Annual Industrial Stormwater Monitoring Report

Seattle-Tacoma International Airport

For the Period July 1, 2019 through June 30, 2020

September 30, 2020

Prepared by

Aviation Environmental Programs

Port of Seattle

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EXECUTIVE SUMMARY

This Annual Industrial Stormwater Monitoring Report provides a summary of industrial monitoring results conducted pursuant to Part 2, Condition S2.G of the National Pollutant Discharge Elimination System (NPDES) permit for the Port of Seattle's (Port) Seattle-Tacoma International Airport (SEA) NPDES Permit WA0024651. Industrial stormwater discharges authorized under Part 2 of the permit include runoff associated with roads, runways, taxiways, airfield, rooftops, cargo operations, flight kitchens, and other areas associated with airport industrial activities, and excludes construction runoff and industrial wastewater discharges associated with ramp operations .

This report summarizes the results of stormwater sampling at outfalls listed in permit Condition 2S1 between July 1, 2019 and June 30, 2020 and satisfies the annual reporting requirement detailed in Part 2 Condition S2.G. Monitoring of construction activities, sanitary sewer discharges and the Industrial Wastewater System (IWS) are subject to other reporting requirements. Annual summaries of Part I IWS, Part I sanitary sewer monitoring results and Part 3 construction monitoring results are provided separately.

SEA met all required sampling collection and reporting requirements in the NPDES permit for the 2019-2020 data collection period. Stormwater samples are collected from eleven (11) outfalls which discharge to five (5) different receiving waters; Lake Reba, Miller Creek, Walker Creek, Northwest Ponds, and Des Moines Creek. A total of forty-five (45) grab and forty-four (44) composite stormwater samples from 11 storm events were collected in the past year with results reported on quarterly Discharge Monitoring Reports (DMRs). There were six (6) instances of permit limit exceedances associated with 223 individual constituent analyses.

In addition to routine NPDES monitoring required by Condition 2S1, the SEA conducted monitoring activities pursuant to other NPDES Part 2 permit conditions. *In situ* toxicity sampling (Condition 2S9) was conducted in the fall 2019 and spring 2020. Permit renewal toxicity sampling was collected as required by permit Conditions 2S7 and 2S8.A.

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1.0 INTRODUCTION

This Annual Report summarizes industrial stormwater monitoring results from the Seattle-Tacoma International Airport (SEA) as required by Part 1, Condition S2.F of the Airport's NPDES permit. The Permit authorizes discharges from airport industrial activities. Airport industrial activity areas include roads, runways, taxiways, airfield, rooftops, cargo operations, flight kitchens, and other areas associated with airport industrial activities. The purpose of this Annual Report is to present the monitoring results from discharges to the Airport's stormwater drainage system (SDS) outfalls identified in Part 2 of the NPDES permit. This Annual Report does not address discharges to the Airport's Industrial Wastewater System (IWS) or construction-related stormwater discharges.

The report covers samples collected in the 12-month period of July 2019 through June 2020. Outfall sampling results summarized in this report include data previously submitted to Ecology in the NPDES permit Part 2 Discharge Monitoring Reports (DMRs), plus additional stormwater sample data such as that from quality assurance sampling and samples that were analyzed for additional parameters not required by the Permit. These additional monitoring data are presented in Appendix B of this report. Toxicity monitoring and priority pollutant sampling as required by Part 2 of the NPDES permit are discussed but results will be contained in separate report submittals.

This report is organized into four sections following the introduction. Section 2 describes background conditions at the Airport including descriptions of each drainage subbasin and outfall sampling location. Section 3 presents all of the discharge monitoring report (DMR) related grab sample and composite sample analytical data collected during the reporting period and the rainfall totals for the period. Section 4 provides a summary of the effluent limit compliance and best management practices (BMP) implementation during the monitoring period. A summary and conclusion are provided in Section 5.

2.0 BACKGROUND

2.1 Seattle-Tacoma International Airport Drainage

Located mid-way between the cities of Seattle and Tacoma, Washington, SEA was built in the 1940s and is owned and operated by the Port. According to the Port's 2019 Airport Activity Report, SEA handled 450,487 aircraft operations, 453,547 metric tons of air cargo, and 51.8 million passengers. In 2019, the Federal Aviation Administration ranked SEA the eight busiest airport for passenger enplanements and eleventh busiest airport in the U.S. for aircraft operations.

Stormwater drainage at SEA is separated into two different collection systems, the Industrial Wastewater System (IWS) and the Storm Drainage System (SDS). The IWS receives stormwater runoff from the ramp and other areas involved with aircraft servicing and maintenance, providing treatment before discharge to Puget Sound through a separate outfall. Approximately 372 acres are diverted to the IWS.

The SDS drains over 1,200 acres. Half of this area is impervious and primarily associated with airport runways, taxiways, parking lots, roads and roof tops. The remainder is pervious which consists of landscaped or fallow open spaces and areas associated with stormwater treatment best management practices (BMPs) such as runway filterstrips. About 25 percent of the area drained by the SDS flows to Miller Creek. This drainage area represents about 7 percent of Miller Creek's watershed. Approximately 71 percent of the total SDS area drains to the Northwest Ponds and Des Moines Creek, which represents about 21 percent of the creek's watershed.

2.2 SEA Storm Drainage Subbasins, Activities, and Outfall Descriptions

The Airport's SDS is segregated into separate stormwater subbasins that each drain to individual outfall locations. The NPDES permit lists a total of thirteen (13) outfalls in two categories: Existing & New Outfalls and Subbasins, and Future Outfalls to be activated during future development. As of June 30, 2020, eleven (11) of the thirteen (13) outfalls are active and discharge stormwater related to industrial activity.

SEA stormwater subbasins are categorized according to their dominant activities: landside or airfield. These categories group subbasins together by similar land use and other characteristics. In general, passenger vehicle operations are absent from the airfield drainage subbasins while aircraft operations are absent from the landside subbasins. SDE4/S1 subbasin is an exception in that it includes both airfield and landside activities. Previous reports found that concentrations of total petroleum (TPH), total suspended solids (TSS) and other constituent concentrations were different for the landside and airfield categories (POS 1996a, 1997a.) Table 1, *SEA Subbasin Characteristics*, describes each active subbasin, receiving water, activities

within each subbasin, stormwater management BMPs, and total pervious and impervious surface areas. The physical location of the outfalls listed in Table 1 are shown on Figure 1 along with additional receiving water monitoring locations used for sublethal toxicity and *in situ* toxicity testing.

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDE4/S1	Des Moines Creek (East Branch)	Landside	Limited portions of the airfield taxiways.	Public roads, vehicle parking areas, rooftops (terminal, hangar, cargo) and landscaped areas.	41.5	138.1	179.6
SDD-06A	Des Moines Creek (East Branch)	Landside	Loading docks, vehicle maintenance, vehicle washing, equipment parking and maintenance.	Public roads, vehicle parking areas, rooftops (terminal, hangar, cargo) and landscaped areas.	18.2	27.2	45.3
SDN1	Miller Creek via Lake Reba	Landside	Flight service kitchen.	Public roads, building rooftops and vehicle parking.	3.8	14.9	18.6
SDS3/5	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, open areas and building rooftops.	206.3	250.6	456.8

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDS4	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Runway infield and open areas.	40.5	25.9	66.3
SDS6/7	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Access roads, runway infield and open areas.	68.9	48.2	117.1
SDN2/3/4[a]	Miller Creek via Lake Reba	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, access road, taxiway infield and open areas.	68.3	44.6	112.9
SDN3A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	23.1	8.1	31.2
SDW1A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	44.1	26.0	70.1

Table 1. SEA Subbasins Characteristics

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area[b] (acres)	Impervious Area[b] (acres)	Total Area[b, c] (acres)
SDW1B	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	59.5	25.0	84.5
SDW2	Walker Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	30.9	10.8	41.7
Note:				**Total Area**	**584.9**	**639.3**	**1224.1**

a) The SDN2 runoff is pumped to IWS for all flows up to the 6 month /24-hour event. The SDN2 subbasin comprises approximately 46.5 acres, 36.6 of which are impervious. This area is included in acreages reported to the IWS.
b) Subbasin areas as described in the NPDES permit and updated annually in the SEAs Stormwater Pollution Prevention Plan. Based on 2018 GIS analysis completed by Aspect consulting predominantly using a 2017 aerial.
c) Stormwater pond areas were not included in total acres. It is anticipated that ongoing changes resulting from planned construction will alter subbasin totals in the future.

Figure 1. Sampling Locations

3.0 SAMPLING RESULTS AND DISCUSSION

This section of the Annual Report summarizes the results of SDS outfall monitoring. All data summarized in this section has been reported to Ecology on quarterly DMRs and is included in Appendix A. Data generated from grab and composite samples are presented and discussed. These types of samples employ different protocols that represent different temporal periods of the particular stormwater discharge event and are therefore evaluated separately. Grab samples represent an instantaneous or short duration sampling period, while composites are collected over the storm event hydrograph to provide an event mean concentration (EMC).

In addition to the DMR data, this report summarizes other data collected at the outfalls listed in Part 2, 2S1 of the NPDES permit. These other data consist of field equipment blank samples, field duplicate samples, and other parameters collected during the monitoring period. These other data are presented in Appendix B. Section 3.2 of this report summarizes *in situ* toxicity testing at receiving water sites downstream of SEA outfalls.

3.1 Monitoring of Industrial Stormwater Discharges

3.1.1 Sampling Objectives and Procedures

Sampling protocols and locations have been selected to provide data consistent with the requirements of the NPDES permit and the representativeness criteria set forth in the *Quality Assurance Program Plan for Non-Construction Stormwater Runoff Monitoring* (QAPP) (Aspect Consulting, Inc. 2018. The monitoring locations were selected to represent stormwater downstream of the last (BMP) within each subbasin.

The QAPP describes the criteria for sampling storm events and describes all relevant sampling, programming, and handling necessary to satisfy the monitoring requirements of the permit. Table 2 lists the current constituents measured or analyzed, methods used, and detection limits. The SEA reports results on DMRs from storms and samples that were considered representative according to criteria specified in the QAPP.

SEA uses telemetry-based automatic samplers to collect a grab sample followed by a flow-weighted composite sample during rainstorms of 0.10 inches or greater that are preceded by less than 0.10 inch of rainfall in the previous 24 hours. These rainfall and antecedent sampling conditions are specified in the NPDES permit, Part 2, 2S2.B. Each grab or composite sample is analyzed for the constituents listed in Table 2 based on sample type as specified in the NPDES permit.

Table 2. Constituents, Methods and Detection Limits

Constituent	Method	Detection limit (MDL)	Sample Type	Effluent Limits
pH	150.1[(1)]	0.01 S.U.	Grab	6.5 – 8.5 S.U.[3]
Oil & Grease - TPH (by GC)	NWTPH-Dx[(2)]	0.75 mg/l	Grab	15 mg/L – no sheen
Turbidity	180.1[(1)]	0.05 NTU	Grab	25 NTUs
Total Recoverable Copper	200.8[(1)]	0.5 µg/l	flow-wt comp.	25.6 to 59.2 µg/l
Total Recoverable Zinc	200.8[(1)]	4.0 µg/l	flow-wt comp.	71.4 to 117 µg/l

1. Method refers to EPA-600/4-79-020 (U.S. EPA 1983 and updates).
2. Method reports both a motor oil fraction and diesel fraction. TPH-Dx is the sum of these two fractions.
3. Approved limits for pH at stations SDN3A, SDW1A, SDW1B, SDW2 are 6.3 to 9.0 S.U.

3.1.2 Field Quality Control Samples

SEA routinely collects field duplicate and equipment blank samples during NPDES sampling events in accordance with the QAPP. Appendix B summarizes these results. The results reflect on the efficacy of the SEA's "clean" sampling methods developed for stormwater monitoring relative to metals (POS 1999).

Nineteen (19) Field Quality Control samples were collected in the 2019 – 2020 reporting period. There were no anomalies associated with samples collected during these same storm events.

Permit Effluent Limits

The current NPDES permit (2016) specifies effluent limits for turbidity, pH, oil and grease, total copper, and total zinc (see Table 2). The major changes from the previous permit effluent limits are the removal of lead analysis and an adjusted pH range for outfalls SDN3A, SDW1A, SDW1B, and SDW2. The pH range for these listed outfalls was widened to 6.3-9.0 due to a receiving water study that showed discharge within this range would not cause a violation of water quality standards in the receiving water. Lead was removed from the sampling effort for this permit based on Port studies that identified lead exceedences as extremely unlikely.

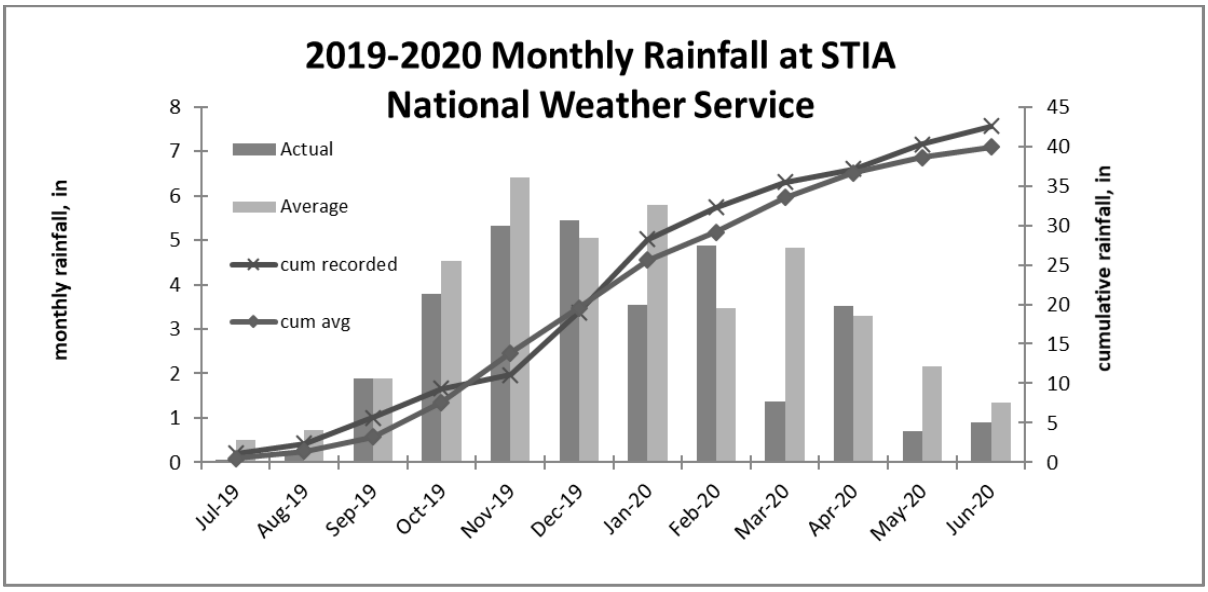
Effluent limits for industrial stormwater became effective several permits ago on December 31, 2007. The site-specific study and subsequent derivation of site-specific water quality based effluent limits for copper and zinc are described in the 2016 NPDES Permit fact sheet. A 25 NTU effluent limit for turbidity was added in the April 1, 2009 permit as a replacement for an earlier TSS benchmark.

The permit specifies effluent limits for ammonia and nitrates/nitrites, however monitoring for these parameters is only required if urea is applied as an anti-icing agent. Urea was not applied in this reporting year and has not been utilized at the Airport since 1996.

3.1.3 Storm Events Sampled

During the current permit's annual reporting schedule, 42.56 inches of precipitation fell at SEA; 2.62 inches great than the historical (2002-2020) average of 39.94 inches and 10.94 inches greater than the previous monitoring year (31.62 inches). Monthly precipitation totals were above average throughout the majority of the monitoring period, during the months of July, August, September, December, January, February, May, and June. Rainfall totals were below average in October, November, March, and April (Figure 2).

Figure 2. Precipitation Summary



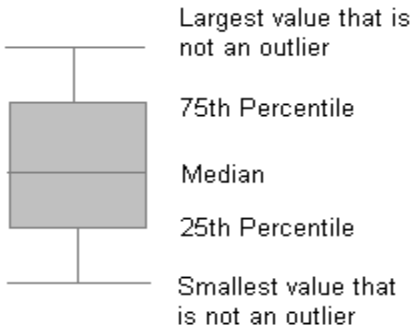
During this reporting period, SEA sampled eleven (11) precipitation events with precipitation ranging from 0.14 to 1.0 inches. Dry weather preceding these sampling events ranged from 18 hours (October 8, 2019) to 4.7 days (June 2, 2019). The tabular sample data in Appendix A includes storm event data such as precipitation depth, antecedent precipitation amounts, and length of antecedent dry period[1].

3.1.4 Data Presentation Methods

Outfall sampling results for the reporting period are summarized graphically in box plots that illustrate the central tendency, spread, and skew of the stormwater data (Figures 3 through 7). For low-censored data (i.e. non-detected values), a value of

[1] The length of the dry antecedent period (the "dryant" data field in Appendix A) is the time, in hours, to the previous measurable (0.01") rainfall, which may or may not have actually produced runoff at a particular outfall.

one half the detection limit was assumed for any calculation purposes (i.e. median, percentiles, etc.).



The data set may include outliers and extreme values that represent unusual conditions or anomalies. Outliers are displayed on the box plots as circles and extreme values are shown as asterisks.. A flat horizontal line indicates the analyte was not detected during the reporting period.

Appendix A tabulates and summarizes analytical results for each outfall for parameters required by the current permit, for the current annual reporting period July 1, 2019 through June 30, 2020. All data included in Appendix A has previously been provided to Ecology in quarterly DMRs and represents samples collected from those storms and sampling routines that met the criteria of the QAPP.

3.1.5 Grab Sample Results and Discussion

The following discussion includes results from 45 grab samples collected in the past year. Grab samples are analyzed for pH, TPH, and turbidity per current permit requirements, with tabular results and summary statistics contained in Appendix A.

3.1.5.1 *pH*

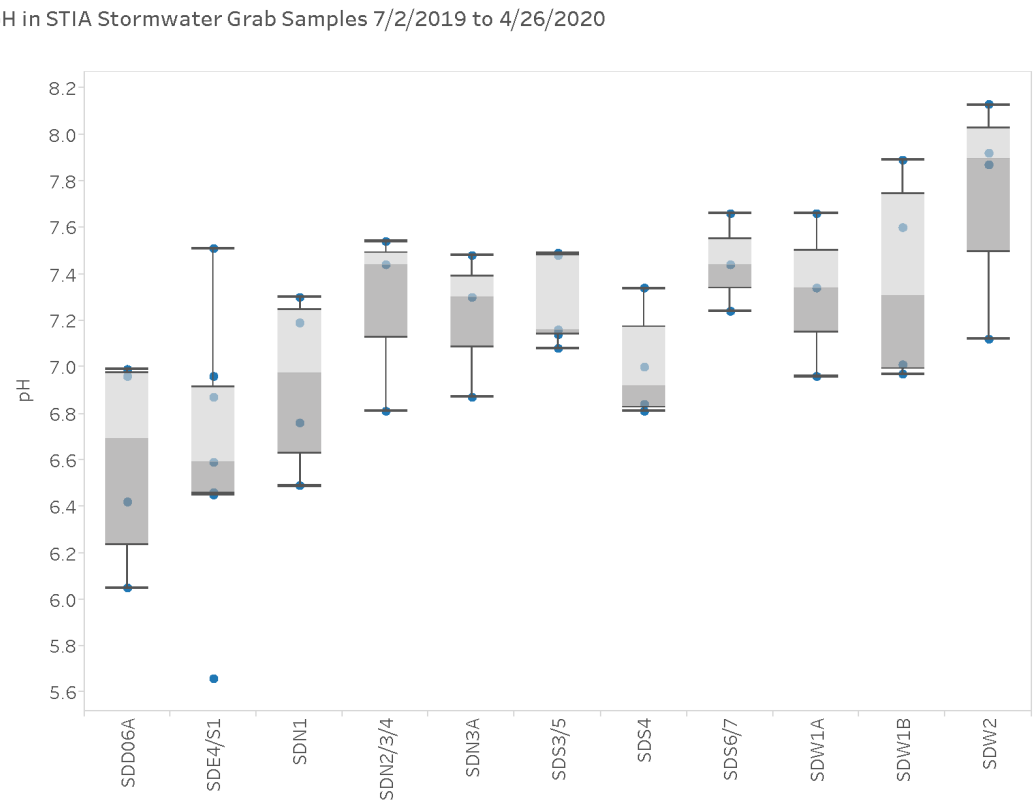
Figure 3 shows pH data for the current year. The median pH value from all outfalls was 7.1. Standard Units (S.U.) Sample results fell consistently within the effluent limit range of 6.5 to 8.5 (6.3-9.0 at SDN3A, SDW1A, SDW1B and SDW2) with the exception of six (6) samples.

Three (3) of the depressed pH samples occurred at SDE4/S1. These results occurred on October 8, 2019, January 10, 2020 and January 30, 2020 measuring 6.45, 6.46 and 5.66 respectively. Site inspections did not identify any operations or conditions that would result in depressed pH stormwater runoff.

The January 10, 2020 monitoring had two additional low pH measurements reported. The SDD06A sample was 6.42 and the SDN1 sample was 6.49. The rain event that led to the low pH measurements was likely a highly acidic storm event. There were no unusual activities that may have generated the low pH.

In an effort to better understand potential pH sources, SEA is sampling the storm event rainfall pH and collecting data from upstream and downstream locations for several segment of the receiving waters. Additionally, the SDD06A bioswales performance is being monitored for flow and bypass to see if they are operating correctly. A slight modification has been made to the piping to ensure equal distribution of the flow to each swale segment.

Figure 3. pH Results



pH effluent limits:

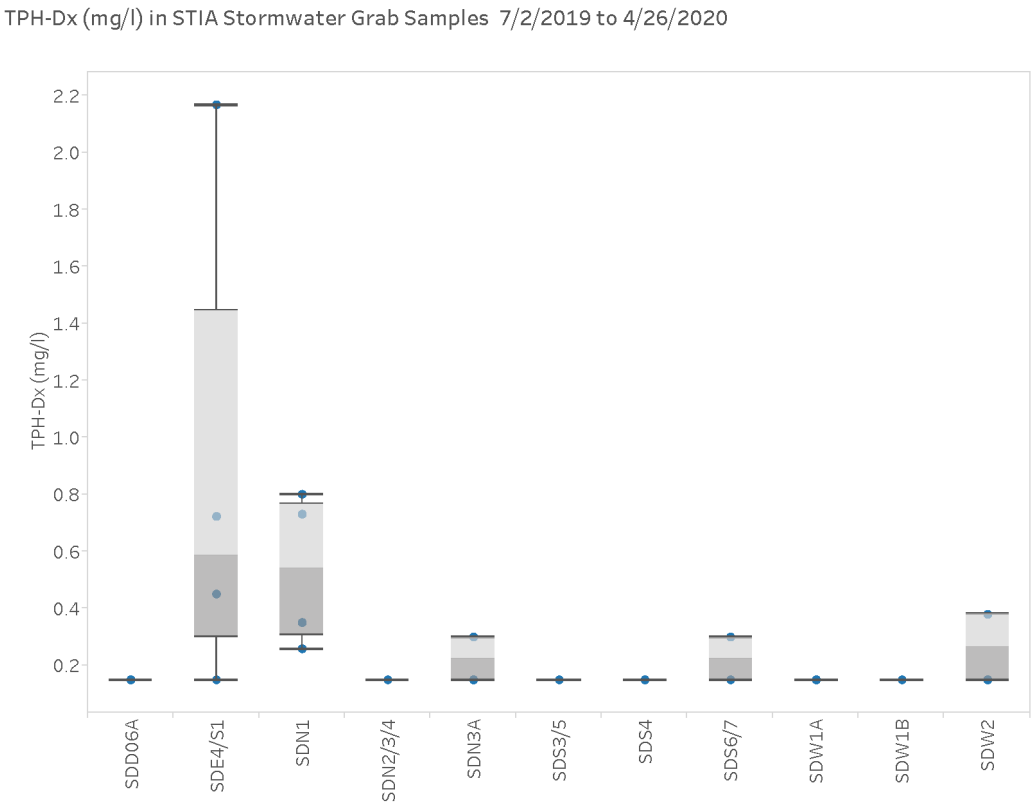
Stations SDE4/S1, SDD06A, SDN1, SDN2/3/4, SDS3/5, SDS6/7, SDS4: 6.5 to 8.5 S.U.

Stations SDN3A, SDW1A, SDW1B, SDW2: 6.3 to 9.0 S.U.

3.1.5.2 *Total Petroleum Hydrocarbons (TPH)*

Total Petroleum Hydrocarbons is determined by Washington State Department of Ecology (WDOE) method NWTPH-Dx; the summation of the diesel and motor oil range TPH quantified by this method resembles the concentration of oil & grease. Figure 4 shows TPH data for the current reporting year. TPH ranged from less than 0.15 mg/L to 2.17mg/L. The estimated median TPH concentration at all outfalls was 0.15 mg/L. However, the actual median TPH concentration may have been lower since TPH was only detected in 10 of the 45 samples. All sample results were well below the TPH effluent limit of 15 mg/L.

Figure 4. Total Petroleum Hydrocarbons Results

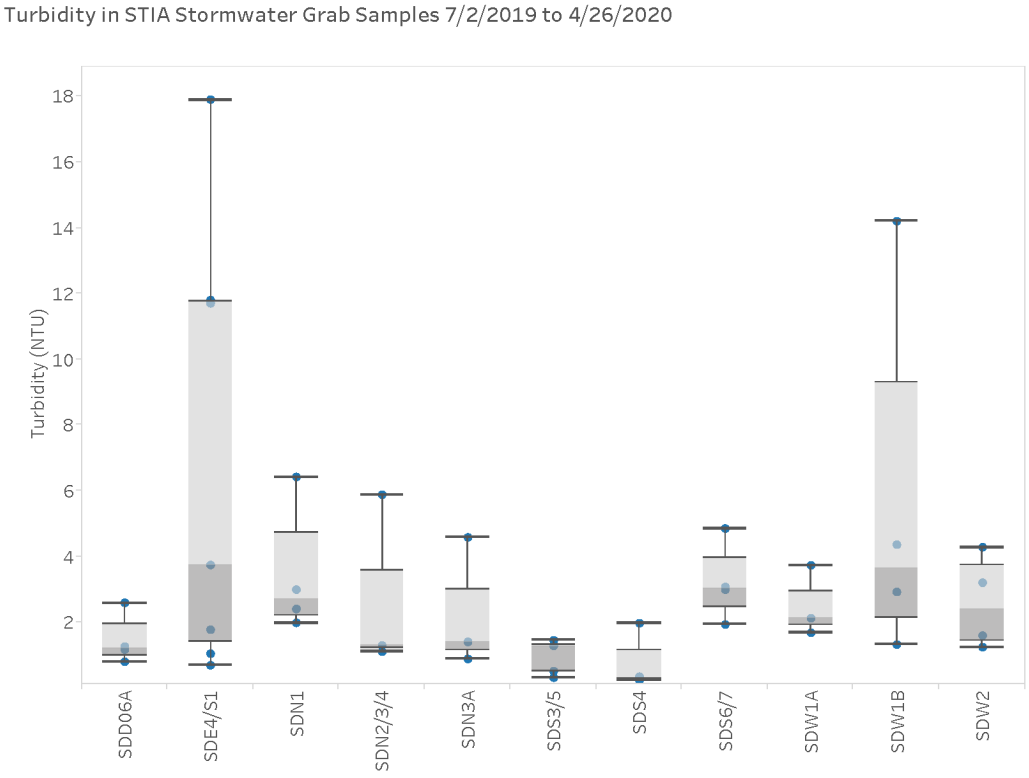


TPH Effluent Limit = 15 mg/L

3.1.5.3 *Turbidity*

Turbidity results for the current year are shown in Figure 5. The median turbidity for all outfalls was 1.93 NTU with a range from 0.23 NTU to 17.90 NTU. There were no permit limit exceedances for turbidity at any outfalls during the monitoring period.

Figure 5. Turbidity Results



Turbidity Effluent Limit = 25 NTU

3.1.6 Composite Sample Results and Discussion

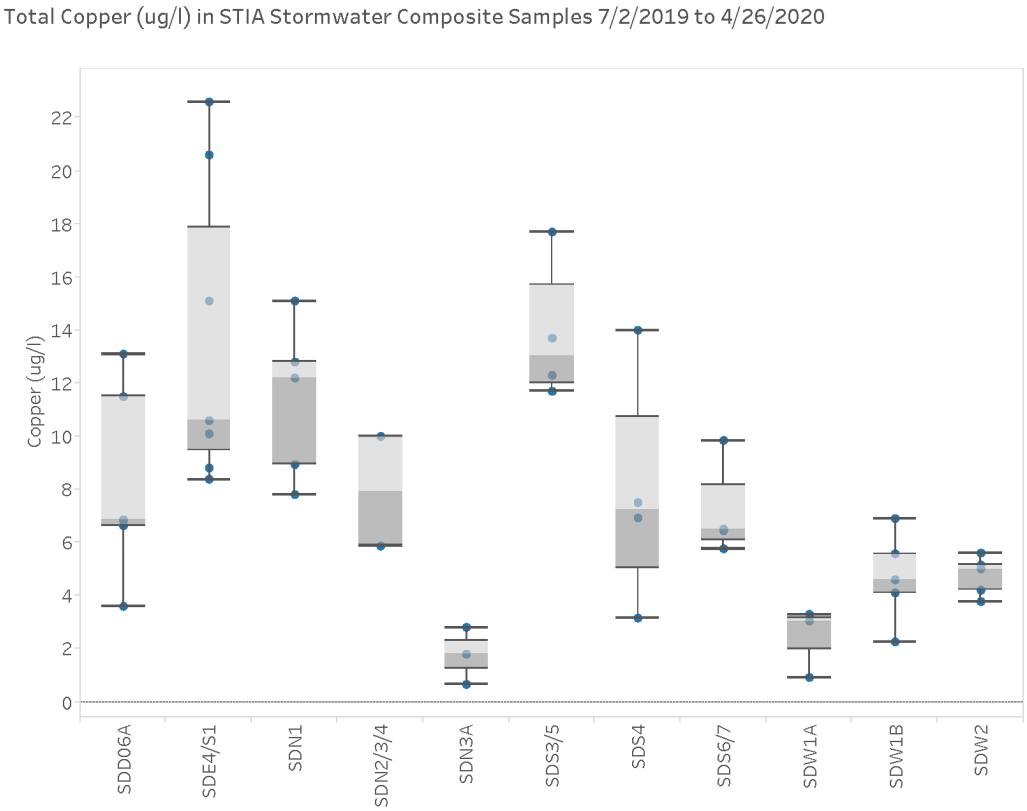
For the 2019-2020 sampling period, the SEA collected a total of 44 flow-weighted composite samples. Composite sample results are described separately from grab samples because grab samples represent an isolated segment of the storm event runoff. Composite sample results represent a flow-weighted average value over a longer time period. All composite sample data contained within this report and on the

DMRs met the representativeness criteria of the SEA's QAPP, which provides samples comparable with EPA methods (U.S. EPA 1992).

3.1.6.1 ***Copper***

All data reported below are for total recoverable copper. The median copper concentration for all outfalls was 7.0 µg/L, with individual storm sample concentrations ranging from 0.66 µg/L to 22.60 µg/L (Figure 6). The permit effluent limit for copper at each outfall is variable based on a site-specific study and ranges from 26 µg/L to 59 µg/L depending on receiving water location. There were no permit limit exceedances for copper during the monitoring year.

Figure 6. Copper Results

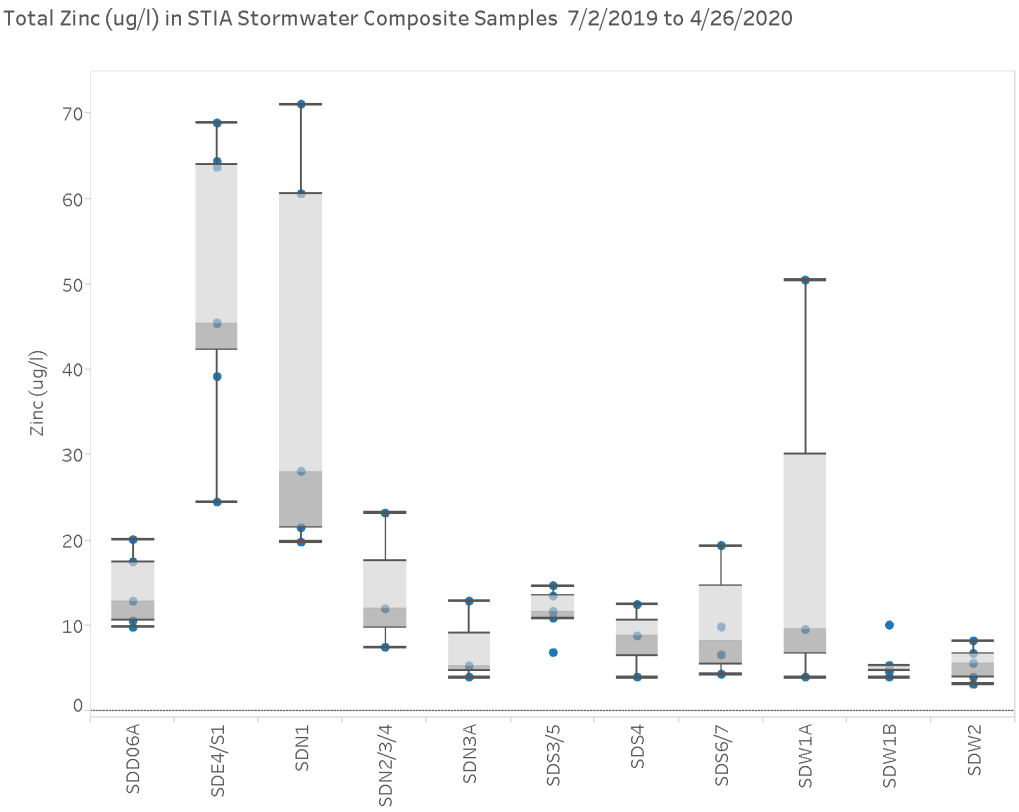


Effluent limits by outfall: 32.2 ug/l (SDS3/5, SDS4, SDS6/7), 28.5 ug/l (SDN1, SDN2/3/4), 25.6 ug/l (SDE4/S1, SDD06A), 59.2 ug/l (SDN3A, SDW1A, SDW1B), 47.9 ug/l (SDW2)

3.1.6.2 ***Zinc***

All data reported are for total recoverable zinc. The median zinc concentration at all outfalls was 11 µg/L (Figure 7). Zinc concentrations ranged from 2 µg/L to 71 µg/L. There were no permit limit exceedances for zinc during the monitoring period.

Figure 7. Zinc Results



SDS4 effluent limit = 71.4 ug/l, all other outfalls 117 ug/l

3.2 Toxicity Monitoring

The following sections discusses stormwater monitoring data related to the *in situ* monitoring program that was completed during fall 2019 and spring 2020 along with permit renewal related toxicity sampling completed. during a multi-day deicing event in February 2019.

3.2.1 In Situ Toxicity Monitoring

The in situ monitoring approach utilizes the early life stage (ELS) salmonid bioassay testing procedure using rainbow trout that can be applied in a laboratory or field (i.e., in situ) context. The test encompasses a number of developmental milestones (e.g., hatching, yolk-sac absorption, etc.), and provides a variety of biological endpoints, such as survival and growth, that can be used to assess water quality.

Results from the in situ bioassays and supporting analytical data are intended to provide an indication of attainment of receiving water quality standards and associated beneficial uses related to salmonid spawning and rearing. Initial Phase 1 testing conducted previously demonstrated that the RBT in situ ELS bioassay is an effective instream biological monitoring tool for assessing the potential effects of stormwater discharges on the receiving environment.

The sampling events conducted during this reporting period were completed under the Port's Permit, WA0024651, Part 2. 2S9, and are required to be conducted biannually in the fall and spring, corresponding to the spawning regimes of local salmonid species. Sampling was performed using the revised *Quality Assurance Program Plan: Seattle-Tacoma International Airport Receiving Water Sublethal Toxicity Testing* (Port of Seattle 2016).

For a full discussion on results of the sampling, please refer to *Rainbow Trout Early Life Stages In Situ Monitoring Testing, Fall 2019 and Spring 2020 Testing Events* (Nautilus report in final preparation).

3.2.2 Sublethal Monitoring

Sublethal toxicity sampling is completed using ambient receiving water samples and rainbow trout embryos. The testing is conducted in an approved lab using the approved Environment Canada method as outlined in the permit.

The Port completed sublethal monitoring as required under Part 2, 2S8.A which specifies completing testing for the last fall and last winter periods prior to submittal of the permit renewal application.The Port sampled on October 22, 2019 and March 31, 2020 and submitted samples to Nautilus Environmental for toxicity testing.

Sublethal toxicity tests are performed on ambient receiving water samples collected downstream of stormwater outfalls (permit Part 2, Section 2S8). Samples from six representative sites were tested for sublethal toxicity using the 7-day embryo test on rainbow trout *(Oncorhynchus mykiss, Environment Canada 1998; modifications from Canaria et al. 1999*).

Sublethal tests were conducted in accordance with permit section 2S8 requiring testing once during the last fall and last spring seasons prior to submission of the permit application, as well as from an event when deicing and anti-icing operations are occurring. Sublethal toxicity is defined in permit section 2S8.B as an effect concentration of 50% (EC50) for any test dilution of ≤100% sample. An EC50 corresponds to the concentration of sample at which 50% of the exposed organisms would be expected to exhibit adverse effects. In the event toxicity was observed, the Port would be required to submit a Toxicity Identification and Reduction Evaluation (TI/RE) Plan to Ecology within 60 days, based on guidance from based on WAC 173-205-100(2)(b) and (c).

Testing for all samples was conducted using five concentrations (full-strength sample and four concentrations spaced across a one-half [0.5x] dilution series) and a control. The test response was evaluated using two separate endpoints under the Ecology guidelines: embryo survival and normal development (Ecology, 2008). Survival is defined as the number of live embryos divided by the initial number of exposed embryos. Development is defined as the number of normal embryos divided by the total number of survivors.

Based on the EC50 results for survival and normally developed rainbow trout embryos, receiving water samples consistently showed no evidence of sublethal toxicity. No adverse effects were observed in sublethal samples collected from receiving water sites at SEA using rainbow trout embryo tests, with all samples resulting in EC50s of >100% sample, and no TI/RE was required There were no significant toxicity effects identified during these sampling events. For a full analysis on the results of this sampling please refer to the reports submitted to Ecology on June 30, 2019. (Nautilus Environmental, 2020a and b)

3.2.3 Acute Toxicity

Acute toxicity tests were performed on stormwater samples collected from stormwater outfalls as detailed in the permit Part 2, Section 2S7. Permit section 2S7.A requires acute toxicity testing from seven representative outfalls discharging stormwater from SEA, including: SDS3/5, SDD06A, SDE4/S1, SDN1, SDN2/3/4, SDW1B and SDW2. Acute testing is required once during the last winter and last summer periods prior to permit renewal application with sampling occurring during

active discharge periods. SEA completed sampling on July 3rd and 4th of 2019 and October 9, 2019. Testing was performed by Rainier Environmental.

Samples were tested for acute toxicity using the water flea *(Daphnia pulex*) and fathead minnow (*Pimephales promelas*) per USEPA (2002) methodology. Ecology has recognized that testing of low hardness samples can result in over-estimating the risk of toxicity in the receiving environment and, consequently, their laboratory guidance document for whole effluent toxicity testing (Ecology, 2008) includes a provision that allows for an adjustment of the hardness of stormwater samples to that of the receiving environment in cases where the outfall sample hardness is less than 50 mg/L.

Hardness adjustments were made by addition of reagent grade salts in the same proportions used to prepare the control water (i.e., moderately hard synthetic water per USEPA (2002). Following adjustment, hardness was measured on the adjusted samples to confirm that they were within ±10% of the targeted hardness and, if not, additional adjustments were made to achieve the desired value.

Testing for all samples was conducted using five concentrations (i.e., a full-strength sample and four lower concentrations spaced at one-half [0.5x] dilution intervals), plus a control. In cases where hardness adjustment was required, an unadjusted 100% sample and a hardness-adjusted control were also included in the dilution series.

The current permit has no established acute toxicity limits for the representative outfalls during the 2016 – 2020 term. However, test results detailed in this report are compared to previously held toxicity limits as a benchmark, defined as follows:

1. The median survival of any species in 100% effluent is below 80%; or

2. Any one test of any species exhibits less than 65% survival in 100% effluent.

Results of toxicity tests indicate that none of the samples exhibited toxicity to either of the species tested with no change to the percent survival of the test organisms in the undiluted samples (with hardness adjustment, as appropriate). Adverse effects sufficient to trigger an acute effluent limit were not observed with either species in any of the outfall samples tested during the last summer and last winter prior to permit renewal For a full analysis on the results of this sampling please refer to the reports submitted to Ecology on June 30, 2019. (Rainier Environmental, 2019a and b)

4.0 BMP Implementation

SEA designed and constructed stormwater peak runoff rate and flow control BMPS to retrofit the entire airport. In addition to flow control BMPs, treatment BMPs are implemented to achieve stormwater effluent limits. Redeveloped areas are assessed for BMP requirements and implemented as necessary to meet NPDES permit requirements. During the design process, opportunities to implement LID technologies are explored.

An oil water separator connected to the IWS was installed for a concrete generator pad as part of the North Satellite Modernization Project. Maintenance of existing BMP's continues with an emphasis being placed on sweeping and drainage system cleanouts. Specific actions include cleaning the Doug Fox vault, cleaning the roofs and gutters of buildings 161F and 161D, cleaning out the Delta Airlines parking lot vaults, and cleaning of all catchbasins in the SDE4 subbasin.

As a follow-up to the source tracing efforts completed in early 2019 for SDE4 and the subsequent catchbasin cleanout, a second round of sampling was completed for selected hotspots within the basin to determine the effectiveness of the maintenance action. The sampling results showed a significant reduction in metals levels. Increased monitoring of the drainage system to establish proper cleanout timing protocols will be performed so as to continue this effective process.

To ensure proper function of the bioswale BMP at SDD06A, a modification to the flow was installed to assist in equalizing the flow between swales. This should help prevent water from bypassing the treatment swales. Further study of this sytem will be completed during the next reporting cycle.

5.0 SUMMARY AND CONCLUSIONS

During the reporting period from July 2019 to June 2020 the SEA fulfilled requirements for outfall monitoring under the current NPDES permit. The Port collected a total of 45 grab samples and 44 composite stormwater samples during 11 storm events. Outfalls were sampled quarterly when discharges occurred from rain events that met the minimum rainfall criteria of 0.1 inch. There were six (6) instances of permit limit exceedances associated with 89 samples and 223 individual constituent analyses that were tested to meet the monitoring requirements of the NPDES permit.

To address the ongoing pH issues, the Port is tracking rainfall pH and will be performing site visits during storm events to ensure the available BMP's are operating effectively. Results of these investigations will be used to assess possible implementation actions the Port can take to reduce future exceedences.

This high level of compliance is an indication that the stormwater BMP's and ongoing process of continual improvement for the overall stormwater management program are effective at mitigating impacts from Airport operations on the adjacent receiving waters.

6.0 REFERENCES

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APPENDIX A

TABULAR NPDES SAMPLE DATA SUMMARIES and STATISTICS

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Port of Seattle

EMIS

Summary of Storms Sampled 7/2/2019 - 4/26/2020

StormDate	Depth, in.	Dur, hr	Max Int, in/hr	24hrant, in	48hrant, in	Dryant, hr	Dryant, Days	Load Factor	Event Type	Comment
4/26/2020	0.27	9	0.07	0	0.54	35	1.5	2.5	NPDES-Part II	JF to confirm values Y
4/22/2020	0.92	22	0.1	0	0	94	3.9	9.4	NPDES-Part II	JF to confirm values Y
1/30/2020	1	28	0.08	0.06	0.51	21	0.9	1.7	NPDES-Part II	Update with Stormdata
1/21/2020	0.46	20	0.1	0	0.03	39	1.6	3.9	NPDES-Part II	Update with Stormdata
1/10/2020	0.43	21	0.07	0.04	0.1	20	0.8	1.4	NPDES-Part II	Update with Stormdata
2/10/2019	0.88	60	0.09	0	0.02	44	1.8	4.0	NPDES-Part II	
12/7/2019	0.3	25	0.06	0	0	59	2.5	3.5	NPDES-Part II	
1/25/2019	0.14	7	0.05	0.04	0.09	22	0.9	1.1	NPDES-Part II	
1/18/2019	0.63	23	0.13	0	0.07	27	1.1	3.5	NPDES-Part II	
10/8/2019	0.27	15	0.15	0.04	0	18	0.8	2.7	NPDES-Part II	
7/2/2019	0.48	18	0.22	0	0	113	4.7	24.9	NPDES-Part II	JF to update with storm profile data
Count	11	11	11	11	11	11	11	11		
Median	0.46	21	0.09	0	0.03	35	1.5	3.5		
Average	0.53	23	0.10	0.02	0.12	45	1.9	5.3		

load factor = maxint (in/hr)*dryant(hrs)

Event Type defined in Procedure Manual for Stormwater Monitoring

"dur" = rainfuall duration in hours

"24hrant" and "48hrant" is the total rainfall in the 24 and 48 hours preceding the event respectively

Port of Seattle

EMIS

Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
All Outfalls	Count	45	42	45	45	45	45
	Max	8.1		2.17	0.43	1.74	17.9
	95th	7.9		0.73	0.34	0.43	12
	75th	7.5		0.15	0.05	0.10	4
	Median	7.1		0.15	0.05	0.10	1.93
	25th	6.9		0.15	0.05	0.10	1
	Min	5.7		0.15	0.05	0.10	0.233
	SD	0.5		0.53	0.14	0.42	5
	CV%	7%		120%	88%	145%	114%
	#NonDetects	0	0	35	35	36	0
	%NonDetects	0%	0%	78%	78%	80%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDE4/SDS1 (002)	Count	7	7	7	7	7	7
	Max	7.5		2.17	0.43	1.74	17.9
	95th	7.3		1.73	0.37	1.36	16
	75th	6.9		0.59	0.23	0.35	12
	Median	6.6		0.15	0.05	0.10	3.74
	25th	6.5		0.15	0.05	0.10	1
	Min	5.7		0.15	0.05	0.10	0.689
	SD	0.6		0.74	0.15	0.60	7
	CV%	9%		132%	95%	148%	98%
	#NonDetects	0	0	4	4	4	0
	%NonDetects	0%	0%	57%	57%	57%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDS3/5 (005)	Count	5	5	5	5	5	5
	Max	7.5		0.15	0.05	0.10	1.45
	95th	7.5		0.15	0.05	0.10	1
	75th	7.5		0.15	0.05	0.10	1
	Median	7.2		0.15	0.05	0.10	1.28
	25th	7.1		0.15	0.05	0.10	1
	Min	7.1		0.15	0.05	0.10	0.312
	SD	0.2		0.00	0.00	0.00	1
	CV%	3%		0%	0%	0%	54%
	#NonDetects	0	0	5	5	5	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDS4 (009)	Count	4	4	4	4	4	4
	Max	7.3		0.15	0.05	0.10	1.97
	95th	7.3		0.15	0.05	0.10	2
	75th	7.1		0.15	0.05	0.10	1
	Median	6.9		0.15	0.05	0.10	0.3225
	25th	6.8		0.15	0.05	0.10	0
	Min	6.8		0.15	0.05	0.10	0.233
	SD	0.2		0.00	0.00	0.00	1
	CV%	3%		0%	0%	0%	118%
	#NonDetects	0	0	4	4	4	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

		CONCENTRATION, mg/L					
		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDS6/7 (014)	Count	4	3	4	4	4	4
	Max	7.7		0.30	0.10	0.20	4.85
	95th	7.6		0.28	0.09	0.19	5
	75th	7.5		0.19	0.06	0.13	4
	Median	7.4		0.15	0.05	0.10	3.03
	25th	7.4		0.15	0.05	0.10	3
	Min	7.2		0.15	0.05	0.10	1.93
	SD	0.2		0.08	0.03	0.05	1
	CV%	2%		40%	40%	40%	38%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	75%	75%	75%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDN1 (006)	Count	4	4	4	4	4	4
	Max	7.3		0.80	0.36	0.44	6.42
	95th	7.3		0.79	0.36	0.43	6
	75th	7.2		0.75	0.36	0.39	4
	Median	7.0		0.54	0.26	0.29	2.695
	25th	6.7		0.33	0.16	0.17	2
	Min	6.5		0.26	0.15	0.10	1.98
	SD	0.4		0.27	0.12	0.16	2
	CV%	5%		50%	46%	56%	59%
	#NonDetects	0	0	0	0	1	0
	%NonDetects	0%	0%	0%	0%	25%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

		CONCENTRATION, mg/L					
		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDW2 (016)	Count	4	4	4	4	4	4
	Max	8.1		0.38	0.15	0.23	4.28
	95th	8.1		0.35	0.14	0.21	4
	75th	8.0		0.21	0.08	0.13	3
	Median	7.9		0.15	0.05	0.10	2.395
	25th	7.7		0.15	0.05	0.10	2
	Min	7.1		0.15	0.05	0.10	1.24
	SD	0.4		0.12	0.05	0.06	1
	CV%	6%		55%	68%	48%	55%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	75%	75%	75%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDW1B (017)	Count	4	3	4	4	4	4
	Max	7.9		0.15	0.05	0.10	14.2
	95th	7.8		0.15	0.05	0.10	13
	75th	7.7		0.15	0.05	0.10	7
	Median	7.3		0.15	0.05	0.10	3.64
	25th	7.0		0.15	0.05	0.10	3
	Min	7.0		0.15	0.05	0.10	1.32
	SD	0.5		0.00	0.00	0.00	6
	CV%	6%		0%	0%	0%	102%
	#NonDetects	0	0	4	4	4	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

		CONCENTRATION, mg/L					
		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDW1A (018)	Count	3	2	3	3	3	3
	Max	7.7		0.15	0.05	0.10	3.73
	95th	7.6		0.15	0.05	0.10	4
	75th	7.5		0.15	0.05	0.10	3
	Median	7.3		0.15	0.05	0.10	2.12
	25th	7.2		0.15	0.05	0.10	2
	Min	7.0		0.15	0.05	0.10	1.68
	SD	0.4		0.00	0.00	0.00	1
	CV%	5%		0%	0%	0%	43%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDN3A (019)	Count	3	3	3	3	3	3
	Max	7.5		0.30	0.10	0.20	4.58
	95th	7.5		0.28	0.09	0.19	4
	75th	7.4		0.22	0.08	0.15	3
	Median	7.3		0.15	0.05	0.10	1.4
	25th	7.1		0.15	0.05	0.10	1
	Min	6.9		0.15	0.05	0.10	0.881
	SD	0.3		0.09	0.03	0.06	2
	CV%	4%		43%	43%	43%	88%
	#NonDetects	0	0	2	2	2	0
	%NonDetects	0%	0%	67%	67%	67%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

		CONCENTRATION, mg/L					
		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
SDN2/3/4 (007)	Count	3	3	3	3	3	3
	Max	7.5		0.15	0.05	0.10	5.88
	95th	7.5		0.15	0.05	0.10	5
	75th	7.5		0.15	0.05	0.10	4
	Median	7.4		0.15	0.05	0.10	1.29
	25th	7.1		0.15	0.05	0.10	1
	Min	6.8		0.15	0.05	0.10	1.1
	SD	0.4		0.00	0.00	0.00	3
	CV%	5%		0%	0%	0%	98%
	#NonDetects	0	0	3	3	3	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
SDD06A (020)	Count	4	4	4	4	4	4
	Max	7.0		0.15	0.05	0.10	2.59
	95th	7.0		0.15	0.05	0.10	2
	75th	7.0		0.15	0.05	0.10	2
	Median	6.7		0.15	0.05	0.10	1.215
	25th	6.3		0.15	0.05	0.10	1
	Min	6.1		0.15	0.05	0.10	0.796
	SD	0.5		0.00	0.00	0.00	1
	CV%	7%		0%	0%	0%	54%
	#NonDetects	0	0	4	4	4	0
	%NonDetects	0%	0%	100%	100%	100%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		pH	Sheen	TPH-Dx	TPH-D	TPH-MO	Turb
Landside (SDE4/SDS1, SDN1, SDD06A)	Count	15	15	15	15	15	15
	Max	7.5		2.17	0.43	1.74	17.9
	95th	7.4		1.21	0.38	0.85	14
	75th	7.0		0.59	0.23	0.31	5
	Median	6.8		0.15	0.05	0.10	2.4
	25th	6.5		0.15	0.05	0.10	1
	Min	5.7		0.15	0.05	0.10	0.689
	#NonDetects	0	0	8	8	9	0
	%NonDetects	0%	0%	53%	53%	60%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%
Airfield (SDS3/5, SDS4, SDS6/7, SDW2, SDW1B, SDW1A, SDN3A, SDN2/3/4)	Count	30	27	30	30	30	30
	Max	8.1		0.38	0.15	0.23	14.2
	95th	7.9		0.30	0.10	0.20	5
	75th	7.5		0.15	0.05	0.10	3
	Median	7.3		0.15	0.05	0.10	1.635
	25th	7.0		0.15	0.05	0.10	1
	Min	6.8		0.15	0.05	0.10	0.233
	SD	0.4		0.06	0.02	0.03	3
	CV%	5%		33%	39%	30%	105%
	#NonDetects	0	0	27	27	27	0
	%NonDetects	0%	0%	90%	90%	90%	0%
	#Trimmed	0	0	0	0	0	0
	%Trimmed	0%	0%	0%	0%	0%	0%

load factor = maxint (in/hr)*dryant(hrs)

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

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NPDES Grab Sample Data 7/1/2019 - 6/30/2020

SAMPLE DATA			STORM CHARACTERISTICS							CONCENTRATION, mg/L							
Seq	Out fall	Sample ID	Storm Date	Dpth in	Dur hr	MaxInt in/hr	24hrant in	48hrant in	Dryant hr	Ground Deice?	pH	Sheen	TPH-Dx	TPH - D	TPH - MO	Turb	
1	SDE4/SDS1	SDE4/S1070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.51	No Sheen	0.723	0.250	0.473	B 11.8	
2	SDE4/SDS1	SDE4/S1100819GRAB	10/8/2019	0.27	15	0.15	0.04	0	18	No	H 6.45	No Sheen	2.167	0.427	1.74	17.9	
3	SDE4/SDS1	SDE4/S1121019GRAB	12/10/2019	0.88	60	0.09	0	0.02	44	No	H 6.96	No Sheen	< 0.3	< 0.100	< 0.200	0.689	
4	SDE4/SDS1	SDE4/S1011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.46	No Sheen	< 0.3	< 0.100	< 0.200	3.74	
5	SDE4/SDS1	SDE4/S1013020GRAB	1/30/2020	1	28	0.08	0.06	0.51	21	No	H 5.66	No Sheen	< 0.3	< 0.100	< 0.200	1.77	
6	SDE4/SDS1	SDE4/S1042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 6.87	No Sheen	0.451	0.214	0.237	11.7	
7	SDE4/SDS1	SDE4/S1042620GRAB	4/26/2020	0.27	9	0.07	0	0.54	35	No	H 6.59	No Sheen	< 0.3	< 0.100	< 0.200	1.04	
8	SDS3/5	SDS3/5070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.16	No Sheen	< 0.3	< 0.100	< 0.200	B 1.45	
9	SDS3/5	SDS3/5112519GRAB	11/25/2019	0.14	7	0.05	0.04	0.09	22	No	H 7.08	No Sheen	< 0.3	< 0.100	< 0.200	0.312	
10	SDS3/5	SDS3/5012120GRAB	1/21/2020	0.46	20	0.1	0	0.03	39	No	H 7.49	No Sheen	< 0.3	< 0.100	< 0.200	1.31	
11	SDS3/5	SDS3/5042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.48	No Sheen	< 0.3	< 0.100	< 0.200	1.28	
12	SDS3/5	SDS3/5042720GRAB	4/26/2020	0.27	9	0.07	0	0.54	35	No	H 7.14	No Sheen	< 0.3	< 0.100	< 0.200	0.510	
13	SDS4	SDS4070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 6.84	No Sheen	< 0.3	< 0.100	< 0.200	B 1.97	
14	SDS4	SDS4111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 7.34	No Sheen	< 0.3	< 0.100	< 0.200	0.233	
15	SDS4	SDS4011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.81	No Sheen	< 0.3	< 0.100	< 0.200	0.342	
16	SDS4	SDS4042720GRAB	4/26/2020	0.27	9	0.07	0	0.54	35	No	H 7.00	No Sheen	< 0.3	< 0.100	< 0.200	0.303	
17	SDS6/7	SDS6/7070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.24	No Sheen	< 0.3	< 0.100	< 0.200	B 3.07	
18	SDS6/7	SDS6/7120719GRAB	12/7/2019	0.3	25	0.06	0	0	59	No	H 7.44	No Sheen	UH 0.3	UH 0.100	UH 0.200	2.99	
19	SDS6/7	SDS6/7012120GRAB	1/21/2020	0.46	20	0.1	0	0.03	39	No	H 7.66	No Sheen	< 0.3	< 0.100	< 0.200	4.85	
20	SDS6/7	SDS6/7042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.44		< 0.3	< 0.100	< 0.200	1.93	
21	SDN1	SDN1070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.30	No Sheen	0.731	0.358	0.373	B 2.99	
22	SDN1	SDN1111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 6.76	No Sheen	0.801	0.357	0.444	2.40	
23	SDN1	SDN1012120GRAB	1/21/2020	0.46	20	0.1	0	0.03	39	No	H 6.49	No Sheen	0.351	0.151	0.200	6.42	
24	SDN1	SDN1042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.19	No Sheen	0.259	0.159	< 0.200	1.98	
25	SDW2	SDW2070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.87	No Sheen	0.38	0.152	0.228	B 4.28	
26	SDW2	SDW2111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 7.92	No Sheen	< 0.3	< 0.100	< 0.200	1.24	
27	SDW2	SDW2011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 7.12	No Sheen	< 0.3	< 0.100	< 0.200	3.20	
28	SDW2	SDW2042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 8.13	No Sheen	< 0.3	< 0.100	< 0.200	1.59	
29	SDW1B	SDW1B070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 7.60	No Sheen	< 0.3	< 0.100	< 0.200	B 4.36	
30	SDW1B	SDW1B111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 7.89	No Sheen	< 0.3	< 0.100	< 0.200	1.32	
31	SDW1B	SDW1B011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.97	No Sheen	< 0.3	< 0.100	< 0.200	2.92	
32	SDW1B	SDW1B042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.01		< 0.3	< 0.100	< 0.200	14.2	

R=Rejected Non-Representative Data - Refer to line comment for detail

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NPDES Grab Sample Data 7/1/2019 - 6/30/2020

SAMPLE DATA			STORM CHARACTERISTICS								CONCENTRATION, mg/L							
Seq	Out fall	Sample ID	Storm Date	Dpth in	Dur hr	MaxInt in/hr	24hrant in	48hrant in	Dryant hr	Ground Deice?	pH	Sheen	TPH-Dx	TPH - D	TPH - MO	Turb		
33	SDW1A	SDW1A111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 7.66	No Sheen	< 0.3	< 0.100	< 0.200	1.68		
34	SDW1A	SDW1A011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.96	No Sheen	< 0.3	< 0.100	< 0.200	2.12		
35	SDW1A	SDW1A042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.34		< 0.3	< 0.100	< 0.200	3.73		
36	SDN3A	SDN3A120719GRAB	12/7/2019	0.3	25	0.06	0	0	59	No	H 7.30	No Sheen	UH 0.3	UH 0.100	UH 0.200	0.881		
37	SDN3A	SDN3A011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.87	No Sheen	< 0.3	< 0.100	< 0.200	4.58		
38	SDN3A	SDN3A042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.48	No Sheen	< 0.3	< 0.100	< 0.200	1.40		
39	SDN2/3/4	SDN2/3/4100819GRAB	10/8/2019	0.27	15	0.15	0.04	0	18	No	H 7.54	No Sheen	< 0.3	< 0.100	< 0.200	1.10		
40	SDN2/3/4	SDN2/3/4011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.81	No Sheen	< 0.3	< 0.100	< 0.200	5.88		
41	SDN2/3/4	SDN2/3/4042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 7.44	No Sheen	< 0.3	< 0.100	< 0.200	1.29		
42	SDD06A	SDD06A070219GRAB	7/2/2019	0.48	18	0.22	0	0	113	No	H 6.96	No Sheen	< 0.3	< 0.100	< 0.200	B 0.796		
43	SDD06A	SDD06A111819GRAB	11/18/2019	0.63	23	0.13	0	0.07	27	No	H 6.99	No Sheen	< 0.3	< 0.100	< 0.200	1.26		
44	SDD06A	SDD06A011020GRAB	1/10/2020	0.43	21	0.07	0.04	0.1	20	No	H 6.42	No Sheen	< 0.3	< 0.100	< 0.200	2.59		
45	SDD06A	SDD06A042220GRAB	4/22/2020	0.92	22	0.1	0	0	94	No	H 6.05	No Sheen	< 0.3	< 0.100	< 0.200	1.17		

R=Rejected Non-Representative Data - Refer to line comment for detail

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EMIS

Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
All Outfalls	Count							44		44
	Max							0.023		0.071
	95th							0.017		0.064
	75th							0.011		0.024
	Median							0.007		0.011
	25th							0.005		0.006
	Min							0.001		0.002
	SD							0.005		0.022
	CV%							46%		56%
	#NonDetects							0		6
	%NonDetects							0%		14%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDE4/SDS1 (002)	Count							7		7
	Max							0.023		0.069
	95th							0.022		0.068
	75th							0.018		0.064
	Median							0.011		0.045
	25th							0.009		0.042
	Min							0.008		0.024
	SD							0.006		0.016
	CV%							42%		32%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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EMIS

Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDS3/5 (005)	Count							4		4
	Max							0.018		0.015
	95th							0.017		0.015
	75th							0.015		0.014
	Median							0.013		0.013
	25th							0.012		0.010
	Min							0.012		0.007
	SD							0.003		0.003
	CV%							19%		29%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDS4 (009)	Count							4		4
	Max							0.014		0.013
	95th							0.013		0.012
	75th							0.009		0.010
	Median							0.007		0.005
	25th							0.006		0.002
	Min							0.003		0.002
	SD							0.005		0.005
	CV%							57%		82%
	#NonDetects							0		2
	%NonDetects							0%		50%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDS6/7 (014)	Count							4		4
	Max							0.010		0.019
	95th							0.009		0.018
	75th							0.007		0.012
	Median							0.006		0.008
	25th							0.006		0.006
	Min							0.006		0.004
	SD							0.002		0.007
	CV%							26%		66%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDN1 (006)	Count							4		4
	Max							0.015		0.071
	95th							0.015		0.070
	75th							0.013		0.063
	Median							0.011		0.044
	25th							0.009		0.026
	Min							0.008		0.022
	SD							0.003		0.024
	CV%							30%		53%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDW2 (016)	Count							4		4
	Max							0.006		0.008
	95th							0.006		0.008
	75th							0.005		0.007
	Median							0.005		0.006
	25th							0.005		0.005
	Min							0.004		0.002
	SD							0.001		0.003
	CV%							12%		47%
	#NonDetects							0		1
	%NonDetects							0%		25%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDW1B (017)	Count							4		4
	Max							0.007		0.010
	95th							0.007		0.009
	75th							0.006		0.007
	Median							0.005		0.005
	25th							0.004		0.004
	Min							0.002		0.002
	SD							0.002		0.003
	CV%							42%		60%
	#NonDetects							0		1
	%NonDetects							0%		25%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDW1A (018)	Count							3		3
	Max							0.003		0.051
	95th							0.003		0.046
	75th							0.003		0.030
	Median							0.003		0.010
	25th							0.002		0.006
	Min							0.001		0.002
	SD							0.001		0.026
	CV%							54%		126%
	#NonDetects							0		1
	%NonDetects							0%		33%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDN3A (019)	Count							3		3
	Max							0.003		0.013
	95th							0.003		0.012
	75th							0.002		0.009
	Median							0.002		0.005
	25th							0.001		0.004
	Min							0.001		0.002
	SD							0.001		0.006
	CV%							61%		83%
	#NonDetects							0		1
	%NonDetects							0%		33%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
SDN2/3/4 (007)	Count							3		3
	Max							0.010		0.023
	95th							0.010		0.022
	75th							0.010		0.018
	Median							0.010		0.012
	25th							0.008		0.010
	Min							0.006		0.007
	SD							0.002		0.008
	CV%							28%		57%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
SDD06A (020)	Count							4		4
	Max							0.013		0.020
	95th							0.012		0.020
	75th							0.008		0.018
	Median							0.007		0.014
	25th							0.006		0.010
	Min							0.004		0.010
	SD							0.004		0.005
	CV%							53%		35%
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

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Summary of Storms Sampled 7/1/2019 - 6/30/2020

CONCENTRATION, mg/L

		TSS	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn
Landside (SDE4/SDS1, SDN1, SDD06A)	Count							15		15
	Max							0.023		0.071
	95th							0.021		0.070
	75th							0.014		0.062
	Median							0.010		0.039
	25th							0.008		0.021
	Min							0.004		0.010
	#NonDetects							0		0
	%NonDetects							0%		0%
	#Trimmed							0		0
	%Trimmed							0%		0%
Airfield (SDS3/5, SDS4, SDS6/7, SDW2, SDW1B, SDW1A, SDN3A, SDN2/3/4)	Count							29		29
	Max							0.018		0.051
	95th							0.014		0.022
	75th							0.010		0.012
	Median							0.006		0.007
	25th							0.003		0.005
	Min							0.001		0.002
	SD							0.004		0.009
	CV%							64%		97%
	#NonDetects							0		6
	%NonDetects							0%		21%
	#Trimmed							0		0
	%Trimmed							0%		0%

load factor = maxint (in/hr)*dryant(hrs)

Values qualified as non-detect (<) calculated at 1/2 the reported detection limit.

Port of Seattle

EMIS

NPDES Composite Sample Data 7/1/2019 - 6/30/2020

SAMPLE DATA			STORM CHARACTERISTICS										CONCENTRATION, mg/L									
Seq	Out fall	Sample ID	Storm Date	Dpth in	Dur hr	MaxInt in/hr	24hrant in	48hrant in	Dryant hr	Type	Ground Deice?	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn			
1	SDE4/SDS1	SDE4/S1070319COMP	7/2/2019	0.48	18	0.22	0	0	113	EMC	No						0.023		0.069			
2	SDE4/SDS1	SDE4/S1100919COMP	10/8/2019	0.27	15	0.15	0.04	0	18	EMC	No						0.021		0.064			
3	SDE4/SDS1	SDE4/S1121119COMP	12/10/2019	0.88	60	0.09	0	0.02	44	SMC	No						0.011		0.039			
4	SDE4/SDS1	SDE4/S1011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.01		0.064			
5	SDE4/SDS1	SDE4/S1013120COMP	1/30/2020	1	28	0.08	0.06	0.51	21	EMC	No						0.009		0.046			
6	SDE4/SDS1	SDE4/S1042320COMP	4/22/2020	0.92	22	0.1	0	0	94	EMC	No						0.015		0.045			
7	SDE4/SDS1	SDE4/S1042720COMP	4/26/2020	0.27	9	0.07	0	0.54	35	EMC	No						0.008		0.024			
8	SDS3/5	SDS3/5070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.014		0.012			
9	SDS3/5	SDS3/5112519COMP	11/25/2019	0.14	7	0.05	0.04	0.09	22	SMC	No						0.012		0.014			
10	SDS3/5	SDS3/5012220COMP	1/21/2020	0.46	20	0.1	0	0.03	39	EMC	No						0.018		0.015			
11	SDS3/5	SDS3/5042720COMP	4/26/2020	0.27	9	0.07	0	0.54	35	EMC	No						0.012		0.007			
12	SDS4	SDS4070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.007		< 0.004			
13	SDS4	SDS4111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	EMC	No						0.014		0.012			
14	SDS4	SDS4011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.008		0.009			
15	SDS4	SDS4042720COMP	4/26/2020	0.27	9	0.07	0	0.54	35	EMC	No						0.003		< 0.004			
16	SDS6/7	SDS6/7070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.01		0.004			
17	SDS6/7	SDS6/7120819COMP	12/7/2019	0.3	25	0.06	0	0	59	EMC	No						0.006		0.019			
18	SDS6/7	SDS6/7012220COMP	1/21/2020	0.46	20	0.1	0	0.03	39	EMC	No						0.006		0.01			
19	SDS6/7	SDS6/7042320COMP	4/22/2020	0.92	22	0.1	0	0	94	EMC	No						0.007		0.007			
20	SDN1	SDN1070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.015		0.022			
21	SDN1	SDN1111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	SMC	No						0.012		0.071			
22	SDN1	SDN1012220COMP	1/21/2020	0.46	20	0.1	0	0.03	39	EMC	No						0.009		0.061			
23	SDN1	SDN1042320COMP	4/22/2020	0.92	22	0.1	0	0	94	SMC	No						0.008		0.028			
24	SDW2	SDW2070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.005		< 0.004			
25	SDW2	SDW2111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	SMC	No						0.006		0.006			
26	SDW2	SDW2011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.005		0.008			
27	SDW2	SDW2042320COMP	4/22/2020	0.92	22	0.1	0	0	94	SMC	No						0.004		0.007			
28	SDW1B	SDW1B070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.006		0.005			
29	SDW1B	SDW1B111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	SMC	No						0.007		0.01			
30	SDW1B	SDW1B011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.004		0.005			
31	SDW1B	SDW1B042320COMP	4/22/2020	0.92	22	0.1	0	0	94	SMC	No						0.002		< 0.004			
32	SDW1A	SDW1A111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	SMC	No						0.003		0.01			

R=Rejected Non-Representative Data - Refer to line comment for detail

Port of Seattle

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NPDES Composite Sample Data 7/1/2019 - 6/30/2020

SAMPLE DATA			STORM CHARACTERISTICS										CONCENTRATION, mg/L								
Seq	Out fall	Sample ID	Storm Date	Dpth in	Dur hr	MaxInt in/hr	24hrant in	48hrant in	Dryant hr	Type	Ground Deice?	Turb, NTU		E-Glycol	P-Glycol	Total Glycol	Cu	Pb	Zn		
33	SDW1A	SDW1A011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.003		0.05		
34	SDW1A	SDW1A042320COMP	4/22/2020	0.92	22	0.1	0	0	94	SMC	No						0.001		< 0.004		
35	SDN3A	SDN3A120819COMP	12/7/2019	0.3	25	0.06	0	0	59	SMC	No						0.002		0.013		
36	SDN3A	SDN3A011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.003		0.005		
37	SDN3A	SDN3A042320COMP	4/22/2020	0.92	22	0.1	0	0	94	SMC	No						.000662		< 0.004		
38	SDN2/3/4	SDN2/3/4100919COMP	10/8/2019	0.27	15	0.15	0.04	0	18	EMC	No						0.006		0.023		
39	SDN2/3/4	SDN2/3/4011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.01		0.012		
40	SDN2/3/4	SDN2/3/4042320COMP	4/22/2020	0.92	22	0.1	0	0	94	EMC	No						0.01		0.008		
41	SDD06A	SDD06A070319COMP	7/2/2019	0.48	18	0.22	0	0	113	SMC	No						0.013		0.018		
42	SDD06A	SDD06A111919COMP	11/18/2019	0.63	23	0.13	0	0.07	27	EMC	No						0.007		0.02		
43	SDD06A	SDD06A011120COMP	1/10/2020	0.43	21	0.07	0.04	0.1	20	EMC	No						0.004		0.011		
44	SDD06A	SDD06A042320COMP	4/22/2020	0.92	22	0.1	0	0	94	EMC	No						0.007		0.01		

R=Rejected Non-Representative Data - Refer to line comment for detail

APPENDIX B

OTHER SAMPLE DATA

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QC Samples Dups - 7/1/2019-6/30/2020

															Conventionals		Metals		TPH		
Outfall	Sample	Storm	depth	dur	maxint	ant24	ant48	dryant	Event Type	Sub Type	Comp Type	Type	Purpose	Grnd Deice	ph pH Units	Turb NTU	Cu Total mg/l	Zn Total mg/l	Sheen N/A	TPH-D mg/l	TPH-MO mg/l
SDE4/SDS	SDE4/S1121019DUPG	12/10/2019	0.88	60	0.09	0	0.02	44	NPDES-Part II	first flush grab		FD	FldQC	No	H 6.87	0.691			No Sheen	< 0.05	< 0.1
SDE4/SDS	SDE4/S1121119DUPC	12/10/2019	0.88	60	0.09	0	0.02	44	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No			0.0105	0.0459			
SDE4/SDS	SDE4/S1011020DUPG	1/10/2020	0.43	21	0.07	0.04	0.1	20	NPDES-Part II	first flush grab		FD	FldQC	No	H 6.91	3.59			No Sheen	< 0.05	< 0.1
SDE4/SDS	SDE4/S1011120DUPC	1/10/2020	0.43	21	0.07	0.04	0.1	20	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No			0.0101	0.0555			
SDS3/5	SDS3/5112519DUPG	11/25/2019	0.14	7	0.05	0.04	0.09	22	NPDES-Part II	first flush grab		FD	FldQC	No	H 7.15	0.318			No Sheen	< 0.05	< 0.1
SDS3/5	SDS3/5112519DUPC	11/25/2019	0.14	7	0.05	0.04	0.09	22	NPDES-Part II	flow-wt comp	SMC	FD	FldQC	No			0.0118	0.0128			
SDS3/5	SDS3/5042720DUPG	4/26/2020	0.27	9	0.07	0	0.54	35	NPDES-Part II	first flush grab		FD	FldQC	No	H 7.2	0.508			No Sheen	< 0.05	< 0.1
SDS3/5	SDS3/5042720DUPC	4/26/2020	0.27	9	0.07	0	0.54	35	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No			0.0123	0.00734			
SDS4	SDS4111819DUPG	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	first flush grab		FD	FldQC	No	H 7.26	0.248			No Sheen	< 0.05	< 0.1
SDS4	SDS4111919DUPC	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No			0.0146	0.0177			
SDD06A	SDD06A111819DUPG	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	first flush grab		FD	FldQC	No	H 7.47	1.28			No Sheen	< 0.05	< 0.1
SDD06A	SDD06A111919DUPC	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No			0.00688	0.0219			
SDD06A	SDD06A011020DUPG	1/10/2020	0.43	21	0.07	0.04	0.1	20	NPDES-Part II	first flush grab		FD	FldQC	No	H 7.05	2.62			No Sheen	< 0.05	< 0.1
SDD06A	SDD06A011120DUPC	1/10/2020	0.43	21	0.07	0.04	0.1	20	NPDES-Part II	flow-wt comp	EMC	FD	FldQC	No			0.0036	0.0113			

Selected Date Range; 7/1/2019-6/30/2020; Values Qualified as (<) are included as 1/2 the reported Detection Limit; Rejected Values not included.

QC Samples Blanks - 7/1/2019-6/30/2020

															Metals		TPH	
Outfall	Sample	Storm	depth	dur	maxint	ant24	ant48	dryant	Event Type	Sub Type	Type	Comp Type	Purpose	Grnd Deice	Cu Total mg/l	Zn Total mg/l	TPH-D mg/l	TPH-MO mg/l
SDN8	SDN8013120COMP	1/30/2020	1	28	0.08	0.06	0.51	21	NPDES-Part II	discreet series	EB		FldQC	No	< 0.00025	0.00473		
SDS3/5	SDS3/5112519BLNK	11/25/2019	0.14	7	0.05	0.04	0.09	22	NPDES-Part II	discreet series	FB		FldQC	No	< 0.00025	< 0.002	< 0.05	< 0.1
SDS4	SDS4112019BLNK	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	discreet series	EB		FldQC	No	< 0.00025	< 0.002	0.131	< 0.1
SDN3A	SDN3A120919BLNK	12/7/2019	0.3	25	0.06	0	0	59	NPDES-Part II	discreet series	EB		FldQC	No	< 0.00025	0.00488	< 0.05	< 0.1
SDD06A	SDD06A112019BLNK	11/18/2019	0.63	23	0.13	0	0.07	27	NPDES-Part II	discreet series	EB		FldQC	No	0.000663	< 0.002	0.146	< 0.1

Selected Date Range; 7/1/2019-6/30/2020; Values Qualified as (<) are included as 1/2 the reported Detection Limit; Rejected Values not included.