Annual Non-Construction Stormwater Monitoring Report

Seattle-Tacoma International Airport

For the Period July 1, 2014 through June 30, 2015

September 25, 2015

Prepared by

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Port of Seattle

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EXECUTIVE SUMMARY

This Annual Stormwater Monitoring Report provides a summary of “non-construction stormwater” monitoring results conducted pursuant to Part II, Condition S1 of the National Pollutant Discharge Elimination System (NPDES) permit for the Port of Seattle’s Seattle-Tacoma International Airport (STIA) NPDES Permit WA-002465-1. Non-construction stormwater discharges authorized under Part II of the permit includes runoff associated with industrial areas at the airport and excludes construction runoff.

This report summarizes the results of stormwater sampling at outfalls listed in permit Condition S1 between July 1, 2014 and June 30, 2015 and satisfies the annual reporting requirement detailed in Part II Condition S1. 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 III construction monitoring results are provided separately.

The Port met all required sampling and reporting requirements in the NPDES permit for the 2014-2015 data collection period. A total of 71 grab and 70 composite stormwater samples from 17 storm events were collected in the past year with results reported on quarterly Discharge Monitoring Reports (DMRs).

There were nine instances of permit limit exceedances associated with 353 individual constituent analyses. In addition to routine NPDES monitoring required by Condition S1, the Port continued monitoring activities pursuant to other NPDES Part II permit conditions. These activities include sublethal and *in situ* toxicity sampling (Condition S8 and S9) and additional monitoring associated with Agreed Order 8755.

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1.0 INTRODUCTION

This Annual Report summarizes non-construction stormwater monitoring results from the Seattle-Tacoma International Airport (STIA) as required by Part II, Condition S1.G. of the Airport's NPDES permit. The Permit authorizes discharges from airport industrial activities. Airport industrial activity areas include a mix of roadway, rooftops, taxiways and runways. The purpose of this Annual Report is to present the monitoring results from the stormwater discharging from the outfalls identified in Part II 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 2014 through June 2015. Outfall sampling results summarized in this report include data previously submitted to Ecology in the NPDES permit Part II 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 required by Part II of the NPDES permit also is summarized in this report.

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 BMP implementation during the monitoring period. A summary and conclusion are provided in Section 5.

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2.0 BACKGROUND

2.1 Seattle-Tacoma International Airport Drainage

STIA lies approximately mid-way between the cities of Seattle and Tacoma, Washington. The airport construction began in the 1940s and has expanded throughout the years and is currently the 13th busiest passenger and the 19th busiest cargo airport in the United States. The highly urbanized cities of SeaTac, Des Moines, and Burien surround the airport.

The airport has managed a storm drainage system since commissioning in the 1940s. Stormwater drainage at STIA 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. A total of 375 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. 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 STIA 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 19 outfalls in three categories: Existing & New Outfalls and Subbasins, Future Outfalls to be activated as Part of the CDP Near-Term Project Development, and Existing Outfalls and Subbasins to be Eliminated as Part of the Third Runway Project. As of June 30, 2014, 11 of the 19 outfalls are active and discharge stormwater related to industrial activity.

STIA 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 TPH, TSS and other constituent concentrations were different for the landside and airfield categories (POS 1996a, 1997a.) Table 1, *STIA 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. STIA 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.	41.71	130.47	172.18
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.	17.08	28.35	45.4
SDN1	Miller Creek via Lake Reba	Landside	Flight service kitchen.	Public roads, building rooftops and vehicle parking.	3.8	16.0	19.8
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.	212.44	244.98	457.42
SDS4	NW Ponds and Des Moines Creek West	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Runway infield and open areas.	41.6	24.8	66.4
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.	63.94	45.94	109.88

Table 1. STIA 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)
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.	71.83	41.04	112.87
SDN3A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	22.9	8.62	31.5
SDW1A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	44.35	25.78	70.1
SDW1B	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	59.7	25.0	84.7
SDW2	Walker Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	27.04	10.5	37.51
				Total Area	**606.39**	**601.48**	**1207.76**

Note:

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 Ports Stormwater Pollution Prevention Plan.

c) Stormwater pond areas were not included in total acres. It is anticipated that ongoing chagnes resulting from planned construciton will changes subbasin totals in the future.

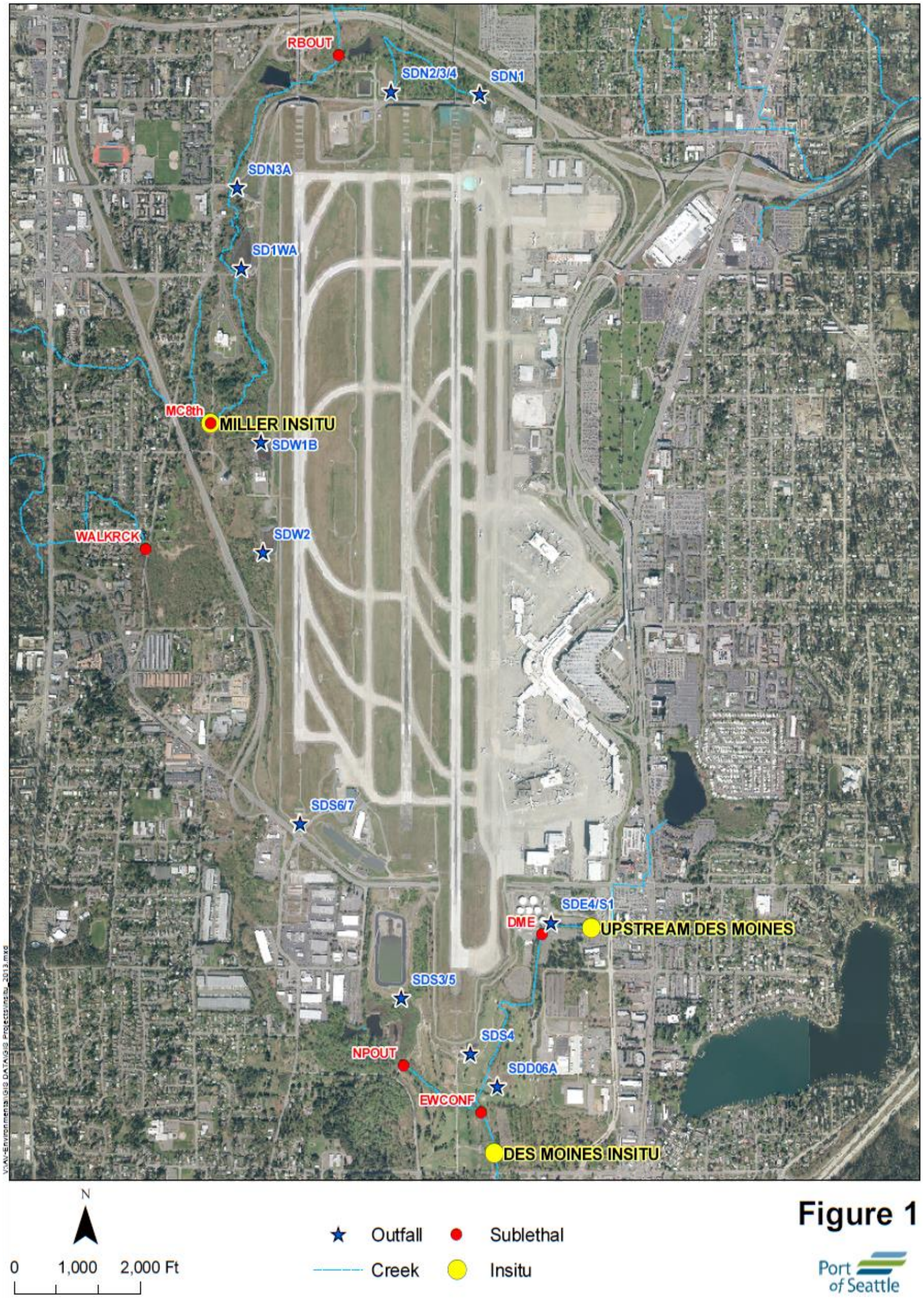

Figure 1

Port of Seattle

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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 II, S1 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 sublethal toxicity and *in situ* toxicity testing at receiving water sites downstream of Port outfalls. Section 3.3 summarizes monitoring conducted in receiving waters under Agreed Order 8755.

3.1 Monitoring of Non-Construction 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) (Taylor Associates, Inc. 2011). The monitoring locations were selected to represent stormwater downstream of the last best management practice (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 Port reports results on DMRs from storms and samples that were considered representative according to criteria specified in the QAPP.

The Port uses telemetry-based automatic samplers to collect a grab sample then 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 II, S1.B. Each grab or composite sample is analyzed for the constituents listed in Table 2 depending 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.
Oil & Grease - TPH (by GC)	NWTPH-Dx[(3)]	0.75 mg/l	grab	15 mg/L – no sheen
Turbidity	180.1[(1)]	0.05 NTU	grab	25 NTUs
Glycols, Ethylene, Propylene	GC FID[(2)]	10.0 mg/l	flow-wt comp.	NA
Total Recoverable Copper	200.8[(1)]	0.5 µg/l	flow-wt comp.	25.6 to 59.2 µg/l
Total Recoverable Lead	200.8[(1)]	0.1 µg/l	flow-wt comp.	NA
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 1979).
2. Analyzed by Gas Chromatograph (GC), Flame Ionization Detector (FID). MDL is 10 mg/l each for propylene and ethylene glycols.
3. Method reports both a motor oil fraction and diesel fraction. TPH-Dx is the sum of these two fractions.

3.1.2 Field Quality Control Samples

The Port 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 Port's "clean" sampling methods developed for stormwater monitoring relative to metals (POS 1999).

Eleven field blanks were collected in the 2014 – 2015 reporting period. Ethylene glycol and propylene glycol were non-detectable in all field blank samples. Zinc was detected in one field blank sample at 7 ug/L. Copper was detected in one field blank sample at a concentration slightly over the detection limit (0.8 ug/L). TPH-D was also detected in one field blank with a diesel concentration of 0.13 mg/L. There were no other anomalies associated with samples collected during these same storm events. Due to the low concentrations in the field blanks, the associated samples were not qualified and were considered representative of the discharge.

3.1.3 Permit Effluent Limits

The current NPDES permit specifies effluent limits for turbidity, pH, oil and grease, total copper, and total zinc at all outfalls (see Table 2). Effluent limits for non-construction stormwater first became effective during the previous permit 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 2009 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 also 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 used in the reporting year and has not been used at the Airport since 1996.

3.1.4 Storm Events Sampled

During the current permit's annual reporting schedule, 37.43 inches of rain fell at STIA, 0.06 inches less than the historical normal of 37.49. inches and more than 4 inches less than the past monitoring year (41.82 inches). Monthly rainfall totals were well below average in November, January, May and June. June 2015 was the fourth driest on record. July through October 2014 all had more monthly rainfall than normal with October having nearly two times the monthly normal rainfall (Figure 2).

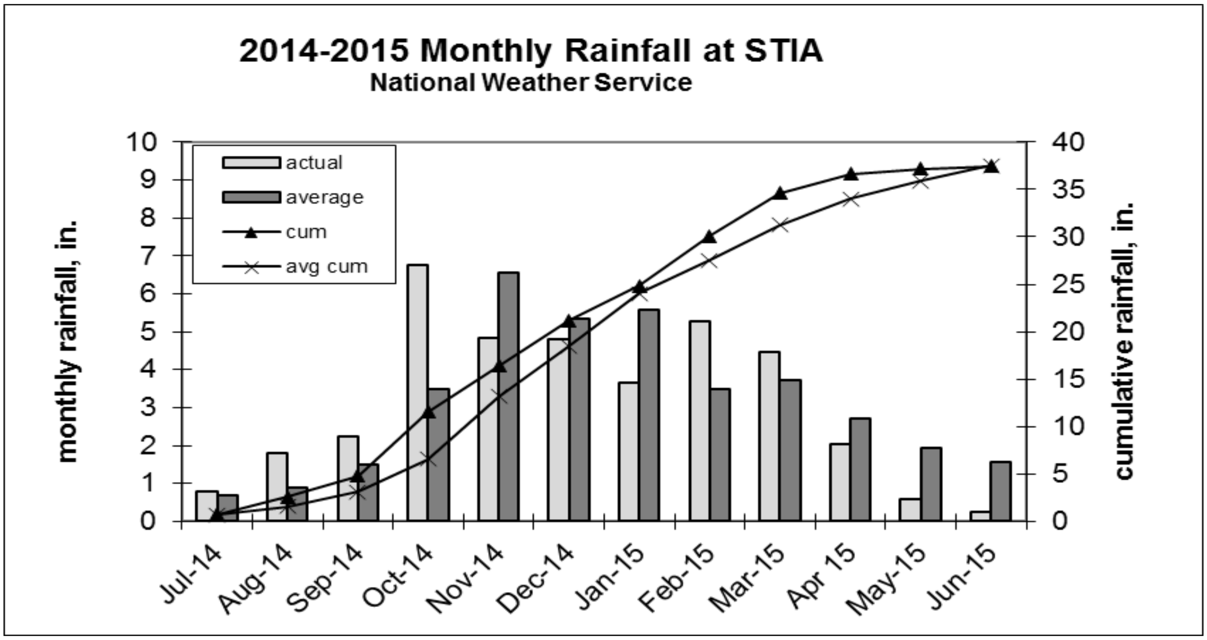

Figure 2. Rainfall Summary

In the 12 months ending June 30, 2015, the Port sampled 17 rainfall events with rainfall ranging from 0.05[1] to 2.75 inches. Dry weather preceding these events ranged from 13 hours (November 21, 2014) to 25.5 days (July 23, 2014). The tabular sample data in Appendix A includes storm event data such as rainfall depth, antecedent rainfall, and length of antecedent dry period[2].

3.1.5 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

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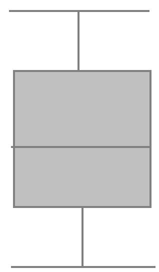
1 In order to obtain a second quarterly sample for SDN2/3/4 outfall, a storm with a total depth of 0.05 inches was sampled on April 24, 2015.

2 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.

(Figures 3 through 8). For low-censored data (i.e. non-detected values), a value of 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. With the exception of pH, permit effluent limits (where applicable) are indicated in a note below each graph, solid reference lines are used to indicate the upper and lower pH effluent limit. 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, 2014 through June 30, 2015. 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.

3.1.6 Grab Sample Results and Discussion

The following discussion includes results from 71 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.

3.1.6.1 *pH*

Figure 3 shows pH data for the current year. The median pH value from all outfalls was 7.5. Standard Units (S.U.) Sample results fell consistently within the effluent limit range of 6.5 to 8.5 with the exception of nine samples collected at outfalls SDN-1, SDD-06A, SDW-1A, SDW-1B, and SDW-2. Three of the nine exceedances were at the SDN-1 outfall and were below the lower pH effluent limit range. On one occasion, the low pH was found to be related to improperly managed trash compactors at a flight kitchen. Compactor repairs, conveyance cleaning and other corrective actions were completed. Subsequent monitoring indicated pH had returned to normal range. There were no sources found to be contributing to the two other low pH readings at SDN1. Elevated pH readings attributable to algal growth in detention ponds were measured at SDW2 (3), SDW-1A (1) and SDW-1B (1).   Algal growth in the SDD-06A detention pond was also found in associated with the one elevated measurement. Elevated pH due to pond algae and relation to receiving water quality measurements is discussed further Section 3.3.1.

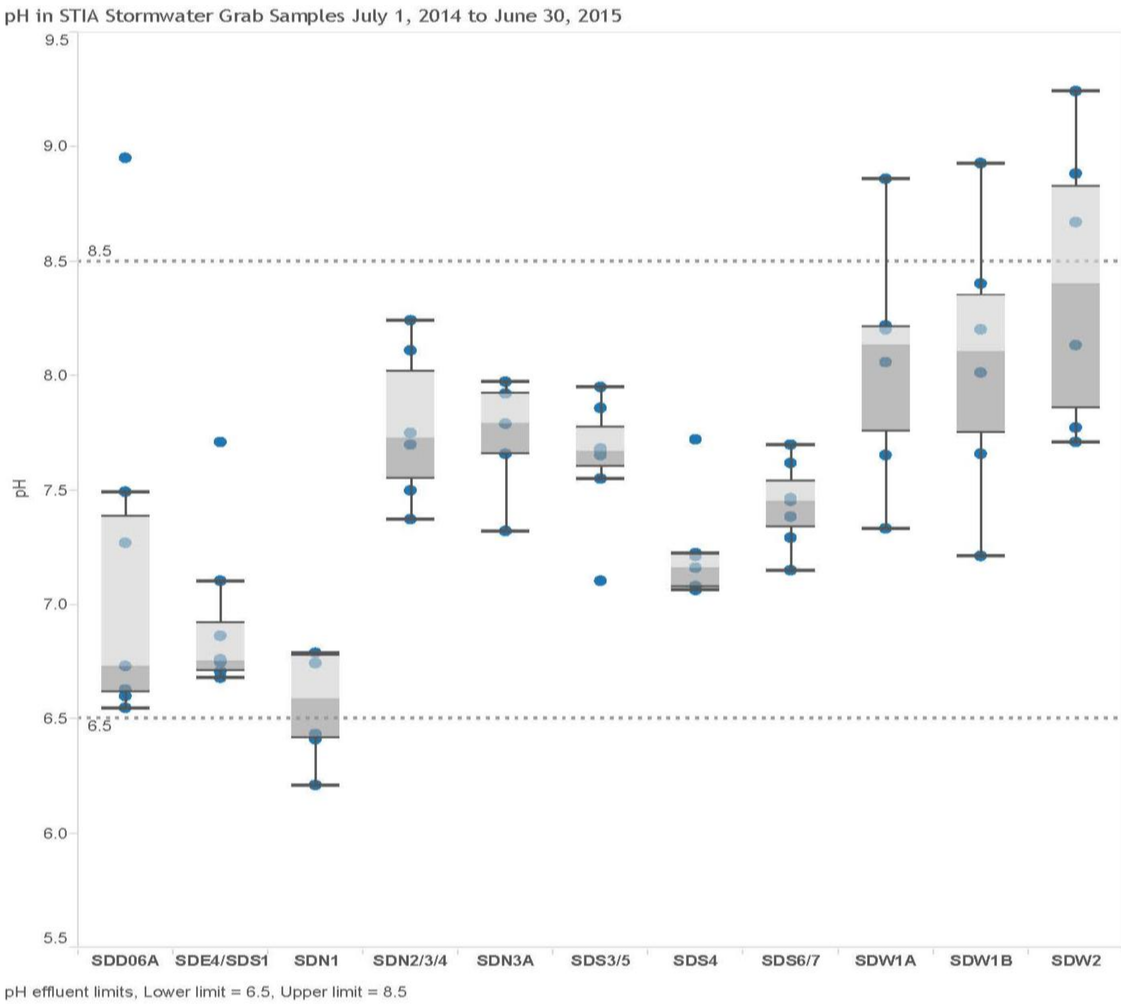


Figure 3. pH Results

3.1.6.2 Total Petroleum Hydrocarbons (TPH)

Figure 4 shows TPH data for the current reporting year. TPH ranged from less than 0.15 mg/L to 0.85 mg/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 12 of the 71 samples. All sample results were well below the TPH effluent limit of 15 mg/L.

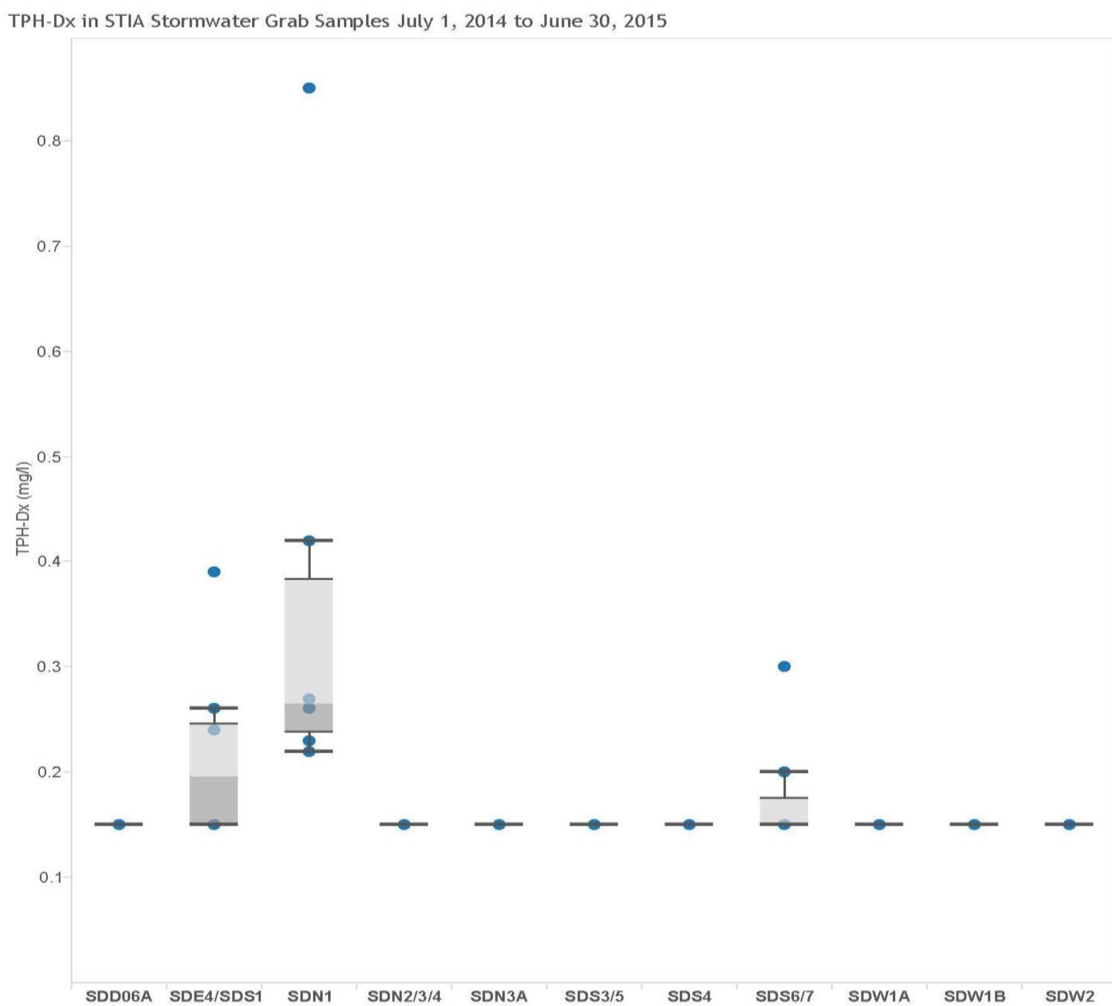


Figure 4. TPH Results

3.1.6.3 Turbidity

Turbidity results for the current year are shown in Figure 5. The median turbidity for all outfalls was 1.25 NTU with a range from 0.37 NTU to 7.37 NTU. There were no permit limit exceedances for turbidity at any outfall during the monitoring period.

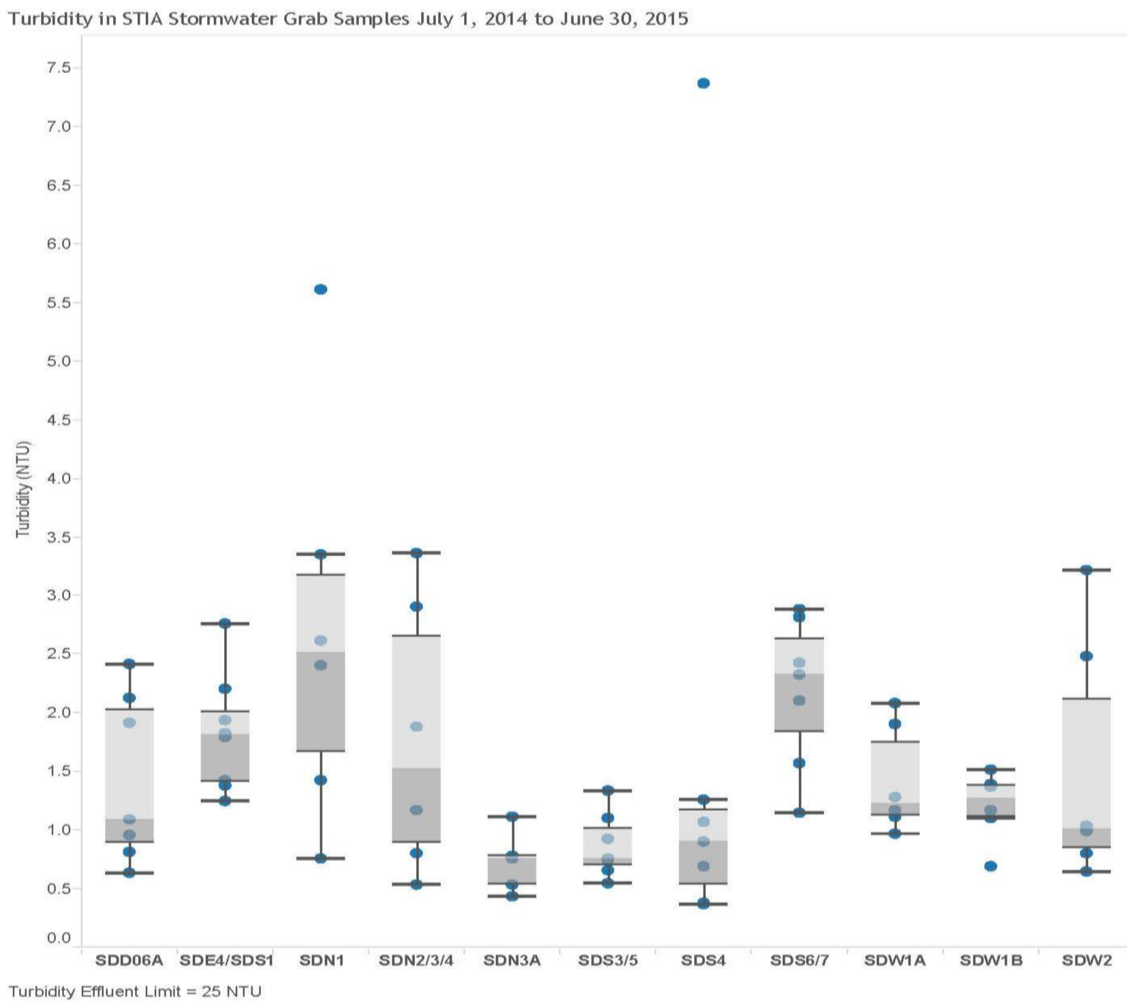


Figure 5. Turbidity Results

3.1.7 Composite Sample Results and Discussion

For the 2014-2015 sampling period, the Port collected a total of 70 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 an average value or event-mean concentration (EMC) over a longer time period. All composite sample data contained within this report and on the DMRs met the representativeness criteria of the Port's QAPP, which provides samples comparable with EPA methods (U.S. EPA 1992).

3.1.7.1 Glycols

The Federal Aviation Administration (FAA) authorizes specially formulated ethylene and propylene glycols for aircraft deicing and anti-icing. Port tenants perform all glycol application at STIA (applied by airlines or their ground service providers). To ensure public safety and comply with FAA regulations, aircraft pilots make the ultimate decision on whether to apply glycols or not. Monitoring for propylene and ethylene glycol is required by the NPDES permit during months when deicing and anti-icing is conducted. Glycol monitoring is required to assess track-out and sheer and drip from aircraft that are deiced within the IWS drainage area. No aircraft deicing occurs within the SDS.

The length of the deicing season and the annual volume of aircraft deicing anti-icing fluid (ADAF) (glycol) applied are reported in the Port's *2014-2015 Deicing/Anti-icing Fluids Usage Summary Report* (POS 2015). This report summarizes data provided by the airlines for the volumes of both ethylene and propylene glycol applied within the IWS. According to the *2014-2015 Deicing/Anti-icing Fluids Usage Summary Report*, airlines applied a total of 80,751 gallons of glycol during the months of April, 2014, October 2014, November 2014, December 2014, January 2015, February 2015, and March 2015.

Ethylene and propylene glycol were not detected in any of the 65 samples analyzed during deicing months in 2014 and 2015.

3.1.7.2 Copper

All data reported below are for total recoverable copper. The median copper concentration for all outfalls was 6 µg/L, with individual storm sample concentrations ranging from 2 µg/L to 26 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 at any outfall during the monitoring period.

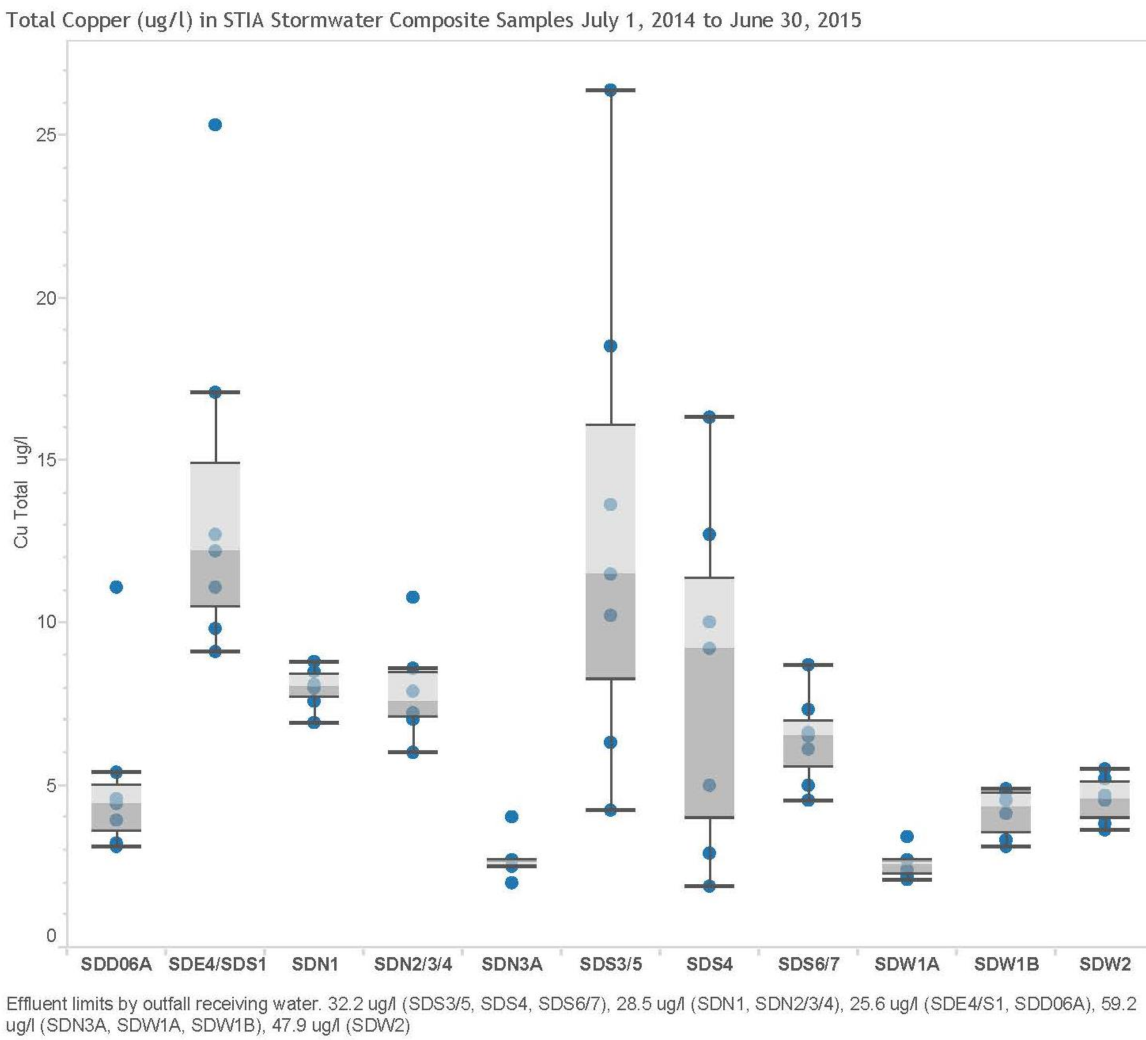


Figure 6. Copper Results

3.1.7.3 Lead

All data reported below are for total recoverable lead. The estimated median lead concentration for all outfalls was 0.1 µg/L (Figure 7). Lead concentrations ranged from not detected to 4.0 µg/L. Overall, lead was not detected in 39% of the 70 samples and was not detected in any sample from two outfalls (SDN-3A and SDW-1A).

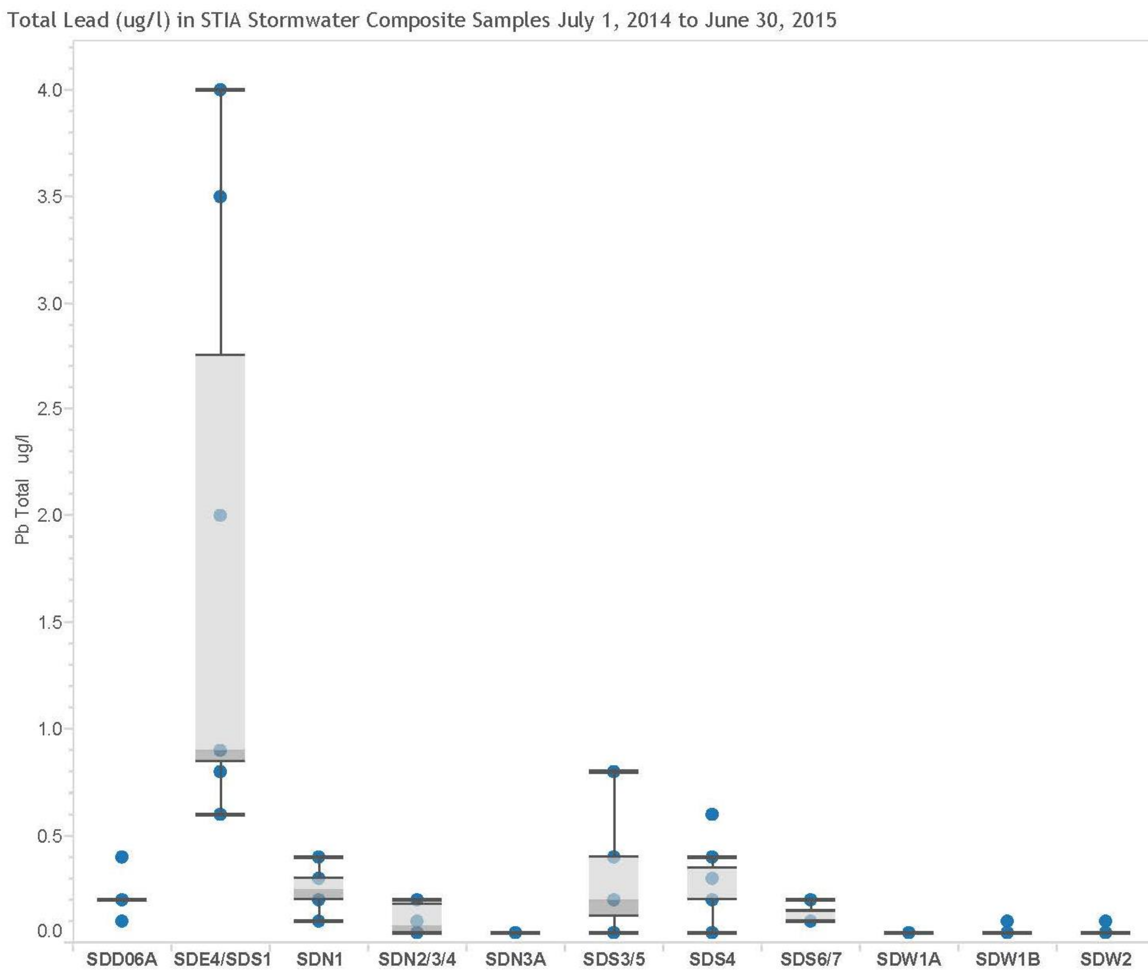


Figure 7. Lead Results

3.1.7.4 Zinc

All data reported are for total recoverable zinc. The median zinc concentration at all outfalls was 6 µg/L (Figure 8). Zinc concentrations ranged from not detected to 61 µg/L. There were no permit limit exceedances for zinc at any outfall during the monitoring period. Two landside subbasins, SDN-1 and SDE4/S1 had the highest range of zinc concentrations at 30 µg/L to 48 µg/L and 24 µg/L to 61 µg/L, respectively. In comparison airfield subbasin zinc concentrations range from not detected to 26 µg/L.

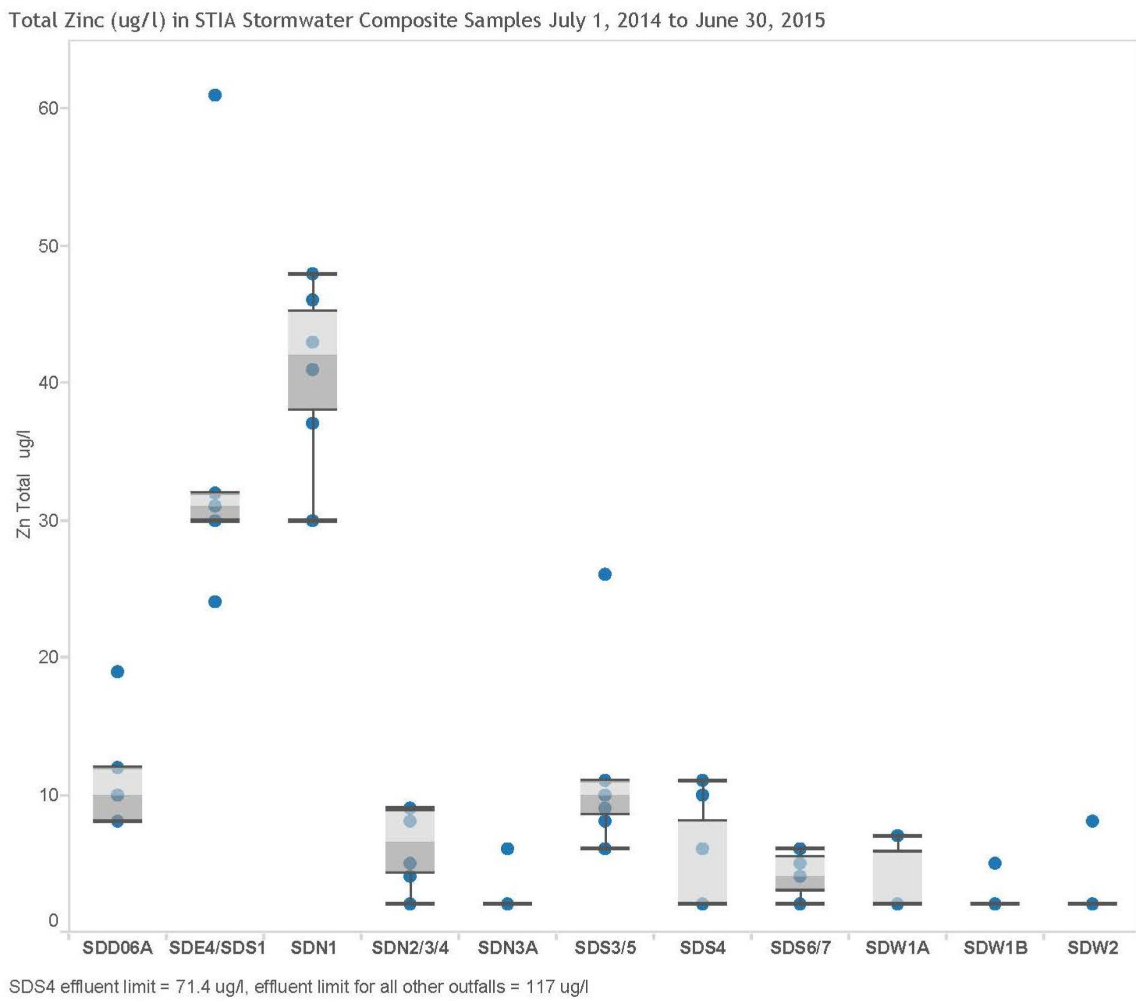


Figure 8. Zinc Results

3.2 Toxicity Monitoring

The following section discusses stormwater monitoring data related to sublethal toxicity sampling as well as a description of an *in situ* monitoring program that was completed during fall season 2014 and spring season 2015.

3.2.1 Sublethal Toxicity Sampling

Part II. S8.A of the permit requires sublethal toxicity testing on ambient samples from Miller Creek, Des Moines Creek, Walker Creek, Northwest Ponds, and Lake Reba biannually in the fall and spring during times of stormwater or snow melt runoff. If possible, another test is also required at stations receiving runoff from areas where deicing and anti-icing operations are occurring (winter event).

During the reporting period, samples were collected during fall 2014 and spring 2015 only. Samples were not collected during winter deicing season because there was only one limited deicing event on November 29, 2014 during a period when trout embryos were not available.

During fall and spring seasons, samples were collected from the East Branch of Des Moines Creek (DME), downstream of the confluence of the East and West Branch of Des Moines Creek (EWConf), the outlet of Northwest Ponds (NPOUT), the outlet of Lake Reba (RBOUT), Miller Creek at 8th Avenue (MC8TH) and the headwaters of Walker Creek (WLKR). The sublethal toxicity sampling locations are shown on Figure 1. There was no toxicity associated with any of the samples collected during the fall or spring sampling events. The Fall 2014 Sublethal Toxicity Testing Report was submitted to Ecology on December 2, 2014 (Nautilus 2014). The Spring 2015 Sublethal Toxicity Testing Report was submitted to Ecology on June 5, 2015 (Nautilus 2015).

3.2.2 In Situ Toxicity Monitoring

During the 2014-2015 reporting period, the Port continued Phase I *in situ* testing per the *In Situ Monitoring Plan* that was submitted to Ecology in 2009 (Nautilus, 2010). Testing was conducted during the 2014 fall season and 2015 spring season at three instream locations shown on Figure 1.

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. Phase I was originally intended to last for one year and include testing from spring and fall seasons. However, this phase is being extended to allow for additional comparison with the sublethal testing currently being conducted by the Port at sites downstream of Port outfalls as identified in Part II, Special Condition S8 of the Permit.

In fall 2014, adverse effects on survival were observed in Miller Creek (Nautilus 2015b), with hatching success and cumulative survival significantly reduced compared to the controls. The rainfall total for fall 2014 was well above average. Field measurements of temperature, dissolved oxygen, pH and conductivity were collected weekly and were all within ranges tolerated by early life stages of salmonids. Accumulation of sediments reaching over 80% of the hatch box volumes were observed. Although it is likely that sedimentation impacts the test, the effects on test endpoints has not been clearly established. Limited evidence of adverse effects were observed in the hatch boxes deployed at Miller Creek in spring 2015 with only weight being significantly reduced. The spring 2015 exposure period was drier than normal and experienced appreciably less discharge than the fall 2014 exposure period.

There were adverse effects observed at Des Moines at S 200th during the fall and spring season deployments. Hatching success and cumulative survival were significantly reduced in the fall but only weight was reduced in the spring. Significant effects were observed at the Upstream Des Moines Creek site for hatching success, post-hatch survival, and cumulative survival during the fall event with a cumulative survival rate of less than 2%. This suggests that the effects observed at the downstream site could be related to inputs originating upstream of STIA. There were no adverse effects observed at Upstream Des Moines Creek in the spring season deployment, this is the first time that Des Moines Creek Upstream has not exhibited significant adverse effects since testing at this site began in 2011.The full results can be found in the Rainbow Trout Early Life Stages *In Situ* Monitoring Testing, Phase 1: Development and Demonstration - Fall 2014 and Spring 2015 Testing Events Final Report.

3.3 Other Monitoring

3.3.1 Agreed Order 8755 Monitoring – Stormwater pH Study Results

On January 11, 2012 the Port entered into an Agreed Order with Ecology to evaluate the cause of the pH exceedances and evaluate steps to prevent future occurrences (WDOE, 2012). The Agreed Order required the Port to monitor pH of runoff entering each pond, pH of the effluent discharged from each pond, and pH in the receiving water downstream of each pond's outlet. Study related monitoring was conducted from November 2011 through May 2012, following the sampling frequency specified in the Port's NPDES permit. The results of the study indicate that primary productivity within the ponds, through the process of photosynthesis, caused elevated pH levels at the pond outfalls. Results of the continuous pH monitoring in the receiving waters show that pH downstream from the pond discharge locations were within the 6.5 to 8.5 range in both wet and dry weather conditions (Cardno TEC, Inc. 2012).

Following submittal of the pH Study results to Ecology in October 2012, the Port recommended continued receiving water monitoring for pH concurrent with routine NPDES storm events. This data collection continued through the 2014/ 2015 monitoring period. An analysis of all the pH data collected from the pond outfalls and the receiving waters from November 2011 through February 2015 continues to support the results of the pH study. The 2014/2015 monitoring results have been submitted to Ecology quarterly along with the DMRs. Based on the results of the pH study and the receiving water monitoring for pH from November 2011 through February 2015 the Port submitted a request for a "Notice of Compliance" to Ecology on June 3, 2015 (POS 2015).

4.0 BMP IMPLEMENTATION

The Port has 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.

During the 2014-2015 year, newly added BMPs included a flow control vault that serves the Doug Fox Parking lot, a LID bioretention swale to treat flows from the newly constructed cell phone parking lot, and conversion of SDS areas to IWS for areas where planned industrial activities will occur. In addition to BMP upgrades or modifications, BMPs are maintained on scheduled frequency to ensure effluent limits are being met.

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5.0 SUMMARY AND CONCLUSIONS

During the reporting period from July 2014 to June 2015 the Port fulfilled requirements for outfall monitoring under the current NPDES permit by collecting a total of 71 grab samples and 70 composite stormwater samples during 17 storm events. Outfalls were sampled quarterly when discharges occurred from rain events that met the minimum rainfall criteria of 0.1 inch with the exception of one sample[3]. There were only nine instances of effluent limit exceedance associated with 353 constituents that were tested to meet the monitoring requirements of the NPDES permit. This high level of compliance is an indication that the stormwater BMPS and the overall stormwater management program are effective at mitigating impacts from Airport operations on the adjacent receiving waters.

No sublethal toxicity was found in instream samples below STIA outfalls during the monitoring period. Adverse effects were observed during the Fall 2014 *in situ* monitoring in Miller Creek, Des Moines Creek at S 200th, and Upstream Des Moines Creek; The fall monitoring period was characterized by above normal rainfall. The instream conditions that caused the very low cumulative survival rates upstream of the STIA outfalls may have affected the survival rates at Des Moines Creek at S 200th as well. All three sites showed no adverse effects in spring 2015 *in situ* monitoring. The spring exposure period occurred during well below normal rainfall conditions. The *in situ* testing continued to be a reliable and consistent monitoring approach that is less likely to be impacted by the timing of storm events, laboratory scheduling and rainbow trout egg availability.

[3] The April 24, 2015 sample at SDN2/3/4 only had 0.05”. See footnote 1.

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APPENDIX A

TABULAR NPDES SAMPLE DATA SUMMARIES and STATISTICS

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APPENDIX B

OTHER SAMPLE DATA

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