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Phenanthrene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Pyrene	µg/L		x	x	x	x	x	-	x	x	x	x	x
Phthalates													
Benzyl Butyl Phthalate	µg/L	SW846-8270D	x	x	x	x	x	-	x	x	x	x	x
Bis(2-Ethylhexyl)Phthalate	µg/L		x	x	x	x	x	-	x	x	x	x	x
Diethyl Phthalate	µg/L		x	x	x	x	x	-	x	x	x	x	x
Dimethyl Phthalate	µg/L		x	x	x	x	x	-	x	x	x	x	x
Di-N-Butyl Phthalate	µg/L		x	x	x	x	x	-	x	x	x	x	x
Di-N-Octyl Phthalate	µg/L		x	x	x	x	x	-	x	x	x	x	x
Pesticides													
2,4-D	µg/L	SW846-8270D-SIM	x	x	x	x	x	x	x	x	x	x	x
Chlorpyrifos	µg/L		x	x	x	x	x	x	x	x	x	x	x
Diazinon	µg/L		x	x	x	x	x	x	x	x	x	x	x
Dichlobenil	µg/L		x	x	x	x	x	x	x	x	x	x	x

Table 6. Parameters analyzed in composite stormwater samples at COM monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date										
			10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
Pesticides (cont'd)													
Malathion	µg/L		x	x	x	x	x	x	x	x	x	x	x
MCPP	µg/L		x	x	x	x	x	x	x	x	x	x	x
Pentachlorophenol	µg/L		x	x	x	x	x	-	x	x	x	x	x
Prometon	µg/L		x	x	x	x	x	x	x	x	x	x	x
Triclopyr	µg/L		x	x	x	x	x	x	x	x	x	x	x

Notes:

"x" – Sample analyzed for parameter.

"-" – Sample not analyzed for parameter. Due to low sample volume not all parameters could be analyzed. Parameters were analyzed in the order of priority listed in the project QAPP.

Table 7. Parameters analyzed in grab stormwater samples at COM monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date									
			10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	3/2/13	3/6/13	3/13/13
GRAB SAMPLE PARAMETERS												
Bacteria												
Fecal Coliform	cfu/100mL	SM9222D	x	x	x	x	x	x	x	x	x	x
Organics												
TPH												
Diesel Range (>C12-C24)	mg/L	NWTPH-Dx	x	x	x	x	x	x	x	x	x	x
Lube Oil Range (>C24)	mg/L		x	x	x	x	x	x	x	x	x	x
Gasoline Range (C7-C12)	µg/L	NWTPH-Gx	x	x	x	x	x	x	x	x	x	x

Notes:

"x" – Sample analyzed for parameter.

3.2.2 Sampled Events at High Density Residential (HDR) Site

During the abbreviated WY13 wet season there were 13 forecasted qualifying storm events measured by the Fall City rain gage, which serves as the gage for the HDR monitoring site. These forecasted qualifying events, plus 4 storms that were forecasted and targeted but did not meet the storm size criterion, are outlined in Table 8. Details of each successfully sampled event are presented in Table 9.

There was sufficient volume to complete the full analysis for all of the grab samples and 2 of the 4 composite samples. The 10/18/12 composite sample was not analyzed for BOD. Rainfall intensity for the 12/11/12 event was lighter than forecasted, resulting in low sample volume. Because of the lower sample volume not all parameters could be analyzed. Therefore, parameters were analyzed in the order of priority listed in the project QAPP. Table 10 and Table 11 indicate the analyses completed and laboratory methods for the composite and grab samples for HDR.

Table 8. Details of targeted storms and forecasted qualifying storms at HDR monitoring site.

Event Date	Description of sampling attempts
10/13/12	Forecast called for 0.29-inches and the event was targeted for a composite sample. Actual rainfall totaled 0.16-inches followed by a 7 hour break so the sample was discarded.
10/18/12	A 0.81-inch event was preceded by an over 49 hour antecedent dry period. The event was successfully targeted for grabs and composite samples. The composite sample included 12 aliquots and represented 95 percent of the first 24 hours of storm runoff.
10/27/12	Forecast called for 0.6-inches and event was targeted for composite samples. Actual rainfall totaled 0.13-inches. There was no rise in water level and the auto-sampler never enabled.
11/11/12	The 0.3-inch event was targeted for a composite sample; however, the storm resulted in very little runoff at the site. There was no rise in water level and the auto-sampler never enabled.
11/23/12	A grab and composite sample were collected from the 1.43-inch event, which was preceded by a 35 hour antecedent dry period. The composite sample represented 75 percent of the first 24 hours of runoff and consisted of 35 aliquots.
12/06/12	The targeted event was forecast to be a 0.9-inch storm. Actual rainfall totaled 0.13-inches, which was not intense enough for grab or composite sample collection.
12/09/12	The storm event totaled 0.37-inches and was targeted for composite sample collection. The water level did not respond enough to enable the auto-sampler and only 70 cubic feet of flow was recorded at the site. No composite sample was collected.
12/11/12	A 0.28-inch event was followed by a 9-hour break in the rain and then another 0.28-inch storm. The event was targeted for both a grab and composite sample. The composite sample was successfully collected during the first 0.28-inch event, with 8 aliquots representing 92 percent of the storm runoff. The grab sample was collected during the second 0.28-inch storm. Both samples were submitted to the lab for analysis.
12/13/12	The 0.26-inch event was targeted for a composite sample. The water level did not respond enough to enable the auto-sampler and there was very little flow recorded at the site. No composite sample was collected.
12/15/12	Rainfall totaled 0.26-inches after an almost 32 hour antecedent dry period. The storm was targeted for a composite sample; however, the water level did not respond enough to enable the auto-sampler and there was very little flow recorded at the site. No composite sample was collected.

Table 8. Details of targeted storms and forecasted qualifying storms at HDR monitoring site.

Event Date	Description of sampling attempts
1/23/13	A 0.20-inch event was preceded by an over 300 hour antecedent dry period. The event was successfully targeted for both a grab and composite sample, with the composite sample composed of 9 aliquots representing 78 percent of the first 24 hours of storm runoff.
2/05/13	The event totaled 0.45-inches after a 32 hour antecedent dry period. A grab and composite sample were collected; however, the composite sample only represented 36 percent of the runoff from the first 24 hours of the event. The composite sample was discarded and the grab sample was submitted for analysis.
2/16/13	Event was targeted and was forecasted to total 0.4-inches. Actual rainfall was 0.84-inches. As a result, the flow pacing was off and the composite sample only represented 66 percent of the first 24 hours of storm runoff. The composite sample was discarded.
2/25/13	Event was forecast for 0.4-inches of rain and was targeted for a composite sample. Actual rainfall was 0.19-inches, which did not meet the storm size criterion. Only 1 aliquot was collected therefore the sample was discarded.
3/02/13	The event was preceded by a 36 hour dry antecedent period and totaled 0.43-inches. The event was targeted for a composite sample; however, only 2 aliquots were collected. The composite sample was discarded.
3/06/13	The event totaled 0.56-inches after an 85 hour antecedent dry period. The event was targeted for a composite sample; however, the water level did not respond enough to enable the auto-sampler and there was no flow recorded at the site. No composite sample was collected.
3/13/13	The 0.31-inch event was targeted for a grab and composite sample. While there was a response in water level, it was not enough to enable the auto-sampler, therefore a composite sample was not collected. A grab sample was collected and submitted to the lab for analysis.

Notes:

Dates in bold represent storms that were successfully sampled for grab and/or composite samples.

Table 9. Characteristics of sampled storms at HDR.

	Rainfall total (in)	Storm duration (hrs)	Interevent Dry Period <6 hrs?	Antecedent period w/ ≤ 0.02" rain (hrs)	Grab sample analyzed?	Composite sample analyzed?	Number of aliquots in composite	Average flow rate (cfs)	Runoff volume 1st 24 hours (cf)	Runoff volume sampled (cf)	Percent runoff sampled
Permit Criteria	**≥ 0.2**	**NA**	**Y**	**≥ 24[a]**	**Samples must be collected early in storm**	**NA**	**10[b]**	**NA**	**NA**	**NA**	**≥ 75**
10/18/12	0.81	13.5	Y	49.75	Y, j	Y	12	0.062	1,415	1,351	95
11/23/12	1.43	27.25	Y	35.23	Y	Y	35	0.144	5,095	3,800	75
12/11/12	0.28	7.5	Y	35.75	Y, j	Y	8	0.008	299	275	92
1/23/13	0.2	10.5	Y	312.5	Y, j	Y	9	0.01	199	155	79
2/5/13	0.45	26.5	Y	32.25	Y	N [c]	-	-	-	-	-
3/13/13	0.31	17.25	Y	30	Y	N [d]	-	-	-	-	-

Notes:
(a) applies to wet season (October 1 through April 30).
(b) 10 aliquots is the goal, but 7 to 9 aliquots are acceptable if other sampling criteria are met.
(c) composite sample targeted, but the level did not rise enough to enable the auto-sampler.
(d) composite sample collected, but did not represent 75 percent of the hydrograph so sample was not submitted for analysis.
NA – not applicable.
"-" – no data, composite sample not submitted.
j – did not meet Permit criterion.

Table 10. Parameters analyzed in composite stormwater samples at HDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date			
			10/18/12	11/23/12	12/11/12	1/23/13
COMPOSITE SAMPLE PARAMETERS						
Conventionals						
Total Suspended Solids	mg/L	SM2540D	x	x	x	x
Turbidity	NTU	SM2130B	x	x	x	x
Conductivity	µmhos/cm	SM2510B	x	x	x	x
Chloride	mg/L	SM4110B	x	x	x	x
Biochemical Oxygen Demand	mg/L	SM5210B	-	x	x	x
Hardness as $CaCO_3$	mg $CaC0_3$/L	EPA 200.8/ SM2340B.ED19	x	x	x	x
Methylene Blue Act. Substances	mg/L	SM5540C	x	x	x	x
Nutrients						
Nitrite + Nitrate Nitrogen	mg/L	SM4500-NO3-F	x	x	x	x
Total Kjeldahl Nitrogen	mg/L	EPA 351.2	x	x	x	x
Total Phosphorus	mg/L	SM4500-P-B,F	x	x	x	x
Orthophosphate Phosphorus	mg/L	SM4500-P-F	x	x	x	x
Metals						
Cadmium, Dissolved	µg/L	EPA 200.8	x	x	x	x
Cadmium, Total	µg/L		x	x	x	x
Calcium, Total	µg/L		x	x	x	x
Copper, Dissolved	µg/L		x	x	x	x
Copper, Total	µg/L		x	x	x	x
Lead, Dissolved	µg/L		x	x	x	x
Lead, Total	µg/L		x	x	x	x
Magnesium, Total	µg/L		x	x	x	x
Zinc, Dissolved	µg/L	EPA 200.8	x	x	x	x
Zinc, Total	µg/L		x	x	x	x
Organics						
PAHs						
Acenaphthene	µg/L	SW846-8270D	x	x	x	x
Acenaphthylene	µg/L		x	x	x	x
Anthracene	µg/L		x	x	x	x
Benzo(a)anthracene	µg/L		x	x	x	x
Benzo(a)pyrene	µg/L		x	x	x	x
Benzo(b,j,k)fluoranthene	µg/L		x	x	x	x
Benzo(g,h,i)perylene	µg/L		x	x	x	x
Chrysene	µg/L		x	x	x	x
Dibenzo(a,h)anthracene	µg/L		x	x	x	x
Fluoranthene	µg/L		x	x	x	x
Fluorene	µg/L		x	x	x	x
Indeno(1,2,3-Cd)Pyrene	µg/L		x	x	x	x
2-Methylnaphthalene	µg/L		x	x	x	x
Naphthalene	µg/L		x	x	x	x
Phenanthrene	µg/L		x	x	x	x
Pyrene	µg/L		x	x	x	x

Table 10. Parameters analyzed in composite stormwater samples at HDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date			
			10/18/12	11/23/12	12/11/12	1/23/13
Phthalates						
Benzyl Butyl Phthalate	µg/L	SW846-8270D	x	x	x	x
Bis(2-Ethylhexyl)Phthalate	µg/L		x	x	x	x
Diethyl Phthalate	µg/L		x	x	x	x
Dimethyl Phthalate	µg/L		x	x	x	x
Di-N-Butyl Phthalate	µg/L		x	x	x	x
Di-N-Octyl Phthalate	µg/L		x	x	x	x
Pesticides						
2,4-D	µg/L	SW846-8270D-SIM	x	x	x	x
Chlorpyrifos	µg/L		x	x	-	x
Diazinon	µg/L		x	x	-	x
Dichlobenil	µg/L		x	x	-	x
Malathion	µg/L		x	x	-	x
MCPP	µg/L		x	x	x	x
Pentachlorophenol	µg/L		x	x	x	x
Prometon	µg/L		x	x	-	x
Triclopyr	µg/L		x	x	x	x

Notes:

"x" – Sample analyzed for parameter.

"-" – Sample not analyzed for parameter. Due to low sample volume not all parameters could be analyzed. Parameters were analyzed in the order of priority listed in the project QAPP.

Table 11. Parameters analyzed in grab stormwater samples at HDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date					
			10/18/12	11/23/12	12/11/12	1/23/13	2/5/13	3/13/13
GRAB SAMPLE PARAMETERS								
Bacteria								
Fecal Coliform	cfu/100mL	SM9222D	x	x	x	x	x	x
Organics								
TPH								
Diesel Range (>C12-C24)	mg/L	NWTPH-Dx	x	x	x	x	x	x
Lube Oil Range (>C24)	mg/L		x	x	x	x	x	x
Gasoline Range (C7-C12)	µg/L	NWTPH-GX	x	x	x	x	x	x

Notes:

"x" – Sample analyzed for parameter.

3.2.3 Sampled Events at Low Density Residential (LDR) Site

During the abbreviated WY13 wet season there were 7 forecasted qualifying storm events measured by the King County Roads Renton Maintenance Facility rain gage, which serves as the gage for the LDR site. Table 12 provides an outline for these 7 forecasted qualifying events and 3 storms that were forecasted to be qualifying and were targeted but did not meet the storm size criterion. In addition, Table 12 outlines a base flow grab sample event and a base flow composite sample event. Details of each successfully sampled storm event are presented in Table 13.

There was sufficient volume to complete the full analysis of all of the grab samples and 2 of the 4 composite samples. Rainfall intensities for the 1/03/13 and 3/13/13 events were lighter than forecasted, resulting in low sample volumes. Because of the lower sample volume, not all parameters could be analyzed. Therefore, parameters were analyzed in the order of priority listed in the project QAPP. Table 14 and Table 15 indicate the analyses completed and laboratory methods for the composite and grab samples for LDR.

Table 12. Details of targeted storms and forecasted qualifying storms at LDR monitoring site.

Event Date	Description of sampling attempts
10/18/12	A 0.74-inch event was preceded by a 70 hour antecedent dry period. A composite sample was collected that consisted of 50 aliquots and represented 100 percent of the hydrograph from the first 24 hours of the event. There was no storm flow during the site visits so a grab sample was not collected.
11/10/12	The 0.53-inch event was targeted for a composite sample. Problems with the sampler tubing resulted in a false start. No sample was collected or submitted.
11/23/12	Rainfall totaled 1.14-inches after a 34 hour antecedent dry period. Rainfall totals were much larger than forecast, thus the auto-sampler was paced for a smaller storm. As a result the composite sample represented less than 75 percent of the hydrograph from the first 24 hours and the sample was discarded. A grab sample was successfully collected and submitted to the lab as a valid sample.
11/28/12	The event resulted in 0.07-inches after a 109 hour antecedent dry period. The event was targeted for a grab and composite sample; however, the composite sample was discarded since the event did not meet the storm size criterion. The grab sample was submitted to the laboratory for analysis. The grab sample was considered valid because it was (1) submitted prior to knowing if the storm would meet the rainfall criterion, and (2) collected early in the event and during active runoff.
12/11/12	The 0.15-inch event was targeted for a grab and composite sample. A grab sample were collected and submitted to the lab for analysis. The grab sample was considered valid because it was (1) submitted prior to knowing if the storm would meet the rainfall criterion, and (2) collected early in the event and during active runoff. A 6-hour gap in the storm resulted in rainfall totals that did not meet the criterion; therefore, composite sampling was discontinued.
1/3/13	The event produced 0.2-inches of rain after an antecedent dry period of 118 hours. The event was targeted for grab and composite samples, but the site visit occurred well after the peak of storm flow so a grab sample was not collected. Storm flow was very low due to the extended dry antecedent period and low rainfall intensities; therefore, only 8 aliquots were collected for the composite sample. The sample represented 100 percent of the hydrograph from the first 24 hours of the event and was submitted for partial analysis.
2/5/13	Rainfall totaled 0.21-inches with an antecedent dry period of 31 hours. The event was targeted for grab and composite samples; however, the sampler had a false start and triggered well before the start of storm flow. The grab sample was submitted for analysis while the composite sample was discarded.
3/2/13	The event was preceded by a 38 hour antecedent dry period. Renton Rain Gage 31UN recorded 0.13-inches for the storm; however, the on-site rain gage recorded 0.33-inches. A composite sample was collected that consisted of 50 aliquots and represented 96 percent of the hydrograph from the first 24 hours of the event.

Table 12. Details of targeted storms and forecasted qualifying storms at LDR monitoring site.

Event Date	Description of sampling attempts
3/6/13	The LDR site had base flow between mid-November and March. A base flow grab sample was collected prior to the start of a storm on March 6 and after an 81 hour dry antecedent period.
3/6/13	Rainfall totaled 0.78-inches and was preceded by an 85 hour dry antecedent period. The auto-sampler was paced for the forecasted storm size of 0.47-inches. Therefore the flow pacing was off and the composite sample did not represent at least 75 percent of the hydrograph from the first 24 hours of the event. A successful grab sample was collected and submitted to the lab as a valid sample.
3/8/13	The LDR site had base flow between mid-November and March. The base flow composite sample collected on March 8 was flow weighted and collected 44 aliquots over 23 hours. The event was preceded by a 25 hour dry antecedent period.
3/13/13	The event produced 0.1-inches of rain, much smaller than forecast, after a 41 hour antecedent dry period. The storm was successfully targeted for both a grab and composite sample, with the composite sample consisting of 13 aliquots representing 96 percent of the hydrograph from the first 24 hours of the event. The composite sample was submitted as one of three samples allowed from non-qualifying storm events.

Notes:

Dates in bold represent storms that were successfully sampled for stormwater and base flow grab and/or composite samples.

Table 13. Characteristics of sampled storms at LDR.

	Rainfall total (in)	Storm duration (hrs)	Interevent Dry Period <6 hrs?	Antecedent period w/ ≤ 0.02" rain (hrs)	Grab sample analyzed?	Composite sample analyzed?	Number of aliquots in composite	Average flow rate (cfs)	Runoff volume 1st 24 hours (cf)	Runoff volume sampled (cf)	Percent runoff sampled
Permit Criteria	**≥ 0.2**	**NA**	**Y**	**≥ 24[a]**	**Samples must be collected early in storm**	**NA**	**10[b]**	**NA**	**NA**	**NA**	**≥ 75**
10/18/12	0.74	14	Y	70	N	Y	50	0.008	670	670	100
11/23/12	1.14	23.5	Y	34	Y	N [c]	-	-	-	-	-
11/28/12	0.07, j	3.25	Y	35	Y	N [d]	-	-	-	-	-
12/11/12	0.15, j	8	Y	35	Y	N [d]	-	-	-	-	-
1/3/13	0.2	15	Y	118	N	Y	8	0.011	929	929	100
2/5/13	0.21	26	Y	31	Y	N [c]	-	-	-	-	-
3/2/13	0.33	10	Y	38	N	Y	50	0.039	3,381	3,261	96
3/6/13	0.78	23	Y	85	Y	N [c]	-	-	-	-	-
3/13/13	0.1, j	7	Y	41	Y	Y	13	0.017	1,427	1,287	96

Notes:
(a) applies to wet season (October 1 through April 30).
(b) 10 aliquots is the goal, but 7 to 9 aliquots are acceptable if other sampling criteria are met.
(c) composite sample collected, but it did not represent 75 percent of the hydrograph so it was not submitted for analysis.
(d) composite sample collected, but storm did not meet rainfall criterion so it was not submitted for analysis.
NA - not applicable.
"-" – no data, composite sample not submitted.
j - did not meet Permit criterion.

Table 14. Parameters analyzed in composite stormwater and base flow samples at LDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date				Base Flow
			10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
COMPOSITE SAMPLE PARAMETERS							
Conventionals							
Total Suspended Solids	mg/L	SM2540D	x	x	x	x	x
Turbidity	NTU	SM2130B	x	x	x	x	-
Conductivity	µmhos/cm	SM2510B	x	x	x	x	x
Chloride	mg/L	SM4110B	x	x	x	x	x
Biochemical Oxygen Demand	mg/L	SM5210B	x	-	x	-	x
Hardness as $CaCO_3$	mg $CaC0_3$/L	EPA 200.8/ SM2340B.ED19	x	x	x	x	x
Methylene Blue Act. Substances	mg/L	SM5540C	x	x	x	x	x
Nutrients							
Nitrite + Nitrate Nitrogen	mg/L	SM4500-NO3-F	x	x	x	x	x
Total Kjeldahl Nitrogen	mg/L	EPA 351.2	x	x	x	x	x
Total Phosphorus	mg/L	SM4500-P-B,F	x	x	x	x	x
Orthophosphate Phosphorus	mg/L	SM4500-P-F	x	x	x	x	x
Metals							
Cadmium, Dissolved	µg/L	EPA 200.8	x	x	x	x	x
Cadmium, Total	µg/L		x	x	x	x	x
Calcium, Total	µg/L		x	x	x	x	x
Copper, Dissolved	µg/L		x	x	x	x	x
Copper, Total	µg/L		x	x	x	x	x
Lead, Dissolved	µg/L		x	x	x	x	x
Lead, Total	µg/L		x	x	x	x	x
Magnesium, Total	µg/L		x	x	x	x	x
Zinc, Dissolved	µg/L	EPA 200.8	x	x	x	x	x
Zinc, Total	µg/L		x	x	x	x	x
Organics							
PAHs							
Acenaphthene	µg/L	SW846-8270D	x	-	x	x	x
Acenaphthylene	µg/L		x	-	x	x	x

Table 14. Parameters analyzed in composite stormwater and base flow samples at LDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date				Base Flow
			10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
PAHs (cont'd)							
Anthracene	µg/L		x	-	x	x	x
Benzo(a)anthracene	µg/L		x	-	x	x	x
Benzo(a)pyrene	µg/L		x	-	x	x	x
Benzo(b,j,k)fluoranthene	µg/L		x	-	x	x	x
Benzo(g,h,i)perylene	µg/L		x	-	x	x	x
Chrysene	µg/L		x	-	x	x	x
Dibenzo(a,h)anthracene	µg/L		x	-	x	x	x
Fluoranthene	µg/L		x	-	x	x	x
Fluorene	µg/L		x	-	x	x	x
Indeno(1,2,3-Cd)Pyrene	µg/L		x	-	x	x	x
2-Methylnaphthalene	µg/L		x	-	x	x	x
Naphthalene	µg/L		x	-	x	x	x
Phenanthrene	µg/L		x	-	x	x	x
Pyrene	µg/L		x	-	x	x	x
Phthalates							
Benzyl Butyl Phthalate	µg/L	SW846-8270D	x	-	x	x	x
Bis(2-Ethylhexyl)Phthalate	µg/L		x	-	x	x	x
Diethyl Phthalate	µg/L		x	-	x	x	x
Dimethyl Phthalate	µg/L		x	-	x	x	x
Di-N-Butyl Phthalate	µg/L		x	-	x	x	x
Di-N-Octyl Phthalate	µg/L		x	-	x	x	x
Pesticides							
2,4-D	µg/L	SW846-8270D-SIM	x	-	x	x	x
Chlorpyrifos	µg/L		x	-	x	x	x
Diazinon	µg/L		x	-	x	x	x
Dichlobenil	µg/L		x	-	x	x	x
Malathion	µg/L		x	-	x	x	x
MCPP	µg/L		x	-	x	x	x

Table 14. Parameters analyzed in composite stormwater and base flow samples at LDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date				Base Flow
			10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
Pesticides (cont'd)							
Pentachlorophenol	µg/L		x	-	x	x	x
Prometon	µg/L		x	-	x	x	x
Triclopyr	µg/L		x	-	x	x	x

Notes:

"x" – Sample analyzed for parameter.

"-" – Sample not analyzed for parameter. Due to low sample volume not all parameters could be analyzed. Parameters were analyzed in the order of priority listed in the project QAPP.

Table 15. Parameters analyzed in grab stormwater samples at LDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date						Base Flow
			11/23/12	11/28/12	12/11/12	2/5/13	3/6/13	3/13/13	3/6/13
GRAB SAMPLE PARAMETERS									
Bacteria									
Fecal Coliform	cfu/100mL	SM9222D	x	x	x	x	x	x	x
Organics									
TPH									
Diesel Range (>C12-C24)	mg/L	NWTPH-Dx	x	x	x	x	x	x	x
Lube Oil Range (>C24)	mg/L		x	x	x	x	x	x	x
Gasoline Range (C7-C12)	µg/L	NWTPH-GX	x	x	x	x	x	x	x

Notes:

"x" – Sample analyzed for parameter.

4.0. QA/QC REPORT

A data quality assurance quality control report for the stormwater composite samples and grab samples is included as Appendix D.

5.0. DISCUSSION OF RESULTS

The following sections discuss the analytical results for the stormwater composite and grab samples collected from all three monitoring sites and the base flow composite and grab samples collected at LDR during the abbreviated WY13 wet season. Analytical data for WY13, as well as all prior water years, was input in the Environmental Information Management database in June 2013.

5.1 Composite Sample Results

Concentration data for target analytes in the composite samples from COM, HDR and LDR monitoring sites are discussed in the following sections and presented in Tables 16, 17 and 18, respectively. Values reported as "<" indicate the target analyte was below the method detection limit (MDL) reported by the analytical laboratory. Values reported as "<RDL" indicate a target analyte was above the MDL, but below the reporting detection limit (RDL). Additional lab qualifiers listed in the tables are defined as follows[2]:

H – holding time exceeded
B – method blank is ≥ the MDL and sample result is ≥ MDL but ≤ 5 times the method blank
B2 – for acetone, 2-butanone, methylene chloride, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate and di-n-butyl phthalate: method blank is ≥ MDL and sample result is > 5 and ≤ 10 times the method blank
B3 – for all other parameters: method blank is ≥ MDL and sample result is > 5 and ≤ 10 times the method blank
SH – sample handling criterion not met
J – estimated value
JG – estimated value with a low bias
JL – estimated value with a high bias
X, <7.58 – the sample failed the depletion requirement. The result is left blank (X) with the estimated lowest concentration of <7.58 provided as the qualifier.
R – the sample was rejected and unusable for all purposes

A full explanation of the qualifiers can be found in the individual analytical laboratory reports included electronically (see enclosed CD) as Appendix E.

5.1.1 Commercial (COM) Site

At COM, conventional and nutrient parameters were detected in all composite samples (Table 16). However, one biochemical oxygen demand (BOD) result failed the depletion requirement so the result was left blank with the estimated lowest concentration used as MDL value. Metals (dissolved and total recoverable) were detected in all samples with the exception of dissolved cadmium, which was detected in 1 of the 11 samples and total and dissolved mercury, which were not detected in any sample.

[2] LIMS data qualifiers provided by King County Environmental Laboratory.

Measured concentrations for polycyclic aromatic hydrocarbons (PAHs) varied between the sampled events (Table 16). Detection frequencies for PAHs ranged from 0 percent (not detected) for 6 different compounds to 100 percent for fluoranthene and pyrene. Phthalates compounds were detected at the following frequencies:

- Dimethyl phthalate was detected in 2 of the 10 samples.
- Benzyl butyl phthalate, di-n-butyl phthalate and di-n-ocytl phthalate were detected in 9 of the 10 samples.
- Bis(2-ethylhexyl) phthalate and diethyl phthalate were detected in all samples.

For pesticides, pentachlorophenol was detected in 1 of the 11 samples. No other pesticides were detected at the COM site during WY13.

5.1.2 High Density Residential (HDR) Site

At HDR, conventional and nutrient parameters were detected in all 4 composite samples (Table 17) with the exception of methylene blue activated substances (MBAS), which were detected in 2 of the 4 samples. Metals (dissolved and total recoverable) were detected in all composite samples with the following exceptions:

- Dissolved cadmium was not detected in any sample.
- Total cadmium was detected in 2 of the 4 samples.
- Dissolved lead was detected in 3 of the 4 samples.

Measured concentrations for PAHs varied between the sampled events. Detection frequencies for PAHs ranged from 0 percent for 9 different compounds to 100 percent for fluoranthene and pyrene (Table 17). Phthalates compounds were detected at the following frequencies:

- Dimethyl phthalate was detected in 1 of the 4 samples.
- Benzyl butyl phthalate was detected in 2 of the 4 samples.
- Di-n-octyl phthalate was detected in 3 of the 4 samples.
- Bis(2-ethylhexyl) phthalate, diethyl phthalate and di-n-butyl phthalate were detected in all of the samples.

Pesticides were not detected in any of the samples at HDR.

5.1.3 Low Density Residential (LDR) Site

At LDR, conventional and nutrient parameters were detected in all stormwater composite samples (Table 18), with the exception of total suspended solids (TSS) and MBAS, which were detected in 3 of 4 samples and BOD, which was detected in 1 of 2 samples.

Metals were detected in all stormwater composite samples with the following exceptions:

- Dissolved cadmium was not detected in any sample.
- Total cadmium was detected in 1 of 4 samples.
- Dissolved lead was detected in 2 of 4 samples.

Measured concentrations for PAHs varied across the 4 sampled storm events. Detection frequencies for PAHs ranged from 0 percent (not detected) for 5 separate compounds to 100

percent for 7 separate PAH compounds (Table 18). Phthalates compounds were detected at the following frequencies:

- Di-n-ocytl phthalate was not detected in any sample.
- Benzyl butyl phthalate was detected in 1 of the 3 samples.
- Dimethyl phthalate and di-n-butyl phthalate were detected in 2 of the 3 samples.
- Bis(2-ethylhexyl) phthalate and diethyl phthalate were detected in all of the samples.

Pesticides were not detected in any of the samples at LDR.

For the single base flow composite sample collected at LDR all conventional, nutrient and metals parameters were detected except BOD, total and dissolved cadmium and dissolved lead. Five of the 16 PAH compounds and 3 of the 6 phthalate compounds were detected in the base flow sample. No pesticide compounds were detected in the base flow sample from LDR.

Table 16. Concentration data for target analytes in composite stormwater samples collected at COM monitoring site.

Parameters	Units	Storm Start Date										
		10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
COMPOSITE SAMPLE PARAMETERS												
Conventionals												
TSS	mg/L	50	73.6	9.8	53	124	428	298	-	59	72	208
Turbidity	NTU	51	54.2	78.6	71.2	137	500	316	58.7	107	99.4	278
Conductivity	µmhos/cm	26.4	15.2	37.8	34.6	54.6	2150	80.2	33.4	35.2	60.5	50.4
Chloride	mg/L	1.25	0.476	4.54	1.72	9.34	652	14	-	3.66	8.94	4.14
BOD	mg/L	6.88	2.67	8.25	3.96	5.61	45.5	7.18	-	8.87	X, <7.58	6.56
Hardness as $CaCO_3$	mg $CaC0_3$/L	10.7	9.89	16.5	14	26.7	419	43.2	-	18.8	22.4	34.6
Methylene Blue Activated Substances	mg/L	0.16	0.053	0.044	0.12	0.034	-	0.075	-	0.036	0.088	0.052
Nutrients												
Nitrite + Nitrate Nitrogen	mg/L	0.238	0.0646	0.144	0.149	0.179	0.455	0.269	-	0.144	0.16	0.187
Total Kjeldahl Nitrogen	mg/L	0.621, SH	0.491, SH	0.853, SH	0.569, SH	1.06, SH	6.74, SH	1.91, SH	-	0.923, SH	3.05	1.65, SH
Total Phosphorus	mg/L	0.14	0.121	0.17	0.0979	0.233	0.522	0.459	-	0.211	0.124	0.363
Orthophosphate Phosphorus	mg/L	0.0401, H	0.0196, H	0.00893, H	0.007, H	0.00766, H	0.00599, H	0.00647, H	-	0.0107, H	0.00979, H	0.00641, H
Metals												
Cadmium, Dissolved	µg/L	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05, H	0.968, H	<0.05, H	<0.05	<0.05, H	<0.05, H	<0.05, H
Cadmium, Total	µg/L	0.065, <RDL	0.062, <RDL	0.092, <RDL	0.067, <RDL	0.14, <RDL	1.4	0.307	0.066, <RDL	0.13, <RDL	0.1, <RDL	0.22, <RDL
Calcium, Total	µg/L	2740	2070	3990	3540	6360	146000	8410	3100	4250	5780	6730
Copper, Dissolved	µg/L	4.68, H	2.19, H	2.85, H	2.59, H	3.07, H	21, H	4.7, H	3.22, H	2.99, H	4.1, H	4.85, H
Copper, Total	µg/L	13.3	10	14.4	10.6	20.7	71.2	45.5	14.1	18.7	15.6	39.1
Lead, Dissolved	µg/L	0.33, <RDL,H	0.14, <RDL,H	0.14, <RDL,H	0.14, <RDL,H	0.11, <RDL,H	0.21, <RDL,H	0.26, <RDL,H	0.29, <RDL,H	0.15, <RDL,H	<0.1, H	0.14, <RDL,H
Lead, Total	µg/L	5.02	5.09	6.92	4.81	10.7	32.7	26.1	6.16	11.2	6.33	20.3
Magnesium, Total	µg/L	928	1150	1590	1250	2630	13000	5380	1130	1980	1930	4330
Mercury, Dissolved	µg/L	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05	<0.05, H	<0.05, H	<0.05, H
Mercury, Total	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc, Dissolved	µg/L	13.1, H	7.63, H	13, H	12.1, H	16.4, H	123, H	12.7, H	9.8, H	8.81, H	11.9, H	11, H
Zinc, Total	µg/L	50.6	37.9	62.6	46.8	93.2	396	180	46.7	73.5	59.2	165

Table 16. Concentration data for target analytes in composite stormwater samples collected at COM monitoring site.

Parameters	Units	Storm Start Date										
		10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
Organics												
PAHs												
Acenaphthene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094	-	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094
Acenaphthylene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094	-	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094
Anthracene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094	-	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094
Benzo(a)anthracene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094	-	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094
Benzo(a)pyrene	µg/L	<0.0094	0.018, <RDL	<0.0094	<0.0094	<0.0094	-	<0.047	<0.0094	<0.0094	0.0264	0.0417
Benzo(b,j,k)fluoranthene	µg/L	<0.094	<0.094	<0.094	<0.094	0.098, <RDL	-	<0.47	<0.094	<0.094	<0.094	0.11, <RDL
Benzo(g,h,i)perylene	µg/L	<0.047	<0.047	<0.047	<0.047	<0.047	-	<0.24	<0.047	0.057, <RDL	<0.047	0.056, <RDL
Chrysene	µg/L	<0.0094	0.0455	0.088	<0.0094	<0.0094	-	0.182	0.0507	0.0917	0.0561	0.112
Dibenzo(a,h)anthracene	µg/L	<0.047	<0.047	<0.047	<0.047	<0.047	-	<0.24	<0.047	<0.047	<0.047	<0.047
Fluoranthene	µg/L	0.0301	0.0395	0.0572	0.0312	0.0694	-	0.129	0.035	0.0626	0.0379	0.104
Fluorene	µg/L	<0.0094	<0.0094	0.0095, <RDL	<0.0094	<0.0094	-	<0.0094	<0.0094	<0.0094	<0.0094	<0.0094
Indeno(1,2,3-Cd)Pyrene	µg/L	<0.047	<0.047	<0.047	<0.047	<0.047	-	<0.24	<0.047	<0.047	<0.047	<0.047
2-Methylnaphthalene	µg/L	0.0315	0.016, <RDL	0.0299	<0.0094	<0.0094	-	0.105	<0.0094	0.0205	<0.0094	<0.0094
Naphthalene	µg/L	<0.0094	<0.0094	0.0655	<0.0094	<0.0094	-	0.0772	0.0263	0.0278	<0.0094	<0.0094
Phenanthrene	µg/L	0.0408	0.0372	0.0631	<0.0094	<0.0094	-	0.116	<0.0094	0.0566	0.0403	0.0504
Pyrene	µg/L	0.221	0.0704	0.144	0.0829	0.195	-	0.265	0.0806	0.139	0.11	0.215
Phthalates												
Benzyl Butyl Phthalate	µg/L	0.857, B2	0.074, <RDL	0.188	0.082, <RDL	0.0975	-	<0.047	0.069, <RDL	0.335	0.166	0.082, <RDL
Bis(2-Ethylhexyl)Phthalate	µg/L	2.98, B2	1.27, B	2.04	1.35, B2,JL	2.33, JL	-	2.86	1.75, B	2.35, B2	1.69	2.02, B2
Diethyl Phthalate	µg/L	0.402	0.141	0.136	0.1	0.188	-	0.218	0.144	0.158	0.204, B3	0.339
Dimethyl Phthalate	µg/L	0.0954	<0.024	<0.024	<0.024	<0.024	-	0.0797	<0.024	<0.024	<0.024	<0.024
Di-N-Butyl Phthalate	µg/L	0.233	0.0593	0.0626	0.046, <RDL	0.0478	-	<0.024	0.057	0.124	0.106	0.0617
Di-N-Octyl Phthalate	µg/L	0.527	0.172	0.337	0.28	0.602	-	<0.12	0.529	0.398	0.316	0.529
Pesticides												
2,4-D	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.49	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	<0.032	<0.032	<0.032	<0.034	<0.032	<0.032, JG	<0.032	<0.032	<0.032	<0.032	<0.032

Table 16. Concentration data for target analytes in composite stormwater samples collected at COM monitoring site.

Parameters	Units	Storm Start Date										
		10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
Pesticides (cont'd)												
Diazinon	µg/L	<0.041	<0.041	<0.041	<0.043	<0.041	<0.041, JG	<0.041	<0.041	<0.041	<0.041	<0.041
Dichlobenil	µg/L	<0.047	<0.047	<0.047	<0.05	<0.047	<0.047, JG	<0.047	<0.047	<0.047	<0.047	<0.047
Malathion	µg/L	<0.045	<0.045	<0.045	<0.048	<0.045	<0.045, JG	<0.045	<0.045	<0.045	<0.045	<0.045
MCPP	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.49	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	0.14, <RDL	<0.12	<0.12	<0.12	<0.12	-	<0.12	<0.12	<0.12	<0.12	<0.12
Prometon	µg/L	<0.047	<0.047	<0.047	<0.05	<0.047	<0.047, JG	<0.047, R	<0.047	<0.047	<0.047	<0.047
Triclopyr	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.49	<0.5	<0.5	<0.5

Notes:

"-" Parameter not analyzed.
Values reported with "X, <7.58" indicate the sample failed the depletion requirement. The result is left blank (X) with the estimated lowest concentration of <7.58 provided as the qualifier.
Values reported with "<" indicate the target analyte was below the MDL.
Values reported with "<RDL" indicate the target analyte was above the MDL but below the RDL.
Values reported with "SH" indicate sample handling criterion was not met.
Values reported with "H" indicate the holding time was exceeded for that analyte.
Values reported with "B", "B2," or "B3" indicate method blank contamination was observed.
Values reported with "JG" indicate estimated value with a low bias.
Values reported with "JL" indicate estimated value with a high bias.
Values reported with "R" indicate the sample was rejected and unusable for all purposes.

Table 17. Concentration data for target analytes in composite stormwater samples collected at HDR monitoring site.

Parameters	Units	Storm Start Date			
		10/18/12	11/23/12	12/11/12	1/23/13
COMPOSITE SAMPLE PARAMETERS					
Conventionals					
Total Suspended Solids	mg/L	8	17	2.6	22.5
Turbidity	NTU	6.54	8.54	29.9	15
Conductivity	µmhos/cm	20.7	8.42	20.4	75.6
Chloride	mg/L	0.534, SH	0.055, <RDL	0.155	11.5
Biochemical Oxygen Demand	mg/L	-	2.24	4.46, H	8.35
Hardness as $CaCO_3$	mg $CaC0_3$/L	5.23	2.88	6.93	20.4
Methylene Blue Activated Substances	mg/L	0.026	<0.025	<0.025	0.062
Nutrients					
Nitrite + Nitrate Nitrogen	mg/L	0.129	0.012, <RDL	0.031, <RDL,H	0.399
Total Kjeldahl Nitrogen	mg/L	0.59, SH	0.41, SH	1.08, SH	1.07, SH
Total Phosphorus	mg/L	0.107	0.0695	0.144	0.11
Orthophosphate Phosphorus	mg/L	0.0511, H	0.016, H	0.00877, H	0.0381, H
Metals					
Cadmium, Dissolved	µg/L	<0.05, H	<0.05, H	<0.05, H	<0.05, H
Cadmium, Total	µg/L	<0.05	<0.05	0.056, <RDL	0.065, <RDL
Calcium, Total	µg/L	1740	827	2020	6940
Copper, Dissolved	µg/L	4.26, H	0.77, <RDL,H	1.8, <RDL,H	3.7, H
Copper, Total	µg/L	5.27	2.42	7.71	6.91
Lead, Dissolved	µg/L	0.18, <RDL,H	<0.05, H	0.15, <RDL,H	0.29, <RDL,H
Lead, Total	µg/L	1.01	1.33	4.76	2.91
Magnesium, Total	µg/L	217	197	457	749
Zinc, Dissolved	µg/L	3.7, H	1.7, <RDL,H	2.73, H	10.9, H
Zinc, Total	µg/L	6.61	6.47	17.7	20.2
Organics					
PAHs					
Acenaphthene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094
Acenaphthylene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094
Anthracene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094
Benzo(a)anthracene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094
Benzo(a)pyrene	µg/L	<0.0094	0.015, <RDL	0.0568	0.0233
Benzo(b,j,k)fluoranthene	µg/L	<0.094	<0.094	0.12, <RDL	<0.094
Benzo(g,h,i)perylene	µg/L	<0.047	<0.047	<0.047	<0.047
Chrysene	µg/L	0.016, <RDL	0.016, <RDL	0.0875	0.0405
Dibenzo(a,h)anthracene	µg/L	<0.047	<0.047	<0.047	<0.047
Fluoranthene	µg/L	0.0249	0.025	0.0927	0.0593
Fluorene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094
Indeno(1,2,3-Cd)Pyrene	µg/L	<0.047	<0.047	<0.047	<0.047
2-Methylnaphthalene	µg/L	<0.0094	<0.0094	<0.0094	<0.0094, JG
Naphthalene	µg/L	<0.0094	0.0589	0.017, <RDL	<0.0094
Phenanthrene	µg/L	<0.0094	0.0195	0.0621	<0.0094
Pyrene	µg/L	0.195	0.0244	0.131	0.0501

Table 17. Concentration data for target analytes in composite stormwater samples collected at HDR monitoring site.

Parameters	Units	Storm Start Date			
		10/18/12	11/23/12	12/11/12	1/23/13
Phthalates					
Benzyl Butyl Phthalate	µg/L	0.226, B	<0.047	0.06, <RDL	<0.047
Bis(2-Ethylhexyl)Phthalate	µg/L	0.822, B	0.45, B	0.831, B	0.396, B
Diethyl Phthalate	µg/L	0.164	0.0667	0.167	0.155
Dimethyl Phthalate	µg/L	0.025, <RDL	<0.024	<0.024	<0.024
Di-N-Butyl Phthalate	µg/L	0.038, <RDL	0.0482	0.037, <RDL	0.073
Di-N-Octyl Phthalate	µg/L	0.341	0.038, <RDL	0.0631	<0.024
Pesticides					
2,4-D	µg/L	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	<0.032	<0.032	-	<0.032
Diazinon	µg/L	<0.041	<0.041	-	<0.041
Dichlobenil	µg/L	<0.047	<0.047	-	<0.047
Malathion	µg/L	<0.045	<0.045	-	<0.045
MCPP	µg/L	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	<0.12	<0.12	<0.12	<0.12
Prometon	µg/L	<0.047	<0.047	-	<0.047
Triclopyr	µg/L	<0.5	<0.5	<0.5	<0.5

Notes:

"-" Parameter not analyzed.
Values reported with "<" indicate the target analyte was below the MDL.
Values reported with "<RDL" indicate the target analyte was above the MDL but below RDL.
Values reported with "SH" indicate sample handling criterion was not met.
Values reported with "H" indicate the holding time was exceeded for that analyte.
Values reported with "B", "B2" or "B3" indicate method blank contamination was observed.
Values reported with "JG" indicate estimated value with a low bias.

Table 18. Concentration data for target analytes in composite stormwater and base flow samples collected at the LDR monitoring site.

Parameters	Units	Storm Start Date				Base Flow Event
		10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
COMPOSITE SAMPLE PARAMETERS						
Conventionals						
TSS	mg/L	23.6	6.25	16	<5	2.5
Turbidity	NTU	8.29	4.61	13.5	4	-
Conductivity	µmhos/cm	30.8	65.8	61.8	62.2	66.3
Chloride	mg/L	1.33	3.12	2.34	2.31	2.53
BOD	mg/L	4.34	-	<2	-	<2
Hardness as $CaCO_3$	mg $CaC0_3$/L	9.19	19.2	20.2	18.4	18
Methylene Blue Activated Substances	mg/L	0.036	0.13	0.025, RDL	<0.025	0.033
Nutrients						
Nitrite + Nitrate Nitrogen	mg/L	0.617	0.858	0.741	0.582	1.02
Total Kjeldahl Nitrogen	mg/L	0.721, SH	0.229, SH	0.37, SH	0.291, SH	0.304, SH
Total Phosphorus	mg/L	0.125	0.0311	0.0523	0.0293	0.0225
Orthophosphate Phosphorus	mg/L	0.0673, H	0.0133, H	0.0131, H	0.00858, H	0.00766, H
Metals						
Cadmium, Dissolved	µg/L	<0.05, H	<0.05, H	<0.05, H	<0.05, H	<0.05, H
Cadmium, Total	µg/L	<0.05	<0.05	0.061, <RDL	<0.05	<0.05
Calcium, Total	µg/L	2550	5270	5440	4910	4720
Copper, Dissolved	µg/L	2.99, H	1.7, <RDL,H	1.1, <RDL,H	1.3, <RDL,H	1.3, <RDL,H
Copper, Total	µg/L	4.38	2.01	2.93	1.6, <RDL	1.1, <RDL
Lead, Dissolved	µg/L	0.14, <RDL,H	0.31, <RDL,H	<0.1, H	<0.05, H	<0.1, H
Lead, Total	µg/L	1.61	0.694	2.05	0.38, <RDL	0.24, <RDL
Magnesium, Total	µg/L	683	1470	1600	1490	1500
Zinc, Dissolved	µg/L	5.19, H	16.2, H	14.2, H	7.86, H	7.14, H
Zinc, Total	µg/L	10.2	18.3	25.3	9.1	6.9
Organics						
PAHs						
Acenaphthene	µg/L	<0.0094	-	<0.0094	<0.0098	<0.0094
Acenaphthylene	µg/L	<0.0094	-	<0.0094	<0.0098	<0.0094
Anthracene	µg/L	<0.0094	-	0.0097, <RDL	<0.0098	<0.0094
Benzo(a)anthracene	µg/L	0.194	-	0.124	0.0374	<0.0094
Benzo(a)pyrene	µg/L	0.29	-	0.13	0.0479	0.017, <RDL
Benzo(b,j,k)fluoranthene	µg/L	0.18, <RDL	-	0.352	0.13, <RDL	<0.094
Benzo(g,h,i)perylene	µg/L	0.101	-	0.114	<0.049	<0.047
Chrysene	µg/L	0.165	-	0.231	0.0658	0.0226
Dibenzo(a,h)anthracene	µg/L	<0.047	-	<0.047	<0.049	<0.047
Fluoranthene	µg/L	0.283	-	0.344	0.099	0.0364
Fluorene	µg/L	<0.0094	-	<0.0094	<0.0098	<0.0094
Indeno(1,2,3-Cd)Pyrene	µg/L	0.082, <RDL	-	0.086, <RDL	<0.049	<0.047

Table 18. Concentration data for target analytes in composite stormwater and base flow samples collected at the LDR monitoring site.

Parameters	Units	Storm Start Date				Base Flow Event
		10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
PAHs (cont'd)						
2-Methylnaphthalene	µg/L	<0.0094	-	<0.0094	<0.0098	<0.0094
Naphthalene	µg/L	<0.0094	-	0.0202	<0.0098	0.015, <RDL
Phenanthrene	µg/L	0.0741	-	0.0767	0.018, <RDL	<0.0094
Pyrene	µg/L	0.355	-	0.367	0.103	0.038
Phthalates						
Benzyl Butyl Phthalate	µg/L	0.148, B	-	<0.047	<0.049	<0.047
Bis(2-Ethylhexyl)Phthalate	µg/L	1.91, B2	-	0.433, B	0.334, B	0.294, B
Diethyl Phthalate	µg/L	0.718	-	0.127	0.603	0.422
Dimethyl Phthalate	µg/L	0.078	-	<0.024	0.034, <RDL	<0.024
Di-N-Butyl Phthalate	µg/L	0.037, <RDL	-	<0.024	0.025, <RDL	0.033, <RDL
Di-N-Octyl Phthalate	µg/L	<0.024	-	<0.024	<0.025	<0.024
Pesticides						
2,4-D	µg/L	<0.5	-	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	<0.032	-	<0.033	<0.032	<0.032
Diazinon	µg/L	<0.041	-	<0.041	<0.041	<0.041
Dichlobenil	µg/L	<0.047	-	<0.048	<0.047	<0.047
Malathion	µg/L	<0.045	-	<0.046	<0.045	<0.045
MCPP	µg/L	<0.5	-	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	<0.12	-	<0.12	<0.12	<0.12
Prometon	µg/L	<0.047	-	<0.048	<0.047	<0.047
Triclopyr	µg/L	<0.5	-	<0.5	<0.5	<0.5

Notes:

"-" Parameter not analyzed.
Values reported with "<" indicate the target analyte was below the MDL.
Values reported with "<RDL" indicate the target analyte was above the MDL but below the RDL.
Values reported with "RDL" indicate the target analyte was at the RDL.
Values reported with "SH" indicate sample handling criterion was not met.
Values reported with "B", "B2" or "B3" indicate method blank contamination was observed.
Values reported with "H" indicate the holding time was exceeded for that analyte.

5.2 Stormwater Grab Sample Results

Concentration data for target analytes in stormwater grab samples for the COM, HDR and LDR sites are briefly discussed below and presented in Table 19, Table 20 and Table 21, respectively. Grab samples were analyzed for fecal coliform bacteria along with total petroleum hydrocarbons (TPH). The TPH analysis included diesel and lube oil range organics (using NWTPH-Dx) and gasoline range organics (using NWTPH-Gx).

Fecal coliform was detected in all stormwater grab samples from all three sites and the base flow grab sample collected at LDR. The three TPH compounds were not detected in any of the stormwater grab samples collected at the HDR and LDR monitoring sites or the base flow grab sample collected at LDR. For COM, diesel was detected in all 10 of the grab samples, lube oil was detected in 1 of the 10 samples and gasoline was not detected in any sample.

Table 19. Concentration data for target analytes in stormwater grab samples collected at the COM monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date									
			10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/13	2/5/13	3/2/13	3/6/13	3/13/13
GRAB SAMPLE PARAMETERS												
Bacteria												
Fecal Coliform	cfu/100mL	SM9222D	17000	630	2700	6900	2100	560	1200	65	150	1400
Organics												
TPH												
Gasoline Range (C7-C12)	µg/L	NWTPH-GX	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Diesel Range (>C12-C24)	mg/L	NWTPH-DX	0.449	0.349	0.39	0.44	0.841	0.385	0.46	0.194	0.486	1.07
Lube Oil Range (>C24)	mg/L		<0.19	<0.19	<0.19	<0.19	0.21, TA	<0.19	<0.19	<0.19	<0.19	<0.19

Notes:

Values reported with "<" indicate the target analyte was below the MDL.

Values reported with "TA" indicate text information is available in the laboratory report (see Appendix E).

Table 20. Concentration data for target analytes in stormwater grab samples collected at the HDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date					
			10/18/12	11/23/12	12/11/12	1/23/13	2/5/13	3/13/13
GRAB SAMPLE PARAMETERS								
Bacteria								
Fecal Coliform	cfu/100mL	SM9222D	1500	750	300	9	20	220
Organics								
TPH								
Gasoline Range (C7-C12)	µg/L	NWTPH-Gx	<100	<100	<100	<100	<100	<100
Diesel Range (>C12-C24)	mg/L	NWTPH-Dx	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
Lube Oil Range (>C24)	mg/L		<0.19	<0.19	<0.19	<0.19	<0.19	<0.19

Notes:

Values reported with "<" indicate the target analyte was below the MDL.

Table 21. Parameters analyzed in grab stormwater and base flow samples at LDR monitoring site.

Parameters	Units	Analytical Methods	Storm Start Date						Base Flow Event
			11/23/12	11/28/12	12/11/12	2/5/13	3/6/13	3/13/13	3/6/13
GRAB SAMPLE PARAMETERS									
Bacteria									
Fecal Coliform	cfu/100mL	SM9222D	600	30	16000	5	4	4	2
Organics									
TPH									
Gasoline Range (C7-C12)	µg/L	NWTPH-Gx	<100	<100	<100	<100	<100	<100	<100
Diesel Range (>C12-C24)	mg/L	NWTPH-Dx	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
Lube Oil Range (>C24)	mg/L		<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19

Notes:

Values reported with "<" indicate the target analyte was below the MDL.

5.3 Stormwater Management Program Activities within Monitoring Drainage Areas

King County's stormwater management program activities that occurred during WY13 within the monitoring sites' drainage basins are described below.

- Within the Fall City basins, inspected stormwater catch basins within the road right-of-way using a circuit basis methodology as allowed by the Phase I NPDES Municipal Stormwater Permit.
- Cleaned stormwater catch basins within the inspected circuits that were found to be in exceedance of sediment maintenance standards for catch basins. This was completed as defined by the methodology allowed by the Phase I NPDES Municipal Stormwater Permit.
- Within the Fall City basins, inspected the stormwater treatment and flow control facilities King County owns and operates, as required by the Phase I NPDES Municipal Stormwater Permit.
- Within the S8.D monitoring basins, performed maintenance on the stormwater treatment and flow control facilities King County owns and operates. Maintenance was performed on facilities found to be in exceedance of function critical maintenance standards for stormwater treatment and flow control facilities.
- Provided stormwater drainage related technical assistance to rural and agricultural properties near the Fall City Basin.
- Water quality staff conducted water quality audits of numerous businesses along Redmond Fall City Road in Fall City.
- Conducted stormwater conveyance system maintenance in both the Renton and Fall City basins. Maintenance included street sweeping along 148th Ave within the Renton basin.

6.0. POLLUTANT LOADING CALCULATIONS

Pollutant loads were calculated following procedures outlined in Ecology's Standard Operating Procedures (SOP) (Ecology, 2009). The loading results are based on the parameters analyzed for qualifying[3] composite stormwater samples collected from each of the three monitoring sites. The pollutant loading calculation procedures included in the project QAPP were different from the Ecology SOP because the Ecology SOP was created six months after King County's QAPP was approved. In November 2010, King County submitted a modified QAPP, which updated the pollutant loading calculations contained in the QAPP to those outlined in the Ecology SOP.

The first step in calculating the pollutant loading was to determine an event mean concentration value (EMC) for each parameter from composite samples that met all of the Permit criteria. This was done for each qualifying sampled storm from COM, HDR and LDR and from the base flow event for LDR. For all qualifying samples at COM and HDR, and for qualifying samples at LDR when there was no base flow, the value used for the EMC was the value reported by the analytical laboratory. Values reported by the analytical laboratory that were below the MDL were assigned an EMC equal to ½ of the MDL.

Because LDR had base flow for a portion of the water year, an additional step was needed to calculate the EMC for any qualifying sampled storm events with base flow. To calculate the EMC for the storm flow concentration (EMC_s), the base flow volume had to be "unmixed" from the reported EMC (EMC_{tot}) using the following equation:

$$EMC_s = [EMC_{tot} - (C_b \; x \; f_b)]/f_s$$

Where:

C_b = analyte concentration from base flow sample
f_b = fraction of base flow volume from storm event
f_s = fraction of storm flow volume from storm event

Individual storm pollutant loads were calculated for each analyte for all qualifying samples at each site. The base flow pollutant load was calculated using results from the base flow sample collected at LDR on March 8, 2013. The pollutant load was calculated as the product of the EMC and the runoff volume for that event.

$$Pollutant\ Load = EMC_i \; x \; V_i$$

Where:

EMC_i = EMC from event *i* in pounds per liter
V_i = runoff volume from event *i* in liters

Individual storm pollutant loads, reported as pounds, for the qualifying sampled storm events for the COM and HDR monitoring sites are presented in Table 22 and Table 23, respectively.

[3] Analytical results used in pollutant loading calculations were from samples that met all storm and sampling criteria outlined in the Permit §S8.D.2.a.i., §S8.D.2.a.ii, and §S8.D.2.b. Samples that did not meet one or more of the criteria were not included in the calculations.

Individual storm pollutant loads for the qualifying sampled storm events and single base flow event for the LDR site are presented in Table 24.

Storm (for all three monitoring sites) and base flow (for LDR) pollutant loads for the abbreviated WY13 wet season[4], reported in pounds, were calculated for each monitoring site and are presented in Table 25. Wet season pollutant loads calculated as pounds per acre are presented for each site in Table 26. Flow data needed for these calculations included:

- Average flow rates of the qualifying sampled events, which are provided in Table 5 for COM, Table 9 for HDR and Table 13 for LDR.
- The WY13 storm flow volume for COM and HDR for the abbreviated wet season.
- The WY13 storm and base flow volume for LDR for the abbreviated wet season.

The abbreviated wet season storm flow volumes for COM and HDR, and storm and base flow volumes for LDR were:

- COM = 1,548,534 gallons.
- HDR = 547,246 gallons.
- LDR – storm flow = 2,272,069 gallons, base flow = 424,800 gallons.

The continuous flow record from each site for the period of active monitoring was used to determine the flow volumes. The flow data was reviewed and corrected as needed by King County staff. For the pollutant loads in pounds per acre, the size of the drainage areas (in acres) reported in Table 1 were used.

[4] Because the monitoring year was abbreviated (as outlined in Section 3.1) the pollutant loads represent the period of active monitoring: October 1 through March 15. Since sampling during WY13 occurred only during the wet season, there was no pollutant load calculated for the dry season.

Table 22. Pollutant load (pounds) for qualifying sampled storm event at COM for WY13 wet season.

	Storm Event Pollutant Loads (pounds)										
Parameter	**10/18/12**	**11/23/12**	**12/9/12**	**12/13/12**	**12/15/12**	**1/23/12**	**2/5/13**	**2/25/13**	**3/2/13**	**3/6/13**	**3/13/13**
Conventionals											
TSS	2.02E+01	5.09E+01	1.42E+00	4.44E+00	1.54E+01	9.62E+00	2.43E+01	-	8.72E+00	9.75E+00	2.59E+01
Turbidity	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Conductivity	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Chloride	5.04E-04	3.29E-04	6.56E-04	1.44E-04	1.16E-03	1.47E-02	1.14E-03	-	5.41E-04	1.21E-03	5.16E-04
BOD	2.78E+00	1.85E+00	1.19E+00	3.32E-01	6.98E-01	1.02E+00	5.85E-01	-	1.31E+00	-	8.18E-01
Hardness as $CaCO_3$	4.32E+00	6.84E+00	2.39E+00	1.17E+00	3.32E+00	9.42E+00	3.52E+00	-	2.78E+00	3.03E+00	4.32E+00
Methylene Blue Activated Substances	6.45E-02	3.67E-02	6.36E-03	1.00E-02	4.23E-03	-	6.11E-03	-	5.32E-03	1.19E-02	6.49E-03
Nutrients											
Nitrite + Nitrate Nitrogen	9.60E-02	4.47E-02	2.08E-02	1.25E-02	2.23E-02	1.02E-02	2.19E-02	-	2.13E-02	2.17E-02	2.33E-02
Total Kjeldahl Nitrogen	2.51E-01	3.40E-01	1.23E-01	4.76E-02	1.32E-01	1.51E-01	1.56E-01	-	1.36E-01	4.13E-01	2.06E-01
Total Phosphorus	5.65E-02	8.37E-02	2.46E-02	8.20E-03	2.90E-02	1.17E-02	3.74E-02	-	3.12E-02	1.68E-02	4.53E-02
Orthophosphate Phosphorus	1.62E-02	1.36E-02	1.29E-03	5.86E-04	9.53E-04	1.35E-04	5.27E-04	-	1.58E-03	1.33E-03	8.00E-04
Metals											
Cadmium, Dissolved	1.01E-05	1.73E-05	3.61E-06	2.09E-06	3.11E-06	2.18E-05	2.04E-06	1.65E-06	3.69E-06	3.39E-06	3.12E-06
Cadmium, Total	2.62E-05	4.29E-05	1.33E-05	5.61E-06	1.74E-05	3.15E-05	2.50E-05	4.35E-06	1.92E-05	1.35E-05	2.74E-05
Calcium, Total	1.11E+00	1.43E+00	5.77E-01	2.96E-01	7.91E-01	3.28E+00	6.85E-01	2.04E-01	6.28E-01	7.83E-01	8.39E-01
Copper, Dissolved	1.89E-03	1.51E-03	4.12E-04	2.17E-04	3.82E-04	4.72E-04	3.83E-04	2.12E-04	4.42E-04	5.55E-04	6.05E-04
Copper, Total	5.37E-03	6.92E-03	2.08E-03	8.87E-04	2.57E-03	1.60E-03	3.71E-03	9.30E-04	2.76E-03	2.11E-03	4.88E-03
Lead, Dissolved	1.33E-04	9.68E-05	2.02E-05	1.17E-05	1.37E-05	4.72E-06	2.12E-05	1.91E-05	2.22E-05	6.77E-06	1.75E-05
Lead, Total	2.03E-03	3.52E-03	1.00E-03	4.03E-04	1.33E-03	7.35E-04	2.13E-03	4.06E-04	1.65E-03	8.57E-04	2.53E-03
Magnesium, Total	3.74E-01	7.95E-01	2.30E-01	1.05E-01	3.27E-01	2.92E-01	4.38E-01	7.45E-02	2.93E-01	2.61E-01	5.40E-01
Mercury, Dissolved	1.01E-05	1.73E-05	3.61E-06	2.09E-06	3.11E-06	5.62E-07	2.04E-06	1.65E-06	3.69E-06	3.39E-06	3.12E-06
Mercury, Total	1.01E-05	1.73E-05	3.61E-06	2.09E-06	3.11E-06	5.62E-07	2.04E-06	1.65E-06	3.69E-06	3.39E-06	3.12E-06
Zinc, Dissolved	5.28E-03	5.28E-03	1.88E-03	1.01E-03	2.04E-03	2.76E-03	1.03E-03	6.46E-04	1.30E-03	1.61E-03	1.37E-03
Zinc, Total	2.04E-02	2.62E-02	9.05E-03	3.92E-03	1.16E-02	8.90E-03	1.47E-02	3.08E-03	1.09E-02	8.02E-03	2.06E-02
Organics											
PAHs											
Acenaphthene	1.90E-06	3.25E-06	6.80E-07	3.93E-07	5.84E-07	-	3.83E-07	3.10E-07	6.95E-07	6.36E-07	5.86E-07
Acenaphthylene	1.90E-06	3.25E-06	6.80E-07	3.93E-07	5.84E-07	-	3.83E-07	3.10E-07	6.95E-07	6.36E-07	5.86E-07
Anthracene	1.90E-06	3.25E-06	6.80E-07	3.93E-07	5.84E-07	-	3.83E-07	3.10E-07	6.95E-07	6.36E-07	5.86E-07
Benzo(a)anthracene	1.90E-06	3.25E-06	6.80E-07	3.93E-07	5.84E-07	-	3.83E-07	3.10E-07	6.95E-07	6.36E-07	5.86E-07
Benzo(a)pyrene	1.90E-06	1.24E-05	6.80E-07	3.93E-07	5.84E-07	-	1.91E-06	3.10E-07	6.95E-07	3.57E-06	5.20E-06
Benzo(b,j,k)fluoranthene	1.90E-05	3.25E-05	6.80E-06	3.93E-06	1.22E-05	-	1.91E-05	3.10E-06	6.95E-06	6.36E-06	1.37E-05
Benzo(g,h,i)perylene	9.48E-06	1.63E-05	3.40E-06	1.97E-06	2.92E-06	-	9.78E-06	1.55E-06	8.42E-06	3.18E-06	6.98E-06
Chrysene	1.90E-06	3.15E-05	1.27E-05	3.93E-07	5.84E-07	-	1.48E-05	3.34E-06	1.36E-05	7.60E-06	1.40E-05
Dibenzo(a,h)anthracene	9.48E-06	1.63E-05	3.40E-06	1.97E-06	2.92E-06	-	9.78E-06	1.55E-06	3.47E-06	3.18E-06	2.93E-06
Fluoranthene	1.21E-05	2.73E-05	8.27E-06	2.61E-06	8.63E-06	-	1.05E-05	2.31E-06	9.25E-06	5.13E-06	1.30E-05
Fluorene	1.90E-06	3.25E-06	1.37E-06	3.93E-07	5.84E-07	-	3.83E-07	3.10E-07	6.95E-07	6.36E-07	5.86E-07

Table 22. Pollutant load (pounds) for qualifying sampled storm event at COM for WY13 wet season.

Parameter	Storm Event Pollutant Loads (pounds)										
	10/18/12	11/23/12	12/9/12	12/13/12	12/15/12	1/23/12	2/5/13	2/25/13	3/2/13	3/6/13	3/13/13
PAHs (cont'd)											
Indeno(1,2,3-Cd)Pyrene	9.48E-06	1.63E-05	3.40E-06	1.97E-06	2.92E-06	-	9.78E-06	1.55E-06	3.47E-06	3.18E-06	2.93E-06
2-Methylnaphthalene	1.27E-05	1.11E-05	4.32E-06	3.93E-07	5.84E-07	-	8.55E-06	3.10E-07	3.03E-06	6.36E-07	5.86E-07
Naphthalene	1.90E-06	3.25E-06	9.47E-06	3.93E-07	5.84E-07	-	6.29E-06	1.73E-06	4.11E-06	6.36E-07	5.86E-07
Phenanthrene	1.65E-05	2.57E-05	9.12E-06	3.93E-07	5.84E-07	-	9.45E-06	3.10E-07	8.36E-06	5.46E-06	6.29E-06
Pyrene	8.92E-05	4.87E-05	2.08E-05	6.94E-06	2.42E-05	-	2.16E-05	5.31E-06	2.05E-05	1.49E-05	2.68E-05
Phthalates											
Benzyl Butyl Phthalate	3.46E-04	5.12E-05	2.72E-05	6.86E-06	1.21E-05	-	1.91E-06	4.55E-06	4.95E-05	2.25E-05	1.02E-05
Bis(2-Ethylhexyl)Phthalate	1.20E-03	8.78E-04	2.95E-04	1.13E-04	2.90E-04	-	2.33E-04	1.15E-04	3.47E-04	2.29E-04	2.52E-04
Diethyl Phthalate	1.62E-04	9.75E-05	1.97E-05	8.37E-06	2.34E-05	-	1.78E-05	9.49E-06	2.33E-05	2.76E-05	4.23E-05
Dimethyl Phthalate	3.85E-05	8.30E-06	1.73E-06	1.00E-06	1.49E-06	-	6.49E-06	7.91E-07	1.77E-06	1.62E-06	1.50E-06
Di-N-Butyl Phthalate	9.40E-05	4.10E-05	9.05E-06	3.85E-06	5.94E-06	-	9.78E-07	3.76E-06	1.83E-05	1.44E-05	7.70E-06
Di-N-Octyl Phthalate	2.13E-04	1.19E-04	4.87E-05	2.34E-05	7.49E-05	-	4.89E-06	3.49E-05	5.88E-05	4.28E-05	6.60E-05
Pesticides											
2,4-D	1.01E-04	1.73E-04	3.61E-05	2.09E-05	3.11E-05	5.62E-06	2.04E-05	1.62E-05	3.69E-05	3.39E-05	3.12E-05
Chlorpyrifos	6.45E-06	1.11E-05	2.31E-06	1.42E-06	1.99E-06	3.60E-07	1.30E-06	1.05E-06	2.36E-06	2.17E-06	2.00E-06
Diazinon	8.27E-06	1.42E-05	2.96E-06	1.80E-06	2.55E-06	4.61E-07	1.67E-06	1.35E-06	3.03E-06	2.78E-06	2.56E-06
Dichlobenil	9.48E-06	1.63E-05	3.40E-06	2.09E-06	2.92E-06	5.28E-07	1.91E-06	1.55E-06	3.47E-06	3.18E-06	2.93E-06
Malathion	9.08E-06	1.56E-05	3.25E-06	2.01E-06	2.80E-06	5.06E-07	1.83E-06	1.48E-06	3.32E-06	3.05E-06	2.81E-06
MCPP	1.01E-04	1.73E-04	3.61E-05	2.09E-05	3.11E-05	5.62E-06	2.04E-05	1.62E-05	3.69E-05	3.39E-05	3.12E-05
Pentachlorophenol	5.65E-05	4.15E-05	8.67E-06	5.02E-06	7.46E-06	-	4.89E-06	3.96E-06	8.87E-06	8.12E-06	7.48E-06
Prometon	9.48E-06	1.63E-05	3.40E-06	2.09E-06	2.92E-06	5.28E-07	1.91E-06	1.55E-06	3.47E-06	3.18E-06	2.93E-06
Triclopyr	1.01E-04	1.73E-04	3.61E-05	2.09E-05	3.11E-05	5.62E-06	2.04E-05	1.62E-05	3.69E-05	3.39E-05	3.12E-05

Notes:

nc – Load not calculated. Turbidity and conductivity are not measured in terms of concentration and cannot be directly converted into loadings.

"-" – no data reported for target analyte.

Pollutant loading calculations based on Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1 (Ecology, 2009).

Table 23. Pollutant load (pounds) for qualifying sampled storm events at HDR for WY13 wet season.

Parameter	Storm Event Pollutant Loads (pounds)			
	10/18/12	11/23/12	12/11/12	1/23/13
Conventionals				
Total Suspended Solids	7.07E-01	5.41E+00	4.85E-02	2.80E-01
Turbidity	nc	nc	nc	nc
Conductivity	nc	nc	nc	nc
Chloride	4.72E-05	1.75E-05	2.89E-06	1.43E-04
Biochemical Oxygen Demand	-	7.12E-01	8.33E-02	1.04E-01
Hardness as $CaCO_3$	4.62E-01	9.16E-01	1.29E-01	2.53E-01
Methylene Blue Activated Substances	2.30E-03	3.98E-03	2.33E-04	7.70E-04
Nutrients				
Nitrite + Nitrate Nitrogen	1.14E-02	3.82E-03	5.79E-04	4.96E-03
Total Kjeldahl Nitrogen	5.21E-02	1.30E-01	2.02E-02	1.33E-02
Total Phosphorus	9.45E-03	2.21E-02	2.69E-03	1.37E-03
Orthophosphate Phosphorus	4.51E-03	5.09E-03	1.64E-04	4.73E-04
Metals				
Cadmium, Dissolved	2.21E-06	7.95E-06	4.67E-07	3.11E-07
Cadmium, Total	2.21E-06	7.95E-06	1.05E-06	8.08E-07
Calcium, Total	1.54E-01	2.63E-01	3.77E-02	8.62E-02
Copper, Dissolved	3.76E-04	2.45E-04	3.36E-05	4.60E-05
Copper, Total	4.66E-04	7.70E-04	1.44E-04	8.58E-05
Lead, Dissolved	1.59E-05	1.59E-05	2.80E-06	3.60E-06
Lead, Total	8.92E-05	4.23E-04	8.89E-05	3.62E-05
Magnesium, Total	1.92E-02	6.27E-02	8.53E-03	9.30E-03
Zinc, Dissolved	3.27E-04	5.41E-04	5.10E-05	1.35E-04
Zinc, Total	5.84E-04	2.06E-03	3.30E-04	2.51E-04
Organics				
PAHs				
Acenaphthene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Acenaphthylene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Anthracene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Benzo(a)anthracene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Benzo(a)pyrene	4.15E-07	4.77E-06	1.06E-06	2.89E-07
Benzo(b,j,k)fluoranthene	4.15E-06	1.49E-05	2.24E-06	5.84E-07
Benzo(g,h,i)perylene	2.08E-06	7.47E-06	4.39E-07	2.92E-07
Chrysene	1.41E-06	5.09E-06	1.63E-06	5.03E-07
Dibenzo(a,h)anthracene	2.08E-06	7.47E-06	4.39E-07	2.92E-07
Fluoranthene	2.20E-06	7.95E-06	1.73E-06	7.37E-07
Fluorene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Indeno(1,2,3-Cd)Pyrene	2.08E-06	7.47E-06	4.39E-07	2.92E-07
2-Methylnaphthalene	4.15E-07	1.49E-06	8.77E-08	5.84E-08
Naphthalene	4.15E-07	1.87E-05	3.17E-07	5.84E-08
Phenanthrene	4.15E-07	6.20E-06	1.16E-06	5.84E-08
Pyrene	1.72E-05	7.76E-06	2.45E-06	6.22E-07
Phthalates				
Benzyl Butyl Phthalate	2.00E-05	7.47E-06	1.12E-06	2.92E-07
Bis(2-Ethylhexyl)Phthalate	7.26E-05	1.43E-04	1.55E-05	4.92E-06
Diethyl Phthalate	1.45E-05	2.12E-05	3.12E-06	1.93E-06
Dimethyl Phthalate	2.21E-06	3.82E-06	2.24E-07	1.49E-07
Di-N-Butyl Phthalate	3.36E-06	1.53E-05	6.91E-07	9.07E-07
Di-N-Octyl Phthalate	3.01E-05	1.21E-05	1.18E-06	1.49E-07

Table 23. Pollutant load (pounds) for qualifying sampled storm events at HDR for WY13 wet season.

Parameter	Storm Event Pollutant Loads (pounds)			
	10/18/12	11/23/12	12/11/12	1/23/13
Pesticides				
2,4-D	2.21E-05	7.95E-05	4.67E-06	3.11E-06
Chlorpyrifos	1.41E-06	5.09E-06	-	1.99E-07
Diazinon	1.81E-06	6.52E-06	-	2.55E-07
Dichlobenil	2.08E-06	7.47E-06	-	2.92E-07
Malathion	1.99E-06	7.16E-06	-	2.80E-07
MCPP	2.21E-05	7.95E-05	4.67E-06	3.11E-06
Pentachlorophenol	5.30E-06	1.91E-05	-	7.45E-07
Prometon	2.08E-06	7.47E-06	0.00E+00	2.92E-07
Triclopyr	2.21E-05	7.95E-05	4.67E-06	3.11E-06

Notes:

nc – Load not calculated. Turbidity and conductivity are not measured in terms of concentration and cannot be directly converted into loadings.

"-"– no data reported for target analyte.

Pollutant loading calculations based on Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1 (Ecology, 2009).

Table 24. Pollutant load (pounds) for qualifying sampled storm and base flow events at LDR for WY13 wet season.

Parameter	Storm Event Pollutant Loads (pounds)				Base Flow Pollutant Load (pounds)
	10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
Conventionals					
Total Suspended Solids	9.88E-01	5.48E-01	7.01E+00	2.23E-01	3.94E-01
Turbidity	nc	nc	nc	nc	nc
Conductivity	nc	nc	nc	nc	nc
Chloride	5.57E-05	2.10E-04	4.43E-04	1.60E-04	3.99E-04
Biochemical Oxygen Demand	1.82E-01	-	2.11E-01	-	1.58E-01
Hardness as $CaCO_3$	3.85E-01	1.17E+00	4.86E+00	1.72E+00	2.84E+00
Methylene Blue Activated Substances	1.51E-03	1.23E-02	3.13E-03	-3.15E-03[1]	5.21E-03
Nutrients					
Nitrite + Nitrate Nitrogen	2.58E-02	4.18E-02	8.15E-02	-3.92E-02[1]	1.61E-01
Total Kjeldahl Nitrogen	3.02E-02	9.58E-03	9.58E-02	2.32E-02	4.80E-02
Total Phosphorus	5.23E-03	2.23E-03	1.90E-02	4.02E-03	3.55E-03
Orthophosphate Phosphorus	2.82E-03	1.05E-03	4.23E-03	9.56E-04	1.21E-03
Metals					
Cadmium, Dissolved	1.05E-06	1.45E-06	5.28E-06	2.23E-06	3.94E-06
Cadmium, Total	1.05E-06	1.45E-06	2.26E-05	2.23E-06	3.94E-06
Calcium, Total	1.07E-01	3.33E-01	1.34E+00	4.77E-01	7.45E-01
Copper, Dissolved	1.25E-04	1.18E-04	1.78E-04	1.16E-04	2.05E-04
Copper, Total	1.83E-04	1.62E-04	1.11E-03	2.47E-04	1.74E-04
Lead, Dissolved	5.86E-06	3.08E-05	1.06E-05	-2.97E-06[1]	7.89E-06
Lead, Total	6.74E-05	6.27E-05	9.19E-04	6.30E-05	3.79E-05
Magnesium, Total	2.86E-02	8.38E-02	3.65E-01	1.31E-01	2.37E-01
Zinc, Dissolved	2.17E-04	1.39E-03	4.89E-03	8.50E-04	1.13E-03
Zinc, Total	4.27E-04	1.62E-03	1.03E-02	1.27E-03	1.09E-03
Organics					
PAHs					
Acenaphthene	1.97E-07	-	9.92E-07	4.78E-07	7.42E-07
Acenaphthylene	1.97E-07	-	9.92E-07	4.78E-07	7.42E-07
Anthracene	1.97E-07	-	3.39E-06	4.78E-07	7.42E-07
Benzo(a)anthracene	8.12E-06	-	5.82E-05	1.01E-05	7.42E-07
Benzo(a)pyrene	1.21E-05	-	5.78E-05	1.07E-05	2.68E-06
Benzo(b,j,k)fluoranthene	7.53E-06	-	1.56E-04	2.88E-05	7.42E-06
Benzo(g,h,i)perylene	4.23E-06	-	4.84E-05	2.39E-06	3.71E-06
Chrysene	6.90E-06	-	1.05E-04	1.48E-05	3.57E-06
Dibenzo(a,h)anthracene	9.83E-07	-	4.96E-06	2.39E-06	3.71E-06
Fluoranthene	1.18E-05	-	1.55E-04	2.18E-05	5.74E-06
Fluorene	1.97E-07	-	9.92E-07	4.78E-07	7.42E-07
Indeno(1,2,3-Cd)Pyrene	3.43E-06	-	3.50E-05	2.39E-06	3.71E-06
2-Methylnaphthalene	1.97E-07	-	9.92E-07	4.78E-07	7.42E-07
Naphthalene	1.97E-07	-	5.66E-06	-1.66E-06[1]	2.37E-06
Phenanthrene	3.10E-06	-	3.55E-05	4.37E-06	7.42E-07
Pyrene	1.49E-05	-	1.66E-04	2.27E-05	6.00E-06
Phthalates					
Benzyl Butyl Phthalate	6.19E-06	-	4.96E-06	2.39E-06	3.71E-06
Bis(2-Ethylhexyl)Phthalate	7.99E-05	-	1.29E-04	3.81E-05	4.64E-05
Diethyl Phthalate	3.00E-05	-	-5.25E-05[1]	9.14E-05	6.66E-05
Dimethyl Phthalate	3.26E-06	-	2.53E-06	7.60E-06	1.89E-06
Di-N-Butyl Phthalate	1.55E-06	-	-3.11E-06[1]	5.64E-07	5.21E-06
Di-N-Octyl Phthalate	5.02E-07	-	2.53E-06	1.22E-06	1.89E-06

Table 24. Pollutant load (pounds) for qualifying sampled storm and base flow events at LDR for WY13 wet season.

Parameter	Storm Event Pollutant Loads (pounds)				Base Flow Pollutant Load (pounds)
	10/18/12	1/3/13	3/2/13	3/13/13	3/8/13
Pesticides					
2,4-D	1.05E-05	-	5.28E-05	2.23E-05	3.94E-05
Chlorpyrifos	6.70E-07	-	3.62E-06	1.43E-06	2.52E-06
Diazinon	8.58E-07	-	4.33E-06	1.83E-06	3.23E-06
Dichlobenil	9.83E-07	-	5.20E-06	2.09E-06	3.71E-06
Malathion	9.41E-07	-	4.99E-06	2.01E-06	3.55E-06
MCPP	1.05E-05	-	5.28E-05	2.23E-05	3.94E-05
Pentachlorophenol	2.51E-06	-	1.27E-05	5.35E-06	9.47E-06
Prometon	9.83E-07	-	5.20E-06	2.09E-06	3.71E-06
Triclopyr	1.05E-05	-	5.28E-05	2.23E-05	3.94E-05

Notes:

nc – Load not calculated. Turbidity and conductivity are not measured in terms of concentration and cannot be directly converted into loadings.

"-"– no data reported for target analyte.

[1] Negative pollutant load calculations resulted due to higher pollutant concentrations in the base flow sample than the storm event sample.

Pollutant loading calculations based on Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1 (Ecology, 2009).

Table 25. Pollutant loads (pounds) for COM, HDR and LDR for WY13 wet season.

Parameter	Pollutant Loads (pounds)[1]			
	COM	HDR	LDR	
			Storm	Base Flow
Conventionals				
Total Suspended Solids	1.19E+03	6.50E+01	5.19E+02	8.86E+00
Turbidity	nc	nc	nc	nc
Conductivity	nc	nc	nc	nc
Chloride	1.80E-01	3.21E-03	4.33E-02	8.97E-03
Biochemical Oxygen Demand	7.73E+01	1.25E+01	2.97E+01	3.55E+00
Hardness as $CaCO_3$	3.04E+02	2.04E+01	3.90E+02	6.38E+01
Methylene Blue Activated Substances	9.24E-01	8.42E-02	1.05E+00	1.17E-01
Nutrients				
Nitrite + Nitrate Nitrogen	1.93E+00	2.85E-01	9.12E+00	3.62E+00
Total Kjeldahl Nitrogen	1.21E+01	2.34E+00	8.27E+00	1.08E+00
Total Phosphorus	2.39E+00	3.85E-01	1.62E+00	7.98E-02
Orthophosphate Phosphorus	2.30E-01	1.21E-01	4.96E-01	2.72E-02
Metals				
Cadmium, Dissolved	5.25E-04	1.14E-04	4.74E-04	8.86E-05
Cadmium, Total	1.59E-03	1.27E-04	1.52E-03	8.86E-05
Calcium, Total	7.92E+01	6.37E+00	1.08E+02	1.67E+01
Copper, Dissolved	4.55E-02	8.69E-03	2.59E-02	4.61E-03
Copper, Total	2.27E-01	1.64E-02	8.85E-02	3.90E-03
Lead, Dissolved	2.23E-03	4.58E-04	2.91E-03	1.77E-04
Lead, Total	1.13E-01	6.55E-03	6.36E-02	8.51E-04
Magnesium, Total	2.58E+01	1.08E+00	2.90E+01	5.32E+00
Mercury, Dissolved	3.23E-04	NA	NA	NA
Mercury, Total	3.23E-04	NA	NA	NA
Zinc, Dissolved	1.65E-01	1.23E-02	3.95E-01	2.53E-02
Zinc, Total	9.48E-01	3.44E-02	7.49E-01	2.45E-02
Organics				
PAHs				
Acenaphthene	6.07E-05	2.15E-05	8.91E-05	1.67E-05
Acenaphthylene	6.07E-05	2.15E-05	8.91E-05	1.67E-05
Anthracene	6.07E-05	2.15E-05	2.68E-04	1.67E-05
Benzo(a)anthracene	6.07E-05	2.15E-05	4.97E-03	1.67E-05
Benzo(a)pyrene	1.78E-04	6.40E-05	5.24E-03	6.03E-05
Benzo(b,j,k)fluoranthene	8.19E-04	2.27E-04	1.22E-02	1.67E-04
Benzo(g,h,i)perylene	4.09E-04	1.07E-04	3.93E-03	8.33E-05
Chrysene	6.18E-04	8.97E-05	8.34E-03	8.01E-05
Dibenzo(a,h)anthracene	3.30E-04	1.07E-04	4.46E-04	8.33E-05
Fluoranthene	6.79E-04	1.32E-04	1.25E-02	1.29E-04
Fluorene	6.50E-05	2.15E-05	8.91E-05	1.67E-05
Indeno(1,2,3-Cd)Pyrene	3.30E-04	1.07E-04	2.87E-03	8.33E-05
2-Methylnaphthalene	2.43E-04	2.15E-05	8.91E-05	1.67E-05
Naphthalene	1.62E-04	1.83E-04	4.37E-04	5.32E-05
Phenanthrene	5.02E-04	7.43E-05	2.89E-03	1.67E-05
Pyrene	1.82E-03	3.50E-04	1.35E-02	1.35E-04
Phthalates				
Benzyl Butyl Phthalate	3.23E-03	3.69E-04	8.47E-04	8.33E-05
Bis(2-Ethylhexyl)Phthalate	2.55E-02	2.58E-03	1.58E-02	1.04E-03
Diethyl Phthalate	2.77E-03	4.62E-04	-1.59E-03[2]	1.50E-03
Dimethyl Phthalate	3.66E-04	7.12E-05	4.41E-04	4.25E-05
Di-N-Butyl Phthalate	1.22E-03	2.10E-04	-1.12E-04[2]	1.17E-04
Di-N-Octyl Phthalate	4.65E-03	5.55E-04	2.28E-04	4.25E-05

Table 25. Pollutant loads (pounds) for COM, HDR and LDR for WY13 wet season.

Parameter	Pollutant Loads (pounds)[1]			
	COM	HDR	LDR	
			Storm	Base Flow
Pesticides				
2,4-D	3.23E-03	1.14E-03	4.74E-03	8.86E-04
Chlorpyrifos	2.07E-04	7.31E-05	3.21E-04	5.67E-05
Diazinon	2.46E-04	9.36E-05	3.89E-04	7.27E-05
Dichlobenil	3.05E-04	1.07E-04	4.63E-04	8.33E-05
Malathion	2.92E-04	1.03E-04	4.45E-04	7.98E-05
MCPP	3.23E-03	1.14E-03	4.74E-03	8.86E-04
Pentachlorophenol	9.60E-04	2.74E-04	1.14E-03	2.13E-04
Prometon	3.05E-04	1.07E-04	4.63E-04	8.33E-05
Triclopyr	3.23E-03	1.14E-03	4.74E-03	8.86E-04

Notes:

[1] – Pollutant loads calculated using flow volumes from the abbreviated WY13 sampling period. Since sampling during WY13 occurred only during the wet season, there was no pollutant load calculated for the dry season.
nc – Load not calculated. Turbidity and conductivity are not measured in terms of concentration and cannot be directly converted into loadings.
NA – Samples from HDR and LDR were not analyzed for total and dissolved mercury.
[2] – Negative pollutant load calculations resulted due to higher pollutant concentrations in the base flow sample than the storm event sample.
Pollutant loading calculations based on Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1 (Ecology, 2009).

Table 26. Pollutant loads (pounds per acre) for COM, HDR and LDR for the WY13 wet season.

Parameter	Pollutant Loads for WY13[1] (pounds per acre)			
	COM	HDR	LDR	
			Storm	Base Flow
Conventionals				
Total Suspended Solids	2.39E+02	1.24E+01	1.21E+01	2.08E-01
Turbidity	nc	nc	nc	nc
Conductivity	nc	nc	nc	nc
Chloride	3.59E-02	6.11E-04	1.01E-03	2.10E-04
Biochemical Oxygen Demand	1.55E+01	2.37E+00	6.97E-01	8.30E-02
Hardness as $CaCO_3$	6.09E+01	3.88E+00	9.13E+00	1.49E+00
Methylene Blue Activated Substances	1.85E-01	1.60E-02	2.45E-02	2.74E-03
Nutrients				
Nitrite + Nitrate Nitrogen	3.85E-01	5.42E-02	2.14E-01	8.47E-02
Total Kjeldahl Nitrogen	2.42E+00	4.46E-01	1.94E-01	2.52E-02
Total Phosphorus	4.78E-01	7.34E-02	3.78E-02	1.87E-03
Orthophosphate Phosphorus	4.59E-02	2.30E-02	1.16E-02	6.36E-04
Metals				
Cadmium, Dissolved	1.05E-04	2.17E-05	1.11E-05	2.08E-06
Cadmium, Total	3.19E-04	2.43E-05	3.55E-05	2.08E-06
Calcium, Total	1.58E+01	1.21E+00	2.54E+00	3.92E-01
Copper, Dissolved	9.09E-03	1.66E-03	6.07E-04	1.08E-04
Copper, Total	4.54E-02	3.13E-03	2.07E-03	9.13E-05
Lead, Dissolved	4.46E-04	8.72E-05	6.83E-05	4.15E-06
Lead, Total	2.27E-02	1.25E-03	1.49E-03	1.99E-05
Magnesium, Total	5.16E+00	2.06E-01	6.79E-01	1.25E-01
Mercury, Dissolved	6.46E-05	NA	NA	NA
Mercury, Total	6.46E-05	NA	NA	NA
Zinc, Dissolved	3.29E-02	2.35E-03	9.26E-03	5.93E-04
Zinc, Total	1.90E-01	6.54E-03	1.75E-02	5.73E-04
Organics				
PAHs				
Acenaphthene	1.21E-05	4.09E-06	2.09E-06	3.90E-07
Acenaphthylene	1.21E-05	4.09E-06	2.09E-06	3.90E-07
Anthracene	1.21E-05	4.09E-06	6.27E-06	3.90E-07
Benzo(a)anthracene	1.21E-05	4.09E-06	1.16E-04	3.90E-07
Benzo(a)pyrene	3.57E-05	1.22E-05	1.23E-04	1.41E-06
Benzo(b,j,k)fluoranthene	1.64E-04	4.32E-05	2.86E-04	3.90E-06
Benzo(g,h,i)perylene	8.18E-05	2.04E-05	9.21E-05	1.95E-06
Chrysene	1.24E-04	1.71E-05	1.95E-04	1.88E-06
Dibenzo(a,h)anthracene	6.60E-05	2.04E-05	1.04E-05	1.95E-06
Fluoranthene	1.36E-04	2.52E-05	2.92E-04	3.02E-06
Fluorene	1.30E-05	4.09E-06	2.09E-06	3.90E-07
Indeno(1,2,3-Cd)Pyrene	6.60E-05	2.04E-05	6.72E-05	1.95E-06
2-Methylnaphthalene	4.86E-05	4.09E-06	2.09E-06	3.90E-07
Naphthalene	3.23E-05	3.48E-05	1.02E-05	1.25E-06
Phenanthrene	1.00E-04	1.41E-05	6.76E-05	3.90E-07
Pyrene	3.64E-04	6.66E-05	3.16E-04	3.15E-06
Phthalates				
Benzyl Butyl Phthalate	6.46E-04	7.03E-05	1.98E-05	1.95E-06
Bis(2-Ethylhexyl)Phthalate	5.10E-03	4.91E-04	3.69E-04	2.44E-05
Diethyl Phthalate	5.55E-04	8.80E-05	-3.73E-05[2]	3.50E-05
Dimethyl Phthalate	7.32E-05	1.36E-05	1.03E-05	9.96E-07
Di-N-Butyl Phthalate	2.44E-04	4.01E-05	-2.63E-06[2]	2.74E-06
Di-N-Octyl Phthalate	9.31E-04	1.06E-04	5.33E-06	9.96E-07

Table 26. Pollutant loads (pounds per acre) for COM, HDR and LDR for the WY13 wet season.

Parameter	Pollutant Loads for WY13[1] (pounds per acre)			
	COM	HDR	LDR	
			Storm	Base Flow
Pesticides				
2,4-D	6.46E-04	2.17E-04	1.11E-04	2.08E-05
Chlorpyrifos	4.15E-05	1.39E-05	7.52E-06	1.33E-06
Diazinon	4.92E-05	1.78E-05	9.10E-06	1.70E-06
Dichlobenil	6.09E-05	2.04E-05	1.09E-05	1.95E-06
Malathion	5.83E-05	1.96E-05	1.04E-05	1.87E-06
MCPP	6.46E-04	2.17E-04	1.11E-04	2.08E-05
Pentachlorophenol	1.92E-04	5.22E-05	2.66E-05	4.98E-06
Prometon	6.09E-05	2.04E-05	1.09E-05	1.95E-06
Triclopyr	6.46E-04	2.17E-04	1.11E-04	2.08E-05

Notes:

[1] – Pollutant loads calculated using flow volumes from the abbreviated WY13 sampling period. Since sampling during WY13 occurred only during the wet season, there was no pollutant load calculated for the dry season.

nc – Load not calculated. Turbidity and conductivity are not measured in terms of concentration and cannot be directly converted into loadings.

NA – Samples from HDR and LDR were not analyzed for total and dissolved mercury.

[2] – Negative pollutant load calculations resulted due to higher pollutant concentrations in the base flow sample than the storm event sample.

Pollutant loading calculations based on Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1 (Ecology, 2009).

7.0. OTHER STORMWATER MONITORING

Descriptions of stormwater monitoring not included with the annual stormwater monitoring report appear in Section 8.B of King County's annual Stormwater Management Program report.

8.0. REFERENCES

Ecology, 2007. Phase 1 Municipal Stormwater Permit. National Pollutant Discharge Elimination System and State Waste Discharge General Permit for discharges from Large and Medium Municipal Separate Storm Sewer Systems. Olympia WA. January 17, 2007

Ecology, 2009. Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, Version 1

Ecology, 2010. Stormwater Monitoring Report Guidance. Phase I Municipal Stormwater Permit Reporting Requirements for Special Condition S8. June 2010.

King County, 2010. Quality Assurance Project Plan for King County Stormwater Monitoring Under the Phase 1 Municipal Stormwater Permit WAR04-4501 (Issued February 2007). Updated November 2010.