Annual Stormwater Monitoring Report

Seattle-Tacoma International Airport

For the Period July 1, 2010 through June 30, 2011

October 11, 2011

Prepared by

Aviation Environmental Programs

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. This report summarizes the results of stormwater sampling at outfalls listed in permit Condition S1 between July 1, 2010 and June 30, 2011 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 2010-2011 data collection period. A total of 110 grab and 110 composite stormwater samples from 26 storm events were collected in the past year with results reported on quarterly Discharge Monitoring Reports (DMRs).

There were 27 instances of permit limit noncompliance associated with 550 individual constituent analyses. Additional stormwater BMPs were constructed through the Port’s stormwater management program in 2011 to address the instances of noncompliance. In addition to routine NPDES monitoring required by Condition S1, the Port continued monitoring activities pursuant to other NPDES Part II permit conditions and §401 Water Quality Certification for Master Plan Update Improvements. These activities include acute, sublethal and *insitu* toxicity sampling (Condition S7, S8 & S9).

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1 INTRODUCTION

The STIA stormwater monitoring program has been in place since 1993 pursuant to the NPDES permit for the airport. The first Washington State Department of Ecology (Ecology) permit was issued June 30, 1994. The permit was subsequently renewed and reissued on February 20, 1998, September 4, 2003 and October 1, 2003. The current effective permit was renewed on March 13, 2009 and became effective on April 1, 2009. The new permit has more stringent and protective effluent limits for copper and zinc that were based off of an intensive water effects ratio study that set site specific limits for outfalls based on their respective receiving water. The renewed permit removed the monitoring requirement for total suspended solids (TSS), biological oxygen demand (BOD), and hardness. TSS was replaced with an effluent limit for turbidity based on the results of a TSS and Turbidity Study. The effluent limit for lead was also removed due to a long track record of either non-detectable concentrations or very low concentrations.

The NPDES annual stormwater reporting requirement is included in Part II, S2.G. This Annual Report summarizes and discusses non-construction stormwater monitoring results as required by Part II, Condition S1 of the NPDES permit. The purpose of this Annual Report is to summarize 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 IWS or construction-related stormwater discharges. The report covers samples collected in the 12-month period of July 2010 through June 2011. Outfall sampling results summarized in this report include data already 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.

Other monitoring required by Part II of the NPDES permit is also summarized in this report. These other monitoring efforts include those associated with Acute Toxicity (Condition S7), Sublethal Toxicity (Condition S8) and Insitu Toxicity (Condition S9).

This report is organized into four sections following the introduction. Section 2 describes background conditions at the Airport including detailed descriptions of each drainage subbasin and outfall sampling location. Section 3 summarizes all of the discharge monitoring report (DMR) related grab sample and composite sample 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 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 17th busiest passenger and the 20th 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 with much of the current drainage infrastructure designed and constructed prior to 1969. Stormwater drainage at Seattle-Tacoma International Airport is separated into two different collection systems, the Industrial Wastewater System (IWS) and the Storm Drainage System (SDS). The IWS receives stormwater runoff from 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 Storm Drainage System (SDS) drains nearly 1,200 acres. More than one-half of this area is impervious and primarily associated with airport industrial activities, with the remainder being pervious which consists of landscaped or fallow open spaces. On the north portion of STIA, the stormwater drainage is conveyed to Lake Reba and subsequently to Miller Creek, the western portion of STIA drains to Miller Creek and Walker Creek, while in the south the drainage flows to the Northwest Ponds and Des Moines Creek. About 25 percent of the area drained by the SDS flows to Miller Creek. This drainage represents about 7 percent of Miller Creek's watershed. Approximately 71 percent of the total area drains to the Northwest Ponds and Des Moines Creek, which represents about 21 percent of the creek's watershed.

Table 1 STIA Subbasins and Associated Activity

Table 1. STIA Subbasins and Associated Activities

Outfall Name	Receiving Water	General Category	Industrial Activity	Non-Industrial Activity	Pervious Area (acres)	Impervious Area (acres)	Total Area (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.	27.1	128.3	155.4
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.	17.1	28.4	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	Des Moines Creek (West Branch) via NW Ponds	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, open areas and building rooftops.	212.4	244.9	457.4
SDS4	Des Moines Creek (West Branch) via NW Ponds	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Runway infield and open areas.	41.6	24.8	66.5
SDS6/7	Des Moines Creek (West Branch) via NW Ponds	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Access roads, runway infield and open areas.	64.0	45.9	109.9
SDN2 [a, b]	Miller Creek via Lake Reba	Airfield	Ground surface deicing/anti-icing, snow storage, aircraft service, equipment parking, and aircraft taxi.	Perimeter road, taxiway infield and open areas.	0.0	0.0	0.0

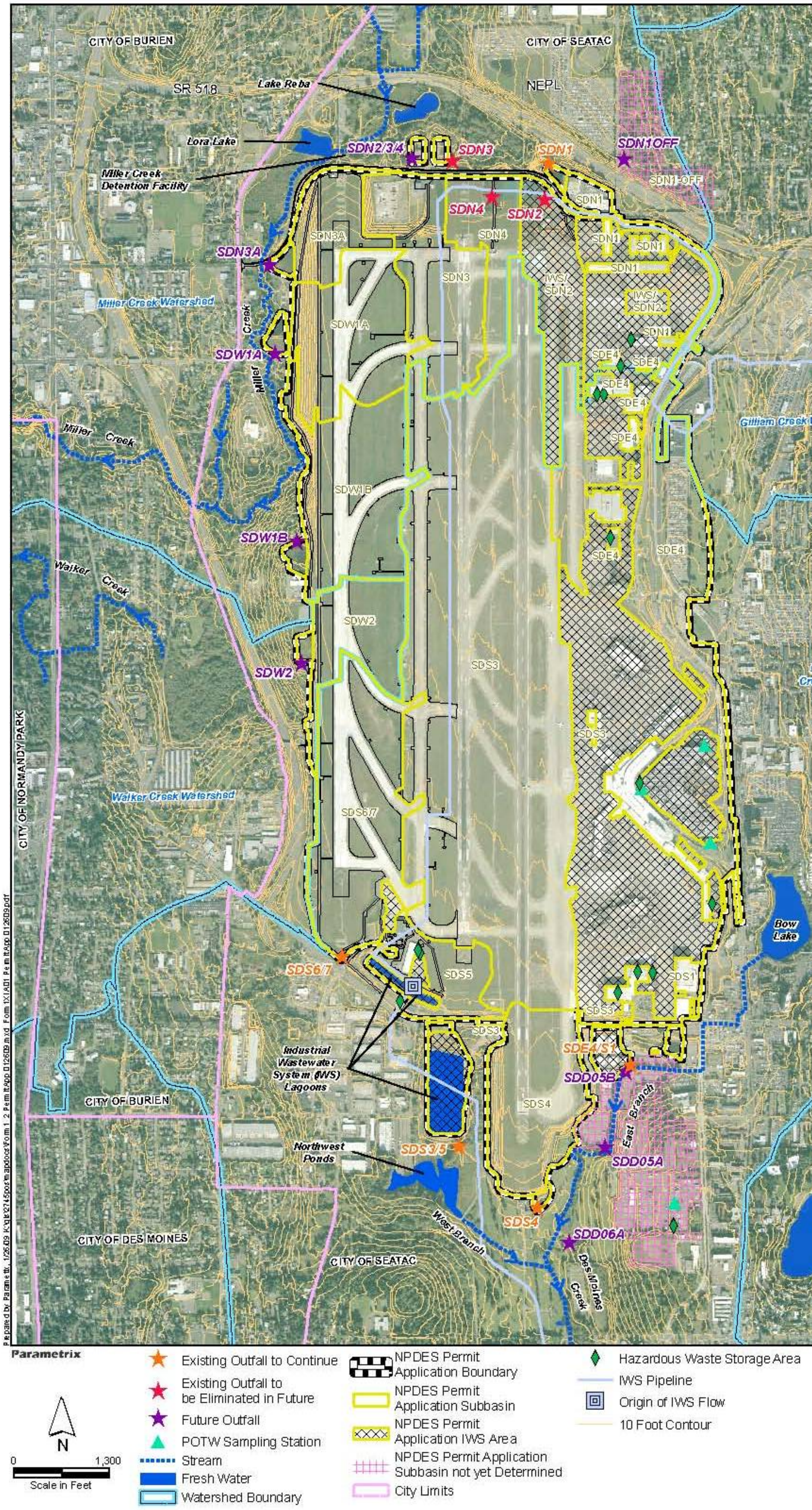
Table 1. STIA Subbasins and Associated Activities							
Outfall Name	**Receiving Water**	**General Category**	**Industrial Activity**	**Non-Industrial Activity**	**Pervious Area (acres)**	**Impervious Area (acres)**	**Total Area (acres)**
SDN3[b]	Miller Creek via Lake Reba	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	42.0	29.6	71.6
SDN4[b]	Miller Creek via Lake Reba	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Access road, runway infield and open areas.	26.4	16.5	37.0
New Outfalls Activated in November 2008 With the Third Runway							
SDN3A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	22.9	8.6	31.5
SDW1A	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	44.4	25.8	70.1
SDW1B	Miller Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	59.8	24.9	84.7
SDW2	Walker Creek	Airfield	Ground surface deicing/anti-icing, aircraft taxi, takeoff and landings.	Perimeter road, runway infield and open areas.	30.8	11.2	42.0
				Total Area	**592.3**	**604.9**	**1191.3**

Note: Total area is based on October 2011 GIS data layer including area updates related to Runway 16L Reconstruction, and extended detention provided by Pond M for outfalls SDN2, SDN3 and SDN4.

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, 40.0 of which are impervious. This area is included in acreages reported to the IWS.

b) SDN2, SDN3 and SDN4 were routed to Pond M on October 12, 2010. The SDN2, SDN3, and SDN4 outfalls were eliminated from the permit and Pond M was activated October 12, 2010. Future outfall SDN2/3/4 will replace Pond M in November 2011.



Form 1 XI
Attachment 01

Figure 1

2.2 STIA Storm Drainage Subbasins, Activities, and Outfall Descriptions

The area covered by the Permit is segregated into separate stormwater subbasins that each drain to individual outfall locations. The NPDES permit (effective April 1, 2009) 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, 2011, only 11 of the 19 outfalls are active outfalls that discharge stormwater related to industrial activity. Table 1 lists each active outfall and the associated land use and subbasin characteristics.

This report refers to drainage subbasins and their outfalls by location names. The Port codes STIA storm drainage subbasin names according to location, for example, "SDN1" means "storm drain north number 1". STIA has undergone significant changes associated with the Third Runway Project, Master Plan Upgrade Projects and Stormwater Retrofits. The airport is an active facility and subbasins and outfalls will continue to change through Comprehensive Development Plan implementation.

STIA stormwater subbasins can be 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 except for SDE4/S1. Previous reports showed that concentrations of TPH, TSS and other constituent concentrations were different for the landside and airfield categories (POS 1996a, 1997a.) Table 1, *STIA Subbasins and Associated Activity*, describes each active subbasin, receiving water, activities within each subbasin and total pervious and non-pervious surface areas.

Four creek basins, Miller, Des Moines Creek East, Des Moines Creek West, and Walker Creek along with the STIA subbasins discharging to each of them are briefly described below. Since 2004 the Port has installed numerous stormwater treatment facilities to remove pollutants from pollution generating surfaces (PGS). PGS includes roads, parking areas, STIA support areas, and aircraft taxiways and runways. Stormwater treatment facilities in each subbasin are also described below.

2.1.1 Miller Creek

Miller Creek is six miles in length. Miller Creek's watershed includes portions of Normandy Park, the City of Sea-Tac, and the City of Burien. Approximately 62 percent of the land use in the Miller Creek Basin is residential, 19 percent is commercial/industrial, and the remainder is open (parks, cemeteries, or forests/wetlands). The creek flows south under SR 518 and through the in-stream Miller Creek Regional Detention Facility, passing Lake Reba and Lora Lake.

The Port constructed Lake Reba in 1973 in compliance with a stipulated order (King County Superior Court No. 726259). Originally identified as the North Clear Zone Detention Pond, the pond was designed to provide 13.5 acre-ft of active storage, limit release rates to Miller Creek to 40 cubic feet per second and treat runoff from the northern portion of STIA. A study conducted in the mid-1990s confirmed that this facility provided removal of pollutants, specifically zinc and suspended solids (Port of Seattle, 1997). Although initially operated as a stormwater facility, in April 2005 Ecology determined that Lake Reba was constructed in a wetland and therefore constituted waters of the state, subject to regulation as a natural water body.

Miller Creek continues southward through land owned by the Port of Seattle. Portions of the creek in this vicinity have been relocated and were restored as mitigation during construction of the third runway. The creek then turns west and flows to Puget Sound, two miles distant.

The Miller Creek Basin is urbanized and exhibits rapid changes in stream flow typical of developed basins. The large amount of impervious area produces much more runoff than occurred under native, forested conditions, and this runoff reaches surface water much more quickly. In 1992, King County constructed the in-stream Miller Creek Regional Detention Facility and the 1st Avenue South Regional Detention Facility (Ambaum Pond) as partial mitigation for increased flows attributed to regional development within the watershed.

Airport subbasins in Miller Creek consist of SDN-1, SDN-2, SDN-3, SDN-3A, SDN-4, SDW-1A, SDW-1B and Pond M are described in detail in Sections 2.2.1.1 through 2.2.1.8 below.

2.2.1.1 Drainage Basin SDN-1

The SDN-1 subbasin is located in the northeastern portion of the airport and discharges to Miller Creek via Lake Reba. Runoff from the subbasin includes flight kitchens, roads and the roofs of several buildings. Several galvanized rooftops are painted in the SDN-1 subbasin as a source control measure to reduce zinc concentrations in stormwater. Bioswales along Air Cargo Road treat runoff from this roadway within the SDN-1 subbasin. A stormwater detention pond provides 7.15 acre-feet of live storage with 2.1 acre-feet of wet pond dead storage for flow control and treatment.

2.2.1.2 Drainage Basin SDN-2

The SDN-2 subbasin is primarily an IWS drainage area that collects runoff from over 42 acres of taxiways and cargo ramp areas. Runoff from the subbasin is collected and diverted to the IWS using two pump stations designed to divert runoff up to the water quality design flow rate. Peak flows exceeding the capacity of the pump stations drain to the SDN-2 outfall which discharges to Miller Creek via Lake Reba. SDN-2 industrial activities include cargo aircraft servicing/deicing and pavement deicing/anti-icing chemical applications. The SDN-2 outfall was eliminated from the permit on October 12, 2010. Stormwater from the SDN-2 subbasin was combined with runoff from subbasins SDN-3 and SDN-4 and routed to Pond M. Pond M is being reconstructed to provide Level 2 (duration-based) flow control for all runoff from the SDN-2, SDN-3, and SDN-4 subbasins with construction scheduled to be complete November 2011. The Pond M outfall was eliminated from the permit following the 2010/2011 annual reporting period and the SDN2/3/4 outfall was activated for third quarter 2011 monitoring.

2.2.1.3 Drainage Basin SDN-3

SDN-3 subbasin is located on the northern portion of the airport and discharges to Miller Creek via Lake Reba. SDN-3 contains airfield activities at the north end of the airport, including service roads, runways, taxiways, and associated infield areas. Infield areas are the open, grassed areas between taxiways and runways that are managed as filter strips to treat runoff from the adjacent pollution-generating surfaces (runways). As a source control measure, the Port conducts annual runway rubber removal of those portions of the runway subject to accumulation of aircraft tire tread worn off by repeated aircraft touchdowns. The SDN-3 outfall was eliminated from the permit on October 12, 2010. Stormwater from the SDN-3 subbasin was combined with runoff from subbasins SDN-2 and SDN-4 and routed to Pond M. Pond M is being reconstructed to provide Level 2 (duration-based) flow control for all runoff from the SDN-2, SDN-3, and SDN-4 subbasins with construction scheduled to be complete November 2011. The Pond M outfall was eliminated from the permit following the 2010/2011 annual reporting period and the SDN2/3/4 outfall was activated for third quarter 2011 monitoring.

2.2.1.4 Drainage Basin SDN-4

SDN-4 subbasin is located on the northern portion of the airport and discharges to Miller Creek via Lake Reba. SDN-4 consists of service roads, runways, taxiways, and associated infield areas. Re-construction of Runway 16L during the summer of 2009 allowed the Port to move the catch basins further away from the edge of the runway. This work lengthened the effective treatment area of the filter strips within the SDN-4 subbasin. The SDN-4 outfall was eliminated from the permit on October 12, 2010. Stormwater from the SDN-4 subbasin was combined with runoff from subbasins SDN-2 and SDN-3 and routed to Pond M. Pond M is being reconstructed to provide Level 2 (duration-based) flow control for all runoff from the SDN-2, SDN-3, and SDN-4 subbasins with construction scheduled to be complete November 2011. The Pond M outfall was eliminated from the permit following the 2010/2011 annual reporting period and the SDN2/3/4 outfall was activated for third quarter 2011 monitoring.

2.2.1.5 Drainage Basin SDN-3A

The SDN3-A subbasin discharges directly to Miller Creek and collects stormwater from the northern most portion of Runway 16R (Third Runway) and its’ runway safety area. Runway filter strips provide treatment. Flow control is provided by a Level 2 detention pond.

2.2.1.6 Drainage Basin SDW-1A

The SDW-1A subbasin located south of SDN-3A discharges directly to Miller Creek and collects stormwater from the north portion of Runway 16R and its taxiways. Runway filter strips provide treatment. Flow control is provided by a Level 2 detention pond.

2.2.1.7 Drainage Basin SDW-1B

The SDW-1B subbasin discharges directly to Miller Creek and collects stormwater from the central portion of the Runway 16R and its taxiways. Runway filter strips provide treatment. Flow control is provided by a Level 2 detention pond.

2.2.1.8 Drainage Basin Pond M

The Pond M subbasin discharges directly to Miller Creek and collects stormwater from subbasins SDN-2, SDN-3, and SDN-4. Pond M is a temporary outfall that was activated on October 12, 2010 and upgraded to provide sedimentation treatment within the ponds dead storage zone and provide duration based flow control for ½ of the 2-year to the 2-year flow rates. Reconstruction of Pond M is underway to provide Level 2 (duration-based) flow control for all runoff from the SDN-2, SDN-3, and SDN-4 subbasins and is on schedule to be completed in November 2011. On May 11, 2011 construction stormwater runoff from subbasins SDN-2, SDN-3, and SDN-4 was routed around the Pond M construction area to discharge to Lake Reba. The Pond M outfall was eliminated from the permit at this time and the SDN2/3/4 outfall was activated for third quarter 2011 monitoring.

2.1.2 Walker Creek

Walker Creek is approximately 2 miles in length. It begins immediately west of Des Moines Memorial Drive, just inside the City of Sea-Tac and heads westward through a series of wetlands and open water areas in the City of Burien and Normandy Park. Walker Creek joins Miller Creek before discharging into the Puget Sound. SDW-2 is the only STIA drainage basin that discharges to Walker Creek. The SDW-2 outfall was activated in November 2008 with the opening of the third runway (runway 16R).

2.2.4.1 Drainage Basin SDW-2

The SDW-2 drainage basin is located on the south-western corner of the airfield. This area receives runoff from runway, taxiways and infield areas associated with the west portion of the Runway 16R. Runway filter strips provide treatment. Flow control is provided by a Level 2 detention pond.

<u>2.1.3</u> <u>Des Moines Creek East</u>

Des Moines Creek East begins at Bow Lake, one-quarter mile east of STIA. The creek flows mostly within pipes through the City of SeaTac and along the east side of STIA. Des Moines Creek East daylights in the southeast portion of STIA and flows through a golf course and Tyee Detention Facility (constructed by King County in 1989). Des Moines Creek East joins with Des Moines Creek West a short distance downstream of Tyee Detention Facility, south of the runways, and then crosses under South 200th Street. Des Moines Creek flows an additional two miles south and west to Puget Sound. The Des Moines Creek basin covers the Cities of Des Moines, Normandy Park, and SeaTac and a small portion of the City of Burien.

The area of the Des Moines East Basin above its confluence with Des Moines West is approximately 1,000 acres. The majority of this area lies west of STIA in the City of SeaTac. Off-airport land uses include single family residential, a large mobile home park, a highly commercialized area along International Boulevard and a golf course.

Des Moines Creek is urbanized and exhibits large variations in stream flow that are characteristic of developed basins, similar to Miller Creek. In addition to the Tyee Detention Facility, the Des Moines Creek Regional Detention Facility and Des Moines Creek High Flow Bypass have been constructed through Des Moines Creek Basin Planning efforts.

Des Moines Creek East subbasins SDE-4/S1 and SDD-06A are described in detail in the following Sections 2.2.2.1 and 2.2.2.2 below.

2.2.2.1 Drainage Basin SDE-4/S1.

The SDE-4/S1 subbasin is located in the southern portion of the airport and includes the SDE-4 and the SDS-1 subbasins into one single outfall which discharges to Des Moines Creek (East Branch).

The SDS-1 area receives runoff from aircraft maintenance building rooftops, parking areas, cargo building rooftops, roads, and parking lots. In October 2006, a galvanized maintenance building rooftop was painted along with galvanized portions of an HVAC I-beam super-structure on an adjacent office building (source separation). Two bioswales were also constructed in SDS-1. They are located in an approximately 1-acre area along South 188th Street at the downstream end of the subbasin and treat parking lot and road runoff in this area.

SDE-4 drains the passenger terminal area on the east side of STIA. This area receives runoff from roads, parking lots, terminal area roofs, and taxiways. Multiple BMPs constructed in the SDE-4 subbasin were designed to meet AKART requirements (basic treatment) and provide additional enhanced treatment for dissolved metals. The SDE-4 subbasin receives flow control and treatment via an 11-acre-foot flow-control extended detention pond, a 600-cartridge media filtration vault providing enhanced treatment, and a bioswale.

2.2.2.2 Drainage Basin SDD-06A

The SDD-06A subbasin and outfall was activated following completion of the Port's new Consolidated Maintenance Warehouse project. This area receives runoff from public roads, vehicle parking areas, rooftops and landscaped areas. The SDD-06A outfall discharges to Des Moines Creek (East Branch). Water quality treatment for the SDD-06A subbasin consists of a bioretention swale with oyster shell placed at the end for additional treatment. The SDD-06A is also served by a flow-control extended detention pond.

2.1.4 Des Moines Creek West

Des Moines Creek West has its origins in the area southwest of the runways. The upper portion of its basin originates in a highly developed area. The creek flows into a series of ponds known as the Northwest Ponds. Historical aerial photos indicate that the area occupied by the ponds was farmland until the late 1950s. The ponds were dredged during the following decade. The area of this basin above its confluence with Des Moines Creek East is approximately 1,200 acres. Nearly one half of this area lies within the boundaries of the STIA. Off-airport land uses include streets, single family residential, warehouses, and a large wetland area south of the ponds.

The Northwest Ponds were enlarged to provide regional detention to control high flows in the middle and lower reaches of Des Moines Creek by the Des Moines Creek Basin Committee which consists of the Port of Seattle, City of Sea-Tac, City of Des Moines and Washington State Department of Transportation. Additional committee projects include a high creek flow bypass pipe that conveys flows directly to Puget Sound via an existing outfall. Habitat improvements have been added to the stream channel south to S. 200th Street. Downstream, an undersized culvert under Marine View Drive has been replaced by a bridge to improve fish passage. Additional stream habitat improvement projects will continue to be constructed as further funding is secured.

There are three STIA subbasins in Des Moines West Basin: SDS-3/5, SDS-4 and SDS-6/7. Each of these subbasins within the Des Moines West Basin receives runoff from runways, taxiways, and service roads. During 2003-2008, all of the subbasins that drain to the Des Moines West Basin were improved through the addition of a variety of water quality and flow control BMPs. Des Moines Creek West subbasins are described in detail in the following Sections 2.2.3.1, 2.2.3.2, and 2.2.3.3 below.

2.2.3.1 Drainage Basin SDS-3/5.

The SDS-3/5 subbasin is located in the southern portion of the airport and includes the SDS-3 and the SDS-5 subbasins into one single outfall which discharges to the West Fork of Des Moines Creek via Northwest Ponds.

SDS-3/5 drainage area is the largest at STIA, consisting primarily of runway, taxiway, limited/maintenance access roadways and runway infield. The SDS-3/5 subbasin is treated by filter strips, bioswales, catch basin media filters and two Level 1 flow control detention facilities. Re-construction of Runway 16L during the summer of 2009 allowed the Port to move the catch basins further away from the edge of the runway. This work lengthened the effective treatment area of the filter strips within the SDS-3/5 subbasin.

2.2.3.2 Drainage Basin SDS-4.

SDS-4 drainage basin is located on the southern portion of the airport and receives drainage from runways, taxiways, runway safety areas and perimeter roads. SDS-4 drainage is collected at a stormwater facility located south of Runway 34R in the Tyee Valley Golf Course. This detention pond discharges to Northwest Ponds prior to entering Des Moines Creek West. The facility supplements the Des Moines Creek regional detention facility by providing detention to the SDS-4 subbasin. Runway filter strips provide treatment. Re-construction of Runway 16L during the summer of 2009 allowed the Port to move the catch basins further away from the edge of the runway. This work lengthened the effective treatment area of the filter strips within the SDS-4 subbasin.

2.2.3.3 Drainage Basin SDS-6/7.

SDS6/7 is located on the southwestern portion of the airport and the drainage basin receives runoff from runways, taxiways, infield and perimeter roads. Level 1 flow control for the SDS-6 subbasin is provided by a 3.5-acre-foot vault. The runways and taxiways within the SDS-6/-7 subbasin are treated with filter strips and bioswales.

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3 SAMPLING RESULTS AND DISCUSSION

This section of the Annual Report summarizes the results of outfall monitoring as required under Part II Condition S1 of the Airports NPDES Permit. Data are presented and discussed from grab samples and composite samples. 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 event hydrograph to yield an event mean concentration (EMC).

In addition to the DMR data, this report summarizes other data collected at the storm drain outfalls listed in Part II, S1 of the NPDES permit. These other data consist of field equipment blank samples, field duplicate samples, non-representative samples, and samples that were analyzed for additional parameters not required by the Permit. These other data are presented in Appendix B. This report also summarizes acute toxicity testing at outfalls as well as sublethal toxicity testing and *insitu* toxicity testing at receiving water sites downstream of Port outfalls.

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 Procedure Manual (POS 2008a). These monitoring locations were selected to represent stormwater downstream of the last BMP within each subbasin. Because these sampling locations are not in-stream, their associated water quality data are not suited for direct comparison with water quality standards. Site-specific water quality based effluent limitations have been developed and are used to assess discharge monitoring results. The Procedure Manual 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 data on DMRs for results from storms and samples that were validated according to the representativeness criteria of the Procedure Manual.

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 conditions are the sampling conditions specified in the NPDES permit, Part II, S1.B. Each grab sample 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
pH	150.1[(1)]	0.01 S.U.	grab
Oil & Grease - TPH (by GC)	NWTPH-Dx[(3)]	0.75 mg/l	grab
Turbidity	180.1[(1)]	0.05 NTU	grab
Glycols, Ethylene, Propylene	GC FID[(2)]	10.0 mg/l	flow-wt comp.
Total Recoverable Copper	200.8[(1)]	0.5 µg/l	flow-wt comp.
Total Recoverable Lead	200.8[(1)]	1.0 µg/l	flow-wt comp.
Total Recoverable Zinc	200.8[(1)]	4.0 µg/l	flow-wt comp.

Table Notes:

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 according to the Procedure Manual. 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 1999b). Eleven field blanks were collected in the 2010 – 2011 reporting period. Copper, lead and zinc was non-detectable in all field blank samples. Ethylene glycol and propylene glycol were consistently non-detectable in all blank samples and total petroleum hydrocarbons (TPH) was only detected on one occasion at a concentration slightly higher than the reporting limit.

3.1.3 Permit Effluent Limits

The current NPDES permit (effective April 1, 2009) specifies effluent limits for turbidity, pH, oil and grease, total copper, and total zinc at all outfalls. A 25 NTU effluent limit for turbidity was added in the April 1, 2009 permit which replaced the TSS benchmark from the previous permit. The monitoring requirement for BOD and hardness were also removed from the permit. 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 is not used at the Port therefore monitoring and subsequent effluent limits for ammonia and nitrates/nitrites are not required. Effluent limits became effective December 31, 2007. The site specific study and subsequent derivation of site-specific water quality based effluent limits are described in the following Section.

3.1.3.1 Site-Specific Study

The Port completed a Site-Specific Study (e.g., Water Effects Ratio determination) for copper and zinc. The study was required by the Airport's 401 Certification for Master Plan Update (MPU) projects and the current NPDES permit. The study developed site-specific water quality objectives (SSWQOs) that incorporated water effect ratios and dissolved to total translators for each stream segment that receives existing and future Airport stormwater runoff. SSWQO-based effluent limits were subsequently derived using the10th percentile hardness associated with the receiving water and assumed no dilution.

In the case of copper, the SSWQO-based effluent limits were less than the previous permit effluent limitations and were used in the renewed permit. Zinc SSWQO-based effluent limits were greater than the current previous permit limits with the exception of SDS4 where a WER reduction resulting in a water quality-based limit of 0.0714 mg/L was needed to reach the reasonable potential threshold. For all other outfalls the zinc effluent limit of 0.117 mg/L was retained in the renewed permit. A summary of SSWQO-based limits are summarized in Table 3.

Table 3 Site-Specific Study Derived Water Quality-Based Effluent Limits

Receiving Water	Associated Outfalls	Copper (mg/L)	Zinc (mg/L)
East Des Moines Creek	SDE4/S1, SDD06A	0.0256	0.117
West Des Moines Creek and Northwest Ponds	SDS3/5, SDS6/7	0.0322	0.117
Northwest Ponds	SDS4	0.0322	0.0714
Lake Reba	SDN1, SDN2, SDN3, SDN4, SDN2/3/4	0.0285	0.117
Miller Creek	SDN3A, SDW1A, SDW1B, Pond M	0.0597	0.117
Walker Creek	SDW2	0.0479	0.117

3.1.4 Storm Events Sampled

During the current permit's annual reporting schedule (July 1, 2010 through June 30, 2011), 48.15 inches of rain fell at STIA, 10.06 inches (21%) above the historical average of 38.09 inches and significantly more than the past monitoring year (42.48 inches). Monthly rainfall totals for the year were near average with the exception of September, October, December, March, April, and May which were well above average (Figure 2).

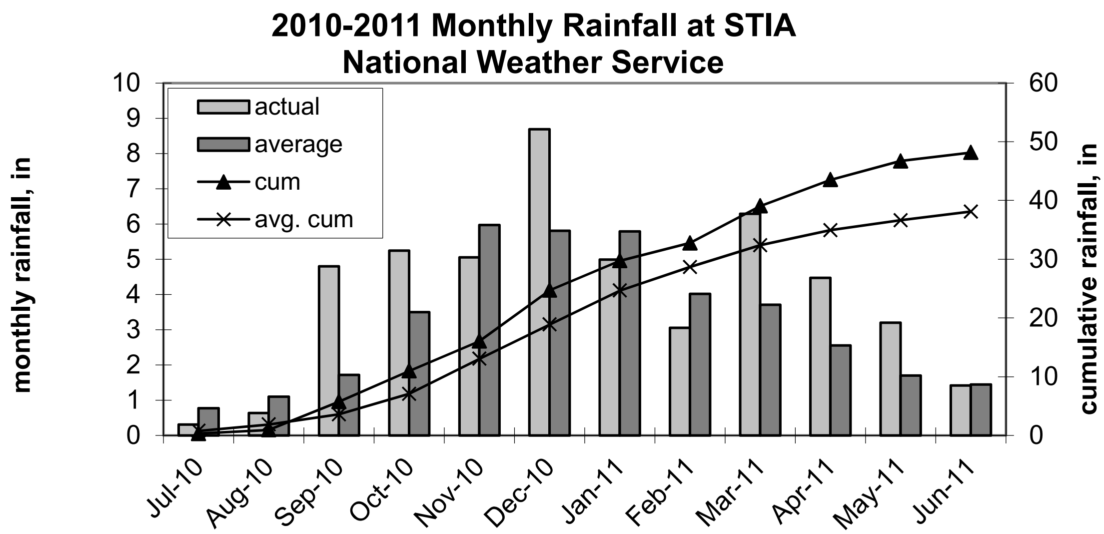

Figure 2 Rainfall Summary

In the 12 months ending June 30, 2011, the Port sampled 26 rainfall events with rainfall ranging from 0.11 to 3.40 inches. Dry weather preceding these events ranged from 13 hours (January 13, 2010) to 33 days (August 7, 2010). The tabular sample data in Appendix A includes storm event data such as rainfall depth, antecedent rainfall, and length of antecedent dry period[1].

Representative samples were collected from all active outfalls during the 2010-2011 reporting period.

[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.

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3.1.5 Data Presentation Methods

Outfall sampling results for the current year are summarized graphically in box plots that illustrate the central tendency, spread, and skew of the stormwater data (Figures 3 through 8). The bold line within a box represents the median value, while the bottom and top of a box show the 25th and 75th percentiles, respectively. In other words, the central 50 percent (interquartile range) of the data lie within values highlighted by the box. 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 parameters glycols and lead have a high frequency of non-detection as indicated in this section and Appendix A summary statistics.

The data set includes outliers and extreme values that usually represent unusual conditions or anomalies. Outliers are defined as cases with values between 1.5 and 3 box lengths from the upper or lower edge of the box and extreme values are defined as cases with values more than 3 box lengths from the upper or lower edge of the box. In a box plot, the “whiskers” show the largest values that are not considered outliers (SPSS, 2005). The number of cases (n) included in the calculation of each outfall box plot is located above the x-axis under each box. The box plot graphs also display the applicable permit effluent for reference within each graph as a solid line horizontally across the graph. 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, 2010 through June 30, 2011. 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 Procedure Manual.

3.1.6 Grab Sample Results and Discussion

The following discussion includes results from 110 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 7.8. All sample results fell consistently within the effluent limit range of 6.5 to 8.5 with the exception of some of the samples collected at outfalls Pond M, SDD06A, SDW-1A, SDW-1B, and.SDW-2. During the previous annual reporting period, on May 2nd, 2010 the upper pH effluent limit was exceeded at the SDW-2 outfall. This was the first effluent limit exceedance at the SDW2 outfall. Additional monitoring was conducted to determine the source of the elevated pH at the SDW-2 outfall and any impacts to the receiving water. The source of the elevated pH was determined to be caused by algal growth within the SDW-2 pond and associated diurnal fluctuation of pH levels. The pH monitoring found no impact to the receiving water.

Corrective actions taken by the Port to prevent future pH exceedances involved closing the outlet valve to the pond to prevent discharge during the critical summer period. The same approach was used at other ponds with similar characteristics SDN-3A, SDW-1A, and SDW-1B.

Recurrent pH violations have occurred in discharges from SDW-1A, SDW-1B, and SDW-2. The first pH violation observed at the Pond M outfall appeared to be due to installation of a new concrete manhole but the later additional two violations were likely due to algal growth. However, the Port has implemented operational and structure BMPs to eliminate the Pond M exceedances. One isolated upper pH effluent limit exceedance also occurred at outfall SDD06A. However, this violation was isolated and is not believed to have been associated with other reported occurrences. The Port will continue to work with Ecology during the 2011/2012 monitoring period to conduct additional monitoring to determine the cause of algal growth in the SDW-1A, SDW-1B, and SDW-2 ponds.   This additional monitoring will be used to evaluate stormwater best management practice options to prevent algal growth and associated pH exceedances.

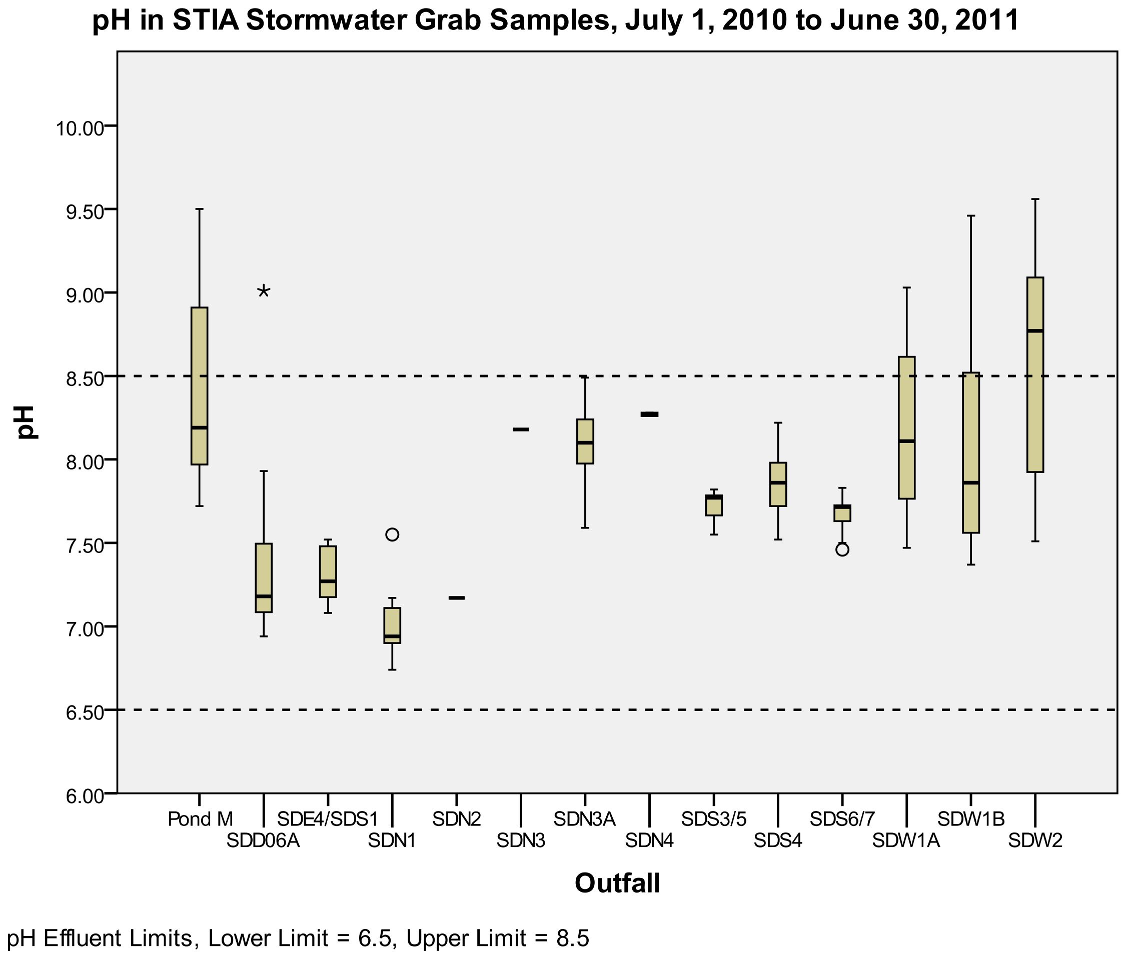
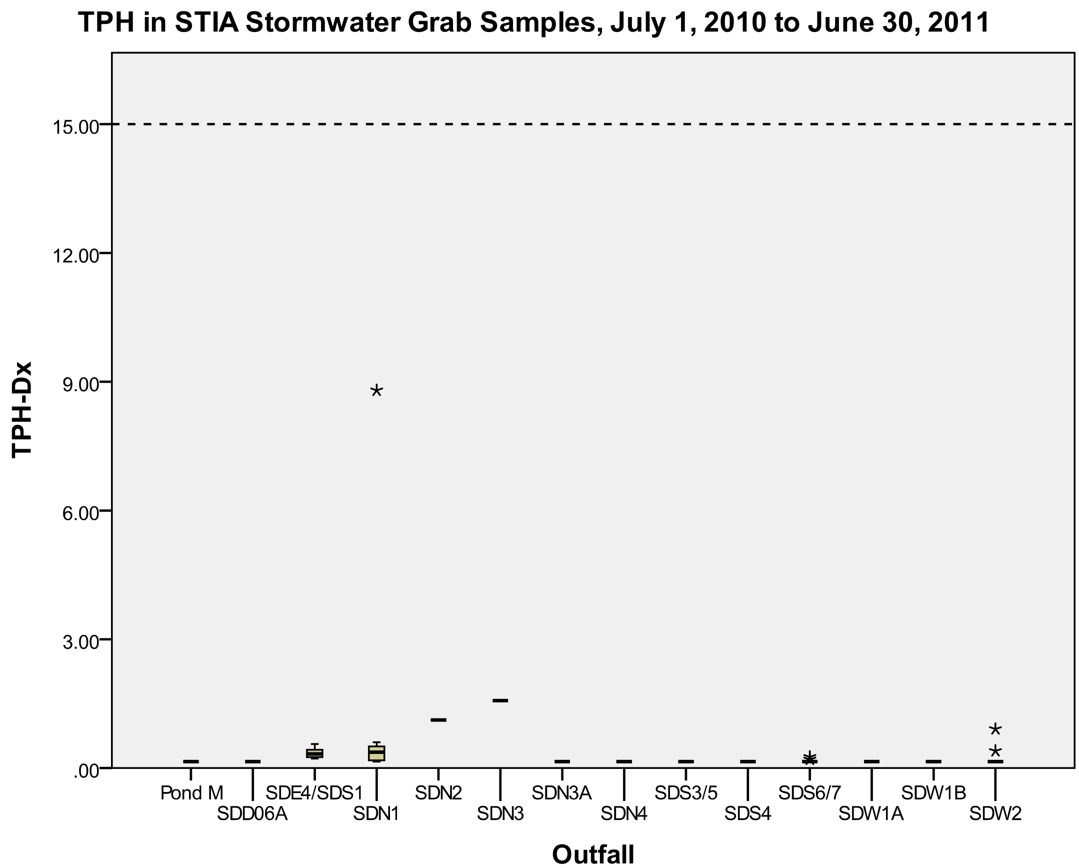


Figure 3 pH Results

3.1.6.2 Total Petroleum Hydrocarbons (TPH)

Figure 4 shows TPH data for the current reporting year. 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 detected in 19 of the 110 samples. All sample results were well below the TPH effluent limit 15 mg/L.

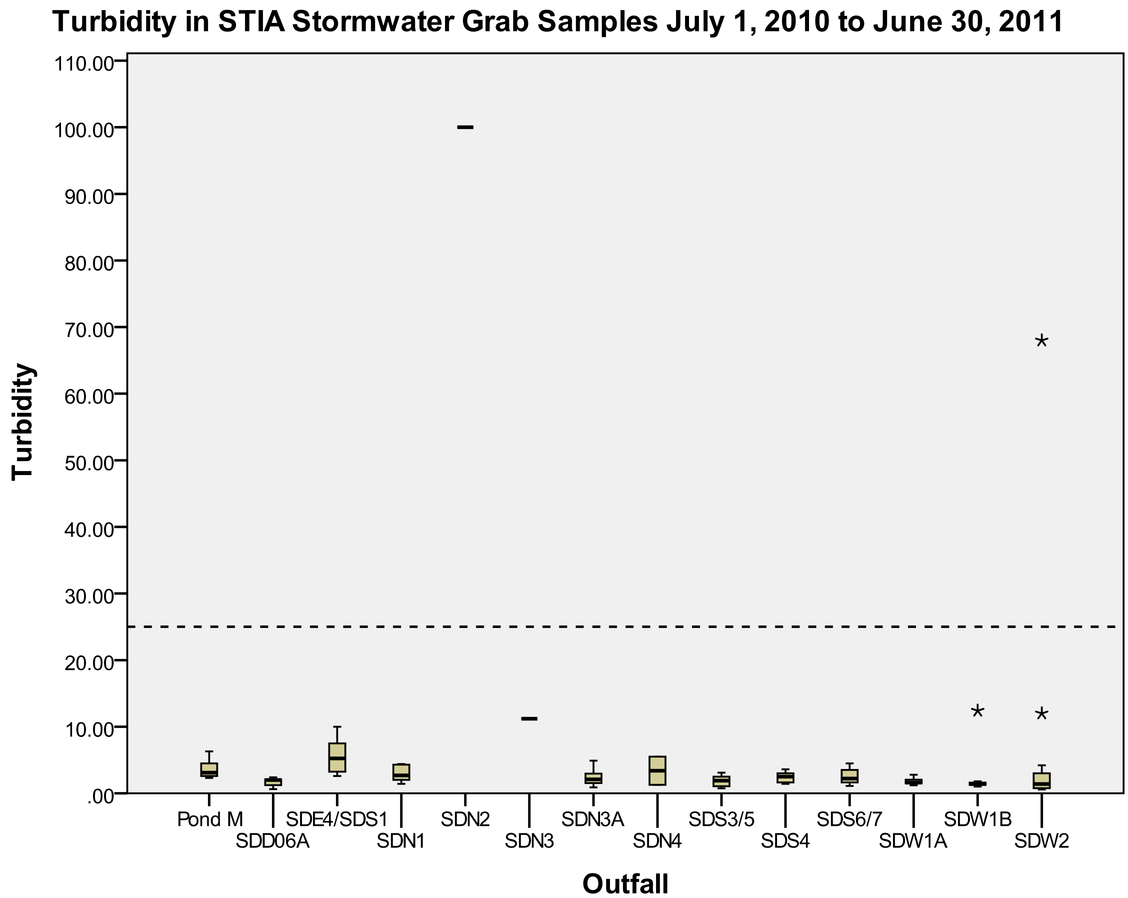


TPH Effluent Limit = 15 mg/L (shown on chart as dashed line)

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 2.05 NTU. Only 3 of the 110 samples collected exceeded the 25 NTU turbidity effluent limit. Elevated turbidity results were sporadic among few outfalls (SDN-1, SDN-2, and SDW-2). The highest turbidity was found in a sample collected from the SDN-1 outfall which was caused by resuspension of sediment within the SDN-1 pond during a high intensity storm event. An energy dissipation structure was installed in summer 2010 to prevent resuspension in the future and associated effluent limit exceedances.



Outlier value for SDN1 (260 NTU) not shown on chart due to scaling.

Turbidity Effluent Limit = 25 NTU (shown on chart as dashed line)

Figure 5 Turbidity Results

3.1.7 Composite Sample Results and Discussion

For the 2010-2011 sampling period, the Port collected a total of 110 flow-weighted composite samples. Composite sample results are described separately from grab samples because grab samples represent nearly instantaneous values. Composite sample results, especially those from samples that comprise the entire hydrograph, 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 Procedure Manual, which provides samples comparable with EPA methods (U.S. EPA 1992).

3.1.7.1 Glycols

Monitoring for propylene and ethylene glycol is required by the NPDES permit during months when deicing and anti-icing is conducted. The Port's 2010-2011 Deicing/Anti-icing Fluids Summary Report (POS 2011) report Aircraft Deicing Anti-icing Fluid (ADAF) (glycol) application. This report summarizes data provided by the airlines for the volumes of both ethylene and propylene glycol applied. The Federal Aviation Administration (FAA) authorizes only 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.

According to the 2010-2011 Deicing/Anti-icing Fluids Summary Report, airlines applied a total of 195,146 gallons of glycols between April 2010 and March 2011. Propylene glycol was only detected in 1 out of the 99 samples analyzed during the winter season and ethylene glycol was also only detected in 1 of the 99 samples analyzed. Glycols were not detected in any monthly sample from 10 outfalls (SDD-06A, SDN-1, SDN-2, SDN-3A, SDN-4, SDS-4, SDS6/7, SDW-1A, SDW-1B, and SDW-2). Glycol detections were limited to two samples during January 2011. The highest propylene glycol concentration (94 mg/l) was found in the SDS3/5 sample, on January 12, 2011 (Table 4). The highest ethylene glycol concentration (11 mg/l) was found in the Pond M sample, on April 3, 2011 (Table 5). Box plots were not prepared for ethylene glycol and propylene glycol since all but two samples were below the method reporting limits.

Table 4 Glycol Detection and Application Summary[1]

Event	Outfall	Ethylene glycol, mg/l	Propylene glycol, mg/l	Glycols applied[2] Gallons
1/12/2011	SDS3/5	<10	94	11,628
4/3/2011	Pond M	11	<10	0

Table Notes:

1. Events listed had other outfalls sampled but these had non-detected glycols
2. "Glycols applied" is the total volume applied during the dry-antecedent period as reported by the airlines.

3.1.7.2 Copper

All data reported below are for total recoverable copper as required in the permit. The median copper concentration for all outfalls was 0.005 mg/l. The copper effluent limit was exceeded five times during the reporting period. The remaining copper results were well below the effluent limit as shown in Figure 6.

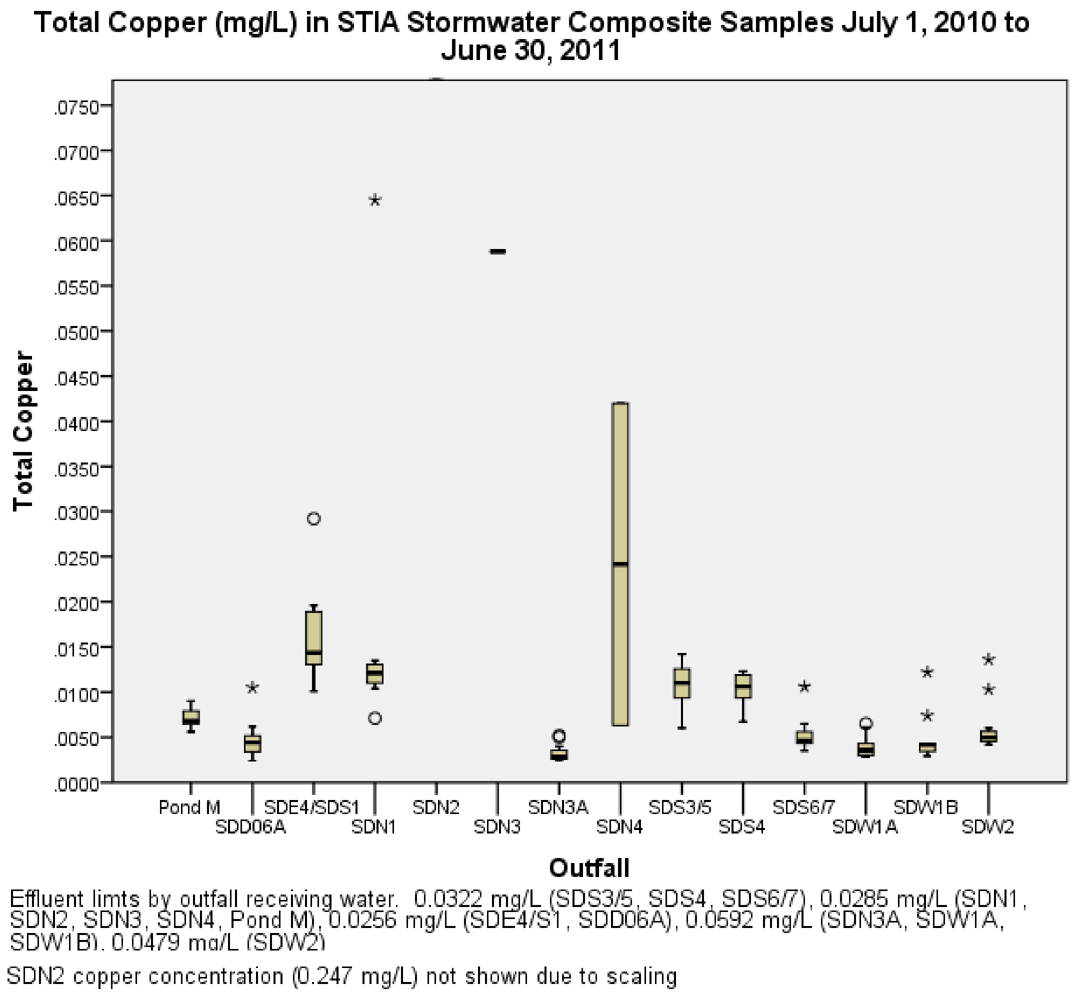


Figure 6 Copper Results

Copper from the three principal landside outfalls, SDE4/S1, SDN-1and SDD-06A had medians of 0.014 mg/l, 0.012 mg/l and 0.004 mg/l respectively. Airfield outfalls medians ranged from 0.003 mg/l to 0.019 mg/l. SDN-2 had the highest median of 0.019 mg/l.

3.1.7.3 Lead

All data reported below are for total recoverable lead as required in the permit. The calculated median lead concentration for all outfalls was 0.001 mg/l (Figure 7).

Overall, lead was not detected in 70% of the 110 samples and was not detected in any sample from two outfalls (SDW-1A, and SDW-2). Lead was most frequently detected in samples collected from landside outfalls SDE4/S1 and SDN1. The analytical laboratory method reporting limit for lead was modified by the lab during the 2010-2011 monitoring period from 0.001 mg/L to 0.0001 mg/L.

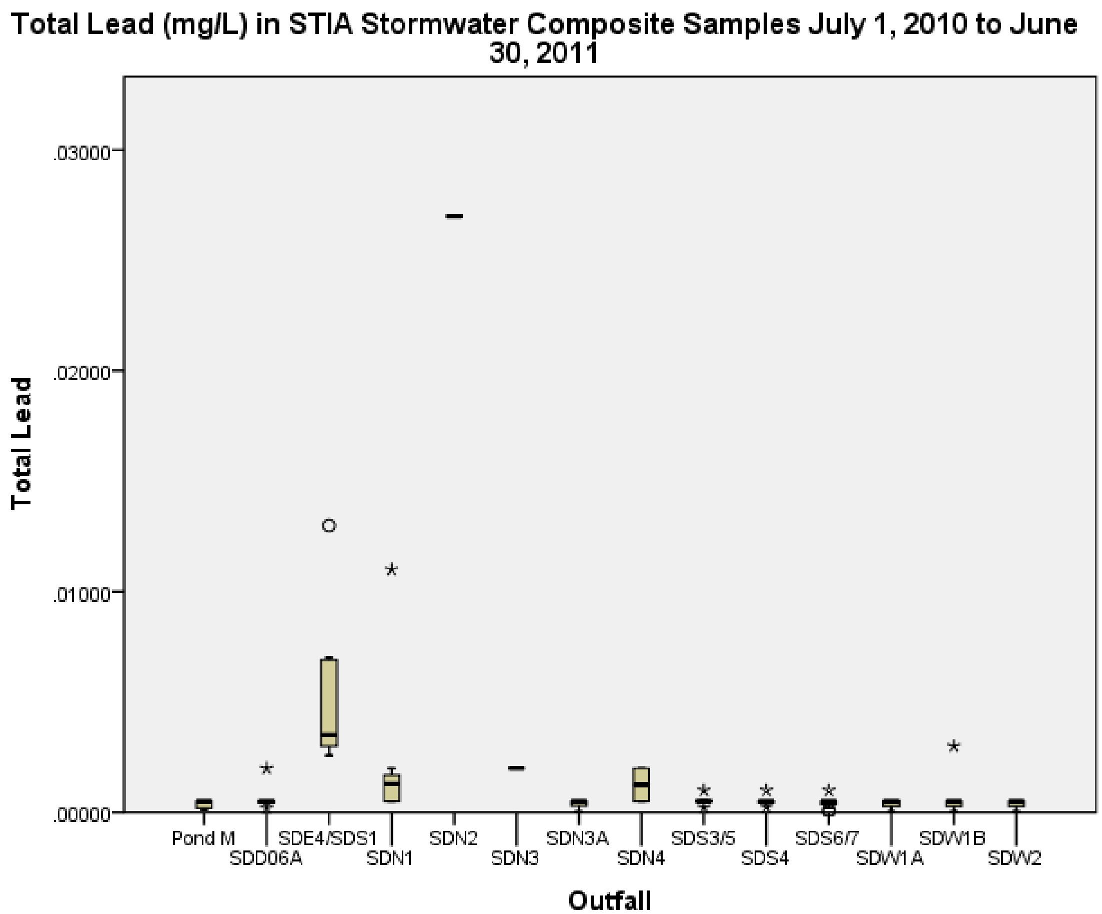


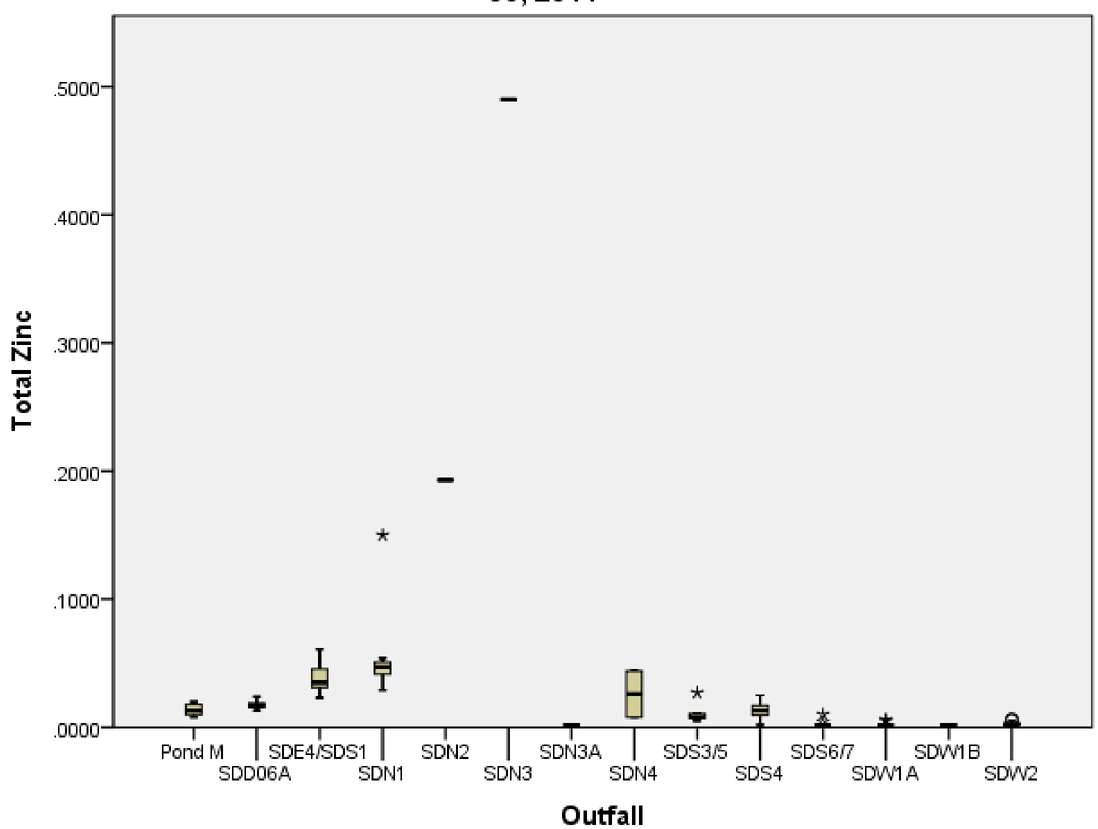
Figure 7 Lead Results

3.1.7.4 Zinc

All data reported below are for total recoverable zinc as required in the permit. The median zinc concentration at all outfalls was 0.005 mg/l, which is over twenty times less than the effluent limit value (0.117 mg/l), similarly the median concentration from the SDS-4 outfall was 0.011 mg/l which is about one sixth of the effluent limit value (0.0714 mg/l). No effluent limit exceedances occurred in any samples collected from ten outfalls (SDD-06A, SDE4/S1, SDN-3A, SDS-3/5, SDS-4, SDS-6/7, SDW-1A, SDW-1B, SDW-2, and Pond M) (Figure 8).

Zinc effluent limit exceedances occurred on four occasions, once in a sample from the SDN-3 outfall and once in a sample from the SDN-4 outfall. Both of these exceedances were related to construction activity in the area along with elevated turbidity values and not due to industrial activity.

Total Zinc (mg/L) in STIA Stormwater Composite Samples July 1, 2010 to June 30, 2011



SDS4 effluent limit = 0.0714 mg/L, effluent limit for all other outfalls = 0.117 mg/L

Figure 8 Zinc Results

The median zinc concentration for airfield outfalls (0.002 mg/L) was well below the median for landside outfalls (0.020 mg/l). This difference appears related to the presence and type of zinc sources and the degree of source control and treatment BMPs provided. Landside subbasins have significant sources of zinc. In contrast, airfield subbasins have fewer zinc sources and have significant treatment provided by filter strips and bioswales as shown by the CSMP. Common zinc sources include passenger and service vehicles, galvanized steel materials and metal roofing. Tire wear is a common source of zinc (U.S. EPA 1993a).

In the airfield subbasins, galvanized steel structures are generally limited to numerous utility vault lids and perimeter fencing. Direct runoff from these lids and fencing typically enters grass filter strips that serve as treatment BMPs. The other potential zinc source in airfield subbasins is aircraft tire deposition material. In contrast, landside subbasins have numerous galvanized steel structures and metal roofing. The landside subbasins also have passenger vehicle roads and parking lots where tire wear is a likely source of zinc. Roads and parking areas constitute more than 50% of the impervious surfaces draining to SDE4/S1 and SDN-1. Several acres of metal roofing are limited to the SDE4/S1 and SDN-1 drainage areas. To address zinc leaching from these metal roofs, the Port has implemented either a source control BMP (four roofs were painted in 2004) or treatment BMP (one roof has had ongoing treatment provided since July 2003). Ongoing monitoring has shown the runoff treatment system to remove between 60 and 90% of the zinc, depending on media type used for filtration (Taylor 2006). In addition the entire SDE4 drainage subbasin receives treatment from a 600 cartridge media filtration vault.

3.2 Toxicity Monitoring

The following section discusses stormwater monitoring data related to Acute and Sublethal Toxicity Sampling as well as a description of the developmental phase of an *insitu* monitoring program that was completed during Fall season 2010 and Spring season 2011.

3.2.1 Acute Toxicity Sampling

The 2003 NPDES permit issued to the Port of Seattle by the Washington Department of Ecology required acute toxicity testing on stormwater samples from a number of stations at STIA. The Port has invested considerably in efforts to reduce metals in stormwater, and these efforts appear to have improved performance. Collectively, the results of acute toxicity testing of stormwater samples from the airport have demonstrated a low frequency of adverse effects.

Quarterly outfall characterization for acute toxicity is required under Part II, S6 of the revised permit for new outfalls for one year. Samples collected from SDN-3A, SDW-1A, SDW-1B, SDW-2, and SDS-6/7 outfalls found no acute toxicity in any of the samples during the one year characterization period during the previous annual reporting period. The first quarterly characterization sample collected from newly activated outfall SDD-06A found no acute toxicity during the previous annual reporting period. The remaining quarterly acute characterization at SDD-06A was completed 1st Quarter 2011 with no acute toxicity found.

3.2.2 Sublethal Toxicity Sampling

The 2003 NPDES and 2009 NPDES permits required sublethal toxicity testing on ambient water samples from a number of receiving water locations at STIA. Samples were collected during Fall 2010, Winter (deicing event) 2011, and Spring 2011. 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) during the 2010 – 2011 reporting period. The samples collected during Fall 2010 and Spring 2011 did not result in any adverse effects. The samples collected from DME and EWConf during the Winter 2011 (deicing) event found some adverse effects. In response, the Port prepared a Toxicity Identification/Reduction Evaluation (TI/RE) Plan to determine the cause of toxicity in these samples. The TI/RE Plan included a schedule to target up to four deicing events to determine the cause of toxicity in the samples and determine if it was a one-time occurrence or is reoccurring. One additional deicing event was sampled in 2011at DME and EWConf with no adverse effects observed.

3.2.3 *In Situ* Monitoring

During the 2009-2010 reporting period the Port completed a draft *In Situ* Monitoring Plan that was submitted to Ecology for review and approval as required by Part II, Section S9 of the renewed permit. The first phase of developmental *in situ* testing was completed in Fall 2010 and Spring 2011. A brief summary of the *in situ* monitoring approach follows.

The early life stage (ELS) salmonid bioassay is a testing procedure that can be applied in a laboratory or field (i.e., *in situ*) context. The exposure is initiated at the embryo stage, continued through various developmental stages, and concluded at the swim-up fry stage—i.e., the point at which naturally spawned organisms leave the gravels, inflate their swimbladders, and begin feeding. Thus, it 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. In general, salmonid ELS tend to be sensitive to a variety of environmental contaminants, depending on exposure concentrations and water chemistry. Because declines in water quality in urban streams in the Puget Sound region may have contributed to a regional decline in salmonid populations, using an *in situ* ELS approach as a monitoring tool has direct relevance for addressing this issue. The initial Phase 1 and Phase 2 *in situ* testing will be performed with rainbow trout, which are in the same genus as local salmon species and are available year round from a local commercial hatchery. This approach will

eliminate interspecies differences in comparing seasonal trends in toxicity, and will also be directly comparable to laboratory tests conducted with this species.
During Phase 1 and Phase 2 testing the salmonid ELS will be applied as an *in situ* monitoring tool to assess the quality of receiving waters potentially affected by stormwater discharges from the Seattle-Tacoma International Airport (STIA), as well as a multitude of other discharges from the surrounding urban environment. The advantages of the ELS *in situ* approach over sampling wild fish include fixed exposure sites, known exposure duration and conditions, and statistical sensitivity. The main advantage over laboratory testing is integration of exposure over multiple storm events and life-history stages. However, it is important to recognize that successful implementation of this monitoring program will depend on a phased program. The objective of the first phase was to validate the approach, particularly with respect to determining if the selected sites and exposure methodologies were appropriate, or if they need to be modified to compensate for confounding variables (e.g., deposition of fine sediments, mobilization of anoxic sediments during storm events, etc.). The Phase 1 testing has established that the exposure methodology (with some modifications from the original plan) and site selection were suitable. Phase 2 will focus on the design and future implementation of the monitoring program. The spring season, fall season, and winter season (deicing) sublethal laboratory testing continued throughout Phase 1 and results were used for permit compliance purposes. These laboratory tests were timed to occur during the *in situ* exposure period(s) and the results used to complement the *in situ* endpoints. A separate document will be prepared prior to initiating Phase 2 and submitted to Ecology for review and approval.

As described above, Phase 1 of the *in situ* program was completed Fall 2010 and Spring 2011 and was largely focused on method development which resulted in two important changes to the monitoring approach. The first change to the monitoring approach involved modifying the hatch box deployment technique from burying the hatch boxes within the stream substrate to utilizing crates placed on the surface of the stream substrate. Early testing demonstrated that during periods of high stream flow the hatch boxes were not accessible for inspection and cleaning which resulted in smothering of the eggs by fine particles. This new deployment method allowed for easier deployment and monitoring with less disturbance of the substrate and the ability to access the hatch boxes during a wider range of stream flows.

The second change to the monitoring approach involved the addition of an upstream monitoring site within Des Moines Creek to determine if adverse effects observed in Fall 2010 at the Des Moines Creek site were due to upstream non-Port contributions. Results of the Spring 2011 *in situ* exposure indicated that adverse effects were associated with the Upstream site replicates, compared to the laboratory controls.

The Phase 2 monitoring plan is currently under development. Part II, Special Condition S9 of the NPDES Permit states "The Permittee may replace the corresponding fall and spring sublethal toxicity testing as described in Condition S8 with *in situ* toxicity testing per Ecology approval". The Phase 2 monitoring plan will propose a hybrid approach that includes the continued use of spring and fall sublethal toxicity testing along with alternating spring and fall *in situ* testing rather than discontinuing the sublethal toxicity testing as allowed by the permit. The Phase 2 monitoring plan will propose sublethal toxicity monitoring be conducted concurrently at the watershed-based *in situ* monitoring locations allowing a comparison between *in situ* and sublethal toxicity testing exposures. This monitoring approach will provide the benefit of continuing the long track record of laboratory sublethal testing at STIA along with the continued development of the *in situ* monitoring method.

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4 PERMIT COMPLIANCE AND IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

4.1 Compliance with Permit Effluent Limits

Condition S5.A.3 of the Airport's NPDES permit requires implementation of BMPs necessary to eliminate or reduce the potential to contaminate stormwater. During the 2010 – 2011 monitoring period overall permit compliance was high with only 27 instances of non-compliance with permit effluent limits out of the 550 constituents analyzed in relation to permit effluent limits (5%).

4.2 Stormwater Management Projects

During the 2008-2009 annual reporting period adaptive management stormwater project planning was initiated to provide additional stormwater treatment to subbasins identified based on permit effluent limit compliance. Design and project procurement was completed during the 2009-2010 monitoring period. Four specific stormwater management projects were identified to be constructed during the 2010-2011 monitoring period. Each project is described in further detail in sections 4.2.1 through 4.2.4.

4.2.1 SDE4/S1

Based on the examination of past sampling data and the performance to date of the SDE-4/S1 treatment train (extended detention pond, storm filter media vault, and bioswale) it was noted that there were several instances where the new permit limit for copper would have been exceeded. The Port has taken a proactive approach to determine what additional BMPs or enhancements to existing BMPs could be employed to prevent future permit exceedances. Four specific projects were identified to improve the treatment ability of the existing BMPs. The first is a drain pipe that was installed to allow the ability to slowly treat the settled water in the dead storage portion of the SDE-4 pond in an adjacent bioswale. Removing the settled dead storage volume will prevent summer growth of algae within the pond and protect the storm filters from premature clogging due to suspended algae particles. The drain pipe project was completed February 2010. The second project is to redesign the adjacent bioswale as a bioretention swale area with amended soils and filtration media. The third project will redesign and rebuild the existing SDE-4/S1 bioswale to increase the treatment and bioretention ability also by using a variety of media within the swale. The fourth project will modify the existing flow splitter that mixes the flow from SDE-4 and SDS-1 subbasins. The flow splitter will be fitted with an adjustable weir to allow the SDS-1 stormwater flow to be isolated from SDE-4 flows to provide more treatment for SDS-1 with the improved swale described in project three. Projects two, three, and four described above were constructed in summer 2011.

4.2.2 SDS-4

This project was also identified based on the examination of past monitoring data in relation to the new copper limit in the Port's NPDES Permit. Based on past data there were four instances where the copper concentration would have exceeded the new permit limit. The Port has taken a proactive approach to prevent future permit exceedances by exploring options for additional stormwater BMPs within the SDS-4 subbasin to remove copper. This project design will incorporate a bio-filtration and media contact channel installed downstream of the existing flow control pond to provide additional metals removal. This project was constructed in summer of 2011.

4.2.3 SDN-1

During the 2007-2008 monitoring period a high intensity storm caused resuspension of sediment within the SDN-1 Pond and subsequently an exceedance of the permit limit for zinc. The resuspension would also have been over the new permit limit for copper had it been in effect at the time. The SDN-1 adaptive management project added energy dissipation at the inlet to the SDN-1 pond to prevent resuspension of pond sediment during high intensity storm events. This work was completed in September 2010. The project also proposes to construct a bioretention/media contact channel and pump system to allow summer draw down of the SDN-1 pond. The pump system will allow summer stormwater to be held in the pond and slowly treated in the bioretention/media contact channel. Summer periods are the most likely for high metals concentrations due to long antecedent dry periods coupled with low rainfall depths. This project was constructed in summer of 2011.

4.2.4 Pond M Modifications

Pond M is located on the North end of the Airport and has been utilized as a construction stormwater pond throughout the construction of the third runway and 16L repaving project. Per the CSMP update for Master Plan Update Improvements (Parametrix 2005), the outfalls of SDN-2, SDN-3, and SDN-4 will be routed to two detention facilities with a single surface water outfall to Lake Reba. The two ponds will have a combined capacity of 15.8 acre feet. Based on removal efficiencies observed in other large detention ponds (SDE4 pond) the performance of the M ponds should be similar including increased sedimentation and metals removal. The conveyance work to route outfalls SDN-2, SDN-3, and SDN-4 to Pond M was completed in October 2010. The temporary Pond M outlet was fitted with an outlet control structure designed to maximize flow control until the final Pond M modifications are completed in November 2011.

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5 SUMMARY AND CONCLUSIONS

During the reporting period from July 2010 to June 2011 the Port fulfilled requirements for outfall monitoring under the current NPDES permit by collecting a total of 110 grab samples and 110 composite stormwater samples during 26 storm events. Outfalls were sampled quarterly when discharges occurred from rain events that met the minimum rainfall criteria of 0.1". Constituents and concentrations of concern at STIA have generally been associated with specific activities or locations, and usually not routine runoff. The results from the current year show that even when petroleum constituents are detected in STIA stormwater they are well below the effluent limit. The current and historical results for TPH demonstrate the effectiveness of the IWS in preventing fuel and other petroleum products associated with aircraft and vehicle servicing from entering the SDS.

There were only 27 instances of noncompliance associated with 550 individual constituents (with effluent limits) that were tested to meet the monitoring requirements of the NPDES permit. Construction of additional stormwater BMPs through the Port's adaptive management program was completed in summer 2011 to prevent or limit further instances of noncompliance. Recurrent pH violations have occurred in discharges from SDW-1A, SDW-1B, and SDW-2 caused by algal growth within the ponds. Corrective actions taken by the Port to prevent future pH exceedances have involved closing the outlet valves to the ponds to prevent discharge during the critical summer period. The Port will continue to work with Ecology during the 2011/2012 monitoring period to conduct additional monitoring to determine the cause of algal growth in the SDW-1A, SDW-1B, and SDW-2 ponds. This additional monitoring will be used to evaluate stormwater best management practice options to prevent algal growth and associated pH exceedances.

No sublethal toxicity was found in instream samples below STIA outfalls during the monitoring period during the spring and fall testing periods. The samples collected from DME and EWConf during the Winter 2011 (deicing) event found some adverse effects. In response, the Port prepared a Toxicity Identification/Reduction Evaluation (TI/RE) Plan to determine the cause of toxicity in these samples. The TI/RE Plan included a schedule to target up to four deicing events to determine the cause of toxicity in the samples and determine if it was a one-time occurrence or is reoccurring. One additional deicing event was sampled in 2011at DME and EWConf with no adverse effects observed.

The Phase I *in situ* monitoring plan was implemented during the 2010 – 2011 annual reporting period. Phase I monitoring was successful in demonstrating the *in situ* methodology and identifying changes to the deployment methodology to allow for easier access to the hatch boxes during periods of high stream flow. The Phase I monitoring also established an upstream location in one watershed to use as a baseline location to determine impacts associated with offsite sources. The Phase 2 monitoring plan will propose a hybrid approach that includes the continued use of spring and fall sublethal toxicity testing along with alternating spring and fall *in situ* testing rather than discontinuing the sublethal toxicity testing as allowed by the permit. The Phase 2 monitoring plan will propose sublethal toxicity monitoring be conducted concurrently at the watershed-based *in situ* monitoring locations allowing a comparison between *in situ* and sublethal toxicity testing exposures. This monitoring approach will provide the benefit of continuing the long track record of laboratory sublethal testing at STIA along with the continued development of the *in situ* monitoring method.

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APPENDICES

APPENDIX A TABULAR NPDES SAMPLE DATA SUMMARIES and STATISTICS

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APPENDIX B OTHER SAMPLE DATA