

Water Year 2019
Stormwater Monitoring Report
In Compliance with Appendix 9
Of NPDES Phase I Permit
For Section S8.B.2 Monitoring

Clark County Public Works Department
Clean Water Division

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Introduction.....	5
Project Update.....	7
Location, Land Use, Drainage Area, and Hydrology Summary.....	7
Monitoring Efforts and Results.....	11
QA / QC	21
Annual and Seasonal Pollutant Load	26
Study Area Stormwater Management Activities	28

Table of Figures

Figure 1 Monitoring sites within southwestern Clark County.....	7
Figure 2 Commercial site drainage area	8
Figure 3 High density residential site drainage area	9
Figure 4 Commercial site rainfall and flow during water year 2019.....	14
Figure 5 High density residential site rainfall and flow during water year 2019	15
Figure 6 Commercial site rainfall versus runoff relationships through water year 2017	17
Figure 7 High density residential site rainfall versus runoff relationships through water year 2017.....	17

Tables

Table 1 Stormwater monitoring site characteristics.....	10
Table 2 Storm event composite and grab sample monitoring tally for WY2019	12
Table 3 Flow-weighted composite sample counts through WY2019	13
Table 4 Important Clark County S8.B stormwater parameters' water year medians versus NSQD medians and typically observed ranges for urban stormwater.....	19
Table 5 WY2019 Summary of stormwater bias analyses: impact on applicable analytes	23
Table 6 WY2019 Summary of stormwater precision analyses: impact on applicable analytes	24

Appendices

Appendix 1 S8B Sites Rainfall Versus Runoff Volumes	30
Appendix 2 S8B Water Year 2019 Individual Storm Reports.....	49
Appendix 3 S8B Water Year 2019 Sediment Analyses Results.....	75
Appendix 4 S8B Water Year 2019 Seasonal and Annual Loads.....	77
Appendix 5 Calendar Year 2019 Stormwater Facility Inspections and Maintenance Upstream from two S8B Monitoring Sites	81

Introduction

The purpose of this narrative report is to address water year 2019 and final reporting requirements for Clark County under special condition S8C1 stormwater discharge monitoring components of the 2019-2024 Phase I Municipal Stormwater Permit. More specifically this addresses the S8.C.1 final report for the stormwater discharge monitoring conducted pursuant to S8.B.2 of the Phase I Municipal Stormwater Permit 2013-18 that was extended to July 31, 2019; hereafter referred to as S8.B.2 or simply S8.B and its Appendix 9. Much of the background information for this report is from the latest version of the S8.B.2 project's Quality Assurance Project Plan for Stormwater Characterization Monitoring (July 2014). An associated separate report, S8.B Commercial and High Density Residential Sites Stormwater Quality Status and Trend Monitoring Report WY2010-2019, provides the latest detailed stormwater quality status and trend analyses.

This water year 2019 S8.B.2 Stormwater Monitoring Project updated report's sections summarize: location, land use, drainage area, and hydrology information; monitoring efforts and results; quality assurance / quality control; pollutant loading; and recent stormwater management activities. Additionally, S8.B water quality data and loading estimates are being submitted with this report in digital Excel spreadsheets and hardcopy form (in this reports appendices), along with hydrology data as part of a verified and validated data package. The water year 2019 finalized water quality and sediment sample results will be submitted to Ecology's Environmental Information Management (EIM) system prior to the upcoming June 15 deadline.

In summary, monitoring during water year 2019 has been very successful in augmenting ongoing monitoring results from the commercial and high density residential land use monitoring sites selected from those locations utilized under Clark County's earlier permit. Overall, the monitoring systems' greater reliability, extensive rainfall versus runoff information, and increasing staff experience have contributed to a high rate of successful sampling. Enough S8.B forecasted qualifying storms were sampled per monitoring station during water year 2019 to meet the reduced frequency conditions approved by the Washington State Department of Ecology in a December 11, 2018 memo.

The S8.B commercial and high density residential site's results for water year 2019 are similar to those for the previous monitored water years. Therefore, the confidence in the central tendency patterns is increasing. Additionally, the fact that there appear to be no major outliers in the medians suggest that these monitoring sites have typical stormwater runoff values. Overall, the median values of several important stormwater pollutants monitored at our S8 sites are often lower than national medians. Finally, trend analyses based on the commercial and high density residential site stormwater quality data for water years 2010-through 2019 did not show any statistically and practically significant degrading trends representing dramatic changes that would necessitate adjusting ongoing stormwater management activities.

Project Update

Location, Land Use, Drainage Area, and Hydrology Summary

Location, Overall Land Uses, and Physical Setting

The stormwater status and trends study area includes primarily urban and commercial land in southwestern unincorporated Clark County. The study area drainages' land uses could be described as suburban for the high density residential site and typical older highway commercial for the commercial site. Urbanization during the late 20th Century and early 21st Century converted much of the farmland near Vancouver, Washington into residential subdivisions and small commercial areas along existing highways.

The two stormwater status and trends monitoring sites are located among the study area's gently rolling hills, about 200 to 300 feet above sea level (Status and Trends sites in Figure 1). These two sites were also monitored as stormwater characterization sites under the earlier permit. The area's small streams drain north to Salmon Creek or west to Lake River. Late Ice Age Cataclysmic Flood deposits underlay the study area and provide a source for fine-grained sediment. The study area, like much of Clark County, is within the northern-most portion of the Willamette Valley Ecoregion.



Figure 1 Monitoring sites within southwestern Clark County

Land Use, Drainage Area, and Hydrology

Commercial site

The commercial (COM) site represents a segment of Highway 99 and a group of older highway-oriented businesses such as auto repair shops and apartment buildings (Figure 2). The basin is located east of I-5, and drains an area of about 25 acres. Located in the southwest corner of the drainage, the outfall drains directly to a piped section of Cougar Creek. Monitoring access, just upstream from the outfall, is provided via an existing manhole on the sidewalk along the east side of Highway 99 just south of NE 82nd Street.



Figure 2 Commercial site drainage area

High-density residential site

The high-density residential (HDR) site drains multiple neighborhoods, with a drainage area of approximately 240 acres, located near the boundary between Felida and Lakeshore Neighborhoods north of Vancouver (Figure 3). The area is characterized by 1980's – 1990's era single family residences having an average lot size less than $\frac{1}{4}$ acre and generally lacking stormwater facilities. This location represents high density residential areas of Clark County in general. It is monitored from a manhole located on the central western border of the drainage, near 11100 NW 36th Avenue, accessing a 36-inch metal pipe that drains into Vancouver Lake.



Figure 3 High density residential site drainage area

Monitoring site selection and drainage area characteristics

Locations for stormwater monitoring were selected by evaluation of the following GIS maps and pertinent information:

- Stormwater sewer system
- Streets and right-of-way features
- Parcels, land use, and zoning
- Aerial photography and LIDAR imagery
- Representative of target land uses
- Ability to locate a sample site
- Relative quality as a sample site
- Access in perpetuity on County land or right-of-way

Field visits and GIS analyses were conducted to evaluate the prospective monitoring sites regarding basic hydrology and feasibility of monitoring (i.e. access, potential for vandalism, safety issues, equipment installation requirements, drainage area size and character). The results of this field investigation and office analyses for the selected monitoring sites are presented in Table 1. The table’s land use and land cover percentages are based on GIS analyses in 2008 of the latest zoning maps and aerial photos. The status and trends monitoring sites represent continuation of two of the three previous stormwater characterization sites under the earlier permit (the low density residential monitoring site was discontinued).

Table 1 Stormwater monitoring site characteristics

CHARACTERISTIC	COMMERCIAL SITE	HIGH DENSITY RESIDENTIAL SITE
Monitoring Site Hydrology		
Name of monitoring site	GM 34921	MH 5171
Drainage area (acres)	26.77	238.65
Receiving waterbody	Cougar Creek	Vancouver Lake
Nearest county rain gage	On site	On site
Time of concentration	8 minutes	24 minutes
Land Use Distribution (percentages are estimated based on zoning information)*		
High-density residential	18%	99%
Low-density residential	0%	0%
Agricultural	0%	0%
Parks/Wildlife refuge	0%	1%
Commercial	82%	<1%
Land Cover Distribution (percentages are based on GIS analyses of aerial photos)*		
Buildings	22%	23%
Fields	14%	29%
Forest	10%	19%
Pavement	53%	29%

* Percentages may not sum to 100% due to rounding.

Changes in drainage area land uses, monitoring sites, sampling equipment, or staff

During water year 2019, no obvious changes that would substantially impact monitoring results occurred within the S8.B monitored areas. There were no significant changes in land cover resulting in land disturbing activities over 10 acres in size within each of the sampled drainage areas due to their relatively stable, built-out conditions. Each of the S8.B respective commercial and high density residential monitoring site locations remained the same as under the earlier permits. There also have been no significant changes in the project’s sampling equipment or implementation from those described in the project’s latest Ecology approved QAPP (July 2014 version), and remain functionally equivalent to those originally proposed to Ecology. County staff continues in their lead role for stormwater monitoring.

Monitoring Efforts and Results

Data Submittal

All applicable S8.B water quality data are being submitted with this report in digital and hardcopy form with applicable hydrology summary statistics as part of a verified and validated data package. Water quality data will be submitted to Ecology's EIM prior to June 30, 2020. As allowed in the earlier permit, several water quality parameters have been dropped from monitoring because all their results were below their respective Ecology target method reporting limits for at least two years. Unless specified otherwise for both the COM and HDR sites, the following analytes were discontinued from monitoring: dissolved and total mercury (both dropped at COM site only), dichlobenil (dropped at COM site only), chlorpyrifos, and TPH gasoline.

Storm Events Meeting Criteria and Project Sampling Status

Table 2 presents Clark County's WY2019 stormwater monitoring accomplishments for sampling compared to qualifying seasonal storm event criteria. Evaluations of forecasted events and actual qualifying storms are based on calendar day (24 hours from midnight to midnight) because this provides reasonable one-day field preparation time and consistent summary periods. However, captured or sampled storm counts use antecedent dry periods (ADP) measured in hours to more accurately reflect the time between actual rainfall events. Therefore, counts of qualifying storms captured may exceed those based on daily time steps (forecasts) since the hourly ADPs often crossed the midnight boundary.

Enough S8.B forecasted qualifying storms were sampled per monitoring station during water year 2019 to meet the reduced frequency criteria approved by the Washington State Department of Ecology in a December 11, 2018 memo. Both the high density residential and commercial monitoring locations during water year 2019 met this revised sampling frequency criteria for both flow-weighted composite and grab samples along with adequate quality control samples. Total qualifying sample counts for water year 2019 were eight and seven composite samples for the COM and HDR sites, respectively, and six grab samples for each site. The seasonal sampling distribution goals of 60-80% for the October through April wet season and 20-40% for the May through September dry season were met for both sites. The seasonal counts reflect the actual storm patterns for the 2019 water year. All composite samples met the minimum 0.2 inch precipitation depth) and seasonal antecedent dry period criteria for qualifying storm events. While, one COM site grab sampled storm was less (0.14 inches) it still met the qualifying forecasted storm criteria in the project QAPP.

Table 2 Storm event composite and grab sample monitoring tally for WY2019

SITE	SEASON AND WATER YEAR	Qualifying Composite Sample Storms Captured (seasonal % of WY total)~	Qualifying Grab Sample Storms Captured (seasonal % of WY total)~	Captured # of Nonqualifying Storms	Successfully Met Approximate Seasonal Distribution Goals for Samples (Wet: 60-80% & Dry20-40%)
Commercial	Wet	6 (75%)	4 (67%)	0	Yes
	Dry	2 (25%)	2 (33%)	0	Yes
	WY2019	8	6	0	Yes
High Density Residential	Wet	5 (71%)	4 (67%)	0	Yes
	Dry	2 (29%)	2 (33%)	0	Yes
	WY2019	7	6	0	Yes

~ Counts and percentages address Ecology’s December 11, 2018 memo approving reduced sampling frequency criteria to a minimum of one- half of the permit’s total of eleven qualifying storm events per water year while maintaining the same seasonal distribution..

The routine composite sample counts through water year 2019 by water year, season, and sampling site are shown in Table 3. As of the end of water year 2019, routine composite sample counts since monitoring started have reached 98 and 96 for the commercial and high density residential sites, respectively. By the end of water year 2019, approximately 9.5 years of composite sample monitoring have been completed for the commercial and high density residential monitoring locations.

Good faith efforts and professional practices continued to be implemented to maximize successful sampling throughout the water year. Finally, based on the project’s QAPP, adequate quality control samples of at least 5 % of all targeted water year sample types (composite or grab blanks and replicates) were also collected and analyzed.

Table 3 Flow-weighted composite sample counts through WY2019

SITE	WATER YEAR	WET SEASON	DRY SEASON	WATER YEAR TOTAL SAMPLES	SITE TOTAL SAMPLES
Commercial	2010	3	4	7	98
	2011	10	2	12	
	2012	9	0	9	
	2013	5	3	8	
	2014	10	1	11	
	2015	10	1	11	
	2016	10	1	11	
	2017	10	1	11	
	2018	10	0	10	
	2019	6	2	8	
High Density Residential	2010	3	1	4	96
	2011	9	4	13	
	2012	9	2	11	
	2013	5	2	7	
	2014	10	1	11	
	2015	10	1	11	
	2016	9	2	11	
	2017	10	1	11	
	2018	10	0	10	
	2019	5	2	7	

Rainfall Hyetographs and Flow Hydrographs

Water year 2019 hyetographs and hydrographs showing the overall rainfall and runoff flow patterns for the monitored sites are presented in Figure 4 and Figure 5. The sites' hyetographs depict accumulated five minute precipitation (inches) with blue lines and their hydrographs depict instantaneous flow rates (cfs) with blue lines.

The water year hyetographs and hydrographs depict how rainfall and runoff varies over time due to a range of environmental factors such as season and vegetation growth. As expected, the hyetographs and hydrographs generally show more precipitation and corresponding flow during the wet season months of October through April and less for the dry season months of May through September. Longer high flows generally correspond with periods of sustained rainfall and not necessarily with isolated intense rainfall. The apparent direct association of flow with rainfall drops during the dry season because of decreasing sustained rainfall as well as more absorption by soils and evapotranspiration by growing plants from May through September.

There are periods of no flow during smaller dry season rainfall events at both the commercial and high density residential sites. The commercial site's flashier drainage basin reflects its small size and higher percentage of impervious surfaces such as building and pavement land covers (75%) versus those for the high density residential site (52%).

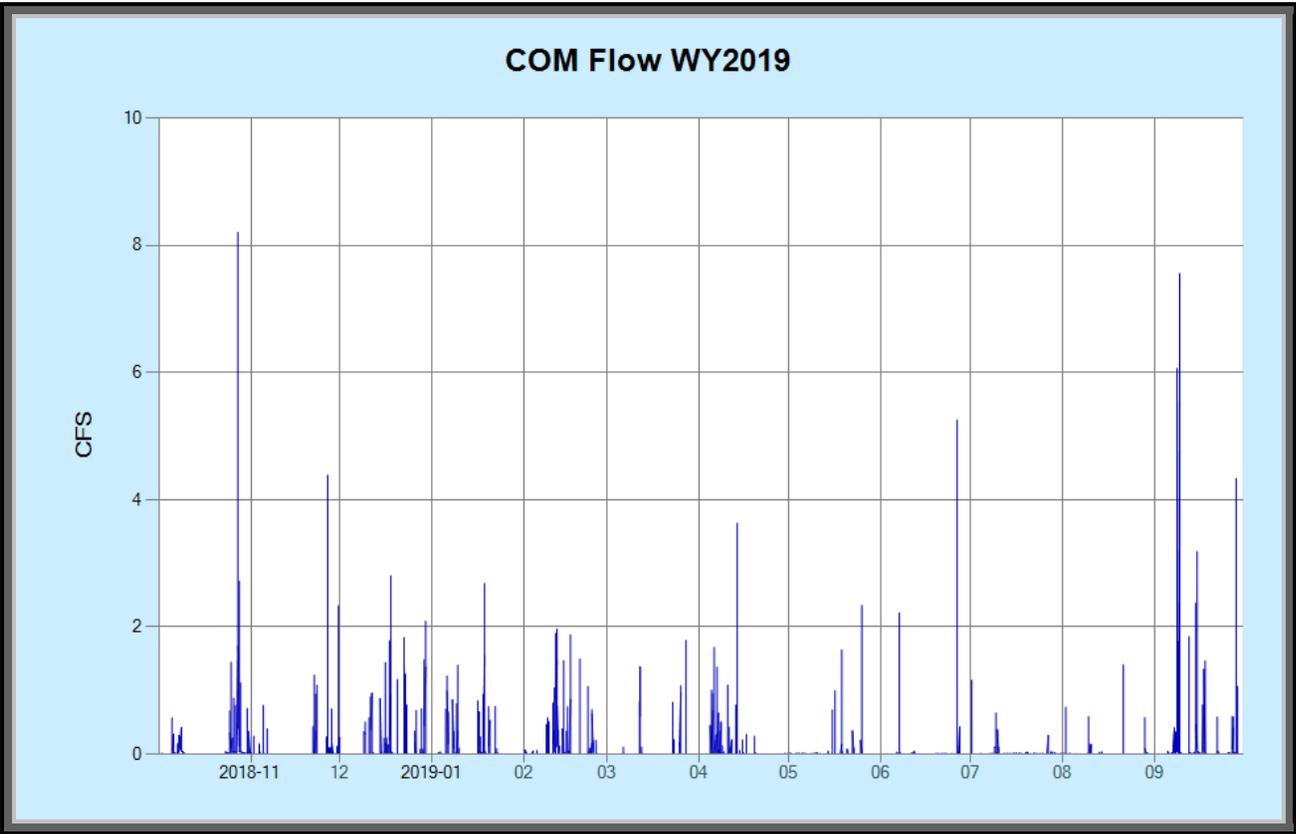
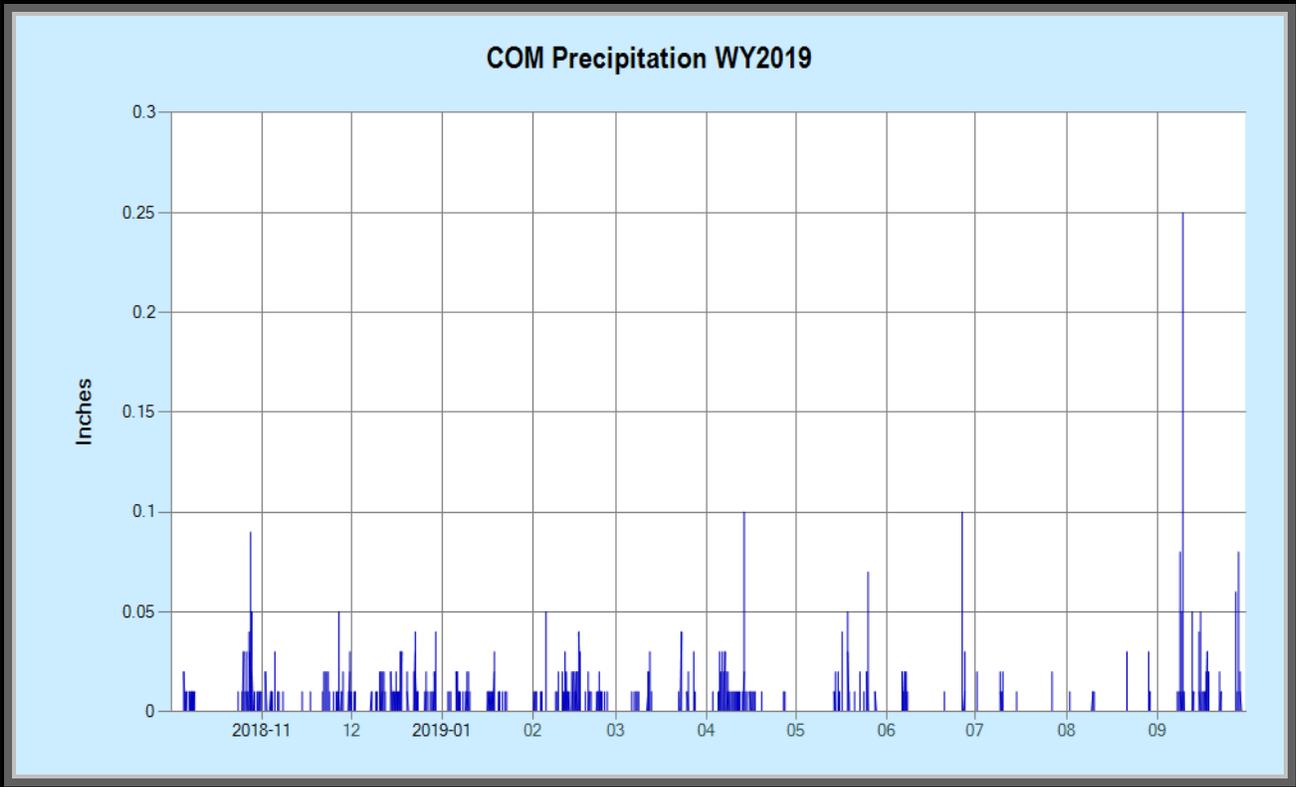


Figure 4 Commercial site rainfall and flow during water year 2019

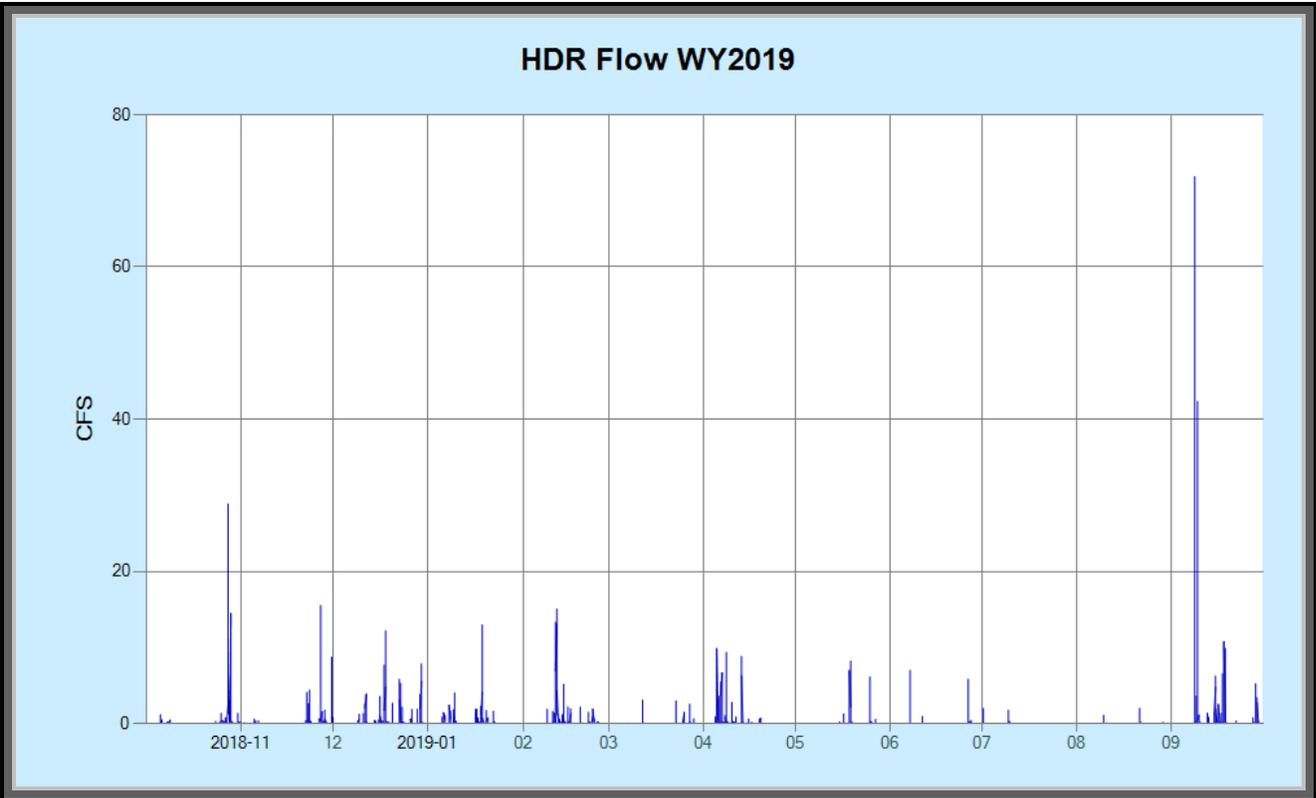
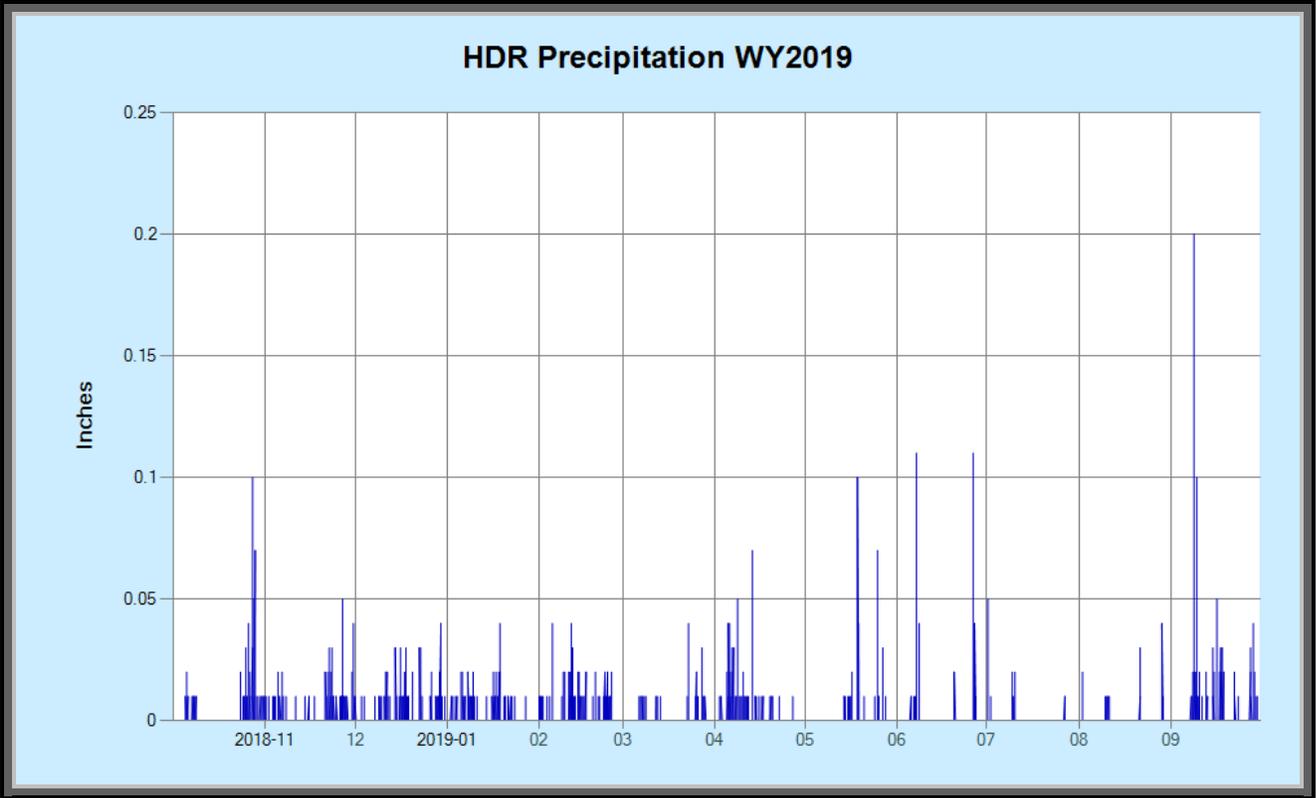


Figure 5 High density residential site rainfall and flow during water year 2019

Rainfall / Runoff Relationships

Rainfall / runoff relationships help provide the basis for successful stormwater monitoring efforts and general insights to hydrologic responses of watershed land uses. Based on the most reliable hydrology monitoring data (Appendix 1) for the two S8.B monitoring sites during water years 2010 through 2017, Figure 6 and Figure 7 show the compilation of linear relationships where events' total runoff volumes have been regressed on their total rainfall depths. These relationships are used to predict runoff volume for pacing flow-weighted composite samples. The relationships likely have not changed much over the past several years so they are not updated for this report.

A visual examination of the plots and comparison of their equations and squared correlation coefficients suggest strong positive linear relationships between the total event runoff and rainfall for both the commercial and high density residential sites' drainages. The high R^2 values for all the commercial and high density residential sites' linear relationships indicate that at least 87% of the total variability in the wet, dry, and combined seasonal events' flow volumes can be accounted for by their corresponding event precipitations.

Compared to the commercial site, the high density residential site's consistently greater magnitude of storm volume values and steeper regression line slopes reflect larger changes in storm flow volumes over equivalent intervals of storm total precipitation depths. These steeper regression slopes are likely driven by the high density residential site's much larger contributing drainage area.

The pattern and slopes of fitted regression lines within each monitoring site are similar with the dry seasons' regression line having slightly smaller slopes and being slightly lower than those for their corresponding wet seasons. These generally slight but consistent differences likely are due to seasonal differences in evapotranspiration and possibly more complete drying of impervious surfaces between storms during the dry season.

However, within each site, the overall relatively small seasonal differences can probably be attributed to their higher amount of impervious surfaces resulting in comparatively little infiltration into soils. The relatively small amount of pervious surfaces in both of these monitored drainages reduces potential confounding factors that would otherwise impact their rainfall / runoff relationships. Also, both drainages have substantial piped stormwater collection systems.

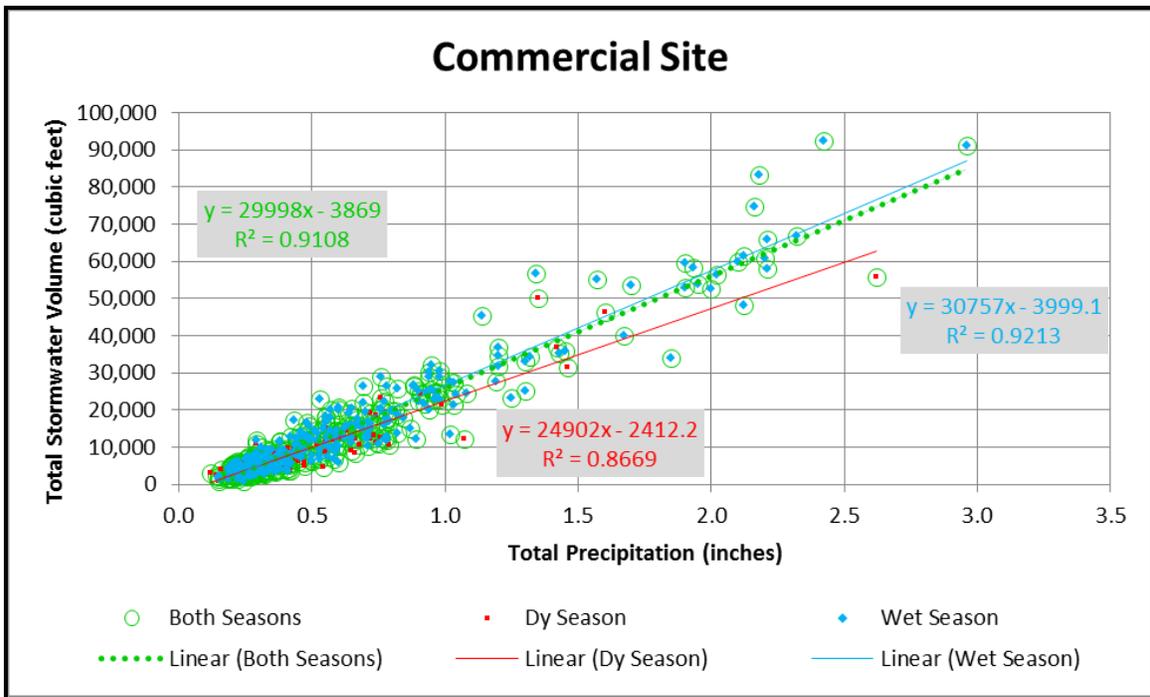


Figure 6 Commercial site rainfall versus runoff relationships through water year 2017

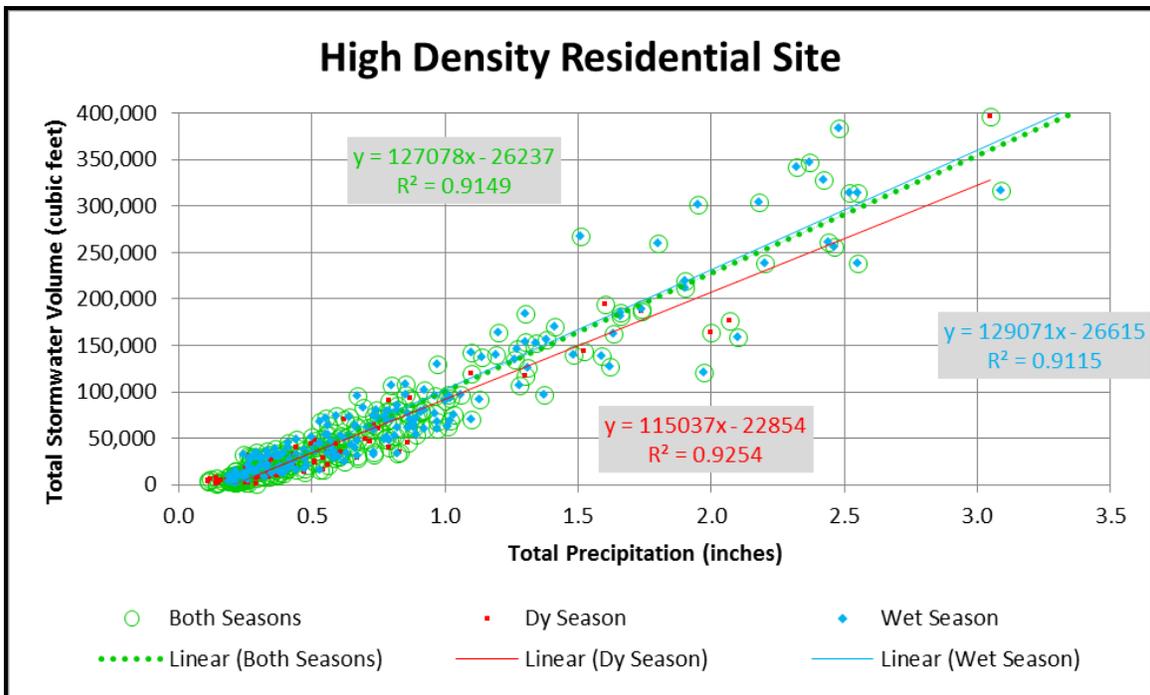


Figure 7 High density residential site rainfall versus runoff relationships through water year 2017

Individual Storm Reports and Important Parameters' Medians

Appendix 2 presents a series of Individual Storm Reports (ISR's) for water year 2019 sampled storms at each site (earlier water years ISR's are in previous annual reports) that address permit required information. Storm hyetographs and hydrographs at the top of each ISR depict aliquot collection times and the total storm event duration. Red text in the upper right of each ISR identifies its applicable monitoring site abbreviation, water year storm number, last aliquot sample date, and laboratory sample identifier.

Additionally, each ISR includes several tables of site, storm, sampling, and individual parameters' analytical result information. Site Information tables include abbreviated site name, location information, and monitoring site's drainage area. Precipitation and Flow Information tables include for each sampled storm: antecedent dry period (hours), precipitation total (inches), precipitation and stormwater flow start and end date/times, and storm flow volume (gallons). Sampling Information tables present, as applicable, for flow-weighted composite or grab samples: sampled flow start and end date/times, sample event volume (gallons), number of flow-weighted sub-sample aliquots collected versus goal for composite storm sample, percent of storm sampled versus goal, and whether grab samples were collected. The Analytical Information tables present for each monitored analyte from the flow-weighted composite or grab sampled storm: units of measurements, the event mean concentration (EMC) results based on the flow-weighted composite sample or just the grab sample results, applicable qualifiers (QA), respective method reporting limits (MRL), composite sample storm loads calculated from multiplying EMC values by the entire storm volume, and applicable qualifiers and notes (e.g., parameters dropped from monitoring due to at least two years of non-detects).

Table 4 shows water year 2019 and the monitoring period's water years 2010 - 2019 S8.B samples' calculated median values for selected important parameters monitored at the commercial (COM) and high density residential (HDR) sites. Also shown for comparison are updated National Stormwater Quality Database (NSQD) median values (Pitt, et. al., 2005) and typical stormwater ranges (Minton, 2002). The two county S8.B stormwater status and trends monitoring sites' medians are compared with their respective closest NSQD land use category medians. The NSQD median analyses excluded non-detect values. Clark County's analyses utilized one-half of non-detect values in the calculation of medians (applicable almost exclusively to most total mercury results). Therefore, the county's calculated medians values for mercury may be slightly biased low compared to their respective NSQD medians or observed typical stormwater ranges.

While differences were not tested for statistical significance, most of the county monitored S8.B parameters' water year medians are less (often substantially lower) than their respective medians in the NSQD and all are less than or within the typical general stormwater ranges found by others (Table 4). Exceptions to this pattern of lower county medians relative to the NSQD medians are shown as grey shaded cells within Table 4. Exceptions for the commercial (COM) site include its total copper's slightly higher water year 2019 median and equivalent water year 2010-2019 overall median as well as its higher total suspended solids medians for both water year 2019 and the overall monitoring period (both approximately twice as much as NSQD median). Exceptions for the high density residential (HDR) site include its very similar water year 2019 total copper median, higher water year 2019 and overall period total zinc medians (both about

twice as much), and its much higher water year 2019 fecal coliform median (about four times as much). The similar and higher commercial site medians could reflect large traffic volumes and the activities of the older highway businesses along Highway 99 that drain to the monitoring site without treatment. The higher median zinc values for the high density residential site could reflect galvanized roof and gutter runoff and moss herbicide use from the many homes in its drainage area. While the source of the high density residential site's much higher water year 2019 fecal coliform is unknown its value appears to be atypical compared to the overall monitoring period median.

Table 4 Important Clark County S8.B stormwater parameters' water year medians versus NSQD medians and typically observed ranges for urban stormwater

SITE	PARAMETER	UNITS	MDL / ECOLOGY MRL	CLARK COUNTY S8 MONITORING				NSQD MEDIANS*	OBSERVED TYPICAL STORM-WATER RANGES ~
				WY 2019 SAMPLE SIZE	WY 2019 MEDIANS	WY 2010 -2019 SAMPLE SIZE	WY 2010 - 2019 MEDIANS		
COM	Total Cadmium	ug/L	0.005 / 0.1	8	0.11	98	0.14	0.96	0.5 – 10
HDR				7	0.05	96	0.04	0.5	
COM	Total Copper	ug/L	0.02 / 0.1	8	19.5	98	17.0	17	5 – 150
HDR				7	14.5	96	7.8	12	
COM	Total Lead	ug/L	0.005 / 0.1	8	6.2	98	9.9	18	20 – 500
HDR				7	1.2	96	1.3	12	
HDR	Total Mercury	ug/L	0.02 / 0.1	7	0.01	64	0.01	0.2	0.2 – 0.5
COM	Total Zinc	ug/L	0.2 / 5	8	118	98	92	150	15 – 600
HDR				7	166	96	172	73	
COM	Fecal Coliform	MPN	NA / 2	6	795	85	350	4600	0.2 – 2,000,000
HDR				6	30000	80	1600	7000	
COM	Total Suspended Solids	mg/L	Depends on Sample / 1	8	92	98	88	43	1 – 36,200
HDR				7	36	96	24	49	
COM	Turbidity	NTU	0.04 / 0.2	8	43.2	98	35.5	NA	50 – 100
HDR				7	7.9	96	11.2	NA	

* National Stormwater Quality Database (Version 1.1, Updated 2005, Pitt, R., et al.)

~ G. Minton, "Stormwater Treatment, (pp. 11 and 28, 2002)

Medians for both county monitoring periods and S8B land use sites' for total cadmium, total lead, and turbidity as well as for the single HDR site's total mercury were all below their respective NSQD medians (Table 4). Similarly, these same medians were all below the lower end of their respective typical ranges observed by others. HDR's median total mercury value (with almost all county results being non-detects calculated as 0.01 ug/L by utilizing one-half of non-detects) was very low and below Ecology's permit target method reporting limit of 0.1.

Where there were substantial differences (i.e. greater than fifty percent higher or lower) in the important parameter medians between the most recent water year 2019 and the overall 2010-19 monitoring periods, almost all of these occurred because of higher water year 2019 medians. Both the commercial and especially the high density residential sites water year 2019 fecal coliform medians were much higher (greater than twice as much) than their overall medians. The high density residential site's higher water year 2019 median total copper and total suspended solids were still less than twice their respective overall medians. Only the commercial site's overall water year 2010-19 total lead median was substantially higher (about 1.5 times as much) than its water year 2019 median.

Sediment Monitoring

Annual sediment samples were collected from in-line sediment traps deployed from May 22, 2018 through May 21, 2019 for both the commercial and high density residential monitoring sites. This collection time coincides with the “month of May or June” deployment timeframe specified in the County’s applicable NPDES stormwater permit Appendix 9. Clark County’s annual spring sediment collection targeted timeframe was also previously approved by Ecology under the earlier permit. Additionally, the beginning of the dry season aligns closest with the end of the typical sediment accumulation period and the annual anniversary of when Clark County began S8 sampling in February 2010.

The two S8 sites’ sediment chemistry and grain size distribution (by percent of total weight recovered) results are presented in two tables in Appendix 3 of this report. Many of the sediment chemical results, especially for PCB compounds, are below lab method detection limits (annotated with “U”). All sediment parameters listed in the applicable permit’s Appendix 9 were analyzed for water year 2019. No chemical parameters were removed from the list of sediment analyses for water year 2019 due to two years of non-detect results.

The commercial and high density residential monitoring sites’ sediment grain size distributions (based on year-long sample bottle deployments) varied somewhat from each other but both were dominated by sand-sized particles. The HDR site has by far the highest proportion of gravel sized particles that approached 20% by weight of all particles (likely limited to very fine gravel) while the COM site’s gravel was approximately 8%. Between the two sites, the HDR site tends to have higher proportions of sand (76% for HDR versus 53% for COM) but lesser amounts for silt (5% for HDR versus 36% for COM) and especially for clay sized particles. Particle size distributions reflect the energy of a stormwater system’s net impact on conveyed suspended solids deposition and resuspension.

QA / QC

Field QA / QC procedures followed those described in the July 2014 version of the S8.B.2 Quality Assurance Project Plan. Field and laboratory procedures followed standard operating procedures.

Field QA / QC

Field and office activities followed documented standard operating procedures that were tailored to each monitoring site. Flow, precipitation, and sampling equipment were maintained according to manufacturers' recommendations.

During sampler set-up visits and sample retrieval, or as needed, a standardized check list of activities were followed and documented on field forms. Rain gages were checked for debris, levelness and proper functioning. Stage sensor readings were compared to actual water surface height and offsets adjusted as needed. Sampler lines were triple rinsed with lab grade water and known test volumes were used to calibrate sampler pump volumes. "Clean hands / dirty hands" procedures were followed as much as practically possible during sampler setup and sample retrieval. Composite sample volumes were compared to expected volumes based on the number of aliquots collected. Composite volumes, carboy counts, and other sample information or observations were documented on field forms. Regular maintenance was performed as needed, such as battery replacement.

Individual field forms were reviewed by the program manager for completeness and accuracy. Any observed issues were addressed as soon as possible. Additionally, the program manager or designee periodically participated in field work to review adherence to standard operating procedures. Procedural issues were addressed as needed.

Laboratory QA / QC

Sample transfer followed standard operating procedures and laboratory activities followed internal standard operating procedures consistent with applicable lab quality assurance programs. County staff filled out laboratory supplied chain of custody forms and placed clearly labeled sample bottles within ice-filled chests prior to transferring them to laboratory delivery personnel. All analyses were performed under contract at the nearby Washington State accredited ALS Environmental (acquired Columbia Analytical Services) laboratory in Kelso, Washington (to help meet hold times), except for a few of the analytes at other accredited subcontracted labs. For precision analyses, a composite sample with adequate volume was split in a laboratory clean room to minimize the possibility of field contamination.

The vast majority of lab analyses achieved QAPP specifications with any deviations flagged and noted in the laboratory supplied report's case narrative (as well as in the associated EDD) for each set of samples submitted. Almost all analyses were performed within prescribed hold times with rare exceptions documented and results addressed according to procedures in the QAPP. Each sample was analyzed according to Ecology approved methods and method reporting limits with any deviations documented in the laboratory report. Where applicable, internal laboratory quality control analyses results (e.g. method blanks, surrogate recoveries, laboratory duplicates, matrix spikes, laboratory control samples, etc.) are also provided in the laboratory report along with potential

issues described in the case narrative. Laboratory quality control samples met objectives the vast majority of times. As a result, there were relatively few changes needed for individual result's data qualifiers (such as indicating estimated values) and even fewer rejected results. No water year 2019 commercial or high density residential site sample results were rejected.

QC Sample Results

Quality control samples were collected during the monitoring effort to help evaluate procedures for potential sources of contamination and to examine precision. As described in the project QAPP, transport, transfer, and field equipment rinsate blanks and split / replicate samples were each collected then analyzed for the same parameters and using the same laboratory processes as used for routine samples. Additional steps were taken at the lab to ensure representative subsamples for the splits.

Bias was evaluated using blank samples whereas precision was evaluated using split or replicate sample results. These QC samples' laboratory results were examined for values that exceeded the project QAPP's respective measurement quality objectives (MQO) criteria for either bias or precision. If multiple types of blanks were collected during a water year, priority for evaluation was given to the blank with the highest result even though the equipment blanks theoretically would be the most inclusive and expected to be the most conservative of the three blank types. The permit's Appendix 9 Laboratory Methods targeted reporting limits were utilized when comparing blank analyte results to the MQO's. Nondetect results in any portion of a pair of split or replicate samples caused the exclusion of that analyte's pair of results from precision analyses due to their inherent higher variability. These QC sample analyses resulted in changing some of the analytes respective routine results' data qualifiers for the 2019 water year according to procedures described in the project's 2014 QAPP.

During water year 2019, a total of eight quality control stormwater samples were collected across the Clark County S8.B project's high density residential (HDR) and commercial (COM) sites with all from the HDR site. These eight quality control samples were a mix of three composite blanks, one composite split, three grab blanks, and one field grab replicate. The QC blank samples (consisting of transport, transfer, and field equipment [rinsate] blanks) were analyzed for bias. The two composite split samples and the two field replicate samples were analyzed for precision.

Overall, the eight composite and grab QC samples, representing 30% of all twenty-seven composite or grab routine samples, easily met the project QAPP's composite QC sample target minimum proportion of 5%. The QC samples help evaluate different potential sources of bias and precision impacts across the entire water year. This larger percentage of QC samples collected helps address each type of required QC sample given fewer overall samples collected now under the reduced sampling frequency and compared to the ten sites monitored under the earlier permit.

From the bias analyses of QC blank stormwater samples, some of the water year 2019 field equipment rinsate, transport, and transfer blanks had a few analyte results that exceeded their respective measurement quality objectives (MQO) criteria. In order to help address the potential observed bias found in these blanks, these analytes' respective water year 2019 applicable routine results have had "J" qualifiers added to their results

(Table 5). This was done to address specific criteria according to procedures in the 2014 project QAPP. Other subsequent corrective actions included review of procedures to minimize potential sources of contamination.

Table 5 WY2019 Summary of stormwater bias analyses: impact on applicable analytes

ANALYTE (UNITS)	PERMIT TARGETED METHOD REPORTING LIMIT (MRL)	QA / QC BLANK TYPE & RESULT	CRITERIA VALUE (5X BLANK) USED TO ADD “J” QUALIFIERS TO NON-QUALIFIED LESSER VALUES	NUMBER OF WATER YEAR RESULTS WITH “J” ESTIMATED QUALIFIER ADDED
Dissolved Copper (ug/L)	0.1	Equipment / 0.55	2.75	1 of 15 (7%)
Nitrate-Nitrite Nitrogen (mg/L)	0.01	Equipment 0.02	0.1	1 of 15 (7%)
Total Kjeldahl Nitrogen (mg/L)	0.5	Equipment 1.02	5.1	10 of 15 (67%)

Based on the analyses of split and field grab replicate stormwater samples (one of each), of the up to forty-two composite and eight grab sample analytes examined only two exceeded their MQO’s for precision during water year 2019 (Table 6). This interpretation is based only on relative percent differences while relative standard deviation is included for additional information. The basis of precision analysis for bis(2-ethylhexyl)phthalate is a single split of a composite sample and for fecal coliform is a single grab sample. These two analytes only had that portion of their water year 2019 results after the date of their split or replicate sample evaluated for possible “J” estimate qualifiers (typically would exclude periods when other replicate pairs met MQO). Fecal coliform has a more lenient precision MQO of 50% due to the inherent higher variability in its laboratory analysis method. Many of the organic analytes’ routine results were non-detects or had relatively low results already qualified with “J’s” indicating that they were estimates between the method detection limit and method reporting limit so their original qualifiers would not be changed.

Table 6 WY2019 Summary of stormwater precision analyses: impact on applicable analytes

Applicable Analyte (Units)	Permits Targeted Reporting Limit	Pooled Standard Deviation	Relative Standard Deviation Using Pooled SD (%)	Highest Duplic. Pair Relative Percent Difference [RPD] vs MQO RPD of 25% (number of pairs exceeding MQO)~	# Of (relative %) Previously Un-qualified Water Year Routine Results Qualified with “J” due to Replicates Exceeding MQO RPD of 25% ~
Bis(2-Ethylhexyl) Phthalate	1.0	0.990	20%	28% (1 Pr.)	8 of 15 (53%)
Fecal Coliform	2	48083	38%	54% (1 Pr.)	12 of 12 (100%)

~ Note - not all duplicate pairs justified revising data qualifiers (non-detect values are inherently variable and excluded from precision analyses). The precision measurement quality objective (MQO) for fecal coliform is 50%.

During water year 2019, there was no sediment replicate sample collected for precision analyses and no blank samples for bias analyses. Given the use of wide mouth glass bottles deployed for up to one year under the Ecology approved sediment sampling design, the usefulness of attempting to monitor for potential non-stormwater sediment contaminants that could be reliably evaluated through blanks is very low. Additionally, the value of evaluating the relative precision for sediment results would also be very limited given the difficulty of capturing comparable replicate samples just due to hydraulic variability and the extremely small sample size of only one routine sediment sample collected at each monitoring site during the water year. However, laboratory quality control results for the sediment samples were deemed acceptable.

Data Review, Verification, and Validation

Procedures described in the project QAPP were followed for data review, verification, and validation. Field sheets and chain of custody documents were reviewed by the project manager for accuracy and completeness. Field sheet corrections are noted and initialed. All laboratory data and reports were reviewed for omissions and errors shortly after their receipt as attachments to sample specific emails. The contracted ALS Environmental lab was notified of omissions or errors as soon as possible so that re-analyses could occur if holding times allowed. Laboratory corrections or missing data were then sent to Clark County as revised reports and / or data. Laboratory produced electronic data spreadsheet files (EDDs) were uploaded into Clark County’s Water Quality Database (WQDB) for subsequent detailed review. Applicable database water year monitoring results were reviewed for missing or erroneous values and, as applicable, supplemented, replaced, qualified, or rejected.

As part of the data verification and validation process and demonstrated in Table 5 and Table 6, evaluation of the blank and replicate / split QC sample results may lead to some changes in reported data qualifiers for applicable analytes. These changes are based on MQO criteria in the QAPP.

All water year 2019 S8.B composite samples had sufficient volume for laboratory analysis of all listed parameters. Thus, there was no need to prioritize parameters for analyses because of insufficient stormwater sample volume.

During water year 2019, several stormwater analytes listed in 2013-18 permit's Appendix 9 continued to no longer be monitored due to more than two years of values below both the method reporting limits and method detection limits. The following analytes were dropped from stormwater monitoring at the commercial site - dissolved and total mercury, dichlobenil, chlorpyrifos, and NWTPH-GX (gasoline); and for the high density residential site – chlorpyrifos and NWTPH. During water year 2019, there were no sediment analytes dropped from monitoring at either monitoring station due to two years of non-detect results.

In summary, based on the results of the QA/QC procedures and the measurement quality objectives, the analytical and hydrological monitoring results package for the water year 2019 S8.B data are considered acceptable, usable, and achieve the project's main monitoring goals and objectives.

Annual and Seasonal Pollutant Load

Loading Methodology

The following loading and storm delineation methodology descriptions have been updated from information originally provided by Herrera Environmental Consultants (earlier performed water year loading estimates for the County) and Washington State Department of Ecology's "Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges" (September 16, 2009). The same general methodology has been applied by Clark County staff for this latest water year annual report.

Pollutant loading was calculated for the two S8.B monitoring sites using the methodology outlined in Ecology's "Stormwater Monitoring Report Guidance: Phase I Municipal Stormwater Permit – Reporting Requirements for Special Condition S8" (Washington Department of Ecology, 2012, Publication 12-10-50). As required in the applicable permit, both annual and seasonal loadings have been calculated. Wet and dry season loading are based on Event Mean Concentration (EMC) values from flow-weighted composite sampled storm events from October 2018 through April 2019 and May 2019 through September 2019, respectively. Analyte loads for each site's sampled storms were calculated by multiplying individual composite sampled storm's analyte EMC by the total storm runoff volume (see Appendix 2 S8 Water Year 2018 Individual Storm Reports). Each analyte's unsampled seasonal load was calculated by multiplying its average seasonal EMC from all sampled storms (seasonal arithmetic mean EMC for each analyte) by the total runoff volume for all unsampled seasonal storm events. Each season's unsampled load was added to the total of loads from each of its sampled events to generate a total seasonal load for each analyte. The total annual load for each parameter is simply the sum of the wet and dry total seasonal loads.

Seasonal loading was calculated for all analytes which had greater than 50 percent detected values. Loads were not calculated for those analytes with more than 50% non-detects (per Ecology's draft non-detect SOP) due to the low accuracy of calculating their loads. For those analytes with more than 50 percent detected results, non-detects were substituted with a value equal to one-half the sample specific detection limit before loading rates were calculated.

Storm Event Delineation Methodology

Storm event delineations were conducted utilizing multiple software programs including LoggerNet, Microsoft Excel, and Aquarius (Aquatics Informatics Inc.) time series data management software. Storm event delineation follows the permit's Appendix 9 requirements. Throughout the water year and especially prior to sample submission to the lab, precipitation start and stop times were examined using LoggerNet to scan each storm's hyetograph for gaps in rainfall (6 hours with no rain would signal the end of a storm). This allowed an evaluation of each storm for conformance to the permit's qualifying storm definitions. Flow start time for sampled storms is interpreted as the first reliably measured storm flow after the first rainfall of a predicted and sampled qualifying precipitation event. The storm flow stop time was demarcated usually as the time when flow reached pre-storm rates (stage) after precipitation ended. For storm flows less than 24 hours long, the sampling period starts with measureable storm flow and ends with the

last aliquot time before stage drops below the initial storm stage. Alternatively, if a storm flow event was greater than 24 hours and at least ten flow-weighted aliquots have been collected then its storm's sampling period end would be demarcated as after 24 hours have passed from the start of the storm flow. On a few occasions, the storm sampling period exceeded 24 hours until ten aliquots were collected. If another storm precipitation event began after a 6-hour intra-storm dry period, the earlier storm flow was artificially truncated at the precipitation start time of the subsequent event even if later flow rose above the prior event's initial flow rate.

After the end of the water year, numerous summary statistics were calculated for individual sampled storms using Aquarius and Excel including: antecedent dry period, total precipitation, precipitation and stormwater flow (and sampled flow) start and end times, storm and sampled volumes, percent of storm volume sampled, and number of aliquots. These statistics are included in Individual Storm Reports (ISRs) for both commercial and high density residential monitoring sites.

Loading Summary

Water Year 2019 total annual as well as wet and dry season loading for each monitored parameter (except those having more than half their results as nondetects – per Ecology draft non-detect SOP) is presented in Appendix 4. Areal loads are based on drainage basin areas of 26.8 and 238.7 acres for the commercial and high density residential sites, respectively. Observed differences in loading were not tested for statistical significance.

Between the two sites, the commercial site typically has the higher annual areal loading (in pounds / acre and often by an order of magnitude) for most parameters including many of the metals, particulates, total phosphorus, and especially some organics. More specifically, the commercial site's annual areal loading was higher for thirty-seven of the forty parameters analyzed (all except 2,4-D, chloride, and dissolved zinc). Additionally, the COM dry season areal loads are higher for all parameters except 2,4-D, chloride, orthophosphate, and total suspended solids and all of its wet season parameters except dissolved zinc. The slightly higher dissolved zinc load for the high density residential site wet season may reflect pollutant sources such as galvanized roof gutters and chemicals used to control moss growth.

Within each monitoring site, the water year 2019 wet season areal loads were almost usually higher than those for the dry season, often at least an order of magnitude higher. Chrysene was the only commercial site parameter which had a higher dry season areal load than its corresponding wet season load. However, five of the high density residential site dry season parameters (2,4-D, total copper and lead, total Kjeldahl nitrogen, and total suspended solids) had higher dry season areal loads than those for their corresponding wet season. The predominance of larger total wet season areal loads across most parameters likely is influenced by its much higher seasonal flows.

Study Area Stormwater Management Activities

During 2019, stormwater management activities were related to the level of development within the monitoring sites' respective drainage areas. Routine activities typically include annual stormwater facility inspections and maintenance, street sweeping and repair of pavement surfaces, catch basin cleaning, roadside mowing, and source control activities. These activities are reported on a calendar year basis since maintenance work has been tracked in this timeframe rather than by water year.

During calendar year 2019, all public and private stormwater facilities were inspected and maintained. There also were no major stormwater capital improvement projects in either of the monitored drainage areas. Inspections and maintenance of both private and public stormwater facilities within the drainage areas of each of the two stormwater characterization sites is summarized in Appendix 5. County stormwater facilities were inspected and maintained according to County maintenance standards.

During calendar year 2019, there were six and nine stormwater facility inspections within the commercial and high density residential monitoring sites drainages, respectively. Within the commercial site drainage, there are six private stormwater facilities: one bioswale, one facility containing two wet ponds, one in-line storage / biofiltration system, one grass biofiltration strip, one cartridge filter catch basin / underground detention facility, and one bioswale with and underground detention facility. Five of the six COM stormwater facilities passed inspection and one was referred for maintenance during calendar year 2019. Within the high density residential drainage, there is one private bioretention facility and eight public stormwater facilities owned by Clark County: three stand-alone biofiltration swales, three combination biofiltration swale / detention ponds, one double detention pond facility and one stand-alone bioretention facility. Seven of the HDR facilities passed inspection while two were referred for maintenance.

During calendar year 2019, typical stormwater related routine maintenance was performed along streets and on stormwater features within both the COM and HDR drainages. This maintenance consisted primarily of street sweeping, catch basin inspection and cleaning, as well as stormwater facility mowing and litter control. Specifically, COM had twelve rounds of Highway 99 arterial sweeping and one round of catch basin inspecting/cleaning. HDR had five rounds of neighborhood sweeping, one round of catch basin inspecting/cleaning, and four rounds of stormwater facility vegetation maintenance. The level of maintenance was typical of that for similar land cover areas within the county's jurisdiction. Thus, the monitoring results are assumed to also be representative for these land uses' contributed pollutants.

Watershed-based source control activities during 2019 included site visits and follow-up actions. No water quality complaint response site visits were made within the two monitoring sites' drainages. A previously discovered HDR drainage area Felida fire station illicit connection was corrected during 2019. No other HDR area businesses were targeted as part of a five-year rotational routine inspection process. Three COM drainage area businesses had issues needing correction based on a dozen routine inspections during 2019. A sporting goods store replaced a leaky dumpster. A restaurant cleaned up a trash enclosure area and pumped out pollutants in its catch basin. Another restaurant replaced a dumpster and was given a plastic drum lid to help properly store fats, oils, and grease.

Appendices

Appendix 1 S8B Sites Rainfall Versus Runoff Volumes

Seasonal Rainfall versus Runoff Volume Data, Pacing Estimates:

Commercial Site through WY 2017

Event Date	Precip (in)	Storm Volume (cf)	Season	Est. Storm Aliquot # = Storm volume / Pacing Volume	Pacing Flow Volume (cf) per Aliquot based on Range in Rainfall / Runoff Relationship
10/21/2014	0.15	2039	Wet	11	Wet Season
3/5/2016	0.15	2015	Wet	11	180
3/8/2016	0.15	1396	Wet	8	300
2/21/2012	0.19	3344	Wet	19	400
11/5/2011	0.19	1392	Wet	8	600
3/24/2011	0.19	1658	Wet	9	800
12/1/2010	0.19	4104	Wet	23	900
2/20/2014	0.19	1910	Wet	11	1200
10/22/2016	0.19	4766	Wet	26	2100
12/27/2014	0.20	4861	Wet	27	Dry Season
3/29/2011	0.20	2524	Wet	14	130
4/4/2010	0.20	4978	Wet	28	200
12/18/2010	0.20	5355	Wet	30	400
4/27/2014	0.21	1988	Wet	11	900
2/9/2012	0.21	2701	Wet	15	1500
3/24/2015	0.21	2850	Wet	16	
4/15/2010	0.21	3614	Wet	20	
12/12/2012	0.21	5601	Wet	31	
12/12/2010	0.21	5866	Wet	33	
2/27/2014	0.21	2252	Wet	13	
2/11/2016	0.21	4432	Wet	25	
3/6/2016	0.21	2358	Wet	13	
3/20/2015	0.22	2910	Wet	16	
3/23/2015	0.22	3937	Wet	22	
3/25/2014	0.22	4556	Wet	25	
3/21/2015	0.22	5641	Wet	31	
3/17/2012	0.22	2116	Wet	12	
2/10/2010	0.22	5259	Wet	29	
10/24/2012	0.22	1609	Wet	9	
12/10/2010	0.22	5140	Wet	29	
4/1/2015	0.22	3408	Wet	19	
10/18/2016	0.22	4739	Wet	26	
12/5/2016	0.22	6233	Wet	35	
2/18/2017	0.22	4035	Wet	22	

1/23/2013	0.23	4538	Wet	25
4/12/2012	0.23	4232	Wet	24
11/20/2010	0.23	5291	Wet	29
11/15/2015	0.23	5704	Wet	32
10/10/2015	0.23	3834	Wet	21
12/29/2015	0.23	3158	Wet	18
3/14/2014	0.23	2605	Wet	14
3/1/2016	0.23	3852	Wet	21
11/22/2010	0.23	4186	Wet	23
10/3/2011	0.24	768	Wet	4
3/26/2010	0.24	3549	Wet	20
3/22/2014	0.24	3710	Wet	21
3/22/2015	0.24	3701	Wet	21
3/5/2012	0.25	3534	Wet	20
12/3/2012	0.25	2189	Wet	12
4/4/2013	0.25	2968	Wet	16
12/20/2015	0.25	5007	Wet	28
4/5/2013	0.25	3621	Wet	20
4/6/2013	0.25	3902	Wet	22
2/15/2010	0.25	6709	Wet	37
3/9/2010	0.25	4838	Wet	27
3/23/2016	0.25	2811	Wet	16
2/11/2010	0.26	7435	Wet	41
3/30/2010	0.26	7021	Wet	39
4/10/2015	0.26	4074	Wet	23
2/1/2015	0.26	4302	Wet	24
4/12/2016	0.26	3185	Wet	18
10/14/2014	0.26	4086	Wet	23
10/31/2011	0.27	1984	Wet	11
11/21/2010	0.27	5679	Wet	32
2/20/2012	0.27	2878	Wet	16
12/22/2016	0.27	6551	Wet	36
4/7/2017	0.27	6899	Wet	38
1/30/2012	0.28	4357	Wet	24
11/12/2011	0.28	4599	Wet	26
11/26/2010	0.28	4405	Wet	24
1/29/2012	0.28	3381	Wet	19
4/22/2014	0.28	2391	Wet	13
12/27/2015	0.28	3861	Wet	21
1/24/2016	0.28	7836	Wet	44
2/19/2016	0.28	5133	Wet	29

10/28/2015	0.29	3697	Wet	21
1/10/2012	0.29	4406	Wet	24
10/10/2011	0.29	4745	Wet	26
11/2/2012	0.29	2881	Wet	16
1/30/2013	0.29	3511	Wet	20
3/26/2011	0.29	8594	Wet	48
3/25/2011	0.29	5449	Wet	30
10/23/2014	0.29	6347	Wet	35
2/24/2014	0.29	3419	Wet	19
1/7/2013	0.30	7429	Wet	41
4/6/2012	0.30	4662	Wet	26
4/3/2012	0.30	4874	Wet	27
4/1/2011	0.30	7812	Wet	43
4/12/2010	0.30	5180	Wet	29
10/30/2016	0.30	5426	Wet	30
2/21/2017	0.30	5354	Wet	30
11/21/2012	0.31	5688	Wet	32
10/5/2011	0.31	5065	Wet	28
1/8/2014	0.31	3525	Wet	20
4/8/2014	0.31	10029	Wet	56
2/18/2016	0.31	6801	Wet	38
3/11/2016	0.31	4178	Wet	23
3/11/2012	0.32	2808	Wet	16
12/28/2014	0.32	7727	Wet	43
10/5/2016	0.32	7349	Wet	41
3/7/2013	0.32	3178	Wet	18
11/3/2012	0.32	3458	Wet	19
2/26/2017	0.32	5405	Wet	30
10/21/2012	0.33	5461	Wet	18
4/5/2010	0.33	6802	Wet	23
11/20/2012	0.33	7541	Wet	25
11/27/2016	0.33	9232	Wet	31
3/11/2017	0.33	8259	Wet	28
2/29/2012	0.34	5003	Wet	17
2/28/2013	0.34	3616	Wet	12
3/5/2011	0.34	9192	Wet	31
11/29/2012	0.34	4539	Wet	15
1/4/2015	0.35	5486	Wet	18
2/16/2016	0.35	9267	Wet	31
1/5/2012	0.36	6077	Wet	20
10/22/2012	0.36	4043	Wet	13

10/16/2012	0.36	5295	Wet	18
10/18/2014	0.36	3699	Wet	12
3/14/2014	0.36	3540	Wet	12
4/11/2017	0.36	7212	Wet	24
3/2/2016	0.37	7756	Wet	26
3/23/2012	0.38	5759	Wet	19
2/14/2010	0.38	11751	Wet	39
11/4/2013	0.38	5357	Wet	18
12/15/2012	0.38	11630	Wet	39
11/23/2014	0.38	11631	Wet	39
2/17/2016	0.38	9205	Wet	31
2/26/2016	0.38	4161	Wet	14
4/27/2012	0.39	6452	Wet	22
4/11/2012	0.39	6327	Wet	21
12/18/2014	0.39	9495	Wet	32
10/6/2016	0.39	8813	Wet	29
3/24/2010	0.40	4051	Wet	14
4/6/2017	0.40	6886	Wet	23
4/19/2017	0.40	7639	Wet	25
2/26/2012	0.41	6251	Wet	21
1/25/2013	0.41	3706	Wet	12
11/30/2012	0.41	5242	Wet	17
10/16/2016	0.41	8161	Wet	27
12/25/2010	0.42	8140	Wet	20
4/21/2014	0.42	5831	Wet	15
10/13/2014	0.42	5642	Wet	14
1/20/2016	0.42	12873	Wet	32
11/8/2015	0.43	17243	Wet	43
2/12/2011	0.44	11009	Wet	28
2/13/2011	0.44	8824	Wet	22
11/2/2015	0.44	10817	Wet	27
2/2/2015	0.44	12646	Wet	32
2/23/2010	0.44	8665	Wet	22
10/30/2010	0.44	10833	Wet	27
1/5/2011	0.44	7751	Wet	19
3/7/2017	0.44	9347	Wet	23
3/29/2017	0.44	10492	Wet	26
4/28/2010	0.46	7659	Wet	19
10/30/2012	0.46	7077	Wet	18
11/7/2015	0.46	9852	Wet	25
12/11/2015	0.46	12727	Wet	32

2/29/2016	0.46	8753	Wet	22
11/26/2016	0.46	14116	Wet	35
12/26/2016	0.46	9759	Wet	24
1/30/2016	0.47	13056	Wet	33
10/2/2016	0.47	9181	Wet	23
1/23/2016	0.48	16788	Wet	42
12/3/2016	0.48	13273	Wet	33
12/9/2014	0.49	12034	Wet	30
1/19/2016	0.49	15791	Wet	39
11/27/2011	0.50	12360	Wet	31
11/18/2013	0.50	6242	Wet	16
1/7/2014	0.50	7665	Wet	19
4/16/2014	0.50	6400	Wet	16
10/14/2016	0.51	14321	Wet	36
10/28/2010	0.52	11829	Wet	30
12/12/2015	0.52	13878	Wet	35
1/18/2012	0.53	7925	Wet	20
10/28/2012	0.53	9500	Wet	24
4/13/2015	0.53	6948	Wet	17
3/29/2014	0.53	23068	Wet	58
12/13/2015	0.54	14954	Wet	37
12/23/2014	0.55	16714	Wet	42
11/22/2011	0.55	10586	Wet	26
2/18/2014	0.55	18313	Wet	46
2/18/2014	0.55	18313	Wet	46
10/28/2012	0.56	7557	Wet	19
12/19/2010	0.56	13059	Wet	33
4/6/2013	0.56	12109	Wet	30
12/23/2012	0.57	20231	Wet	34
10/28/2014	0.57	9858	Wet	16
11/28/2014	0.57	14346	Wet	24
1/28/2016	0.57	17984	Wet	30
4/2/2010	0.58	13558	Wet	23
11/2/2013	0.58	6983	Wet	12
2/22/2013	0.59	12444	Wet	21
10/20/2016	0.59	14540	Wet	24
10/25/2015	0.29	12049	Wet	20
11/17/2012	0.59	10586	Wet	18
1/28/2014	0.59	8840	Wet	15
11/13/2010	0.60	10274	Wet	17
4/18/2013	0.60	5787	Wet	10

4/1/2014	0.60	20010	Wet	33
1/15/2016	0.60	20737	Wet	35
2/15/2016	0.60	14220	Wet	24
3/26/2017	0.61	14062	Wet	23
2/5/2016	0.62	12584	Wet	21
3/12/2016	0.62	15232	Wet	25
11/3/2011	0.63	15565	Wet	26
12/10/2015	0.64	19092	Wet	32
4/5/2011	0.65	11272	Wet	19
12/1/2012	0.65	16116	Wet	27
12/5/2015	0.65	12399	Wet	21
2/17/2014	0.65	20366	Wet	34
11/22/2016	0.66	15841	Wet	26
11/30/2012	0.67	17504	Wet	29
1/15/2015	0.67	16115	Wet	27
3/8/2017	0.68	15570	Wet	26
12/1/2015	0.69	15222	Wet	19
1/17/2016	0.69	26546	Wet	33
3/26/2014	0.69	21898	Wet	27
10/8/2010	0.70	19375	Wet	24
11/23/2015	0.70	12417	Wet	16
4/22/2016	0.71	10431	Wet	13
11/16/2011	0.71	16653	Wet	21
3/8/2014	0.71	13499	Wet	17
3/13/2016	0.71	12623	Wet	16
3/17/2014	0.72	16341	Wet	20
11/18/2015	0.72	15061	Wet	19
3/2/2014	0.75	11049	Wet	14
3/27/2014	0.76	28833	Wet	36
11/21/2014	0.76	20468	Wet	26
3/23/2015	0.76	20273	Wet	25
2/6/2015	0.77	16133	Wet	20
12/20/2015	0.77	22293	Wet	28
4/13/2016	0.77	12312	Wet	15
4/23/2014	0.78	11905	Wet	15
1/24/2012	0.78	17633	Wet	22
1/12/2014	0.78	12763	Wet	16
2/15/2014	0.78	26332	Wet	33
10/9/2016	0.78	17913	Wet	22
12/22/2015	0.79	16836	Wet	21
11/6/2010	0.80	19714	Wet	25

10/26/2016	0.81	19718	Wet	25
10/10/2010	0.82	25823	Wet	32
3/19/2013	0.82	13882	Wet	17
3/17/2017	0.82	18770	Wet	23
11/9/2010	0.84	17824	Wet	22
4/26/2010	0.87	15152	Wet	19
12/25/2012	0.88	26603	Wet	33
12/19/2014	0.88	26760	Wet	33
11/11/2012	0.89	12152	Wet	15
2/25/2010	0.90	25194	Wet	28
12/4/2014	0.90	22470	Wet	25
11/29/2010	0.92	21822	Wet	24
2/20/2017	0.93	24840	Wet	28
4/17/2011	0.94	30210	Wet	34
3/9/2016	0.94	20266	Wet	23
11/13/2016	0.94	28860	Wet	32
12/19/2012	0.95	32216	Wet	36
11/5/2016	0.95	25421	Wet	28
12/13/2010	0.96	24915	Wet	28
12/3/2012	0.96	22844	Wet	25
3/11/2011	0.97	24956	Wet	28
11/1/2010	0.98	28857	Wet	32
12/16/2012	0.98	30668	Wet	34
4/23/2017	0.98	22866	Wet	25
12/1/2013	1.02	13421	Wet	11
2/16/2011	1.02	27742	Wet	23
11/23/2012	1.03	21323	Wet	18
12/19/2016	1.03	27539	Wet	23
4/25/2011	1.04	24392	Wet	20
12/2/2015	1.08	24461	Wet	20
2/17/2014	1.14	45436	Wet	38
3/23/2014	1.19	27685	Wet	23
3/11/2010	1.20	34587	Wet	29
3/28/2010	1.20	31744	Wet	26
12/11/2010	1.20	36879	Wet	31
1/28/2013	1.25	23343	Wet	19
1/11/2011	1.30	33010	Wet	28
2/4/2015	1.30	25165	Wet	21
10/21/2014	1.32	34188	Wet	28
11/16/2015	1.34	56791	Wet	47
3/5/2014	1.43	35259	Wet	29

4/13/2011	1.45	35959	Wet	30
11/25/2016	1.57	55171	Wet	26
10/30/2014	1.67	39987	Wet	19
1/17/2015	1.70	53492	Wet	25
12/9/2016	1.85	34039	Wet	16
11/17/2010	1.90	52976	Wet	25
12/16/2015	1.90	59698	Wet	28
3/13/2017	1.93	58301	Wet	28
1/12/2016	1.95	53775	Wet	26
12/27/2010	2.00	52674	Wet	25
10/13/2016	2.02	56405	Wet	27
10/23/2010	2.10	59878	Wet	29
3/14/2015	2.12	48333	Wet	23
2/15/2017	2.12	61444	Wet	29
11/2/2015	2.16	74879	Wet	36
12/8/2015	2.18	83226	Wet	40
12/7/2010	2.20	60769	Wet	29
3/2/2011	2.21	65868	Wet	31
11/18/2012	2.21	58065	Wet	28
2/28/2011	2.32	66728	Wet	32
12/6/2015	2.42	92385	Wet	44
2/3/2017	2.96	91156	Wet	43
6/18/2012	0.12	3030	Dry	23
6/20/2010	0.14	2508	Dry	19
7/22/2014	0.15	826	Dry	6
8/30/2013	0.16	3898	Dry	30
8/29/2013	0.18	1379	Dry	11
9/7/2010	0.20	4104	Dry	32
9/21/2013	0.20	5263	Dry	40
9/22/2013	0.20	1642	Dry	13
6/22/2012	0.20	2504	Dry	19
5/28/2014	0.21	2695	Dry	21
9/6/2015	0.21	3359	Dry	26
5/4/2010	0.22	2951	Dry	23
9/26/2010	0.23	5800	Dry	45
5/25/2012	0.24	4720	Dry	36
7/12/2011	0.24	3063	Dry	24
6/18/2011	0.24	2331	Dry	18
5/3/2010	0.24	3740	Dry	29
5/9/2010	0.24	2801	Dry	22
9/7/2010	0.24	3577	Dry	28

5/24/2012	0.24	4139	Dry	32
9/25/2015	0.24	4538	Dry	35
6/12/2012	0.25	5835	Dry	29
6/13/2013	0.25	3533	Dry	18
5/1/2012	0.25	3960	Dry	20
5/23/2012	0.26	4736	Dry	24
9/15/2010	0.26	4797	Dry	24
5/22/2010	0.27	4605	Dry	23
9/7/2016	0.27	6542	Dry	33
5/30/2010	0.28	7161	Dry	36
6/13/2013	0.28	5091	Dry	25
5/19/2010	0.29	7090	Dry	35
9/24/2013	0.29	10982	Dry	55
10/10/2011	0.29	5030	Dry	25
5/28/2013	0.29	3134	Dry	16
5/17/2010	0.30	4268	Dry	21
5/22/2013	0.31	4829	Dry	24
5/7/2011	0.31	5942	Dry	30
5/20/2010	0.31	4767	Dry	24
6/15/2010	0.31	3052	Dry	15
7/1/2010	0.32	3937	Dry	20
9/17/2010	0.32	7846	Dry	39
11/3/2014	0.32	6702	Dry	34
9/30/2017	0.32	4637	Dry	23
5/29/2013	0.33	3785	Dry	19
6/8/2010	0.33	8012	Dry	40
6/10/2010	0.36	8441	Dry	21
6/13/2013	0.37	5496	Dry	14
6/8/2017	0.39	5132	Dry	13
8/26/2013	0.40	9061	Dry	23
5/12/2011	0.41	6511	Dry	16
5/25/2012	0.41	9636	Dry	24
6/1/2015	0.41	4422	Dry	11
8/31/2010	0.42	8803	Dry	22
6/12/2014	0.42	3589	Dry	9
5/21/2010	0.43	9283	Dry	23
7/23/2014	0.44	6890	Dry	17
5/8/2014	0.45	6139	Dry	15
6/25/2013	0.47	5011	Dry	13
5/19/2016	0.47	5987	Dry	15
11/2/2014	0.50	7128	Dry	18

5/21/2012	0.52	10710	Dry	27
5/27/2013	0.53	6781	Dry	17
5/11/2015	0.54	4781	Dry	12
6/23/2013	0.55	8801	Dry	22
6/7/2012	0.55	15157	Dry	38
7/25/20105	0.55	11794	Dry	29
6/2/2015	0.58	11843	Dry	13
6/23/2016	0.59	14392	Dry	16
6/25/2014	0.61	14529	Dry	16
9/17/2016	0.61	12698	Dry	14
6/23/2012	0.63	14445	Dry	16
5/21/2016	0.65	9217	Dry	10
5/23/2013	0.66	12160	Dry	14
5/15/2017	0.66	8392	Dry	9
5/19/2014	0.68	10771	Dry	12
5/15/2011	0.72	12226	Dry	14
6/3/2010	0.72	19165	Dry	21
6/15/20147	0.73	13030	Dry	14
5/28/2010	0.74	18688	Dry	21
9/17/2017	0.74	11170	Dry	12
6/4/2012	0.76	23162	Dry	26
6/16/2014	0.76	12649	Dry	14
6/1/2010	0.77	19425	Dry	22
5/14/2016	0.79	10577	Dry	12
5/2/2012	0.91	24247	Dry	27
9/20/2017	0.91	24501	Dry	27
5/25/2010	0.97	24648	Dry	27
9/18/2010	0.99	21322	Dry	24
5/12/2017	1.07	12177	Dry	14
9/5/2013	1.35	50078	Dry	33
8/29/2015	1.42	36771	Dry	25
5/22/2013	1.46	31555	Dry	21
6/6/2010	1.60	46222	Dry	31
9/30/2013	2.62	55922	Dry	37

Seasonal Rainfall versus Runoff Volume Data, Pacing Estimates:

High Density Residential Site through WY 2017

Event Date	Precip. (in)	Storm Volume (cf)	Season	Est. Storm Aliquot # = Storm volume / Pacing Volume	Pacing Flow Volume (cf) per Aliquot based on Range in Rainfall / Runoff Relationship
3/29/2011	0.19	5230	Wet	17	Wet Season
1/7/2012	0.19	3856	Wet	13	300
11/11/2015	0.19	4611	Wet	15	800
4/24/2016	0.19	10286	Wet	34	1600
4/30/2012	0.19	3612	Wet	12	2500
10/31/2011	0.2	3307	Wet	11	4000
12/12/2012	0.21	3889	Wet	13	6500
4/15/2010	0.21	8807	Wet	29	Dry Season
10/29/2011	0.21	1663	Wet	6	350
11/5/2011	0.21	2586	Wet	9	900
3/20/2015	0.21	5604	Wet	19	1300
11/15/2015	0.21	4169	Wet	14	4000
3/8/2016	0.21	6953	Wet	23	8000
10/4/2016	0.21	6318	Wet	21	
10/20/2016	0.21	11501	Wet	38	
4/22/2017	0.21	15306	Wet	51	
1/5/2012	0.22	7072	Wet	24	
2/9/2012	0.22	7602	Wet	25	
3/5/2016	0.22	10659	Wet	36	
11/12/2013	0.23	2855	Wet	10	
12/15/2015	0.23	8240	Wet	27	
3/14/2014	0.24	6986	Wet	23	
3/5/2012	0.24	11974	Wet	40	
3/21/2015	0.24	32868	Wet	110	
2/21/2012	0.25	7912	Wet	26	
2/11/2016	0.25	12029	Wet	40	
2/1/2015	0.26	5851	Wet	20	
11/12/2011	0.26	6267	Wet	21	
3/24/2015	0.26	13365	Wet	45	
3/14/2014	0.26	7596	Wet	25	
3/23/2015	0.26	21283	Wet	27	
3/30/2011	0.27	19131	Wet	24	

4/8/2014	0.27	16964	Wet	21
10/21/20014	0.27	29822	Wet	37
1/24/2016	0.27	27772	Wet	35
3/30/2010	0.28	29404	Wet	37
10/25/2014	0.28	12567	Wet	16
4/17/2017	0.28	14538	Wet	18
4/8/2011	0.29	35188	Wet	44
4/11/2010	0.3	14343	Wet	18
2/16/2016	0.3	18210	Wet	23
4/19/2017	0.3	17525	Wet	22
4/28/2010	0.31	30414	Wet	38
12/29/2015	0.31	13996	Wet	17
11/21/2010	0.31	16995	Wet	21
11/3/2014	0.31	18097	Wet	23
4/13/2016	0.31	16285	Wet	20
10/5/2016	0.31	27560	Wet	34
11/29/2016	0.31	17299	Wet	22
3/29/2017	0.31	27345	Wet	34
11/26/2010	0.32	7888	Wet	10
2/26/2017	0.32	19465	Wet	24
3/25/2011	0.33	30741	Wet	38
3/28/2010	0.33	22931	Wet	29
2/21/2017	0.33	36311	Wet	45
2/24/2014	0.34	18102	Wet	23
11/8/2015	0.34	32903	Wet	41
1/29/2012	0.35	12177	Wet	15
10/10/2015	0.35	18175	Wet	23
4/5/2017	0.35	17950	Wet	22
3/5/2011	0.36	30965	Wet	39
10/17/2014	0.36	16174	Wet	20
12/22/2016	0.36	38772	Wet	48
12/18/2015	0.37	31017	Wet	39
11/27/2016	0.37	34321	Wet	43
2/26/2016	0.38	13573	Wet	17
3/4/2011	0.38	31312	Wet	39
10/30/2010	0.38	19706	Wet	25
2/17/2016	0.39	34029	Wet	43
12/27/20015	0.39	12604	Wet	16
11/19/2016	0.4	18284	Wet	23
10/28/2010	0.41	16749	Wet	21

4/1/2015	0.41	40188	Wet	50
3/1/2016	0.41	45621	Wet	57
10/31/2016	0.42	21472	Wet	27
10/31/2016	0.42	21471	Wet	27
12/26/2016	0.42	26872	Wet	34
2/13/2011	0.43	25820	Wet	32
4/21/2014	0.43	26490	Wet	33
11/2/2014	0.44	16273	Wet	20
12/18/2014	0.44	32517	Wet	41
3/11/2017	0.44	48383	Wet	60
1/5/2011	0.47	16954	Wet	21
10/13/2014	0.47	28946	Wet	36
12/27/2014	0.47	32943	Wet	41
10/6/2016	0.47	37120	Wet	46
11/4/2013	0.48	21223	Wet	27
1/21/2016	0.5	51540	Wet	32
4/24/2014	0.51	39468	Wet	25
10/14/2014	0.51	35816	Wet	22
3/20/2016	0.53	16514	Wet	10
11/27/2011	0.53	45706	Wet	29
2/3/2015	0.53	68346	Wet	43
12/13/2015	0.55	54186	Wet	34
1/23/2016	0.55	71951	Wet	45
4/2/2010	0.56	53567	Wet	33
10/10/2010	0.56	42165	Wet	26
11/13/2010	0.56	33676	Wet	21
11/26/2016	0.56	64123	Wet	40
12/19/2010	0.57	45784	Wet	29
1/19/2016	0.57	42953	Wet	27
4/13/2015	0.58	28487	Wet	18
11/7/2015	0.58	36297	Wet	23
3/28/2011	0.59	74559	Wet	47
4/17/2014	0.59	31486	Wet	20
11/18/2013	0.6	30236	Wet	19
12/11/2015	0.6	50219	Wet	31
2/14/2016	0.61	52320	Wet	33
2/28/2012	0.62	25500	Wet	16
10/19/2016	0.62	50749	Wet	32
4/5/2011	0.63	33162	Wet	21
2/14/2014	0.64	72767	Wet	45

12/4/2016	0.64	53211	Wet	33
10/25/2015	0.65	42600	Wet	27
11/1/2013	0.66	40008	Wet	25
1/28/2016	0.66	64058	Wet	40
4/26/2011	0.67	61161	Wet	38
11/21/2011	0.67	30937	Wet	19
10/28/2014	0.67	47450	Wet	30
4/6/2017	0.67	96142	Wet	60
12/23/2014	0.69	82946	Wet	33
1/15/2015	0.71	61058	Wet	24
11/3/2011	0.73	58836	Wet	24
11/23/2015	0.73	32597	Wet	13
1/30/2016	0.73	73582	Wet	29
10/1/2016	0.73	34880	Wet	14
3/26/2017	0.74	81123	Wet	32
1/15/2016	0.75	71689	Wet	29
3/2/2014	0.77	49401	Wet	20
2/18/2016	0.77	72530	Wet	29
4/1/2014	0.78	51457	Wet	21
1/17/2016	0.78	79448	Wet	32
2/3/2016	0.78	69600	Wet	28
12/1/2015	0.79	48239	Wet	19
3/16/2014	0.79	78638	Wet	31
3/23/20105	0.8	106755	Wet	43
11/22/2016	0.8	70538	Wet	28
3/28/2010	0.81	53268	Wet	21
10/8/2010	0.82	33765	Wet	14
11/6/2010	0.82	80757	Wet	32
11/18/2015	0.82	61105	Wet	24
4/14/2016	0.82	85257	Wet	34
2/18/2014	0.85	108786	Wet	44
11/28/2014	0.85	96370	Wet	39
3/9/2014	0.86	76433	Wet	31
10/26/2016	0.86	61974	Wet	25
11/6/2013	0.87	70772	Wet	28
12/4/2014	0.88	65911	Wet	26
11/16/2011	0.88	62013	Wet	25
12/6/2015	0.89	54259	Wet	22
3/6/2017	0.89	71362	Wet	29
11/9/2010	0.91	78299	Wet	20

2/29/2016	0.91	78827	Wet	20
4/24/2011	0.92	60476	Wet	15
3/10/2017	0.92	101849	Wet	25
4/11/2017	0.92	80712	Wet	20
4/22/2014	0.96	76265	Wet	19
4/22/2016	0.96	95612	Wet	24
2/16/2011	0.97	129643	Wet	32
12/22/2015	0.97	67737	Wet	17
4/26/2010	0.97	59855	Wet	15
1/11/2014	1.01	63140	Wet	16
11/21/2014	1.02	69183	Wet	17
12/1/2013	1.03	75953	Wet	19
11/29/2010	1	90386	Wet	23
12/10/2015	1.01	97375	Wet	24
11/5/2016	1.02	93450	Wet	23
10/8/2016	1.06	97284	Wet	24
11/1/2010	1.1	142209	Wet	36
1/11/2011	1.1	69913	Wet	17
12/2/2015	1.13	91600	Wet	23
3/17/2017	1.14	136814	Wet	34
12/19/2016	1.19	140218	Wet	22
12/13/2010	1.2	163998	Wet	25
12/19/2014	1.26	135362	Wet	21
2/15/2014	1.27	146306	Wet	23
4/18/2011	1.28	106815	Wet	16
12/11/2010	1.3	184032	Wet	28
3/23/2014	1.3	154307	Wet	24
11/14/2016	1.31	125920	Wet	19
4/23/2017	1.34	152077	Wet	23
4/14/2011	1.37	96787	Wet	15
3/9/2016	1.38	156138	Wet	24
2/19/2017	1.41	169854	Wet	26
12/20/2015	1.48	139509	Wet	21
2/17/2014	1.51	267604	Wet	41
10/15/2016	1.59	139129	Wet	21
3/11/2016	1.62	127350	Wet	20
11/16/2015	1.63	162484	Wet	25
1/14/2011	1.66	185930	Wet	29
10/29/2014	1.66	181625	Wet	28
10/21/2014	1.74	188633	Wet	29

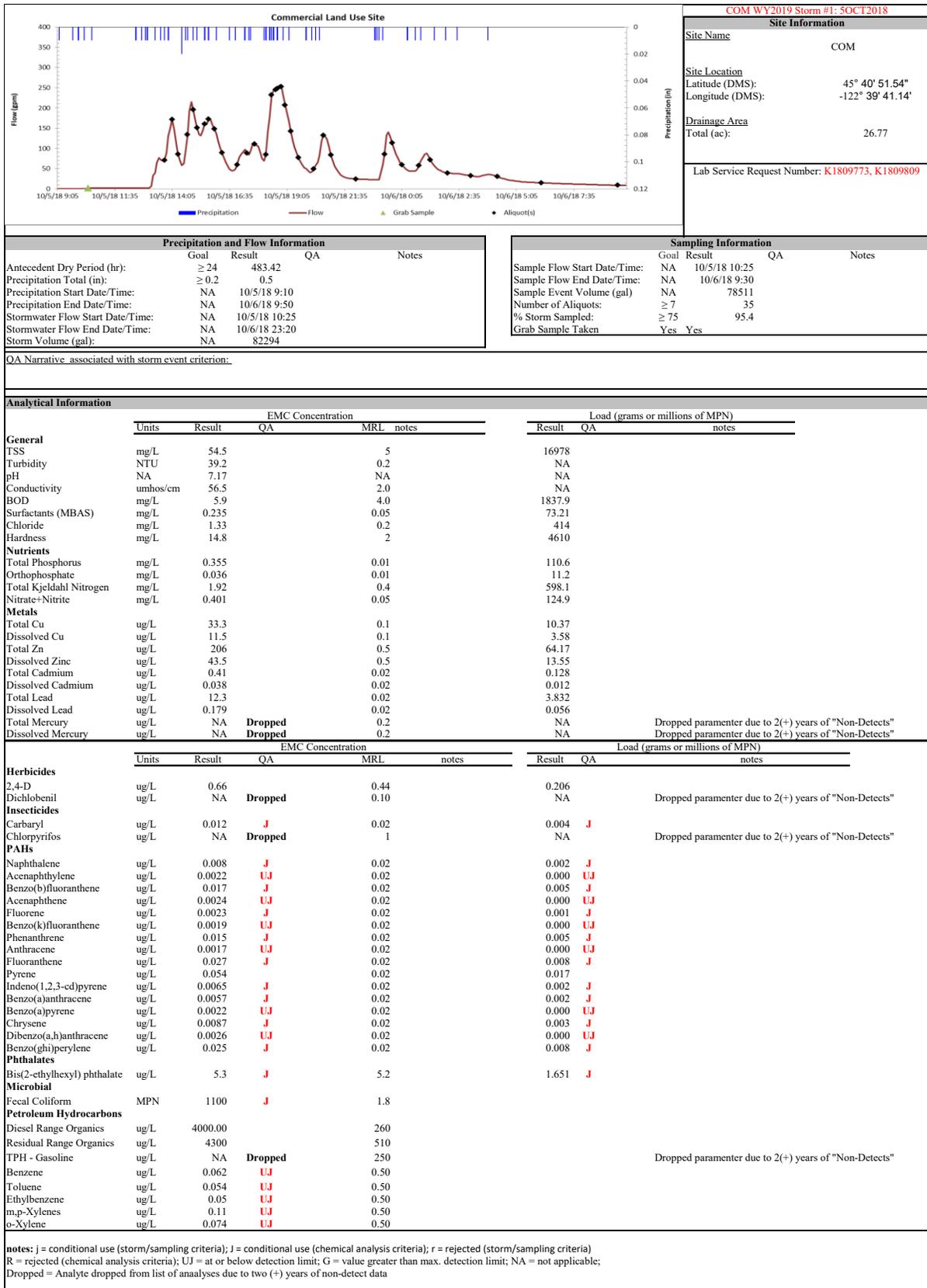
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12/27/2010	1.9	212247	Wet	33
1/17/2015	1.95	301745	Wet	46
12/9/2016	1.97	120348	Wet	19
10/23/2010	2.1	158640	Wet	24
11/24/2016	2.18	304780	Wet	47
12/7/2010	2.2	237844	Wet	37
2/8/2017	2.32	342531	Wet	53
12/16/2015	2.37	346569	Wet	53
3/13/20147	2.42	328759	Wet	51
3/14/2015	2.44	261766	Wet	40
3/2/2011	2.46	255779	Wet	39
12/8/2015	2.48	384242	Wet	59
2/15/2017	2.52	314023	Wet	48
2/4/2015	2.55	314617	Wet	48
1/11/2015	2.55	238087	Wet	37
12/6/2015	3	457159	Wet	70
10/13/2016	3.09	316590	Wet	49
2/3/2017	3.34	426152	Wet	66
5/5/2010	0.11	4803	Dry	14
5/20/2010	0.11	3751	Dry	11
9/9/2010	0.12	6507	Dry	19
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6/20/2010	0.14	1247	Dry	4
6/28/2011	0.14	2088	Dry	6
9/1/2015	0.15	1594	Dry	5
5/28/2014	0.16	4593	Dry	13
9/25/2015	0.18	4815	Dry	14
6/26/2014	0.19	8784	Dry	25
9/26/2010	0.2	7566	Dry	22
6/18/2012	0.2	6429	Dry	18
8/29/2013	0.21	2157	Dry	6
8/30/2013	0.21	14857	Dry	42
7/9/2016	0.21	9256	Dry	26
7/12/2011	0.23	5334	Dry	15
9/6/2015	0.24	5962	Dry	17
9/15/2010	0.25	2636	Dry	8
9/17/2010	0.25	19026	Dry	54
6/9/2016	0.25	4237	Dry	12

5/2/2011	0.26	31374	Dry	90
10/3/2011	0.26	1738	Dry	5
6/30/2012	0.26	12327	Dry	35
5/23/2010	0.27	18840	Dry	54
9/25/2011	0.27	14586	Dry	42
8/31/2010	0.29	1313	Dry	4
5/21/2013	0.29	7412	Dry	21
6/2/2015	0.3	19078	Dry	21
5/30/2010	0.31	15004	Dry	17
5/28/2013	0.31	14790	Dry	16
6/12/2014	0.31	8759	Dry	10
5/9/2010	0.33	10519	Dry	12
8/27/2013	0.34	8116	Dry	9
9/7/2016	0.34	23726	Dry	26
5/7/2011	0.35	27319	Dry	30
6/1/2015	0.36	11041	Dry	12
8/30/2015	0.36	19061	Dry	21
6/12/2013	0.37	18015	Dry	20
6/15/2010	0.37	10023	Dry	11
9/17/2015	0.37	11296	Dry	13
6/13/2013	0.38	17536	Dry	19
5/17/2010	0.39	22975	Dry	26
5/11/2011	0.4	16062	Dry	18
5/4/2010	0.42	24648	Dry	27
5/19/2010	0.43	32233	Dry	36
5/8/2014	0.43	22559	Dry	25
5/25/2010	0.44	39746	Dry	44
9/30/2017	0.44	30221	Dry	34
7/25/2015	0.47	13456	Dry	15
6/1/2014	0.5	44147	Dry	34
7/23/2014	0.51	24870	Dry	19
5/26/2010	0.51	48199	Dry	37
5/19/2016	0.51	23880	Dry	18
6/8/2017	0.52	36493	Dry	28
5/19/2014	0.54	28212	Dry	22
5/11/2015	0.54	16124	Dry	12
5/27/2013	0.56	35040	Dry	27
9/17/2016	0.56	21567	Dry	17
6/10/2016	0.57	46436	Dry	36
6/1/2010	0.59	43835	Dry	34

12/9/2014	0.6	34200	Dry	26
5/12/2017	0.6	29863	Dry	23
6/15/2017	0.61	34498	Dry	27
5/21/2016	0.62	70271	Dry	54
5/15/2011	0.67	29295	Dry	23
5/15/2017	0.7	48810	Dry	38
6/8/2010	0.72	46147	Dry	35
6/25/2014	0.73	64014	Dry	49
6/3/2010	0.75	59811	Dry	46
5/21/2010	0.79	40251	Dry	31
6/23/2016	0.79	90892	Dry	70
9/23/2014	0.83	35485	Dry	27
5/15/2016	0.86	45240	Dry	35
9/7/2010	0.87	92637	Dry	71
9/18/2010	1.1	119930	Dry	30
5/28/2010	1.3	117625	Dry	29
9/5/2013	1.52	143852	Dry	36
6/6/2010	1.6	193812	Dry	24
10/21/2014	1.74	186991	Dry	23
9/17/2017	2	164020	Dry	21
5/22/2013	2.07	176508	Dry	22
9/29/2013	3.05	396223	Dry	50

Appendix 2 S8B Water Year 2019 Individual Storm Reports

Appendix 2A Water Year 2019 Commercial Site Individual Storm Reports



Site Information	
Site Name	COM
Site Location	
Latitude (DMS):	45° 40' 51.54"
Longitude (DMS):	-122° 39' 41.14'
Drainage Area	
Total (ac):	26.77
Lab Service Request Number: K1809773, K1809809	

Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥ 24	483.42		
Precipitation Total (in):	≥ 0.2	0.5		
Precipitation Start Date/Time:	NA	10/5/18 9:10		
Precipitation End Date/Time:	NA	10/6/18 9:50		
Stormwater Flow Start Date/Time:	NA	10/5/18 10:25		
Stormwater Flow End Date/Time:	NA	10/6/18 23:20		
Storm Volume (gal):	NA	82294		

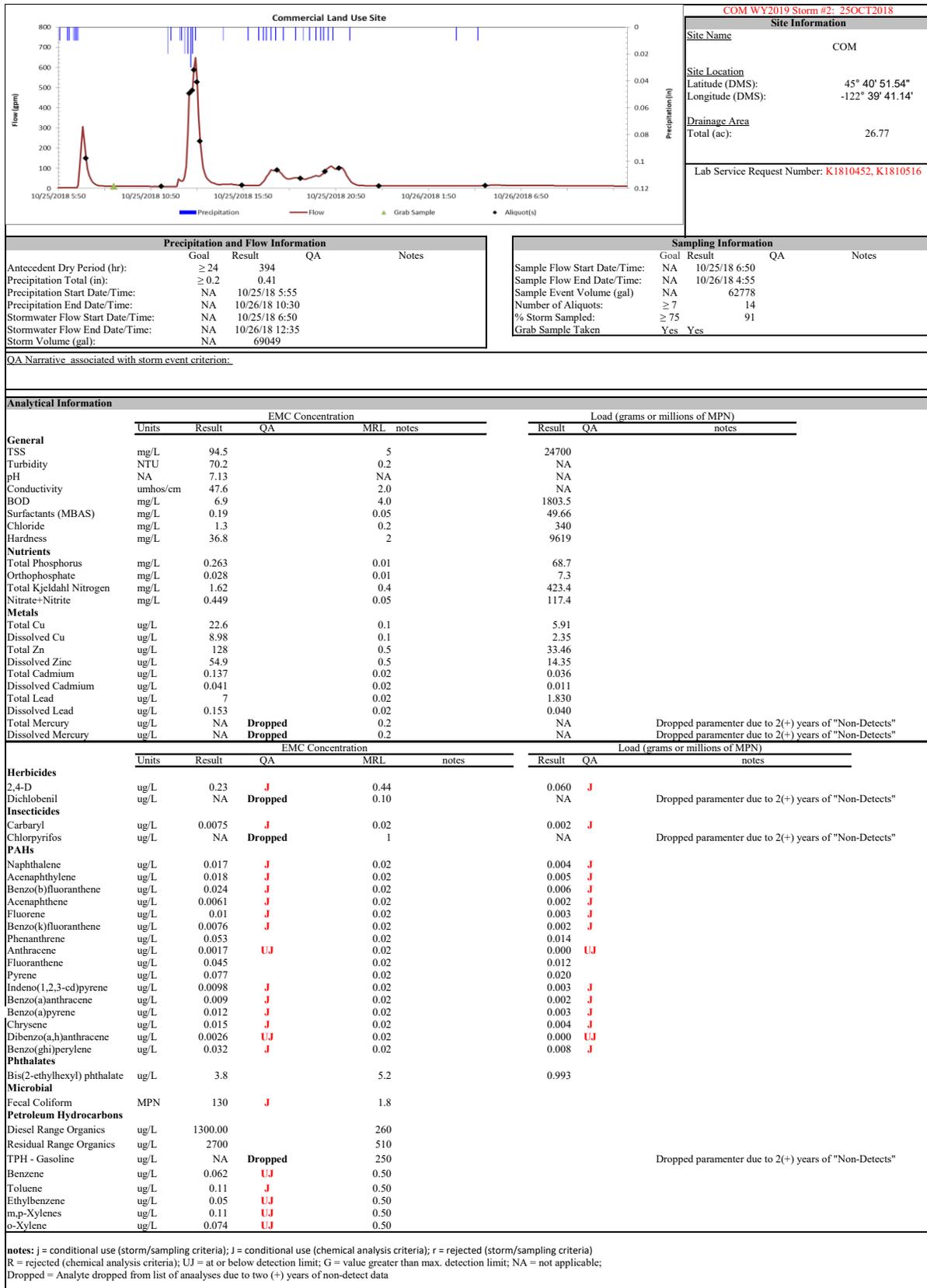
Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	10/5/18 10:25		
Sample Flow End Date/Time:	NA	10/6/18 9:30		
Sample Event Volume (gal):	NA	78511		
Number of Aliquots:	≥ 7	35		
% Storm Sampled:	≥ 75	95.4		
Grab Sample Taken	Yes	Yes		

QA Narrative associated with storm event criterion:

Analytical Information	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
General								
TSS	mg/L	54.5				5		16978
Turbidity	NTU	39.2				0.2		NA
pH	NA	7.17				NA		NA
Conductivity	umhos/cm	56.5				2.0		NA
BOD	mg/L	5.9				4.0		1837.9
Surfactants (MBAS)	mg/L	0.235				0.05		73.21
Chloride	mg/L	1.33				0.2		414
Hardness	mg/L	14.8				2		4610
Nutrients								
Total Phosphorus	mg/L	0.355				0.01		110.6
Orthophosphate	mg/L	0.036				0.01		11.2
Total Kjeldahl Nitrogen	mg/L	1.92				0.4		598.1
Nitrate+Nitrite	mg/L	0.401				0.05		124.9
Metals								
Total Cu	ug/L	33.3				0.1		10.37
Dissolved Cu	ug/L	11.5				0.1		3.58
Total Zn	ug/L	206				0.5		64.17
Dissolved Zinc	ug/L	43.5				0.5		13.55
Total Cadmium	ug/L	0.41				0.02		0.128
Dissolved Cadmium	ug/L	0.038				0.02		0.012
Total Lead	ug/L	12.3				0.02		3.832
Dissolved Lead	ug/L	0.179				0.02		0.056
Total Mercury	ug/L	NA	Dropped			0.2		NA
Dissolved Mercury	ug/L	NA	Dropped			0.2		NA

Analytical Information	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
Herbicides								
2,4-D	ug/L	0.66				0.44		0.206
Dichlobenil	ug/L	NA	Dropped			0.10		NA
Insecticides								
Carbaryl	ug/L	0.012	J			0.02		0.004
Chlorpyrifos	ug/L	NA	Dropped			1		NA
PAHs								
Naphthalene	ug/L	0.008	J			0.02		0.002
Acenaphthylene	ug/L	0.0022	UJ			0.02		0.000
Benzo(b)fluoranthene	ug/L	0.017	J			0.02		0.005
Acenaphthene	ug/L	0.0024	UJ			0.02		0.000
Fluorene	ug/L	0.0023	J			0.02		0.001
Benzo(k)fluoranthene	ug/L	0.0019	UJ			0.02		0.000
Phenanthrene	ug/L	0.015	J			0.02		0.005
Anthracene	ug/L	0.0017	UJ			0.02		0.000
Fluoranthene	ug/L	0.027	J			0.02		0.008
Pyrene	ug/L	0.054				0.02		0.017
Indeno(1,2,3-cd)pyrene	ug/L	0.0065	J			0.02		0.002
Benzo(a)anthracene	ug/L	0.0057	J			0.02		0.002
Benzo(a)pyrene	ug/L	0.0022	UJ			0.02		0.000
Chrysene	ug/L	0.0087	J			0.02		0.003
Dibenzo(a,h)anthracene	ug/L	0.0026	UJ			0.02		0.000
Benzo(ghi)perylene	ug/L	0.025	J			0.02		0.008
Phthalates								
Bis(2-ethylhexyl) phthalate	ug/L	5.3	J			5.2		1.651
Microbial								
Fecal Coliform	MPN	1100	J			1.8		
Petroleum Hydrocarbons								
Diesel Range Organics	ug/L	4000.00				260		
Residual Range Organics	ug/L	4300				510		
TPH - Gasoline	ug/L	NA	Dropped			250		
Benzene	ug/L	0.062	UJ			0.50		
Toluene	ug/L	0.054	UJ			0.50		
Ethylbenzene	ug/L	0.05	UJ			0.50		
m,p-Xylenes	ug/L	0.11	UJ			0.50		
o-Xylene	ug/L	0.074	UJ			0.50		

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable;
Dropped = Analyte dropped from list of analyses due to two (+) years of non-detect data



Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥ 24	394		
Precipitation Total (in):	≥ 0.2	0.41		
Precipitation Start Date/Time:	NA	10/25/18 5:55		
Precipitation End Date/Time:	NA	10/26/18 10:30		
Stormwater Flow Start Date/Time:	NA	10/25/18 6:50		
Stormwater Flow End Date/Time:	NA	10/26/18 12:35		
Storm Volume (gal):	NA	69049		

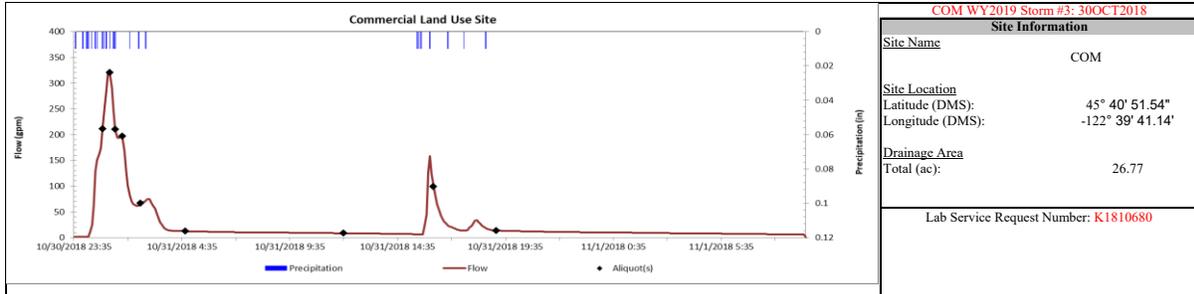
Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	10/25/18 6:50		
Sample Flow End Date/Time:	NA	10/26/18 4:55		
Sample Event Volume (gal):	NA	62778		
Number of Aliquots:	≥ 7	14		
% Storm Sampled:	≥ 75	91		
Grab Sample Taken	Yes	Yes		

QA Narrative associated with storm event criterion:

Analytical Information	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
General								
TSS	mg/L	94.5				5		24700
Turbidity	NTU	70.2				0.2		NA
pH	NA	7.13				NA		NA
Conductivity	umhos/cm	47.6				2.0		NA
BOD	mg/L	6.9				4.0		1803.5
Surfactants (MBAS)	mg/L	0.19				0.05		49.66
Chloride	mg/L	1.3				0.2		340
Hardness	mg/L	36.8				2		9619
Nutrients								
Total Phosphorus	mg/L	0.263				0.01		68.7
Orthophosphate	mg/L	0.028				0.01		7.3
Total Kjeldahl Nitrogen	mg/L	1.62				0.4		423.4
Nitrate-Nitrite	mg/L	0.449				0.05		117.4
Metals								
Total Cu	ug/L	22.6				0.1		5.91
Dissolved Cu	ug/L	8.98				0.1		2.35
Total Zn	ug/L	128				0.5		33.46
Dissolved Zinc	ug/L	54.9				0.5		14.35
Total Cadmium	ug/L	0.137				0.02		0.036
Dissolved Cadmium	ug/L	0.041				0.02		0.011
Total Lead	ug/L	7				0.02		1.830
Dissolved Lead	ug/L	0.153				0.02		0.040
Total Mercury	ug/L	NA	Dropped			0.2		NA
Dissolved Mercury	ug/L	NA	Dropped			0.2		NA

Analytical Information	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
Herbicides								
2,4-D	ug/L	0.23	J	0.44		0.060	J	
Dichlobenil	ug/L	NA	Dropped	0.10		NA		Dropped parameter due to 2(+) years of "Non-Detects"
Insecticides								
Carbaryl	ug/L	0.0075	J	0.02		0.002	J	
Chlorpyrifos	ug/L	NA	Dropped	1		NA		Dropped parameter due to 2(+) years of "Non-Detects"
PAHs								
Naphthalene	ug/L	0.017	J	0.02		0.004	J	
Acenaphthylene	ug/L	0.018	J	0.02		0.005	J	
Benzo(b)fluoranthene	ug/L	0.024	J	0.02		0.006	J	
Acenaphthene	ug/L	0.0061	J	0.02		0.002	J	
Fluorene	ug/L	0.01	J	0.02		0.003	J	
Benzo(k)fluoranthene	ug/L	0.0076	J	0.02		0.002	J	
Phenanthrene	ug/L	0.053		0.02		0.014		
Anthracene	ug/L	0.0017	UJ	0.02		0.000	UJ	
Fluoranthene	ug/L	0.045		0.02		0.012		
Pyrene	ug/L	0.077		0.02		0.020		
Indeno(1,2,3-cd)pyrene	ug/L	0.0098	J	0.02		0.003	J	
Benzo(a)anthracene	ug/L	0.009	J	0.02		0.002	J	
Benzo(a)pyrene	ug/L	0.012	J	0.02		0.003	J	
Chrysene	ug/L	0.015	J	0.02		0.004	J	
Dibenzo(a,h)anthracene	ug/L	0.0026	UJ	0.02		0.000	UJ	
Benzo(ghi)perylene	ug/L	0.032	J	0.02		0.008	J	
Phthalates								
Bis(2-ethylhexyl) phthalate	ug/L	3.8		5.2		0.993		
Microbial								
Fecal Coliform	MPN	130	J	1.8				
Petroleum Hydrocarbons								
Diesel Range Organics	ug/L	1300.00		260				
Residual Range Organics	ug/L	2700		510				
TPH - Gasoline	ug/L	NA	Dropped	250				Dropped parameter due to 2(+) years of "Non-Detects"
Benzene	ug/L	0.062	UJ	0.50				
Toluene	ug/L	0.11	J	0.50				
Ethylbenzene	ug/L	0.05	UJ	0.50				
m,p-Xylenes	ug/L	0.11	UJ	0.50				
o-Xylene	ug/L	0.074	UJ	0.50				

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable;
Dropped = Analyte dropped from list of analyses due to two (+) years of non-detect data



Site Information	
Site Name	COM
Site Location	
Latitude (DMS):	45° 40' 51.54"
Longitude (DMS):	-122° 39' 41.14'
Drainage Area	
Total (ac):	26.77
Lab Service Request Number: K1810680	

Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥ 24	54		
Precipitation Total (in):	≥ 0.2	0.23		
Precipitation Start Date/Time:	NA	10/30/18 23:40		
Precipitation End Date/Time:	NA	11/1/18 0:40		
Stormwater Flow Start Date/Time:	NA	10/31/18 0:20		
Stormwater Flow End Date/Time:	NA	11/1/18 9:30		
Storm Volume (gal):	NA	48311		

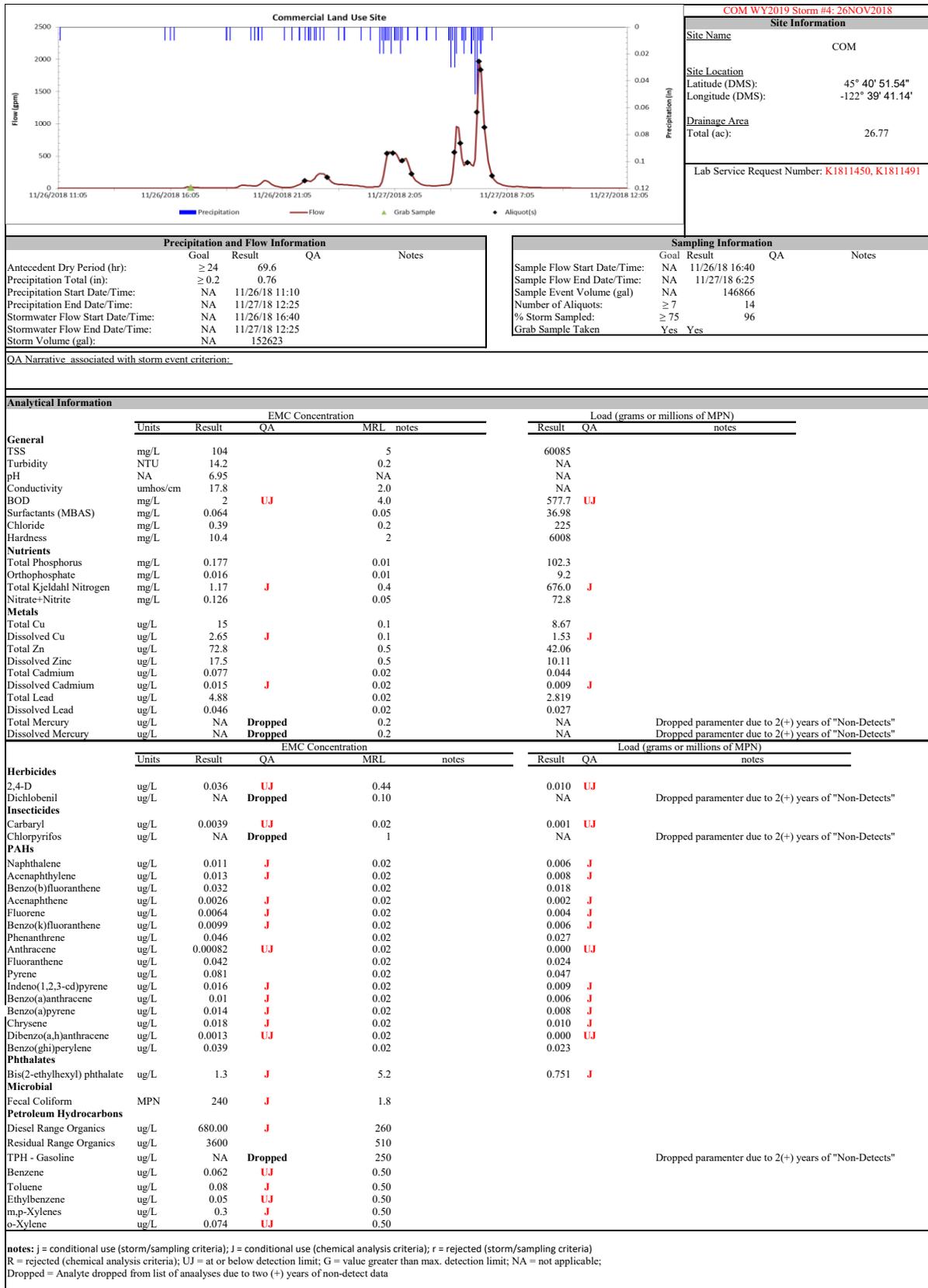
Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	10/31/18 0:20		
Sample Flow End Date/Time:	NA	10/31/18 19:10		
Sample Event Volume (gal):	NA	40348		
Number of Aliquots:	≥ 7	9	j	j
% Storm Sampled:	≥ 75	84		
Grab Sample Taken	Yes	No		

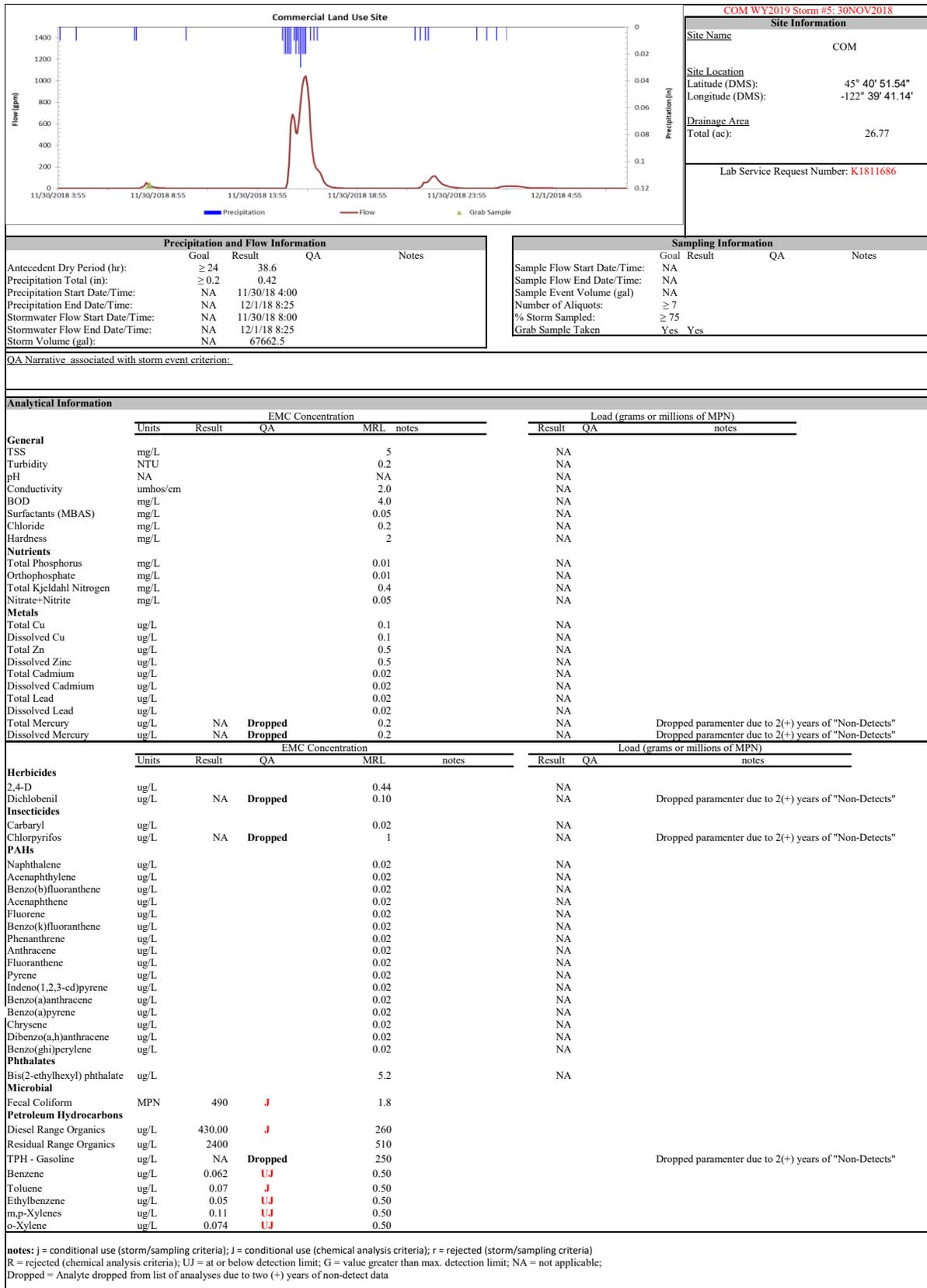
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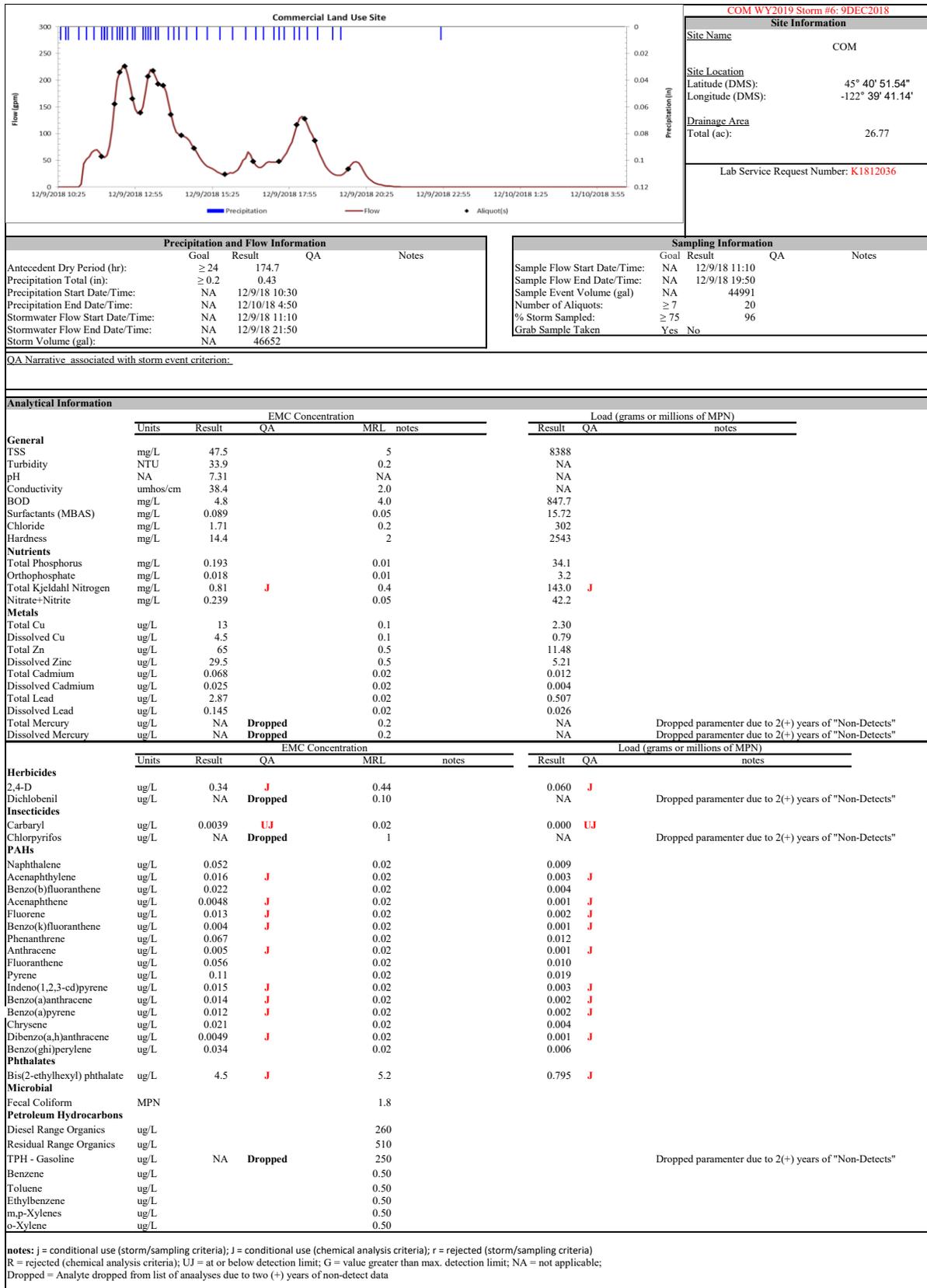
	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
General								
TSS	mg/L	26				5		4755
Turbidity	NTU	27.9				0.2		NA
pH	NA	7.17				NA		NA
Conductivity	umhos/cm	42.4				2.0		NA
BOD	mg/L	2	UJ			4.0		182.9 UJ
Surfactants (MBAS)	mg/L	0.1				0.05		18.29
Chloride	mg/L	1.51				0.2		276
Hardness	mg/L	15.2				2		2780
Nutrients								
Total Phosphorus	mg/L	0.101				0.01		18.5
Orthophosphate	mg/L	0.019				0.01		3.5
Total Kjeldahl Nitrogen	mg/L	1.19				0.4		217.6
Nitrate+Nitrite	mg/L	0.536				0.05		98.0
Metals								
Total Cu	ug/L	10.5				0.1		1.92
Dissolved Cu	ug/L	5.8				0.1		1.06
Total Zn	ug/L	51.3				0.5		9.38
Dissolved Zinc	ug/L	29.9				0.5		5.47
Total Cadmium	ug/L	0.048				0.02		0.009
Dissolved Cadmium	ug/L	0.02	J			0.02		0.004 J
Total Lead	ug/L	2.06				0.02		0.377
Dissolved Lead	ug/L	0.134				0.02		0.025
Total Mercury	ug/L	NA	Dropped			0.2		NA
Dissolved Mercury	ug/L	NA	Dropped			0.2		NA

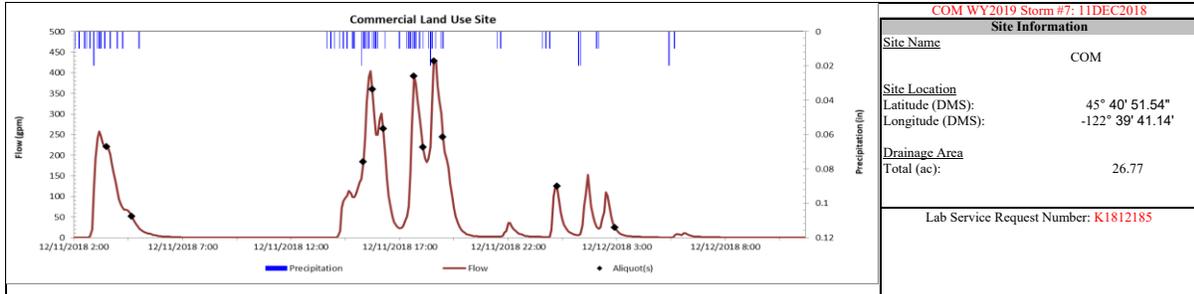
	EMC Concentration				Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes
Herbicides								
2,4-D	ug/L	0.18	J			0.44		0.033 J
Dichlobenil	ug/L	NA	Dropped			0.10		NA
Insecticides								
Carbaryl	ug/L	0.004	UJ			0.02		0.000 UJ
Chlorpyrifos	ug/L	NA	Dropped			1		NA
PAHs								
Naphthalene	ug/L	0.016	J			0.02		0.003 J
Acenaphthylene	ug/L	0.023				0.02		0.004
Benzo(b)fluoranthene	ug/L	0.022				0.02		0.004
Acenaphthene	ug/L	0.0039	J			0.02		0.001 J
Fluorene	ug/L	0.0057	J			0.02		0.001 J
Benzo(k)fluoranthene	ug/L	0.0057	J			0.02		0.001 J
Phenanthrene	ug/L	0.028				0.02		0.005
Anthracene	ug/L	0.00082	UJ			0.02		0.000 UJ
Fluoranthene	ug/L	0.029				0.02		0.005
Pyrene	ug/L	0.06				0.02		0.011
Indeno(1,2,3-cd)pyrene	ug/L	0.011	J			0.02		0.002 J
Benzo(a)anthracene	ug/L	0.008	J			0.02		0.001 J
Benzo(a)pyrene	ug/L	0.0096	J			0.02		0.002 J
Chrysene	ug/L	0.015	J			0.02		0.003 J
Dibenzo(a,h)anthracene	ug/L	0.0013	UJ			0.02		0.000 UJ
Benzo(ghi)perylene	ug/L	0.029				0.02		0.005
Phthalates								
Bis(2-ethylhexyl) phthalate	ug/L	3				5.2		0.549
Microbial								
Fecal Coliform	MPN					1.8		
Petroleum Hydrocarbons								
Diesel Range Organics	ug/L					260		
Residual Range Organics	ug/L					510		
TPH - Gasoline	ug/L	NA	Dropped			250		Dropped parameter due to 2(+) years of "Non-Detects"
Benzene	ug/L					0.50		
Toluene	ug/L					0.50		
Ethylbenzene	ug/L					0.50		
m,p-Xylenes	ug/L					0.50		
o-Xylene	ug/L					0.50		

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
 R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable;
 Dropped = Analyte dropped from list of analyses due to two (+) years of non-detect data









Site Information	
Site Name	COM
Site Location	
Latitude (DMS):	45° 40' 51.54"
Longitude (DMS):	-122° 39' 41.14'
Drainage Area	
Total (ac):	26.77
Lab Service Request Number: K1812185	

Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥ 24	31.8		
Precipitation Total (in):	≥ 0.2	0.64		
Precipitation Start Date/Time:	NA	12/11/18 2:05		
Precipitation End Date/Time:	NA	12/12/18 11:40		
Stormwater Flow Start Date/Time:	NA	12/11/18 2:45		
Stormwater Flow End Date/Time:	NA	12/12/18 10:00		
Storm Volume (gal):	NA	91400		

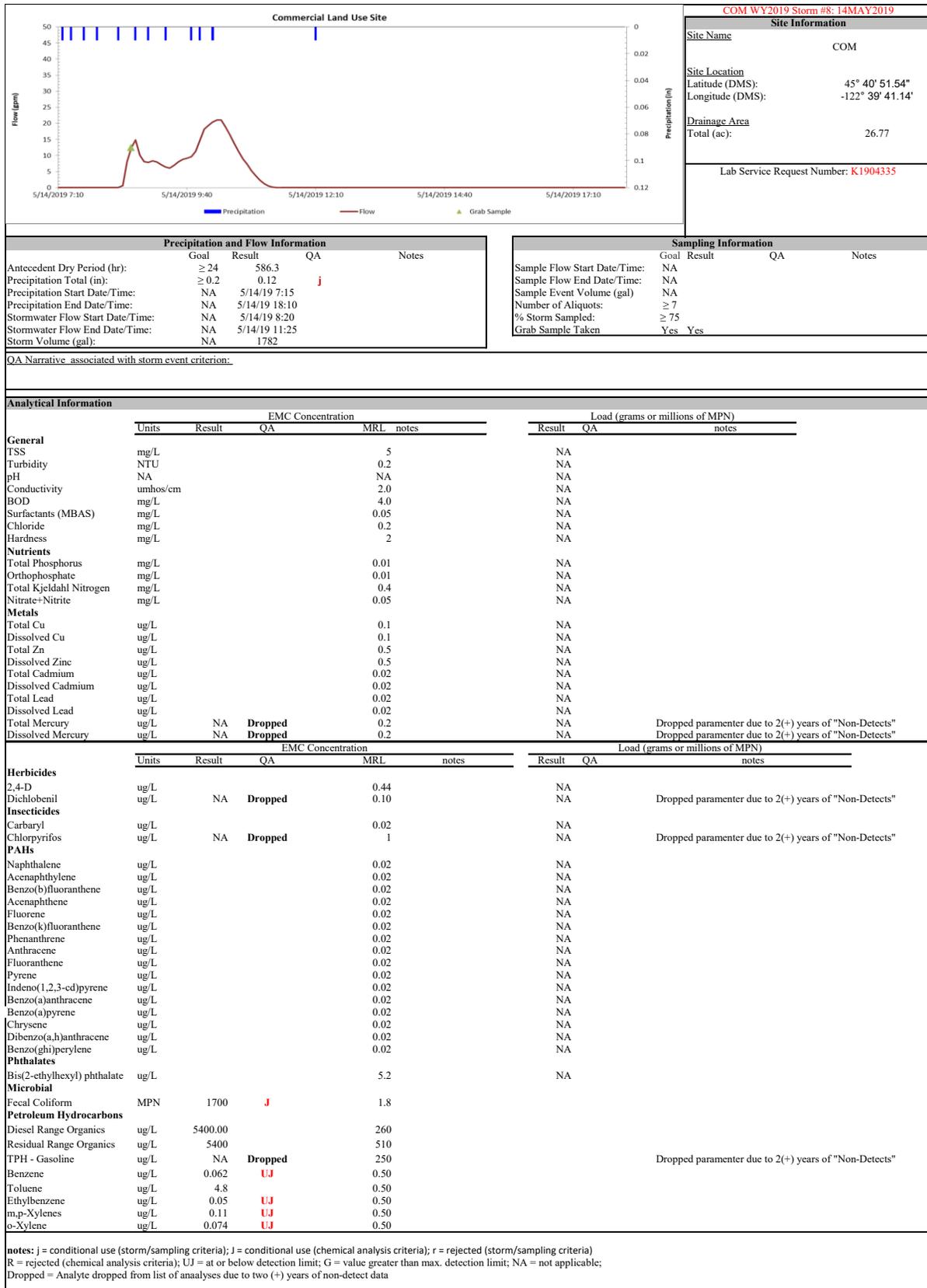
Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	12/11/18 2:45		
Sample Flow End Date/Time:	NA	12/12/18 2:55		
Sample Event Volume (gal):	NA	90402		
Number of Aliquots:	≥ 7	11		
% Storm Sampled:	≥ 75	99		
Grab Sample Taken	Yes	No		

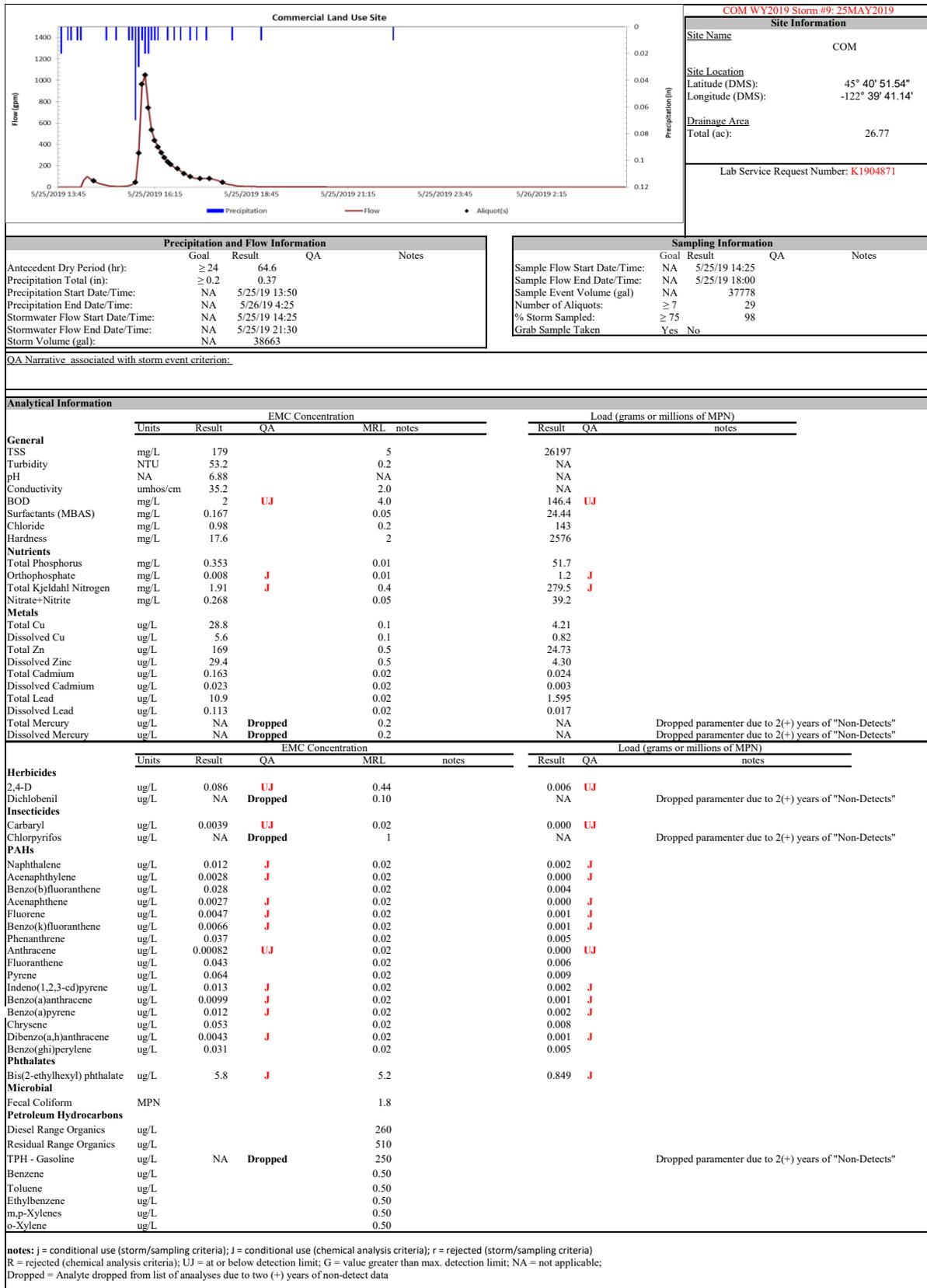
QA Narrative associated with storm event criterion:

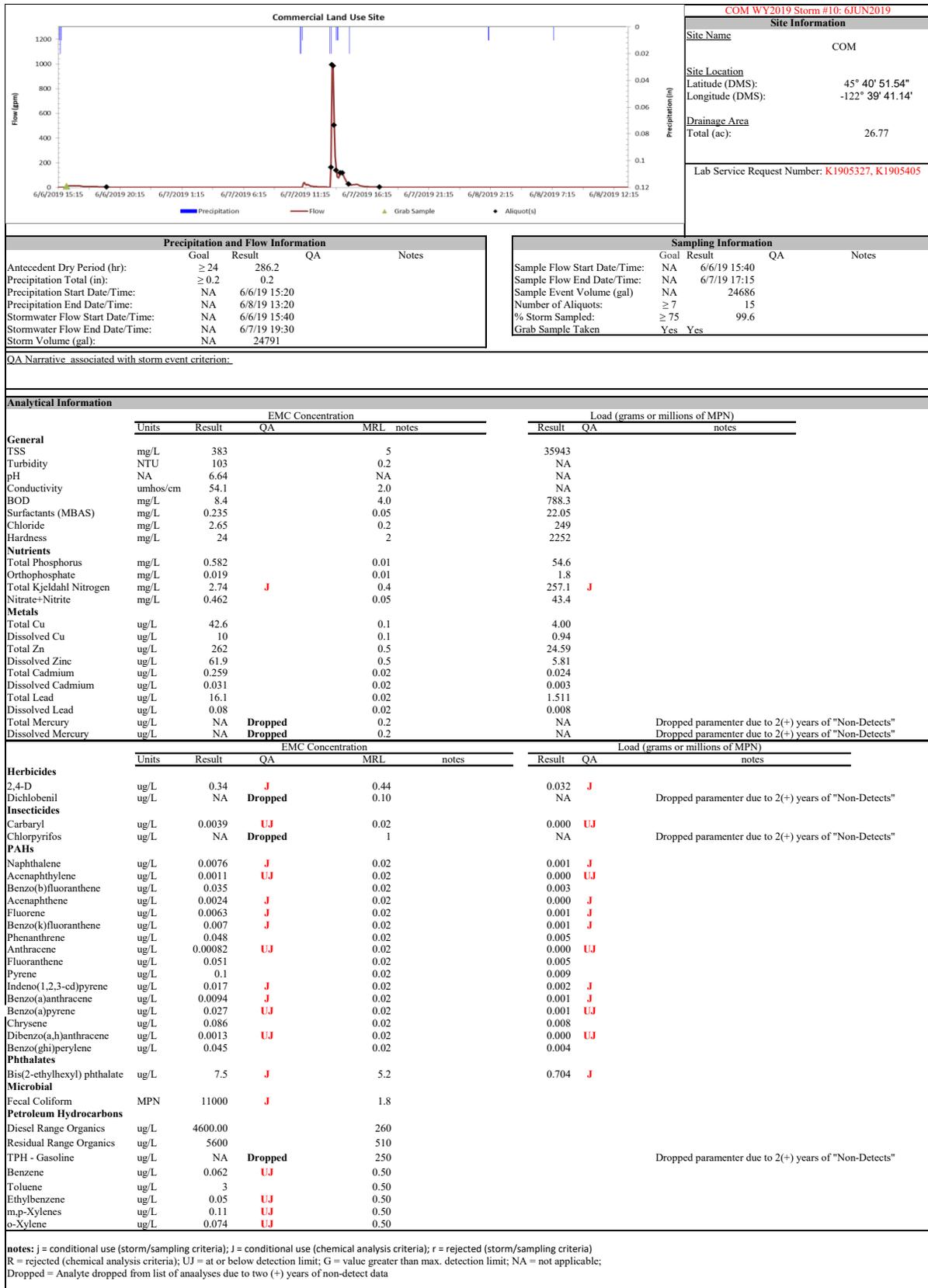
Analytical Information								
	Units	EMC Concentration			Load (grams or millions of MPN)			
		Result	QA	MRL	notes	Result	QA	notes
General								
TSS	mg/L	88.5				5		30620
Turbidity	NTU	47.2				0.2		NA
pH	NA	7.11				NA		NA
Conductivity	umhos/cm	28				2.0		NA
BOD	mg/L	2	UJ			4.0		346.0
Surfactants (MBAS)	mg/L	0.09				0.05		31.14
Chloride	mg/L	1.63				0.2		564
Hardness	mg/L	10				2		3460
Nutrients								
Total Phosphorus	mg/L	0.235				0.01		81.3
Orthophosphate	mg/L	0.015				0.01		5.2
Total Kjeldahl Nitrogen	mg/L	1.12	J			0.4		387.5
Nitrate+Nitrite	mg/L	0.148				0.05		51.2
Metals								
Total Cu	ug/L	16.3				0.1		5.64
Dissolved Cu	ug/L	3.58				0.1		1.24
Total Zn	ug/L	107				0.5		37.02
Dissolved Zinc	ug/L	30				0.5		10.38
Total Cadmium	ug/L	0.084				0.02		0.029
Dissolved Cadmium	ug/L	0.016	J			0.02		0.006
Total Lead	ug/L	5.32				0.02		1.841
Dissolved Lead	ug/L	0.195				0.02		0.067
Total Mercury	ug/L	NA	Dropped			0.2		NA
Dissolved Mercury	ug/L	NA	Dropped			0.2		NA

	Units	EMC Concentration			Load (grams or millions of MPN)			
		Result	QA	MRL	notes	Result	QA	notes
Herbicides								
2,4-D	ug/L	0.042	J		0.44			0.015
Dichlobenil	ug/L	NA	Dropped		0.10			NA
Insecticides								
Carbaryl	ug/L	0.0039	UJ		0.02			0.001
Chlorpyrifos	ug/L	NA	Dropped		1			NA
PAHs								
Naphthalene	ug/L	0.015	J		0.02			0.005
Acenaphthylene	ug/L	0.006	J		0.02			0.002
Benzo(b)fluoranthene	ug/L	0.039			0.02			0.013
Acenaphthene	ug/L	0.0027	J		0.02			0.001
Fluorene	ug/L	0.0085	J		0.02			0.003
Benzo(k)fluoranthene	ug/L	0.01	J		0.02			0.003
Phenanthrene	ug/L	0.067			0.02			0.023
Anthracene	ug/L	0.0054	J		0.02			0.002
Fluoranthene	ug/L	0.077			0.02			0.027
Pyrene	ug/L	0.14			0.02			0.048
Indeno(1,2,3-cd)pyrene	ug/L	0.023			0.02			0.008
Benzo(a)anthracene	ug/L	0.016	J		0.02			0.006
Benzo(a)pyrene	ug/L	0.025			0.02			0.009
Chrysene	ug/L	0.031			0.02			0.011
Dibenzo(a,h)anthracene	ug/L	0.0013	UJ		0.02			0.000
Benzo(ghi)perylene	ug/L	0.061			0.02			0.021
Phthalates								
Bis(2-ethylhexyl) phthalate	ug/L	8	J		5.2			2.768
Microbial								
Fecal Coliform	MPN				1.8			
Petroleum Hydrocarbons								
Diesel Range Organics	ug/L				260			
Residual Range Organics	ug/L				510			
TPH - Gasoline	ug/L	NA	Dropped		250			Dropped parameter due to 2(+) years of "Non-Detects"
Benzene	ug/L				0.50			
Toluene	ug/L				0.50			
Ethylbenzene	ug/L				0.50			
m,p-Xylenes	ug/L				0.50			
o-Xylene	ug/L				0.50			

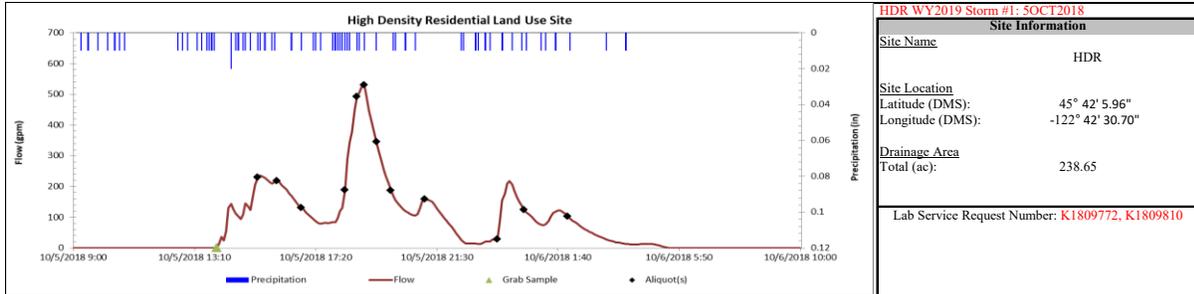
notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable;
Dropped = Analyte dropped from list of analyses due to two (+) years of non-detect data







Appendix 2B Water Year 2019 High Density Residential Site Individual Storm Reports



HDR WY2019 Storm #1: SOCT2018	
Site Information	
Site Name	HDR
Site Location	
Latitude (DMS):	45° 42' 5.96"
Longitude (DMS):	-122° 42' 30.70"
Drainage Area	
Total (ac):	238.65
Lab Service Request Number: K1809772, K1809810	

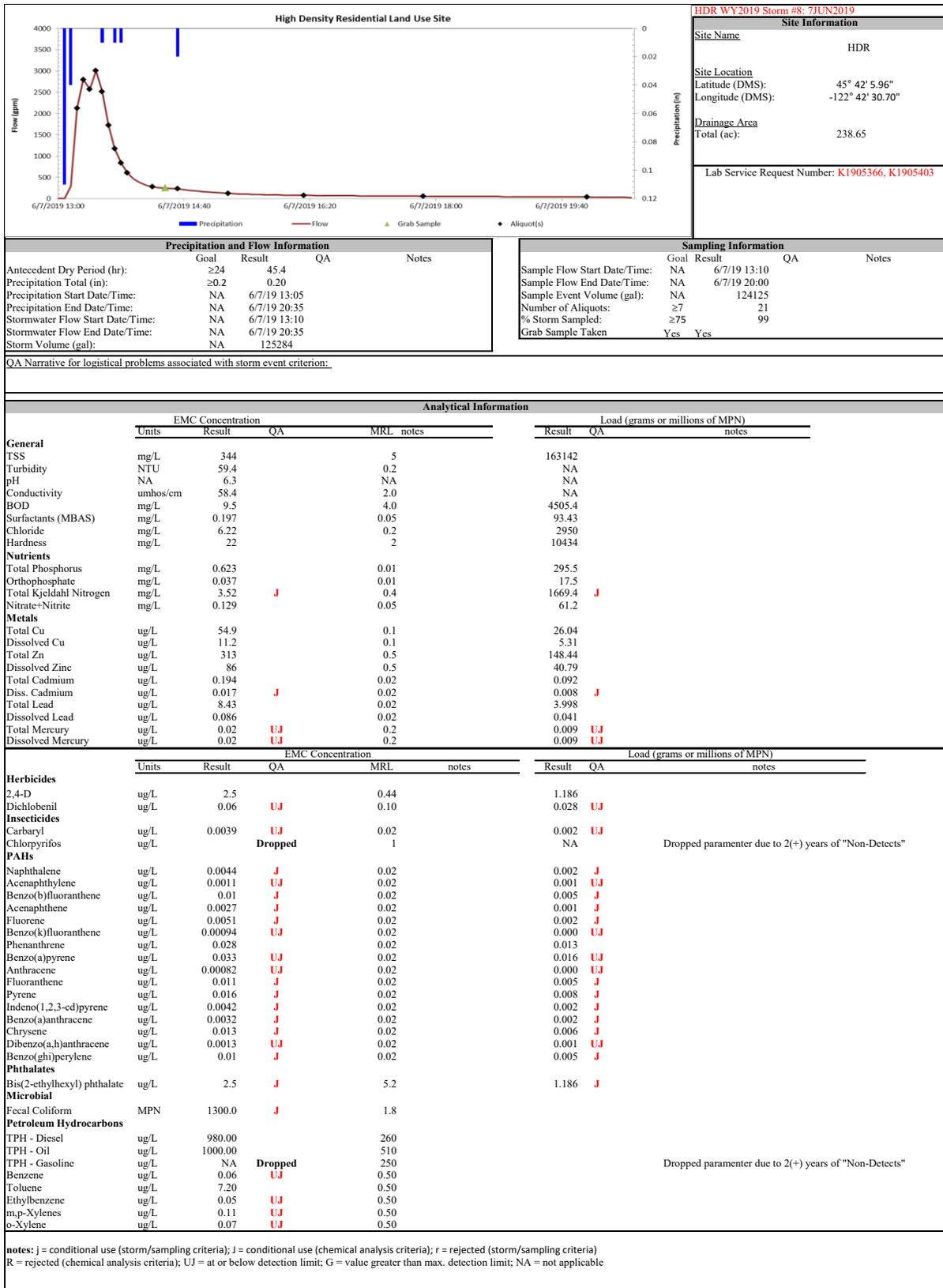
Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥24	456.1		
Precipitation Total (in):	≥0.2	0.65		
Precipitation Start Date/Time:	NA	10/5/18 9:15		
Precipitation End Date/Time:	NA	10/6/18 10:00		
Stormwater Flow Start Date/Time:	NA	10/5/18 13:55		
Stormwater Flow End Date/Time:	NA	10/6/18 5:30		
Storm Volume (gal):	NA	114128		

Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	10/5/18 13:55		
Sample Flow End Date/Time:	NA	10/6/18 2:00		
Sample Event Volume (gal):	NA	107859		
Number of Aliquots:	≥7	12		
% Storm Sampled:	≥75	95		
Grab Sample Taken	Yes	Yes		

QA Narrative for logistical problems associated with storm event criterion:

Analytical Information									
	EMC Concentration					Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes	
General									
TSS	mg/L	35.5		5		15337			
Turbidity	NTU	28.9		0.2		NA			
pH	NA	7.15		NA		NA			
Conductivity	umhos/cm	53.9		2.0		NA			
BOD	mg/L	5.5		4.0		2376.1			
Surfactants (MBAS)	mg/L	0.16		0.05		69.12			
Chloride	mg/L	3.31		0.2		1430			
Hardness	mg/L	24.4		2		10541			
Nutrients									
Total Phosphorus	mg/L	0.317		0.01		137.0			
Orthophosphate	mg/L	0.036		0.01		15.6			
Total Kjeldahl Nitrogen	mg/L	0.8		0.4		345.6			
Nitrate+Nitrite	mg/L	0.313		0.05		135.2			
Metals									
Total Cu	ug/L	17.2		0.1		7.43			
Dissolved Cu	ug/L	10.2		0.1		4.41			
Total Zn	ug/L	176		0.5		76.04			
Dissolved Zinc	ug/L	118		0.5		50.98			
Total Cadmium	ug/L	0.17	J	0.02		0.073	J		
Diss. Cadmium	ug/L	0.035		0.02		0.015			
Total Lead	ug/L	1.2		0.02		0.518			
Dissolved Lead	ug/L	0.138		0.02		0.060			
Total Mercury	ug/L	0.02	UJ	0.2		0.009	UJ		
Dissolved Mercury	ug/L	0.02	UJ	0.2		0.009	UJ		
	EMC Concentration					Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes	
Herbicides									
2,4-D	ug/L	0.49		0.44		0.212			
Dichlobenil	ug/L	0.06	UJ	0.10		0.026	UJ		
Insecticides									
Carbaryl	ug/L	0.0047	J	0.02		0.002	J		
Chlorpyrifos	ug/L		Dropped	1		NA		Dropped parameter due to 2(+) years of "Non-Detects"	
PAHs									
Naphthalene	ug/L	0.0045	J	0.02		0.002	J		
Acenaphthylene	ug/L	0.0022	UJ	0.02		0.001	UJ		
Benzo(b)fluoranthene	ug/L	0.0017	UJ	0.02		0.001	UJ		
Acenaphthene	ug/L	0.0024	UJ	0.02		0.001	UJ		
Fluorene	ug/L	0.0022	UJ	0.02		0.001	UJ		
Benzo(k)fluoranthene	ug/L	0.0019	UJ	0.02		0.001	UJ		
Phenanthrene	ug/L	0.0054	J	0.02		0.002	J		
Benzo(a)pyrene	ug/L	0.0022	UJ	0.02		0.001	UJ		
Anthracene	ug/L	0.0017	UJ	0.02		0.001	UJ		
Fluoranthene	ug/L	0.0027	J	0.02		0.001	J		
Pyrene	ug/L	0.0052	J	0.02		0.002	J		
Indeno(1,2,3-cd)pyrene	ug/L	0.0018	UJ	0.02		0.001	UJ		
Benzo(a)anthracene	ug/L	0.0065	J	0.02		0.003	J		
Chrysene	ug/L	0.0031	J	0.02		0.001	J		
Dibenzo(a,h)anthracene	ug/L	0.0026	UJ	0.02		0.001	UJ		
Benzo(ghi)perylene	ug/L	0.0018	UJ	0.02		0.001	UJ		
Phthalates									
Bis(2-ethylhexyl) phthalate	ug/L	1.5		5.2		0.648			
Microbial									
Fecal Coliform	MPN	92000	J	1.8					
Petroleum Hydrocarbons									
TPH - Diesel	ug/L	1700		260					
TPH - Oil	ug/L	3200		510					
TPH - Gasoline	ug/L	NA	Dropped	250				Dropped parameter due to 2(+) years of "Non-Detects"	
Benzene	ug/L	0.06	UJ	0.50					
Toluene	ug/L	0.79		0.50					
Ethylbenzene	ug/L	0.05	UJ	0.50					
m,p-Xylenes	ug/L	0.11	UJ	0.50					
o-Xylene	ug/L	0.07	UJ	0.50					

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable



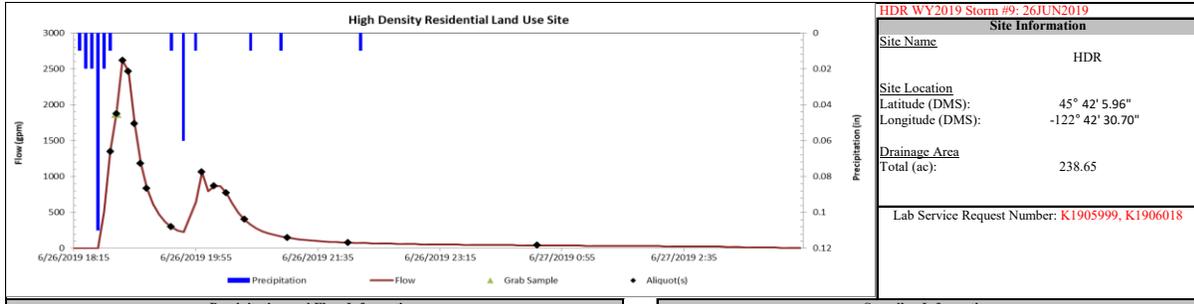
Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥24	45.4		
Precipitation Total (in):	≥0.2	0.20		
Precipitation Start Date/Time:	NA	6/7/19 13:05		
Precipitation End Date/Time:	NA	6/7/19 20:35		
Stormwater Flow Start Date/Time:	NA	6/7/19 13:10		
Stormwater Flow End Date/Time:	NA	6/7/19 20:35		
Storm Volume (gal):	NA	125284		

Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	6/7/19 13:10		
Sample Flow End Date/Time:	NA	6/7/19 20:00		
Sample Event Volume (gal):	NA	124125		
Number of Aliquots:	≥7	21		
% Storm Sampled:	≥75	99		
Grab Sample Taken	Yes	Yes		

QA Narrative for logistical problems associated with storm event criterion:

Analytical Information									
	EMC Concentration					Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes	
General									
TSS	mg/L	344		5		163142			
Turbidity	NTU	59.4		0.2		NA			
pH	NA	6.3		NA		NA			
Conductivity	umhos/cm	58.4		2.0		NA			
BOD	mg/L	9.5		4.0		4505.4			
Surfactants (MBAS)	mg/L	0.197		0.05		93.43			
Chloride	mg/L	6.22		0.2		2950			
Hardness	mg/L	22		2		10434			
Nutrients									
Total Phosphorus	mg/L	0.623		0.01		295.5			
Orthophosphate	mg/L	0.037		0.01		17.5			
Total Kjeldahl Nitrogen	mg/L	3.52	J	0.4		1669.4	J		
Nitrate+Nitrite	mg/L	0.129		0.05		61.2			
Metals									
Total Cu	ug/L	54.9		0.1		26.04			
Dissolved Cu	ug/L	11.2		0.1		5.31			
Total Zn	ug/L	313		0.5		148.44			
Dissolved Zinc	ug/L	86		0.5		40.79			
Total Cadmium	ug/L	0.194		0.02		0.092			
Diss. Cadmium	ug/L	0.017	J	0.02		0.008	J		
Total Lead	ug/L	8.43		0.02		3.998			
Dissolved Lead	ug/L	0.086		0.02		0.041			
Total Mercury	ug/L	0.02	UJ	0.2		0.009	UJ		
Dissolved Mercury	ug/L	0.02	UJ	0.2		0.009	UJ		
	EMC Concentration					Load (grams or millions of MPN)			
	Units	Result	QA	MRL	notes	Result	QA	notes	
Herbicides									
2,4-D	ug/L	2.5		0.44		1.186			
Dichlobenil	ug/L	0.06	UJ	0.10		0.028	UJ		
Insecticides									
Carbaryl	ug/L	0.0039	UJ	0.02		0.002	UJ		
Chlorpyrifos	ug/L		Dropped	1		NA		Dropped parameter due to 2(+) years of "Non-Detects"	
PAHs									
Naphthalene	ug/L	0.0044	J	0.02		0.002	J		
Acenaphthylene	ug/L	0.0011	UJ	0.02		0.001	UJ		
Benzo(b)fluoranthene	ug/L	0.01	J	0.02		0.005	J		
Acenaphthene	ug/L	0.0027	J	0.02		0.001	J		
Fluorene	ug/L	0.0051	J	0.02		0.002	J		
Benzo(k)fluoranthene	ug/L	0.00094	UJ	0.02		0.000	UJ		
Phenanthrene	ug/L	0.028		0.02		0.013			
Benzo(a)pyrene	ug/L	0.033	UJ	0.02		0.016	UJ		
Anthracene	ug/L	0.00082	UJ	0.02		0.000	UJ		
Fluoranthene	ug/L	0.011	J	0.02		0.005	J		
Pyrene	ug/L	0.016	J	0.02		0.008	J		
Indeno(1,2,3-cd)pyrene	ug/L	0.0042	J	0.02		0.002	J		
Benzo(a)anthracene	ug/L	0.0032	J	0.02		0.002	J		
Chrysene	ug/L	0.013	J	0.02		0.006	J		
Dibenzo(a,h)anthracene	ug/L	0.0013	UJ	0.02		0.001	UJ		
Benzo(ghi)perylene	ug/L	0.01	J	0.02		0.005	J		
Phthalates									
Bis(2-ethylhexyl) phthalate	ug/L	2.5	J	5.2		1.186	J		
Microbial									
Fecal Coliform	MPN	1300.0	J	1.8					
Petroleum Hydrocarbons									
TPH - Diesel	ug/L	980.00		260					
TPH - Oil	ug/L	1000.00		510					
TPH - Gasoline	ug/L	NA	Dropped	250				Dropped parameter due to 2(+) years of "Non-Detects"	
Benzene	ug/L	0.06	UJ	0.50					
Toluene	ug/L	7.20		0.50					
Ethylbenzene	ug/L	0.05	UJ	0.50					
m,p-Xylenes	ug/L	0.11	UJ	0.50					
o-Xylene	ug/L	0.07	UJ	0.50					

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable



HDR WY2019 Storm #9: 26JUN2019	
Site Information	
Site Name	HDR
Site Location	
Latitude (DMS):	45° 42' 5.96"
Longitude (DMS):	-122° 42' 30.70"
Drainage Area	
Total (ac):	238.65
Lab Service Request Number: K1905999, K1906018	

Precipitation and Flow Information				
	Goal	Result	QA	Notes
Antecedent Dry Period (hr):	≥24	435.8		
Precipitation Total (in):	≥0.2	0.30		
Precipitation Start Date/Time:	NA	6/26/19 18:20		
Precipitation End Date/Time:	NA	6/27/19 4:10		
Stormwater Flow Start Date/Time:	NA	6/26/19 18:35		
Stormwater Flow End Date/Time:	NA	6/27/19 4:10		
Storm Volume (gal):	NA	136168		

Sampling Information				
	Goal	Result	QA	Notes
Sample Flow Start Date/Time:	NA	6/26/19 18:35		
Sample Flow End Date/Time:	NA	6/26/19 22:00		
Sample Event Volume (gal):	NA	130403		
Number of Aliquots:	≥7	15		
% Storm Sampled:	≥75	96		
Grab Sample Taken	Yes	Yes		

QA Narrative for logistical problems associated with storm event criterion:

Analytical Information										
	EMC Concentration				Load (grams or millions of MPN)					
	Units	Result	QA	MRL	notes	Result	QA	Result	QA	
General										
TSS	mg/L	186		5				95874		
Turbidity	NTU	47.4		0.2				NA		
pH	NA	6.65		NA				NA		
Conductivity	umhos/cm	85.9		2.0				NA		
BOD	mg/L	15		4.0				7731.8		
Surfactants (MBAS)	mg/L	0.204		0.05				105.15		
Chloride	mg/L	8.91		0.2				4593		
Hardness	mg/L	30		2				15464		
Nutrients										
Total Phosphorus	mg/L	0.481		0.01				247.9		
Orthophosphate	mg/L	0.09		0.01				46.4		
Total Kjeldahl Nitrogen	mg/L	3.8	J	0.4				1958.7	J	
Nitrate+Nitrite	mg/L	0.307		0.05				158.2		
Metals										
Total Cu	ug/L	55.4		0.1				28.56		
Dissolved Cu	ug/L	21.6		0.1				11.13		
Total Zn	ug/L	276		0.5				142.27		
Dissolved Zinc	ug/L	130		0.5				67.01		
Total Cadmium	ug/L	0.126		0.02				0.065		
Diss. Cadmium	ug/L	0.039		0.02				0.020		
Total Lead	ug/L	4.84		0.02				2.495		
Dissolved Lead	ug/L	0.216		0.02				0.111		
Total Mercury	ug/L	0.02	UJ	0.2				0.010	UJ	
Dissolved Mercury	ug/L	0.02	UJ	0.2				0.010	UJ	
Herbicides										
2,4-D	ug/L	5.2		0.44				2.680		
Dichlobenil	ug/L	0.06	UJ	0.10				0.031	UJ	
Insecticides										
Carbaryl	ug/L	0.016	J	0.02				0.008	J	
Chlorpyrifos	ug/L		Dropped	1				NA		Dropped parameter due to 2(+) years of "Non-Detects"
PAHs										
Naphthalene	ug/L	0.0038	J	0.02				0.002	J	
Acenaphthylene	ug/L	0.0022	UJ	0.02				0.001	UJ	
Benzo(b)fluoranthene	ug/L	0.0042	J	0.02				0.002	J	
Acenaphthene	ug/L	0.0024	UJ	0.02				0.001	UJ	
Fluorene	ug/L	0.0036	J	0.02				0.002	J	
Benzo(k)fluoranthene	ug/L	0.0019	UJ	0.02				0.001	UJ	
Phenanthrene	ug/L	0.015	J	0.02				0.008	J	
Benzo(a)pyrene	ug/L	0.017	J	0.02				0.009	J	
Anthracene	ug/L	0.0017	UJ	0.02				0.001	UJ	
Fluoranthene	ug/L	0.0053	J	0.02				0.003	J	
Pyrene	ug/L	0.0079	J	0.02				0.004	J	
Indeno(1,2,3-cd)pyrene	ug/L	0.0018	UJ	0.02				0.001	UJ	
Benzo(a)anthracene	ug/L	0.021	J	0.02				0.011	J	
Chrysene	ug/L	0.0016	UJ	0.02				0.001	UJ	
Dibenzo(a,h)anthracene	ug/L	0.0026	UJ	0.02				0.001	UJ	
Benzo(ghi)perylene	ug/L	0.0033	J	0.02				0.002	J	
Phthalates										
Bis(2-ethylhexyl) phthalate	ug/L	4.2	J	5.2				2.165	J	
Microbial										
Fecal Coliform	MPN	46000.0	J	1.8						
Petroleum Hydrocarbons										
TPH - Diesel	ug/L	1600.00		260						
TPH - Oil	ug/L	2700.00		510						
TPH - Gasoline	ug/L	NA	Dropped	250						Dropped parameter due to 2(+) years of "Non-Detects"
Benzene	ug/L	0.06	UJ	0.50						
Toluene	ug/L	2.40		0.50						
Ethylbenzene	ug/L	0.05	UJ	0.50						
m,p-Xylenes	ug/L	0.11	UJ	0.50						
o-Xylene	ug/L	0.07	UJ	0.50						

notes: j = conditional use (storm/sampling criteria); J = conditional use (chemical analysis criteria); r = rejected (storm/sampling criteria)
 R = rejected (chemical analysis criteria); UJ = at or below detection limit; G = value greater than max. detection limit; NA = not applicable

Appendix 3 S8B Water Year 2019 Sediment Analyses Results

S8B Water Yr. 2019 Sediment Chemical Analysis Results for COM (GM34921) and HDR (MH5171)

SITE	SAMPLE RETRIEVAL	ANALYTE	RESULT	UNITS	ANOTE.	DETECTION LIMIT	REPORTING LIMIT
GM34921	5/21/2019 9:30	2,6-Dimethylnaphthalene	31	ug/kg		1.4	13
MH5171	5/21/2019 10:30	2,6-Dimethylnaphthalene	8.8	ug/kg	J	1.1	9.9
GM34921	5/21/2019 9:30	2-Methylnaphthalene	32	ug/kg		0.95	13
MH5171	5/21/2019 10:30	2-Methylnaphthalene	5.8	ug/kg	J	0.74	9.9
GM34921	5/21/2019 9:30	Benzo(a)anthracene	290	ug/kg		0.59	13
MH5171	5/21/2019 10:30	Benzo(a)anthracene	14	ug/kg		0.46	9.9
GM34921	5/21/2019 9:30	Benzo(a)pyrene	160	ug/kg		0.98	13
MH5171	5/21/2019 10:30	Benzo(a)pyrene	33	ug/kg		0.76	9.9
GM34921	5/21/2019 9:30	Benzo(b)fluoranthene	230	ug/kg		0.98	13
MH5171	5/21/2019 10:30	Benzo(b)fluoranthene	46	ug/kg		0.76	9.9
GM34921	5/21/2019 9:30	Benzo(ghi)perylene	320	ug/kg		1.1	13
MH5171	5/21/2019 10:30	Benzo(ghi)perylene	68	ug/kg		0.8	9.9
GM34921	5/21/2019 9:30	Bifenthrin	ND	ug/kg	U		50
MH5171	5/21/2019 10:30	Bifenthrin	ND	ug/kg	U		20
GM34921	5/21/2019 9:30	Cadmium	0.914	mg/kg		0.006	0.017
MH5171	5/21/2019 10:30	Cadmium	0.334	mg/kg		0.005	0.013
GM34921	5/21/2019 9:30	Chrysene	290	ug/kg		0.8	13
MH5171	5/21/2019 10:30	Chrysene	70	ug/kg		0.62	9.9
GM34921	5/21/2019 9:30	Copper	96.8	mg/kg		0.035	0.087
MH5171	5/21/2019 10:30	Copper	54.1	mg/kg		0.027	0.066
GM34921	5/21/2019 9:30	Diesel Range Organics (DRO)	1200	mg/kg		32	660
MH5171	5/21/2019 10:30	Diesel Range Organics (DRO)	270	mg/kg	J	24	500
GM34921	5/21/2019 9:30	Fluoranthene	310	ug/kg		1.7	13
MH5171	5/21/2019 10:30	Fluoranthene	32	ug/kg		1.3	9.9
GM34921	5/21/2019 9:30	Lead	46.8	mg/kg		0.017	0.043
MH5171	5/21/2019 10:30	Lead	16	mg/kg		0.013	0.033
GM34921	5/21/2019 9:30	Mercury	0.057	mg/kg		0.005	0.052
MH5171	5/21/2019 10:30	Mercury	0.035	mg/kg	J	0.004	0.038
GM34921	5/21/2019 9:30	Naphthalene	46	ug/kg		1.3	13
MH5171	5/21/2019 10:30	Naphthalene	6.4	ug/kg	J	0.94	9.9
GM34921	5/21/2019 9:30	PCB-aroclor 1016	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1016	ND	ug/kg	U	26	40
GM34921	5/21/2019 9:30	PCB-aroclor 1221	ND	ug/kg	U	39	270
MH5171	5/21/2019 10:30	PCB-aroclor 1221	ND	ug/kg	U	12	79
GM34921	5/21/2019 9:30	PCB-aroclor 1232	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1232	ND	ug/kg	U	28	40
GM34921	5/21/2019 9:30	PCB-aroclor 1242	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1242	ND	ug/kg	U	36	40
GM34921	5/21/2019 9:30	PCB-aroclor 1248	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1248	ND	ug/kg	U	54	54
GM34921	5/21/2019 9:30	PCB-aroclor 1254	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1254	ND	ug/kg	U	24	40
GM34921	5/21/2019 9:30	PCB-aroclor 1260	ND	ug/kg	U	39	140
MH5171	5/21/2019 10:30	PCB-aroclor 1260	ND	ug/kg	U	16	40
GM34921	5/21/2019 9:30	Phenanthrene	210	ug/kg		1.6	13
MH5171	5/21/2019 10:30	Phenanthrene	32	ug/kg		1.2	9.9
GM34921	5/21/2019 9:30	Pyrene	430	ug/kg		0.82	13
MH5171	5/21/2019 10:30	Pyrene	47	ug/kg		0.64	9.9
GM34921	5/21/2019 9:30	Residual Range Organics (RRO)	8400	mg/kg		77	2700
MH5171	5/21/2019 10:30	Residual Range Organics (RRO)	1800	mg/kg		58	1000
GM34921	5/21/2019 9:30	Total Organic Carbon	17.2	(%)		0.02	0.05
MH5171	5/21/2019 10:30	Total Organic Carbon	7.17	(%)		0.02	0.05
GM34921	5/21/2019 9:30	Total phosphorus	1190	mg/kg		6	26
MH5171	5/21/2019 10:30	Total phosphorus	1330	mg/kg		10	48
GM34921	5/21/2019 9:30	Total Solids	37.6	(%)			
MH5171	5/21/2019 10:30	Total Solids	49.5	(%)			
GM34921	5/21/2019 9:30	Total Volatile Solids	31.3	(%)		0.022	0.022
MH5171	5/21/2019 10:30	Total Volatile Solids	18.2	(%)		0.022	0.022
GM34921	5/21/2019 9:30	Zinc	690	mg/kg		0.17	0.43
MH5171	5/21/2019 10:30	Zinc	773	mg/kg		0.13	0.33

S8B WY2019 Sediment Grain Size Analysis – percentage of Total Weight Recovered by Particle Size

SITE	SAMPLE RETRIEVAL	ANALYTE	RESULT (PERCENT OF TOTAL WEIGHT RECOVERED)	SIZE GROUP SUBTOTAL PERCENT (TOTAL %)*
COM	5/21/19 9:30	Particle/Grain Size, Gravel or Larger (Phi Scale < -1)	7.75	7.5%
		Particle/Grain Size, Very Coarse Sand (Phi Scale -1 to 0)	7.1	
		Particle/Grain Size, Coarse Sand (Phi Scale 0 to 1)	12.48	
		Particle/Grain size, Medium Sand (Phi Scale 1 to 2)	15.99	
		Particle/Grain Size, Fine Sand (Phi Scale 2 to 3)	10.39	
		Particle/Grain Size, Very Fine Sand (Phi Scale 3 to 4)	9.16	53.3%
		Particle/Grain Size, Coarse Silt 31.3 to 62.5 µm (Phi Scale 4 to 5)	10.72	
		Particle/Grain Size, Medium Silt 16 to 31.3 µm (Phi Scale 5 to 6)	11.78	
		Particle/Grain size, Fine Silt 7.8 to 15.6 µm (Phi Scale 6 to 7)	9.58	
		Particle/Grain Size, Very Fine Silt 3.9 to 7.8 µm (Phi Scale 7 to 8)	5.27	36.1%
		Particle/Grain Size, Clay 1.95 to 3.9 µm (Phi Scale 8 to 9)	2.33	
		Particle/Grain Size, Clay 0.98 to 1.95 µm (Phi Scale 9 to 10)	0.53	
		Particle/Grain Size, Colloid up to 0.98 µm (Phi Scale > 10)	0.31	3.1%
Particle/Grain Size, Gravels thru Colloid up to 0.98 µm (Phi Scale <-1 thru > 10)				(103.4%)
HDR	5/21/19 10:30	Particle/Grain Size, Gravel or Larger (Phi Scale < -1)	25.23	19.2%
		Particle/Grain Size, Very Coarse Sand (Phi Scale -1 to 0)	31	
		Particle/Grain Size, Coarse Sand (Phi Scale 0 to 1)	33.64	
		Particle/Grain size, Medium Sand (Phi Scale 1 to 2)	21.77	
		Particle/Grain Size, Fine Sand (Phi Scale 2 to 3)	8.43	
		Particle/Grain Size, Very Fine Sand (Phi Scale 3 to 4)	4.52	75.5%
		Particle/Grain Size, Coarse Silt 31.3 to 62.5 µm (Phi Scale 4 to 5)	2.34	
		Particle/Grain Size, Medium Silt 16 to 31.3 µm (Phi Scale 5 to 6)	1.77	
		Particle/Grain size, Fine Silt 7.8 to 15.6 µm (Phi Scale 6 to 7)	1.67	
		Particle/Grain Size, Very Fine Silt 3.9 to 7.8 µm (Phi Scale 7 to 8)	0.6	4.8%
		Particle/Grain Size, Clay 1.95 to 3.9 µm (Phi Scale 8 to 9)	0.2	
		Particle/Grain Size, Clay 0.98 to 1.95 µm (Phi Scale 9 to 10)	0.13	
		Particle/Grain Size, Colloid up to 0.98 µm (Phi Scale > 10)	0.3	0.5%
Particle/Grain Size, Gravels thru Colloid up to 0.98 µm (Phi Scale <-1 thru > 10)				(131.6%)

* The totals of the individual particle size category percentages may differ from 100% due to overall laboratory expected recoveries being between 90 and 110%.

Appendix 4 S8B Water Year 2019 Seasonal and Annual Loads

Water Year 2019 Commercial Site Seasonal and Annual Loading Summary*

COM WY2018 PARAMETER	DRY SEASON			WET SEASON			TOTAL ANNUAL LOAD		
	Load (g)	Load (lbs)	Areal Load (lbs/acre)	Load (g)	Load (lbs)	Areal Load (lbs/acre)	Load (g)	Load (lbs)	Areal Load (lbs/acre)
2,4-D	1.06E+00	2.32E-03	8.68E-05	4.12E+00	9.06E-03	3.38E-04	5.17E+00	1.14E-02	4.25E-04
Acenaphthene	1.28E-02	2.82E-05	1.05E-06	6.24E-02	1.37E-04	5.13E-06	7.52E-02	1.66E-04	6.18E-06
Acenaphthylene	9.78E-03	2.15E-05	8.04E-07	2.18E-01	4.79E-04	1.79E-05	2.28E-01	5.01E-04	1.87E-05
Anthracene	* More than 50% of this analyte's results were non-detects so loading not calculated for this analyte								
Benzo(a)anthracene	4.84E-02	1.07E-04	3.98E-06	1.77E-01	3.89E-04	1.45E-05	2.25E-01	4.95E-04	1.85E-05
Benzo(a)pyrene	9.62E-02	2.12E-04	7.91E-06	2.12E-01	4.66E-04	1.74E-05	3.08E-01	6.78E-04	2.53E-05
Benzo(b)fluoranthene	1.58E-01	3.47E-04	1.30E-05	4.43E-01	9.74E-04	3.64E-05	6.01E-01	1.32E-03	4.94E-05
Benzo(ghi)perylene	1.90E-01	4.19E-04	1.56E-05	6.23E-01	1.37E-03	5.12E-05	8.14E-01	1.79E-03	6.69E-05
Benzo(k)fluoranthene	3.41E-02	7.51E-05	2.80E-06	1.11E-01	2.45E-04	9.15E-06	1.45E-01	3.20E-04	1.20E-05
Bis(2-ethylhexyl) phthalate	3.33E+01	7.33E-02	2.74E-03	7.25E+01	1.60E-01	5.96E-03	1.06E+02	2.33E-01	8.70E-03
BOD	2.58E+04	5.67E+01	2.12E+00	6.48E+04	1.43E+02	5.33E+00	9.06E+04	1.99E+02	7.45E+00
Carbaryl	* More than 50% of this analyte's results were non-detects so loading not calculated for this analyte								
Chloride	9.07E+03	1.99E+01	7.45E-01	2.19E+04	4.81E+01	1.80E+00	3.09E+04	6.81E+01	2.54E+00
Chlorpyrifos	Discontinued this analyte monitoring due to more than 2 years of results below Ecology method reporting limit								
Chrysene	3.48E-01	7.66E-04	2.86E-05	3.07E-01	6.75E-04	2.52E-05	6.55E-01	1.44E-03	5.38E-05
Dibenzo(a,h)anthracene	* More than 50% of this analyte's results were non-detects so loading not calculated for this analyte								
Dichlobenil	Discontinued this analyte monitoring due to more than 2 years of results below Ecology method reporting limit								
Dissolved Cadmium	1.35E-01	2.98E-04	1.11E-05	4.34E-01	9.54E-04	3.57E-05	5.69E-01	1.25E-03	4.68E-05
Dissolved Copper	3.90E+01	8.59E-02	3.21E-03	1.03E+02	2.28E-01	8.50E-03	1.42E+02	3.13E-01	1.17E-02
Dissolved Lead	4.85E-01	1.07E-03	3.99E-05	2.38E+00	5.23E-03	1.95E-04	2.86E+00	6.30E-03	2.35E-04
Dissolved Mercury	Discontinued this analyte monitoring due to more than 2 years of results below Ecology method reporting limit								
Dissolved Zinc	2.28E+02	5.02E-01	1.88E-02	5.74E+02	1.26E+00	4.72E-02	8.03E+02	1.77E+00	6.60E-02
Fluoranthene	2.36E-01	5.19E-04	1.94E-05	7.79E-01	1.71E-03	6.40E-05	1.01E+00	2.23E-03	8.34E-05
Fluorene	2.76E-02	6.06E-05	2.27E-06	1.28E-01	2.83E-04	1.06E-05	1.56E-01	3.43E-04	1.28E-05
Hardness	1.04E+05	2.29E+02	8.57E+00	2.84E+05	6.25E+02	2.33E+01	3.88E+05	8.54E+02	3.19E+01
Indeno(1,2,3-cd)pyrene	7.52E-02	1.65E-04	6.18E-06	2.30E-01	5.07E-04	1.89E-05	3.06E-01	6.72E-04	2.51E-05
Naphthalene	4.93E-02	1.08E-04	4.05E-06	3.29E-01	7.24E-04	2.71E-05	3.79E-01	8.33E-04	3.11E-05
Nitrate+Nitrite	1.83E+03	4.02E+00	1.50E-01	5.27E+03	1.16E+01	4.33E-01	7.10E+03	1.56E+01	5.83E-01
Orthophosphate	6.75E+01	1.48E-01	5.54E-03	3.71E+02	8.16E-01	3.05E-02	4.38E+02	9.64E-01	3.60E-02
Phenanthrene	2.13E-01	4.69E-04	1.75E-05	7.78E-01	1.71E-03	6.39E-05	9.91E-01	2.18E-03	8.14E-05
Pyrene	4.11E-01	9.03E-04	3.37E-05	1.47E+00	3.24E-03	1.21E-04	1.88E+00	4.14E-03	1.55E-04
Surfactants (MBAS)	1.01E+03	2.22E+00	8.28E-02	2.15E+03	4.73E+00	1.77E-01	3.16E+03	6.95E+00	2.60E-01
Total Cadmium	1.06E+00	2.32E-03	8.68E-05	2.33E+00	5.12E-03	1.91E-04	3.38E+00	7.44E-03	2.78E-04
Total Copper	1.79E+02	3.93E-01	1.47E-02	3.13E+02	6.88E-01	2.57E-02	4.91E+02	1.08E+00	4.04E-02
Total Kjeldahl Nitrogen	1.16E+04	2.56E+01	9.57E-01	2.21E+04	4.86E+01	1.82E+00	3.37E+04	7.42E+01	2.77E+00
Total Lead	6.76E+01	1.49E-01	5.56E-03	9.76E+01	2.15E-01	8.02E-03	1.65E+02	3.64E-01	1.36E-02
Total Mercury	Discontinued this analyte monitoring due to more than 2 years of results below Ecology method reporting limit								
Total Phosphorus	2.34E+03	5.15E+00	1.92E-01	3.74E+03	8.22E+00	3.07E-01	6.08E+03	1.34E+01	5.00E-01
Total Zinc	1.08E+03	2.37E+00	8.87E-02	1.78E+03	3.91E+00	1.46E-01	2.86E+03	6.29E+00	2.35E-01
Total Suspended Solids	1.41E+06	3.09E+03	1.15E+02	1.19E+06	2.61E+03	9.75E+01	2.59E+06	5.70E+03	2.13E+02

*Parameters with more than half of their analytical results reported as non-detects are not included in the loading calculations.

WY 2019 High Density Residential Site Seasonal and Annual Loading Summary*

HDR WY2018 PARAMETER	DRY SEASON			WET SEASON			TOTAL ANNUAL LOAD		
	Load (g)	Load (lbs)	Areal Load (lbs/acre)	Load (g)	Load (lbs)	Areal Load (lbs/acre)	Load (g)	Load (lbs)	Areal Load (lbs/acre)
2,4-D	6.45E+01	1.42E-01	5.94E-04	1.85E+01	4.06E-02	1.70E-04	8.29E+01	1.82E-01	7.64E-04
Acenaphthene	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Acenaphthylene	2.76E-02	6.07E-05	2.55E-07	1.86E-01	4.09E-04	1.71E-06	2.14E-01	4.70E-04	1.97E-06
Anthracene	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Benzo(a)anthracene	2.05E-01	4.51E-04	1.89E-06	2.38E-01	5.23E-04	2.19E-06	4.43E-01	9.74E-04	4.08E-06
Benzo(a)pyrene	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Benzo(b)fluoranthene	1.16E-01	2.55E-04	1.07E-06	2.59E-01	5.69E-04	2.38E-06	3.75E-01	8.25E-04	3.45E-06
Benzo(ghi)perylene	1.08E-01	2.38E-04	9.99E-07	2.59E-01	5.69E-04	2.39E-06	3.67E-01	8.08E-04	3.38E-06
Benzo(k)fluoranthene	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Bis(2-ethylhexyl) phthalate	5.59E+01	1.23E-01	5.15E-04	2.16E+02	4.74E-01	1.99E-03	2.72E+02	5.97E-01	2.50E-03
BOD	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Carbaryl	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Chloride	1.26E+05	2.77E+02	1.16E+00	1.70E+05	3.74E+02	1.57E+00	2.96E+05	6.51E+02	2.73E+00
Chlorpyrifos	Discontinued this analyte monitoring due to more than 2 years of results below Ecology method reporting limit								
Chrysene	1.18E-01	2.59E-04	1.09E-06	2.38E-01	5.24E-04	2.19E-06	3.56E-01	7.83E-04	3.28E-06
Dibenzo(a,h)anthracene	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Dichlobenil	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Dissolved Cadmium	4.69E-01	1.03E-03	4.33E-06	1.15E+00	2.54E-03	1.06E-05	1.62E+00	3.57E-03	1.50E-05
Dissolved Copper	2.74E+02	6.03E-01	2.53E-03	3.30E+02	7.25E-01	3.04E-03	6.04E+02	1.33E+00	5.57E-03
Dissolved Lead	2.53E+00	5.58E-03	2.34E-05	4.30E+00	9.47E-03	3.97E-05	6.84E+00	1.50E-02	6.30E-05
Dissolved Mercury	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Dissolved Zinc	1.80E+03	3.96E+00	1.66E-02	5.53E+03	1.22E+01	5.09E-02	7.33E+03	1.61E+01	6.75E-02
Fluoranthene	1.33E-01	2.94E-04	1.23E-06	3.26E-01	7.18E-04	3.01E-06	4.60E-01	1.01E-03	4.24E-06
Fluorene	7.17E-02	1.58E-04	6.61E-07	2.37E-01	5.22E-04	2.19E-06	3.09E-01	6.80E-04	2.85E-06
Hardness	4.33E+05	9.52E+02	3.99E+00	9.41E+05	2.07E+03	8.67E+00	1.37E+06	3.02E+03	1.27E+01
Indeno(1,2,3-cd)pyrene	4.91E-02	1.08E-04	4.52E-07	1.84E-01	4.04E-04	1.69E-06	2.33E-01	5.12E-04	2.14E-06
Naphthalene	6.77E-02	1.49E-04	6.24E-07	7.96E-01	1.75E-03	7.34E-06	8.64E-01	1.90E-03	7.97E-06
Nitrate+Nitrite	3.66E+03	8.04E+00	3.37E-02	9.97E+03	2.19E+01	9.19E-02	1.36E+04	3.00E+01	1.26E-01
Orthophosphate	1.07E+03	2.34E+00	9.82E-03	2.61E+03	5.75E+00	2.41E-02	3.68E+03	8.09E+00	3.39E-02
Phenanthrene	3.53E-01	7.76E-04	3.25E-06	8.71E-01	1.92E-03	8.03E-06	1.22E+00	2.69E-03	1.13E-05
Pyrene	1.96E-01	4.31E-04	1.81E-06	4.66E-01	1.03E-03	4.30E-06	6.62E-01	1.46E-03	6.10E-06
Surfactants (MBAS)	3.32E+03	7.31E+00	3.06E-02	5.10E+03	1.12E+01	4.70E-02	8.42E+03	1.85E+01	7.76E-02
Total Cadmium	2.63E+00	5.79E-03	2.43E-05	3.66E+00	8.05E-03	3.37E-05	6.29E+00	1.38E-02	5.80E-05
Total Copper	9.13E+02	2.01E+00	8.42E-03	7.57E+02	1.67E+00	6.98E-03	1.67E+03	3.68E+00	1.54E-02
Total Kjeldahl Nitrogen	6.07E+04	1.34E+02	5.59E-01	5.41E+04	1.19E+02	4.99E-01	1.15E+05	2.53E+02	1.06E+00
Total Lead	1.09E+02	2.40E-01	1.00E-03	6.36E+01	1.40E-01	5.86E-04	1.73E+02	3.80E-01	1.59E-03
Total Mercury	* More than 50%of this analyte's results were non-detects so loading not calculated for this analyte								
Total Phosphorus	9.10E+03	2.00E+01	8.39E-02	1.08E+04	2.38E+01	9.97E-02	1.99E+04	4.38E+01	1.84E-01
Total Zinc	4.87E+03	1.07E+01	4.49E-02	8.64E+03	1.90E+01	7.96E-02	1.35E+04	2.97E+01	1.25E-01
Total Suspended Solids	4.51E+06	9.92E+03	4.16E+01	1.85E+06	4.08E+03	1.71E+01	6.36E+06	1.40E+04	5.87E+01

*Parameters with more than half of their analytical results reported as non-detects are not included in the loading calculations.

Appendix 5 Calendar Year 2019 Stormwater Facility Inspections and Maintenance Upstream from two S8B Monitoring Sites

Facility ID	Facility Type	Private or Public Owner	Facility Name	Street Address	Installation Date	Recent Inspection Date(s)	Passed Inspection	Maintenance Needed
Commercial								
FA417	Biofiltration Swale	Private	Avalon Condos	NE 88th St	7/9/1992	6/5/19	Yes	No.
FA1479	Wet Pond	Private	Big 5 Hazel Dell	NE 13th Ave	3/3/2006	9/3/19	Yes	No
FA1578	Inline Storage & Biofilt. Swale	Private	Hazel Dell Brew Pub Expansion	NE Highway 99	11/23/1999	9/3/19	No	Yes
FA3255 FA3256	Grass Biofiltration Strips	Private	Hazel Dell Brew Pub S. & N. of Driveway	NE Highway 99	10/1/1992	9/3/19	Yes	No
FA2411	Cartridge Filter Catch Basin & Undrgrd. Detent.	Private	88th Street Development	NE 88th St	5/29/2008	9/12/19	Yes	No
FA2768	Bioswale & Undrgrd. Detent.	Private	Childrens Village Day School A	NE Highway 99 and NE 86 th St	3/17/2010	10/30/19	Yes	No
High Density Residential								
FA8	Biofil. Swale and Detention Pond	Clark County Public Works	Felida Village	NW 33rd Ave	2/1/1999	10/28/19	Yes	No
FA73	Biofiltration Swale	Clark County Public Works	Mar-Clare Estates	NW 26th Ave	10/21/1992	10/28/19	Yes	No
FA98	Biofilt. Swale and Detention Pond	Clark County Public Works	Felida View	NW 27th Ct	12/1/2000	10/28/19	Yes	No
FA796	Biofilt. Swale and Detention Pond	Clark County Public Works	Lake River Terrace	NW 35th Ave	2/1/1999	10/28/19	No	Yes
FA1222	Wet Pond	Clark County Public Works	Felida Green	NW 29th Ct	3/23/2005	10/28/19	No	Yes
FA1223	Biofiltration Swale	Clark County Public Works	Tiare Hills IV	NW 27th Ct	12/29/1994	10/28/19	Yes	No
FA3383	Bioretention	Clark County Public Works	Felida View Townhomes	3001 NW 117 th Circle	9/10/2015	10/28/19	Yes	No
FA3382	Bioretention	Private	Felida View Townhomes	NW 29 th Ct	9/10/2015	10/14/19	Yes	No
FA20	Biofiltration Swale	Clark County Public Works	Millers Edge	11014 NW 36 th Ave	12/21/1999	10/24/19	Yes	No

